111th Congress, 1st Session – – – – – – – – – – – – – House Document 111–17

EAST ST. LOUIS AND VICINITY, ILLINOIS ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION PROJECT

COMMUNICATION

FROM

THE ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS), THE DEPARTMENT OF THE ARMY

TRANSMITTING

A FEASIBILITY STUDY TO EVALUATE PROBLEMS AND OPPORTUNITIES FOR EAST ST. LOUIS, ILLINOIS

PART 1 OF 2

JANUARY 27, 2009.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

JAN 15 2009

HOUSE DOCUMENT NUMBER 111-19

2009 JAN 26 PM 3:49

Honorable Nancy Pelosi
Speaker of the House
of Representatives
U.S. Capitol Building, Room H-232
Washington, D.C. 20515-0001

Dear Madam Speaker:

In response to Section 310 of the Water Resources Development Act (WRDA) of 2000 for East St. Louis and Vicinity, Illinois, the U.S. Army Corps of Engineers conducted a feasibility study to evaluate problems and opportunities in the study area and completed a feasibility report to document its findings. The recommendations are described in the report of the Chief of Engineers dated December 22, 2004, which includes other pertinent reports and comments. The views of the State of Illinois and the Environmental Protection Agency, as well as the Departments of the Interior and Agriculture are set forth in the enclosed communications. Congress authorized the project in Section 1001(18) of WRDA 2007.

The project recommended in the report of the Chief of Engineers has an ecosystem restoration purpose. The recommended project would provide ecosystem restoration benefits in the vicinity of East St. Louis, Illinois. The recommended plan would restore approximately 1,700 acres of bottomland forest habitat, 1,100 acres of prairie wetland habitat, 840 acres of marsh and shrub swamp habitat, 460 acres of lake habitat, and 380 acres of riparian forest. In addition, the recommended plan also includes restoration of 10.4 miles of floodplain stream, installation of 650 wood duck boxes and 870 prairie bird perches, improvement of 20 acres of lacustrine over wintering and shoreline habitat, construction of 130 tributary sediment detention basins and riffle and pool complexes in 178 miles of streams, 15.5 miles of earthen embankments, and associated water control features (i.e., culverts, flap gates, and new channels). The project includes outdoor recreation as an economically justified project purpose, based on the inclusion of a bike trail at the Old Cahokia Creek action area. The project does not require mitigation for fish and wildlife or cultural resources. The recommend plan is the national ecosystem restoration plan.

At October 2008 price levels, the Corps of Engineers estimates the total first cost of the project to be $221,170,000. The total first cost includes approximately $220,820,000 for ecosystem restoration and approximately $350,000 for recreation. To assure that expected outcomes of the ecosystem restoration project feature are realized, the total first cost includes about $2,570,000 for monitoring and adaptive management. Consistent with the cost-sharing provisions of WRDA of 1986, as amended by Section 210 of WRDA 1996, the Federal share of the ecosystem restoration cost would be approximately $143,530,000 and the non-Federal share would be approximately $77,290,000. Based on the cost-sharing requirements of WRDA 1986, the recreation costs, estimated to be $350,000, would be shared 50 percent Federal and 50 percent non-Federal. Thus the overall Federal share of the estimated total first cost of the project would be $143,705,000 and the estimated non-Federal share would be $77,465,000. The total annual operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) cost for the authorized project, which is the responsibility of the non-Federal sponsor, is estimated to be $125,000 for ecosystem restoration and $1,200 for recreation. Total average annual costs, including initial construction and OMRR&R, are estimated at $11,533,000, based on and interest rate of 4.625 percent and a 50-year period of analysis.

The cost of the recommended plan is justified by the restoration of about 8,300 average annual habitat units. The project would provide both feeding and resting resources for the Federally-threatened bald eagle and would protect and propagate the decurrent false aster. Over 50 migratory bird species covered by international treaties and the state-threatened Illinois chorus frog would also benefit from the project. The plan connects five habitat areas and enlarges three isolated habitats to improve overall resource sustainability. The recommended ecosystem restoration project features are justified on restoration of these habitats which are considered especially valuable due to scarcity and dependence of certain species on these resources.

The average annual recreation benefits are estimated at $26,000 and average annual costs are estimated at $19,000, resulting in a recreation benefit cost ration of 1.4. The recommended plan also provides incidental flood damage reduction benefits estimated at $1,490,000 annually.

Army review of the recommendations contained in the report of the Chief of Engineers determined that the Corps did not demonstrate that the proposed plan represents an efficient way to target Federal and non-Federal resources for aquatic ecosystem restoration. To put this proposed project on par with similar Administration supported aquatic ecosystem restoration projects, those project elements that are not cost effective in providing significant fish and wildlife benefits at the least cost would need to be removed from the project, or provided by other Federal, state, or local agencies without cost to the project as part of a locally preferred plan.

The Office of Management and Budget (OMB) advises that there is no objection to the submission of the report to Congress. However, construction funding would not be considered by the Administration for the project recommended in the report of the Chief of Engineers because the project is not consistent with the policy and programs of the President. A copy of its letter is enclosed. I am providing a copy of this transmittal and the OMB letter, dated January 12, 2009, to the House Subcommittees on Energy and Water Development, and Water Resources and Environment.

Very truly yours,

John Paul Woodley, Jr.

John Paul Woodley, Jr.
Assistant Secretary of the Army
(Civil Works)

Enclosures

3 Enclosures

1. OMB Letter, Jan 12, 2009
2. Report of the Chief of Engineers, Dec 22, 2004
3. East St. Louis and Vicinity, Illinois - Ecosystem Restoration and Flood Damage Reduction Project, November 2003

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

January 12, 2009

The Honorable John Paul Woodley, Jr.
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington D.C. 20310-0108

Dear Mr. Woodley:

As required by Executive Order 12322, the Office of Management and Budget has completed its review of your recommendation concerning the feasibility report of the Army Corps of Engineers East St. Louis and Vicinity, General Reevaluation Report.

We agree with your recommendation that this project is not consistent with the policy and programs of the President, because the Corps of Engineers' report does not demonstrate that the proposed plan represents an efficient way to target Federal and non-Federal resources for aquatic ecosystem restoration.

The Office of Management and Budget does not object to you submitting the report to Congress.

Sincerely,

Richard A. Mertens
Deputy Associate Director
Energy, Science and Water

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-MVD (1105-2-10a)

22 DEC 2004

SUBJECT: East St. Louis and Vicinity, Illinois

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on ecosystem restoration and recreation in the vicinity of East St. Louis, Illinois. It is accompanied by the report of the district and division engineers. These reports constitute a general reevaluation of the flood damage reduction project authorized in Section 204 of the Flood Control Act of 1965, and modified by Section 137 of the Water Resources Development Act (WRDA) of 1976 and Section 310 of WRDA of 2000, for East St. Louis and Vicinity, Illinois. Preconstruction engineering and design activities for this project will be continued under authority of Section 310 of WRDA 2000.

2. The reporting officers recommend further modification to the authorized project. The recommended plan is an extensive restoration of the ecosystem in the vicinity of East St. Louis, Illinois, on the Mississippi River. The recommended plan will restore approximately 1,700 acres of bottomland forest habitat, 1,100 acres of prairie wetland habitat, 840 acres of marsh and shrub swamp habitat, 460 acres of lake habitat, and 380 acres of riparian forest. In addition, the recommended plan also includes restoration of 10.4 miles of floodplain stream, installation of 650 wood duck boxes and 870 prairie bird perches, improvement of 20 acres of lacustrine over wintering and shoreline habitat, construction of 130 tributary sediment detention basins and riffle and pool complexes in 178 miles of streams, 15.5 miles of earthen embankments, and associated water control features (i.e., culverts, flap gates, and new channels). All project features are located within the State of Illinois. Because the recommended plan would not have any significant adverse effects, no mitigation measures (beyond management practices and avoidance) or compensation measures are required. The recommended plan is the national ecosystem restoration plan.

3. Based on October 2004 price levels, the total first cost of the recommended plan is estimated at $191,158,000. The total first cost of the project includes approximately $190,854,000 for ecosystem restoration and approximately $304,000 for recreation. In accordance with the cost sharing provisions of WRDA of 1986, as amended by Section 210 of WRDA 1996, ecosystem restoration features would be cost shared 65 percent Federal and 35 percent non-Federal. Thus the Federal cost of the ecosystem restoration features is estimated at $123,655,000 and the non-Federal cost is estimated at $67,199,000. The estimated total first cost also includes a separable

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recreational trail. This feature is estimated at $304,000; and based on the cost sharing requirements of WRDA of 1986, the costs would be shared 50 percent Federal and 50 percent non-Federal. To assure that expected outputs of the ecosystem restoration project feature are realized, the project also includes about $2,221,000 for monitoring and adaptive management. Thus the overall Federal share of the estimated total first cost of the project would be $123,807,000 and the non-Federal share would be $67,351,000. Average annual recreation benefits are estimated at $25,000 and average annual costs are estimated at $18,000, for a recreation benefit-to-cost ratio of 1.4 to 1. The average annual cost for ecosystem restoration is approximately $11,066,000. The total annual operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs of the recommended project are estimated at $109,000 per year. This includes $108,000 for ecosystem restoration OMRR&R and $1,000 for recreation OMRR&R. Total average annual costs, including initial construction and OMRR&R, are estimated at $11,193,000, based on an interest rate of 5.375 percent and a 50-year period of analysis.

4. During the reevaluation of this authorized project, it became apparent that problems and opportunities in the project area had changed significantly since authorization. While interior flooding problems still exist, other more significant problems and changes (e.g., the environmental degradation of significant resources in the study area, urbanization, changes in the transportation infrastructure, etc.) were identified. While the authorized project was designed to eliminate interior flooding from a 50-year storm event, the plan recommended herein is designed to reconnect watershed functionality by using stormwater for the restoration of significant ecosystem resources. The recommended plan also provides incidental flood damage reduction benefits estimated at $1,445,000 annually.

5. To ensure that an effective environmental restoration plan was recommended, cost effectiveness and incremental analysis techniques were used to evaluate alternative restoration plans. The recommended plan provides both feeding and resting resources for the federally-threatened bald eagle and will protect and propagate the decurrent false aster. The project contributes to the life cycle requirements of more than 50 migratory bird species covered by international treaties and the state-threatened Illinois chorus frog. The palustrine wetland resources to be restored are considered scarce with over 85 percent of the wetlands in Illinois and other midwestern states lost since the 1780's, and the decline is continuing. The plan connects 5 habitat areas and enlarges 3 isolated habitats to improve overall resource sustainability. The project produces approximately 8,332 average annual habitat units. The recommended ecosystem restoration project features are justified on restoration of habitats considered especially valuable due to scarcity and dependence of certain species on these resources.

6. Washington level review indicates that the plan recommended by the reporting officers is environmentally justified, technically sound, cost effective and socially acceptable. The plan conforms with essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and complies with other administration and legislative policies and guidelines. Also, the views of interested parties, including Federal, State and local agencies have been considered.

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7. I concur in the findings, conclusions, and recommendation of the reporting officers. Accordingly, I recommend implementation of the modifications to the authorized project in accordance with the reporting officers' plan with such modifications as in the discretion of the Chief of Engineers may be advisable. The recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and State laws and policies, including Public Law 99-662, as amended by Section 210 of Public Law 104-303, and in accordance with the following requirements which the non-Federal sponsor must agree to prior to project implementation:

a. Provide 35 percent of the total project costs allocated to ecosystem restoration as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to ecosystem restoration in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds needed to cover the non-Federal share of design costs allocated by the Government to ecosystem restoration;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the ecosystem restoration features;

(4) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the ecosystem restoration features;

(5) Provide during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of total project costs allocated to ecosystem restoration;

b. Provide 50 percent of total project costs allocated to recreation as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to recreation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to recreation;

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(3) Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;

(4) Provide, during construction, any additional funds necessary to make its total contribution for recreation equal to 50 percent of total recreation costs;

c. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost-sharing provisions of the agreement;

d. Provide, during construction, 100 percent of total project costs allocated to recreation that exceed an amount equal to 10 percent of the Federal share of costs allocated to ecosystem restoration;

e. Operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

f. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

g. Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

h. Hold and save the Government free from all damages arising from the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

i. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents and other evidence are required, to the

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extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

j. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project. However for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

k. Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA- regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

l. Agree, as between the Federal Government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERLA;

m. Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration benefits, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or addition of facilities that might reduce the benefits of the project;

n. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

o. Do not use Federal funds from other Federal programs, including any non-Federal contribution required as a matching share, to meet any of the non-Federal obligations for the project unless the Federal granting agency providing the Federal portion of such funds verifies in writing that the expenditure of such funds for such purpose is authorized;

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p. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army;" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

q. Provide and maintain recreation features, such as access roads, parking areas and other public use facilities, open and available to all on equal terms.

8. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to the Congress, the non-Federal sponsor, the State of Illinois, interested Federal agencies, and other parties will be advised of any significant modifications and will be afforded the opportunity to comment further.

CARL A. STROCK
Lieutenant General, U.S. Army
Chief of Engineers

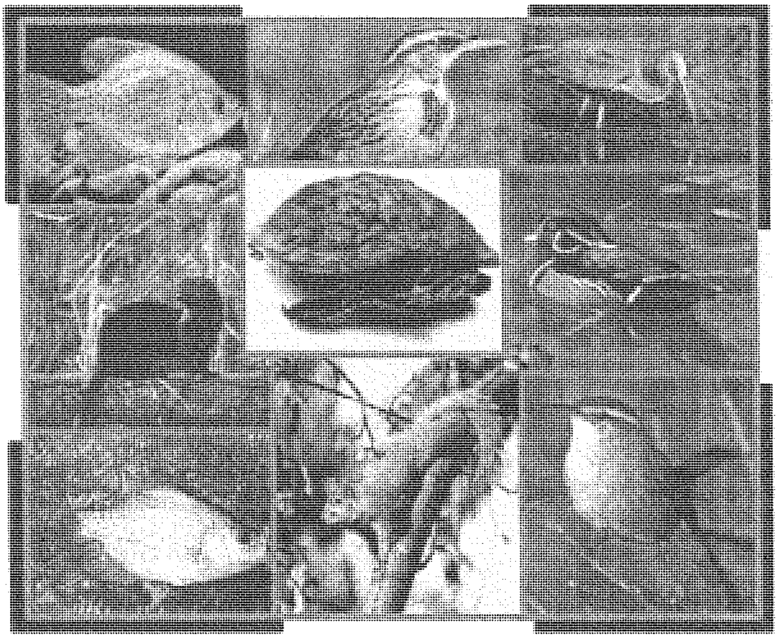
NOTICE

EAST ST LOUIS, IL

Since Congress has authorized the project, the Army Corps of Engineers does not request that the report be printed. If there are any questions about this, please call Mr. Lucyshyn at Corps Headquarters. You can reach Mr. Lucyshyn at (202) 761-4515.

East St. Louis and Vicinity, Illinois Ecosystem Restoration And Flood Damage Reduction Project

General Reevaluation Final Report with Integrated Environmental Impact Statement



US Army Corps
of Engineers
St Louis District

BOOK 1 0F 3

November 2003

**US Army Corps
of Engineers
Saint Louis District**

ADDENDUM

TO THE

GENERAL REEVALUATION REPORT

AND THE

POST-AUTHORIZATION CHANGE REPORT

East St. Louis and Vicinity, Illinois

Ecosystem Restoration and Flood Damage Reduction Project

Dated November 2003

Revised October 2004

ADDENDUM

General Reevaluation Report

East St. Louis and Vicinity, Illinois
Ecosystem Restoration and Flood Damage Reduction Project
Madison and St. Clair County, Illinois

1. Purpose of Addendum

The purpose of this Addendum is to summarize changes made to the General Reevaluation Report for the East St. Louis and Vicinity, Illinois Project dated November 2003. It is intended to be part of the final report and be an integral part of the project process. Since the submission of the report in November, the Washington Level review resulted in several changes to the report. These items include the addition of information supporting selection of the recommended plan, changes resulting from Council review, Real Estate Review and general editorial comments. This Addendum further includes the Final Coordination Act Report as received from the U.S. Fish and Wildlife Service and dated 12 May 2004.

The General Reevaluation Report, as supplemented by this Addendum, is intended to serve as the basis for project authorization and, ultimately the Project cooperation Agreement (PCA). Information contained in this Addendum makes no change to the recommendations contained in the November 2003 report, which has completed State, Agency and NEPA Compliance Review. Details and supporting documentation pertaining to these changes are available in the files of the Planning and Project Management Division of the St. Louis District Corps of Engineers.

This Addendum includes project costs updated to the October 2004 price level and discounted at the FY 2005 rate of 5.375%.

2. Updated Project Costs

Construction Project October 2004 Price Level

Feature	Costs
Lands and Damages	28,292,000
Relocations	6,257,000
Fish and Wildlife Facilities	117,089,000
Recreation Facilities	261,000
Engineering and Design	24,844,000
Construction Management	12,194,000
Monitoring and Adaptive Management	2,221,000
Total	191,158,000

Project Cost Share

First Cost (rounded)	Non-Federal Share (rounded) 65% for ecosystem features and 50% for recreation features	Federal Share (rounded) 65% for ecosystem features and 50% for recreation features
$191,158,000	$67,351,000	$123,807,000

Ecosystem Restoration Project Costs annualized at the Federal Discount Rate for FY 2005 (5.375%) for the 50 year period of analysis equal $11,066,000.

Recreation Costs annualized at the Federal Discount Rate for FY 2005 (5.375%) totals $18,000 providing a Benefit to Cost Ratio of 1.3 to 1.

Total Project Costs annualized at the Federal Discount Rate for FY 2005 (5.375%) for the 50 year period of analysis equal $11,315,000.

Total Project OMRR&R annualized costs at the Federal Discount Rate for FY 2005 (5.375%) total $109,000. $1,000 of this is for annual OMRR&R for the recreation facilities.

Monitoring and Adaptive Management is described in Section 9.11 of the General Reevaluation Report and costs are estimated to be $2,221,000 (1.1% of total project costs).

Incidental Flood Damage Reduction Benefits are estimated to be $1,445,000 (October 04 price level).

3. Summary of Report Changes

Executive Summary

(1) Addenda to Section 1- page II-1 - Change the second sentence of paragraph 3 on this page to read:

> "Section 310 of this Public Law contains the following wording: "The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

(2) Addenda to Section 6- page II-6 - Change the first sentence of paragraph 4 on this page to read:

> "The ecosystem restoration measures, a separable element of the existing authorized East St. Louis and Vicinity project, were formulated in accordance with ER1105-2-100 (3-5c):......."

Section 6 - Plan Formulation and Evaluation

(1) Addenda to page 6-6 - Change Section 6.1.2 Evaluation Methodology by inserting the following after the sixth sentence:

> "The Habitat Evaluation Procedures (HEP) methodology was chosen by the interagency biology team to assess project-induced changes. Although models used in the HEP methodology are often species-based and limited in their overall review of potential changes to ecosystem dynamics and

functionality, HEP was utilized to assess ecosystem health by using a combination of appropriate keystone species or guild-based species models to assess change. Thus, the selection of species from multiple faunal groups better describes the complex functions of an ecosystem, capturing both structure and process.

The model selection process focused on the study's performance measures (i.e., success criteria), community incidence, and architecture and model parameters directly contributing to the ecosystem function. In addition, model selection was based on sensitivity of the species or community to the proposed changes considered to address the planning objectives of the study. Seven distinct communities were identified (i.e., marshes, wetland forests, deciduous forests, shrublands, lakes, channels, and prairies). In addition, the team compiled lists of known regional species of plants and animals. These lists were used to narrow the choices of available Habitat Suitability Index (HSI) models, and focus the selection on critical community dynamics across the ecosystem.

Because of the relatively large area under evaluation, and the diversity of habitat desired to be restored, nine species models were selected for use in analyzing proposed changes to the ecosystem. These species included the Great Blue Heron, Marsh Wren, Mink, Slider Turtle, Wood Duck, Fox Squirrel, White Crappie, Black Crappie, Eastern Meadowlark. The justification for these model selections ranged from faunal group representation (i.e., two mammals, two fishes, one amphibian, two waterfowl, etc.) to public awareness issues including the public's interest in game species populations (e.g., the wood duck, fox squirrel, and mink). Furthermore, these models were selected on the basis of their representation of ongoing critical ecosystem processes. For example, the great blue heron HSI model, as well as both the black and white crappie HSI models, all contained variables measuring water quality conditions (i.e., dissolved oxygen, water temperature, and pH) and sedimentation deposition reduction efforts (i.e., turbidity and overall water clarity). The marsh wren and mink models were selected because they captured functions such as surface water storage monitoring (i.e., water regime, water depth) and species diversity changes (i.e., dominant growth forms, and both tree and shrub canopy coverage). Of course, the primary function the selected HSI models evaluated was the maintenance of plant and wildlife communities across the East St. Louis ecosystem. Appendix A describes this process in detail."

Addenda to Section 6.11.3 page 6-112 - add the following after the second paragraph on this page:

"The Old Cahokia Creek restoration on the Mississippi River floodplain which consists of reopening about 3.5 miles of a historic stream, and creating a 328-foot (100-meter) wide forested corridor along both sides of the channel is important as an increment of the overall restoration plan for a number of reasons. First, it restores habitat diversity to the Mississippi River's floodplain. Like all floodplain streams in the project area, this historic creek was eliminated in the early 1800's in an effort to provide floodplain flood protection. This restoration of habitat diversity as indicated would support the Habitat Needs Assessment of the Upper Mississippi River System – Habitat Rehabilitation and Enhancement Program, which calls for the replacement of ecologically important habitats lost to development within a nationally important ecosystem. Second, this restoration area's footprint would protect and expand two areas of important habitat on the Mississippi River floodplain designated for the Illinois chorus frog, a state threatened species in Illinois. Third, the restoration of Old Cahokia Creek is important to the overall function and sustainability of the Recommended Plan. This restoration improves the ecological functioning of a proposed chain of hydrologically linked habitat restoration areas. Old Cahokia Creek is expected to improve the quality of surface water moving downstream by removing sediment and pollutants. Net primary productivity at Old Cahokia Creek is expected to result in the export of organic carbon in the form of dead and live plant material. The Judy's-Burdicks restoration area, about one mile downstream along Cahokia Canal, would receive cleaner storm water as well as exported carbon. At Judy's-Burdicks, cleaner storm water is expected to improve the sustainability of characteristic plant communities. Likewise, received carbon is expected to help fuel primary productivity and the microbial and detrital food webs at the second restoration area. In turn, this cycle would be repeated at the third restoration area (Brushy Lake), about one mile downstream of Judy's-Burdicks. Assessment tools used in this study were not able to evaluate the benefits created by the synergy of linking these sites. An additional benefits of the Old Cahokia Creek restoration is the provision of migratory or breeding habitat for a number of bird species that the federal government has designated as a concern because of declining or low population levels. They include the mallard, wood duck, American woodcock, black-crowned and yellow-crowned night-herons, and Louisiana waterthrush. Restoration would support these species' conservation plans.

Habitat benefits quantified for Old Cahokia Creek are relatively expensive to achieve when compared to the restoration of wetland resources recommended at other action areas on the floodplain but it is a fact that the cost of providing aquatic habitat is historically higher than the cost of restoring other habitats based on the construction methods (dredging and excavation) that is typically required. However, when the restoration of Old Cahokia Creek aquatic resources is compared to the costs of other like projects in this region and across the country, they are low by comparison. The average annual habitat unit (AAHU) cost of $2,600 for the restoration of the Old Cahokia Creek on the floodplain compares favorably to the cost of other Corps' aquatic restoration programs, such as those under the Upper Mississippi River System's Environmental Management Program (EMP). The EMP does not require the purchase of land and averages between about $2,500 and $3,000 per AAHU. "

(3) Addenda to Section 6.12.2 beginning on page 6-138 - add the following after Table 6-9.

"During plan formulation, a cost effectiveness/incremental cost analysis (CE/ICA) was performed at the action area level. The interagency biological team then used the Best Buy results of this CE/ICA analysis to select the alternative at each site that in their professional judgment best achieved study planning objectives and targets. This process resulted in the Recommended Plan. Although the Recommended Plan was selected only from Best Buy alternatives generated by IWR-Plan, action area Best Buy alternatives were never analyzed together using IWR-Plan. In order to address policy review comments on the final report related to the assembly of the Recommended Plan, a CE/ICA was performed using IWR-Plan at the project level. This analysis was performed using the Best Buy alternatives from each of the 8 action areas identified in Tables 6-6 and 6-7.

The following chart identifies the cross walk between IWR-Plan input from Tables 6-6 and 6-7

A1 - Dobrey Best Buy Least Cost
A2 - Dobrey Best Buy Highest Output
B1 – Elm Best Buy Least Cost and Highest Output
C1 - Cahokia Best Buy Least Cost (No tributary stream restoration)
C2 - Cahokia Best Buy Highest Output (Includes tributary stream restoration)
D1 - Brushy Best Buy Least Cost (No tributary stream restoration)
D2 - Brushy Best Buy Highest Output (Includes tributary stream restoration)
E1- Judy's Burdick Best Buy Least Cost (No tributary stream restoration)
E2 - Judy's/Burdick Best Buy Highest Output (Includes tributary stream restoration)
F1 - Cahokia Mounds Best Buy Least Cost
F2 - Cahokia Mounds Best Buy Highest Output
G1 - Spring Lake Best Buy Least Cost and Highest Output
H1 - Mullens Slough Best Buy Least Cost (No tributary stream restoration)
H2 - Mullens Slough Best Buy Highest Output (Includes tributary stream restoration)

The following charts generated by the IWR-Plan program provide the results of this analysis in a graphic presentation. Chart 1 displays all possible plan combinations with cost effective and Best Buy plans identified as black circles or red triangles.

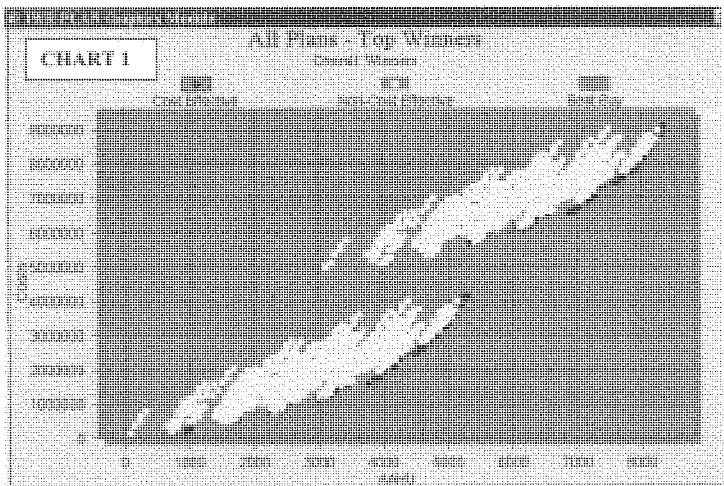
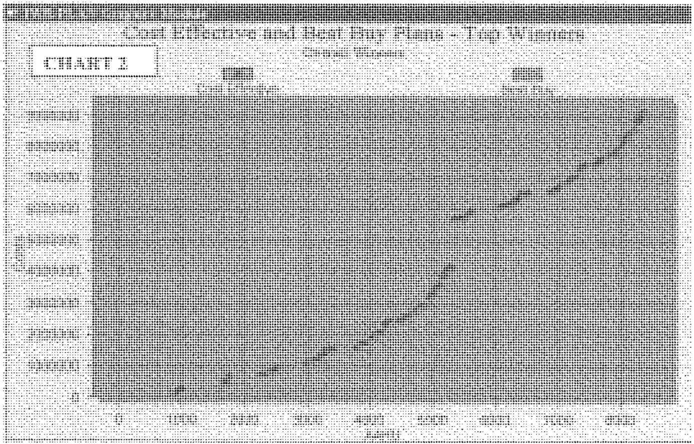


Chart 2 produced by IWR-Plan shows the plans remaining from all possible combinations after those that are not cost effective have been screened out.



IWR Chart 3 shows Best Buy plans represented in a bar chart format to show plans relative to one another in output and incremental cost. Chart 3 shows fourteen plans and the No Action Plan that are identified as Best Buys (Note: no bar is assigned to the "No Action Plan" in this depiction, and the Best Buy Highest Output Plan is represented by the bar at the far right of the graph labeled Plan Combination 15).

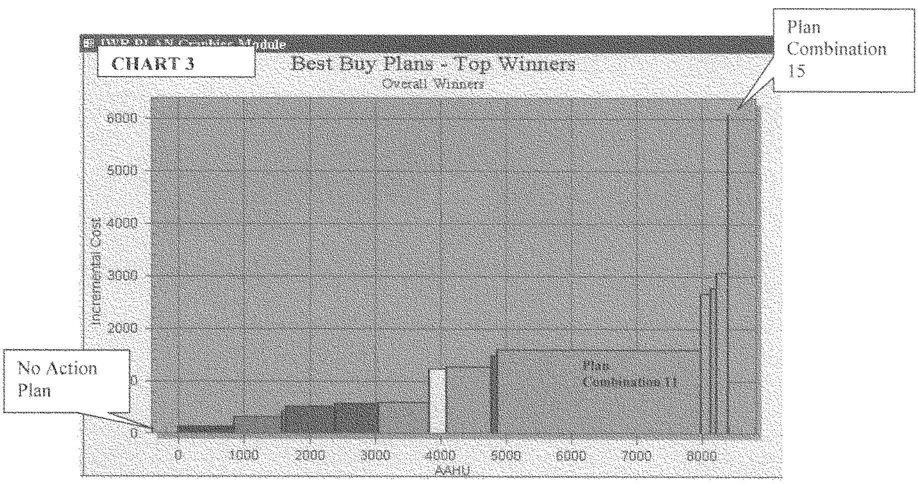


Chart 4 identifies the alternative combinations generated by IWR-Plan (color-coded to match the Best Buy bar chart depicted above) in tabular form. Plan 11 of the IWR-Plan generated combinations represents a logical break point in cost versus production of outputs of all plans compared. As can be seen, Plan 11 produces a significantly increased incremental level of output. The 3,105 AAHU is a 64% increase in incremental output for less than an 8% increase in incremental cost per output.

CHART 4

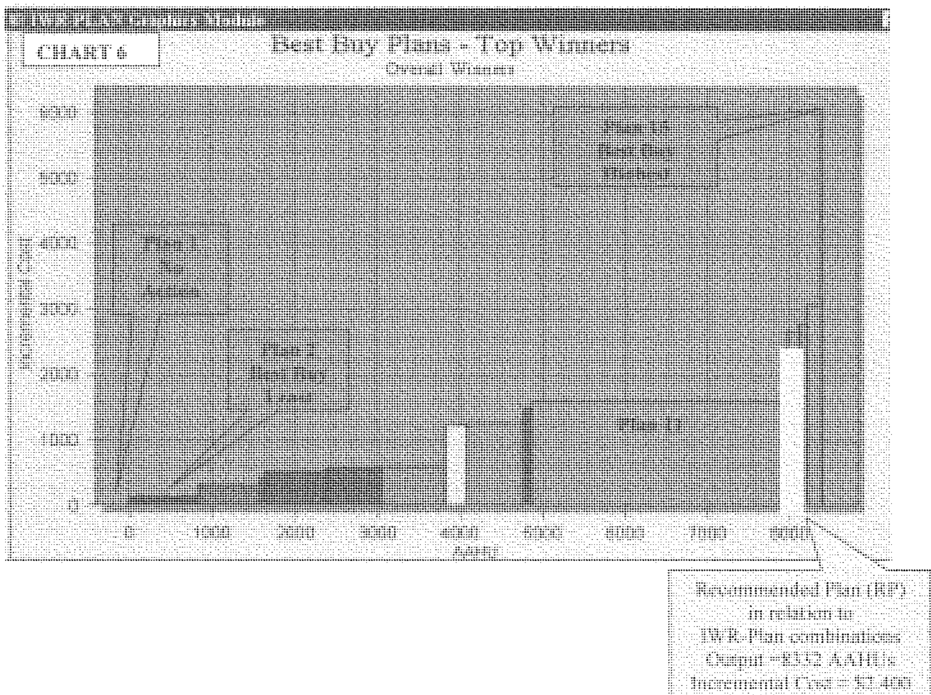
Counter	Plan Code	AAHU	Costs ($)	Avg. Cost $ / AAHU	Inc. Cost ($)	Inc. Output (AAHU)	Incremental Cost Per Output
1	A0 B0 C0 D0 E0 F0 G0 H0	0.00	0.00	0.00	0.00	0.00	0.00
2	A0 B0 C0 D0 E0 F1 G0 H0	849.00	113,200.00	133.33	113,200.00	849.00	133.33
3	A0 B0 C0 D0 E0 F1 G0 H1	1,579.00	347,900.00	220.33	234,700.00	730.00	321.51
4	A0 B0 C0 D0 E0 F2 G0 H1	1,645.00	376,400.00	228.81	28,500.00	66.00	431.82
5	A0 B1 C0 D0 E0 F2 G0 H1	2,390.00	765,900.00	320.46	389,500.00	745.00	522.82
6	A0 B1 C0 D0 E1 F2 G0 H1	3,045.00	1,145,400.00	376.16	379,500.00	655.00	579.39
7	A0 B1 C0 D1 E1 F2 G0 H1	3,287.00	1,605,200.00	419.44	459,800.00	782.00	587.98
8	A0 B1 C0 D2 E1 F2 G0 H1	4,092.00	1,932,700.00	472.31	327,500.00	265.00	1,235.85
9	A0 B1 C0 D2 E2 F2 G0 H1	4,787.00	2,808,900.00	586.78	876,200.00	695.00	1,260.72
10	A1 B1 C0 D2 E2 F2 G0 H1	4,873.00	2,937,000.00	602.71	128,100.00	86.00	1,489.54
11	A1 B1 C0 D2 E2 F2 G1 H1	7,978.00	7,912,075.00	991.74	4,975,075.00	3,105.00	1,602.28
12	A1 B1 C1 D2 E2 F2 G1 H1	8,119.00	8,289,075.00	1,020.95	377,000.00	141.00	2,673.76
13	A1 B1 C2 D2 E2 F2 G1 H1	8,216.00	8,559,075.00	1,041.76	270,000.00	97.00	2,783.51
14	A1 B1 C2 D2 E2 F2 G1 H2	8,398.00	9,118,775.00	1,085.83	559,700.00	182.00	3,075.28
15	A2 B1 C2 D2 E2 F2 G1 H2	8,399.00	9,124,875.00	1,086.42	6,100.00	1.00	6,100.00

The alternatives selected by the Biological Team as the Recommended Plan do not replicate any one of the IWR-Plan generated combinations. Chart 5 shows how the Recommended Plan compares with the array of CE/ICA cost effective plans produced by the IWR-Plan analysis. It was the determination of the interagency Biological Team that the outputs produced by the Best Buy Least Cost alternative F1 for the Cahokia Mounds prairie restoration met the planning criteria and the extra increment produced by alternative F2 at this site was not warranted based on its increased cost. For this reason the Recommended Plan falls between CE/ICA plans 13 and 14 when comparing RP Average Annual Habitat Unit (AAHU) production, first cost and average cost per AAHU. The incremental cost per output for the Recommended Plan falls however, between plans 11 and 12, because its incremental cost per output is less than that of the plan 12 combinations, with a cost of only approximately $2,400 for the increased incremental output. This places the RP for output production above plan 13 but below plan 12 for incremental cost per output produced making it a better buy plan than 12 or 13.

CHART 5

Counter	Plan Code	AAHU	Costs ($)	Avg. Cost $ / AAHU	Inc. Cost ($)	Inc. Output (AAHU)	Incremental Cost Per Output
1	A0 B0 C0 D0 E0 F0 G0 H0	0.00	0.00	0.00	0.00	0.00	0.00
2	A0 B0 C0 D0 E0 F1 G0 H0	849.00	113,200.00	133.33	113,200.00	849.00	133.33
3	A0 B0 C0 D0 E0 F1 G0 H1	1,579.00	347,900.00	220.33	234,700.00	730.00	321.51
4	A0 B0 C0 D0 E0 F2 G0 H1	1,645.00	376,400.00	228.81	28,500.00	66.00	431.82
5	A0 B1 C0 D0 E0 F2 G0 H1	2,390.00	765,900.00	320.46	389,500.00	745.00	522.82
6	A0 B1 C0 D0 E1 F2 G0 H1	3,045.00	1,145,400.00	376.16	379,500.00	655.00	579.39
7	A0 B1 C0 D1 E1 F2 G0 H1	3,287.00	1,605,200.00	419.44	459,800.00	782.00	587.98
8	A0 B1 C0 D2 E1 F2 G0 H1	4,092.00	1,932,700.00	472.31	327,500.00	265.00	1,235.85
9	A0 B1 C0 D2 E2 F2 G0 H1	4,787.00	2,808,900.00	586.78	876,200.00	695.00	1,260.72
10	A1 B1 C0 D2 E2 F2 G0 H1	4,873.00	2,937,000.00	602.71	128,100.00	86.00	1,489.54
11	A1 B1 C0 D2 E2 F2 G1 H1	7,978.00	7,912,075.00	991.74	4,975,075.00	3,105.00	1,602.28
12	A1 B1 C1 D2 E2 F2 G1 H1	8,119.00	8,289,075.00	1,020.95	377,000.00	141.00	2,673.76
13	A1 B1 C2 D2 E2 F2 G1 H1	8,216.00	8,559,075.00	1,041.76	270,000.00	97.00	2,783.51
RP *	A1 B1 C2 D2 E2 F1 G1 H2	8,332.00	8,833,775.00	1,060.00	274,700.00	116.00	2,368.10
14	A1 B1 C2 D2 E2 F2 G1 H2	8,398.00	9,118,775.00	1,085.83	559,700.00	182.00	3,075.28
15	A2 B1 C2 D2 E2 F2 G1 H2	8,399.00	9,124,875.00	1,086.42	6,100.00	1.00	6,100.00

Chart 6 is an illustration of the Recommended Plan overlaid onto the array of alternatives determined to be Best Buy plans using the IWR-Plan software. The Recommended Plan produces a slightly higher output than Plan 13, and carries an incremental cost slightly lower than Plan 12's. The additional increment of AAHU output for the additional cost of approximately $2,400 is related to the inclusion of both the Old Cahokia Creek action area and 16 miles of tributary stream aquatic restoration within the Mullen Slough action area. Both of these components are considered essential to the overall East St. Louis ecosystem restoration plan and have been justified as such.



The IWR-Plan CE/ICA analysis supports the Recommended Plan selection by the Interagency Team. This analysis confirms the importance of the tributary stream restoration with all but 16 miles of stream restoration being included in the Plan 11 combination. The selection of an the RP which produces higher outputs than the Plan 13 combination at an incremental output cost of less than Plan 12 is justified based on considerations of sustainability and connectivity. The use of the IWR-Plan to evaluate all action areas supports the selection of alternatives at each action area site as being appropriate and justified as an increment of the overall restoration plan."

(4) Addenda to page 6-139 - add the following as new Section 6.12.3 and renumber current Section 6.12.3 as Section 6.12.4

"6.12.3 Benefits of Tributary Stream Restoration

Tributary stream restoration is an essential component of the recommended plan because it restores habitat quality to the streams, provides for a comprehensive watershed approach to ecosystem restoration and allows the restored system to operate naturally, which assures its long term sustainability. The restoration of tributary streams may not appear to be justified based solely on HEP analysis outputs. However, the species models available did not assess and measure the benefits derived from restoring these finite stream resources. In addition to the professional judgments made by the interagency biological team during plan selection, the Qualitative Habitat Evaluation Index (QHEI) model was utilized in October 2003 in order to provide an additional measure of the value of tributary stream restoration. The results of this analysis are discussed in detail in Section 7 and Appendix A. The QHEI procedure was applied to evaluate tributary streams as habitat for fish communities and other aquatic species, such as invertebrates. Measurements of physical habitat parameters (i.e., hydrology and geomorphology) that are known to correlate to high biological diversity and biological integrity were used to generate a habitat suitability index on a scale from 0 (no value) to 1 (optimal). The results of this evaluation showed that with the Project, the stream quality increases by 35% and without the Project, stream quality decreases by an additional 14%.

The results of this QHEI evaluation further supports the professional judgment of the interagency biology team by indicating that under the future with Project condition, the combined effects of tributary stream restoration far exceeds that expected under the future without Project condition increasing quality an overall 55%. Additionally, available tools do not readily measure the benefits created by the synergy of linking otherwise isolated sites in this highly disturbed urban area. Tributary stream restoration measures restore habitat quality by accomplishing the following: reducing sediment release, transport and accumulation; reducing nutrient delivery to waters and restored floodplain areas; reducing turbidity while increasing dissolved oxygen; protecting and preserving streams from further headcutting; improving spawning habitat for fish; and creating conditions beneficial to benthic organisms that will increase the sustainability and productivity of the system. Installation of tributary stream restoration measures further improves the quality and manageability of flood pulses that are delivered to restored habitat areas, ensures essential riparian linkages are maintained and allows for the linkage of aquatic resources on the floodplain by supporting the hydrologic integrity of the overall restored system.

These positive effects are difficult to quantify in straight output terms and as a general rule, restoration of aquatic habitats such as streams and lakes is more costly than that of wetland or terrestrial habitats per unit of environmental output achieved because of the construction costs of producing such habitats. As a result, aquatic restoration is automatically placed at a disadvantage when compared dollar for dollar to outputs generated from the restoration of other habitat types. The added increment of cost for the recommended plan that includes 79 miles of tributary stream restoration is between $1,230 and $3,000 per average annual habitat unit (AAHU) depending on the watershed involved for an overall average of $1640 per AAHU. When compared to other like projects in this region and across the country, this incremental cost is low. An average cost for producing aquatic resources in the Environmental Management Program on the upper Mississippi River system that requires no purchase of land is approximately $2,500 to $3,000 per AAHU. As can be seen, the additional cost of restoring the 79 miles of tributary stream in the project area is reasonable when compared to the results achieved and to the typical costs for such restoration activities. The CE/ICA analysis conducted as a result of Policy Compliance Review and included in Section 6.12.2 supports the inclusion of tributary stream restoration as a justified increment of the overall restoration plan."

Section 8 - Recommended Plan, and Section 12 – Commander's Recommendation

Addenda to Section 8.16 pages 8-63 to 8-65, and pages 12-1 and 12-2 - items a-o should be changed to include the following IAW the latest guidance on the sponsor requirements:

"a. Provide 35 percent of the total project costs allocated to ecosystem restoration as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to ecosystem restoration in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds needed to cover the non-Federal share of design costs allocated by the Government to ecosystem restoration;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the ecosystem restoration features;

(4) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the ecosystem restoration features;

(5) Provide during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of total project costs allocated to ecosystem restoration;

b. Provide 50 percent of total project costs allocated to recreation as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to recreation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to recreation;

(3) Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;

(4) Provide, during construction, any additional funds necessary to make its total contribution for recreation equal to 50 percent of total recreation costs;

c. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost-sharing provisions of the agreement;

d. Provide, during construction, 100 percent of total project costs allocated to recreation that exceed an amount equal to 10 percent of the Federal share of costs allocated to ecosystem restoration;

e. Operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

f. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

g. Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

h. Hold and save the Government free from all damages arising from the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

i. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents and other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

j. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project. However for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

k. Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA-regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

l. Agree, as between the Federal Government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERLA;

m. Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration benefits, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or addition of facilities that might reduce the benefits of the project;

n. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

o. Do not use Federal funds from other Federal programs, including any non-Federal contribution required as a matching share, to meet any of the non-Federal obligations for the project unless the Federal granting agency providing the Federal portion of such funds verifies in writing that the expenditure of such funds for such purpose is authorized;

p. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army;" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

q. Provide and maintain recreation features, such as access roads, parking areas and other public use facilities, open and available to all on equal terms."

Section 11 - Environmental Statutes and Requirements

Addenda to page 11-4 - Delete the last sentence of Section 11.4 second paragraph.

Appendix B

(1) Addenda to page B-3 - Add the following:

"B.26 COORDINATION ACT REPORT B-181"

(2) Addenda to page B-106 - Change the third sentence of paragraph 4 to read:

"Section 310 of this Public Law contains the following wording: "The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

(3) Addenda to page B-181- add the following:

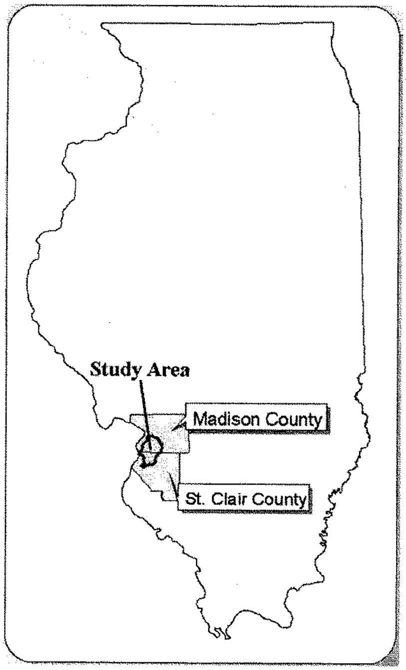
"Section B.26 - COORDINATION ACT REPORT"

EAST ST. LOUIS AND VICINITY, ILLINOIS ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION PROJECT

FINAL GENERAL REEVALUATION STUDY

SUMMARY REPORT

October 2003



EAST ST. LOUIS AND VICINITY, ILLINOIS ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION PROJECT FINAL GENERAL REEVALUATION STUDY

SUMMARY REPORT

OVERVIEW

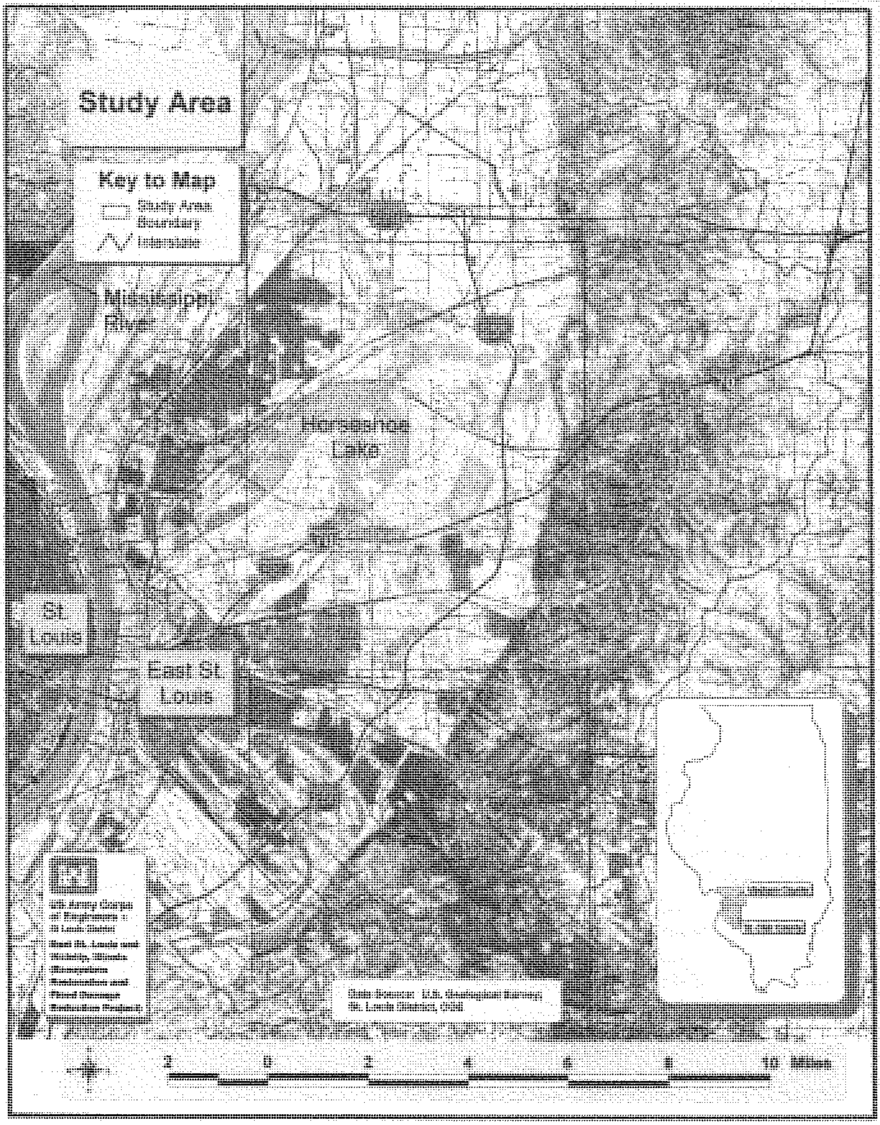
This report presents a summary of the East St. Louis and Vicinity, Illinois, Ecosystem Restoration and Flood Damage Reduction Project General Reevaluation Report with Integrated Environmental Impact Statement. As such, this Summary Report includes material also contained in the above referenced General Reevaluation Report (GRR) but in a much more abbreviated form. For complete details, the reader is urged to reference the above GRR.

The East St. Louis and Vicinity, Illinois Project is located in Madison and St. Clair Counties, Illinois, along the left bank of the Mississippi River between river miles 175 and 195 above the Ohio River. It includes a portion of the bottomlands between the bluffs on the east and the Mississippi River and Chain of Rocks Canal on the west. It extends from the Prairie Du Pont canal on the south to the Cahokia Creek diversion channel on the north.

The study area to be re-evaluated envelops about 166 square miles or 105,000 acres in the MetroEast area. About half of the study area occurs on the floodplain of the Mississippi River, and the remainder consists of small tributary watersheds that drain into the bottoms. The floodplain area includes approximately 55,000 of the 86,000 acres that are protected by an urban levee system along the Mississippi River, Chain of Rocks Canal, Prairie du Pont canal, and Cahokia Creek diversion channel. The upland area includes watersheds of seven named and several unnamed tributary streams draining a total of about 50,000 acres. Tributary streams typically end at the bluff-floodplain border, and continue as a ditch and canal system on the floodplain to carry water as directly as possible to the river. Larger streams to the north and south of these watersheds were diverted many years ago to the Mississippi River between flank levees to reduce drainage into the bottomlands.

Even though the study area is protected from Mississippi River overflow by an urban design levee, the bottomland inside or interior to this levee can experience flooding after significant rainfall. The ditches and canals of the interior flood control system were constructed in the early 1900's, and have not been modified to handle the increased runoff caused by urbanization, and more intense summer rainstorms due to a localized climatic change called the St. Louis effect. As a result, moderate storms over the tributary watersheds are capable of overtopping the ditch and canal system, and damaging adjacent farmland and urbanized areas. Additionally, low lying areas in the mid-region of the floodplain that typically do not flood from overtopping events will pond stormwater that cannot gravity flow into the interior flood control system when its ditches and canals are full of flow from tributary streams. This inability to get water into the interior flood control system also causes flood damages across the study area.

Figure 1 The study area



In 1965 a flood protection project was authorized for East St. Louis and Vicinity, Illinois, to provide protection in the bottoms from flooding caused by local storm events. In 1976 Blue Waters Ditch, a segment of the authorized project was reevaluated, and in 1989 new and improved drainage channels and a pump station were constructed to eliminate flooding from about 700 acres of the original 136,000-acre Project area. In 1984 a reevaluation of the recommendations contained in the 1965 report for the Cahokia Canal and Harding Ditch drainage areas found them not to be economically justified.

In the mid 1990's when interior flooding again became a major issue in the area, it was realized that the un-constructed portions of the authorized project would still not be economically justified. However, by 1998 the Corps was participating with Region 5 of the U. S. Environmental Protection Agency and interested local parties in the MetroEast area on issues related to urban sprawl, smart growth and watershed planning. During this timeframe a second re-evaluation of the un-constructed portions of the 1965 authorized project was initiated. It was determined at the outset that a completely fresh look of the existing problems and opportunities needed to be made, as there had been substantial changes in the existing conditions since the 1965 report was prepared.

In 2000, the project for flood protection was modified to include ecosystem restoration as a project purpose. The purpose of ecosystem restoration activities in the Civil Works program is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. The intent of restoration is to partially or fully reestablish the attributes of a naturalistic, functioning, and self-regulating system. Restoration opportunities most appropriate for Corps involvement are associated with wetlands, riparian and other floodplain and aquatic systems.

When Europeans began settling the study area about two hundred years ago, the Mississippi River floodplain and adjacent tributary watersheds supported a high level of biodiversity. On the floodplain, backwater lakes, sloughs, and marshes punctuated broad expanses of forest and prairie. Streams beginning in upland forests and prairies meandered across the floodplain to discharge into the Mississippi. Forest typically comprised the riparian corridors along rivers and streams. Wetlands consisted of shallow ponds, forested wetlands, wet prairies, and marsh. Seasonal flooding from the Mississippi River and tributary streams inundated the floodplain to various degrees from year to year. The dynamic process of flooding was accompanied by other periodic natural disturbances, such as wildfire and drought. These disturbances were important because they maintained biological diversity, growth and productivity. Wetlands performed various functions, such as temporary storage of surface water, maintenance of habitat for numerous plant and animal species, and export of organic carbon.

Under current conditions, the study area lies within the largest concentration of industrial, commercial, and residential land use on the Mississippi River floodplain north of New Orleans. Development has greatly affected historic ecosystem structure, function, and dynamic processes. By area, about half of all lakes and ponds are gone, about two-thirds of forests, wetlands, and floodplain streams no longer exist, and virtually all historic prairie has disappeared. Remaining resources are fragmented and degraded. Many wetlands have become isolated from historic sources of flooding because riverine overflow has been engineered out of today's environment. Due to their isolation, wetlands no longer temporarily store much surface water.

The lack of significant periodic flood disturbances or flood pulses jeopardizes the sustainability of floodplain resources and the maintenance of characteristic plant and animal communities. Development in tributary watersheds has also degraded tributary streams, where channel and bank instability diminish in-stream habitat quality and give rise to excessive levels of sediment transported by storm water to the floodplain.

Despite these changes, remaining aquatic resources in the study area are significant at the national and regional scale. Such resources include the 2,000-acre Horseshoe Lake, about 6,000 acres of wetlands in the lake's vicinity, and over 200 miles of tributary streams. Sources of significance are technical and institutional, and include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Clean Water Action Plan, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and several international bird conservation initiatives supported by the Federal government to protect a variety of bird species of concern. Technical significance is based on the ecological concepts of connectivity and status and trends.

The recommended plan would restore significant ecosystem structure, dynamic processes, and function to aquatic resources in the study area at a watershed level. About 4,700 acres of forests, prairies, marshes, scrub-shrub wetlands, and lakes and ponds would be restored at eight proposed floodplain habitat restoration sites. Restoration activities would improve about 2,300 acres of existing, degraded habitats, and recreate about 2,400 acres of wetlands and floodplain habitats at sites where they formerly occurred that are now agricultural. About 11 miles of floodplain streams would be restored within the floodplain habitat areas, and about 178 miles of streams in the tributary watersheds would be restored. Introducing storm water from tributary watersheds into the proposed habitat restoration areas, thereby mimicking the historic flood pulse, would restore the dynamic process of flooding. The plan would make significant contributions to the national and regional plans and programs outlined above. By restoring ecosystem functions at a watershed level, existing problems and opportunities including those identified by the public could best be addressed.

The MetroEast Sanitary District has been the local sponsor for this General Reevaluation Study. As a reevaluation of an authorized project, the Planning, Engineering and Design costs were shared on a 25% non-Federal and 75% Federal basis.

STUDY AUTHORITY

The East St. Louis and Vicinity, Illinois Flood Protection Project was specifically authorized (and modified) through Congressional actions in 1965 under Section 204 of the Flood Control Act of 1965, (Public Law 89-298) and subsequently under the Water Resources Development Act of 1976 (Public Law 94-587). Section 204 of the Flood Control Act of 27 October 1965 (Public Law 89-298) provides that:

"The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein. The necessary plans, specifications, and preliminary work may be prosecuted on any project authorized in this title with funds from appropriations hereafter made for flood control so as to be ready for rapid inauguration of a construction program. The projects authorized in this title shall be initiated as expeditiously and prosecuted as vigorously as may be consistent with budgetary requirements. Penstocks and other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this Act for construction by the Department of the Army on the recommendation of the Chief of Engineers and the Federal Power Commission."

UPPER MISSISSIPPI RIVER BASIN

"The project for flood protection at East St. Louis and Vicinity, Illinois, (East Side Levee and Sanitary District), is hereby authorized substantially, as recommended by the Chief of Engineers, in House Document Numbered 329, Eighty-eighth Congress, at an estimated cost of $6,180,000."

The Water Resources Act of 1976 (Public Law 94-587) provides that:

"An Act"

"Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,"

"Sec. 137. The project for flood control in East St. Louis and Vicinity, Illinois, authorized by Section 204 of the Flood Control Act, approved October 27, 1965, is hereby modified to authorize the Secretary of the Army, acting through the Chief of Engineers, to construct the Blue Waters Ditch segment of the overall project independently of the other project segments. Prior to initiation of construction of the Blue Waters Ditch segment, appropriate non-Federal interests shall agree, in accordance with the provisions of section 221 of the Flood Control Act of 1970, to furnish non-Federal cooperation for such segment."

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Blue Waters Ditch in 1976. The results showed that the Blue Waters Ditch portion of the authorized project was still economically justified with a benefit to cost ratio of 1.35 to 1. Blue Waters Ditch was completed in 1989 and includes 4.4 miles of new/improved drainage channels and a 600 c.f.s. pump station, which eliminates flooding from an estimated 700 acres of approximately 136,000 acres of the original project area.

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Cahokia Canal and Harding Ditch Areas in 1984. This evaluation found the recommendations contained in the authorized project to not be economically justified under the existing interest rate at that time of 8 1/8 percent.
Major interior flooding in the study area resulted in four disaster declarations during the period 1993 to 1996. As a result, the 104th Congress, 2d Session provided funding via House Report 104-782, Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1997, to initiate a reevaluation of the authorized project.

PURPOSE AND SCOPE OF STUDY

In broad terms, the purpose of this Study is to re-examine the Cahokia Canal and Harding Ditch areas of the authorized East St. Louis and Vicinity, Illinois Project under current conditions, existing authorities, and Executive Branch priorities with a view towards looking for new solutions to old problems. The principal goal is to identify potential improvements to the natural system for ecosystem restoration and to address related land and water resources problems and opportunities.

The Study follows the Corps' methodology for the reevaluation of a feasibility report. In general, the previous study information was examined and updated to current and future without project conditions. Additionally, an analysis of the pre-levee condition (ca. 1800) was made in order for a full array of ecosystem alternatives to be understood and explored that might best achieve study objectives.

Through a series of public and agency involvement activities, objectives for the ecosystem restoration project were identified and existing baseline data gathered for use in the formulation of alternatives and their analyses. As an outgrowth of utilizing existing Corps' policy guidance and extensive coordination among project partners, environmental restoration benefits were utilized to measure, evaluate and compare alternative plans through the application of an incremental cost analysis methodology. The Waterways Experiment Station's (WES) Integrated Bio-Economic Planning System (IBEPS) was used in conjunction with the Institute for Water Resources' (IWR) method of cost effectiveness analysis for environmental planning. In addition to Corps' expertise, the Study Team included biologists from partnering agencies. They included representatives from: the U.S. Environmental Protection Agency, Region 5; the U.S. Fish and Wildlife Service, Region 3; the Natural Resources Conservation Service, Illinois; and the Illinois Department of Natural Resources. The Study Team was augmented throughout the reevaluation process by technical experts from respective resource agencies as needs arose.

Since a feasibility report normally does not include a significant level of detail and thus, includes an inherent level of uncertainty, the GRR documents the resultant uncertainties involved with plan selection and with the future tasks that will be needed to minimize these uncertainties. Engineering and real estate cost estimates have been based upon the analyses and assumptions made during the process of formulating and developing components of the recommended plan. Uncertainties in design details could impact future alternative analyses and subsequent design and cost estimates. As a result, the Study Team decided, in consultation with the Environmental Protection Agency and the U.S. Fish and Wildlife Service, that a Programmatic Environmental Impact Statement would be most appropriate for this report because of the size of the study area and complexity of ecosystem features. However, after review of the draft report, these agencies agreed that the level of information provided was able to satisfy the requirements for preparation of an Environmental Impact Statement. It was determined following this review that the project should follow a tiered evaluation approach to accomplish future NEPA requirements.

In order to clarify a potential area of confusion, the term "Study" in this report refers to the General Reevaluation Study as addressed in the more detailed "East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project General Reevaluation Report with Integrated Environmental Impact Statement" mentioned above. The term "Project" refers to the congressionally authorized but un-constructed segments of the East St. Louis and Vicinity, Illinois Flood Protection Project (as amended) known as the Cahokia Canal and Harding Ditch Drainage Areas upon which the General Reevaluation Study is based.

RELATED PROJECTS AND STUDIES

Existing Authorized Project. The East St. Louis main line flood protection system, authorized by the Flood Control Act of 1936, has been essentially complete for many years. Its features are approximately 19.8 miles of levee/floodwall improvements including: 6.1 miles of reconstructed riverfront levee, 4.8 miles of upper flank levee; 4.9 miles of lower flank levee; 0.9 miles of new riverfront levee; and 3.1 miles of riverfront floodwall. Complementary appurtenant works consist of gravity drainage structures at highway crossings, alterations and reconstruction of existing pumping plants, construction of new pumping plants, servicing of access roads on the levee crown, seepage corrective measures, and alterations to railroad tracks and bridges at levee crossings. The project levee grade (52 feet on the Market Street gage) affords protection against a flood with a 500-year return period.

Prior Corps' Studies. In 1957, the Corps was authorized to study the engineering and economic feasibility of improvements to the interior flooding problem in the study area. Completion of the study and a recommended plan were documented in a Survey Report published in 1962. The Survey Report plan recommended 14 separate features: improvement of four channel systems; the construction of five bottomland detention areas; the construction of one upland reservoir on Little Canteen Creek; the use of two existing lakes for storage; the construction of one new channel; and, the construction of a new pump station for the Blue Waters Ditch area. The modification of the interior flood control system based on the 1962 Survey Report was authorized by the Flood Control Act of 1965 and had four major components: Blue Waters Ditch, Cahokia Low Water Dam, Harding Ditch drainage area, and the Cahokia Canal drainage area.

The Water Resources Development Act (WRDA) of 1976 modified the 1965 Act by authorizing construction of the Blue Waters Ditch segment of the overall project independently of the other project segments. The Blue Waters segment was constructed in the 1980s.

Major repair work was done on the Cahokia Low Water Dam after the 1993 flood. The success of the repair will likely preclude the need to replace the low water dam as was originally authorized. The Harding Ditch and Cahokia Canal segments, the subject of this reevaluation study, were studied in the 1980s and resulted in a revised unpublished draft report in 1985. The conclusion stated in the document was that there is no economic justification for these two segments. The recommendation in the report was for those segments to be reclassified as inactive. However, due to severe flooding in 1995 through 1997 on the Harding Ditch and Cahokia Canal segments, a new Congressional appropriation in 1997 initiated a re-start of a general reevaluation of the interior area.

Other Related Projects. Due to intense local interest, the State of Illinois became involved in the flooding problems of the Dobrey Slough area. Flooding in the Dobrey Slough area was a problem from both surface water and from a rising groundwater table. In 1974, the State provided a solution for the more frequent surface water flooding through the installation of a small pump station that discharged into the Nameoki Ditch system.

Next, during a Mississippi River flood event, which occurred in October 1986, a roller gate failed at the East St. Louis Pumping Station, resulting in river water backing into East St. Louis. This caused 1200 persons to be evacuated from their homes, and flood damages estimated at $35 million. This disaster helped focus attention on the need for rehabilitation of the very deteriorated flood protection system, and led to the authorization of the Corps' "East St. Louis Flood Protection Rehabilitation Project." The majority of the rehabilitation took place along the mainline Mississippi River protection, but channel rehabilitation in the bottoms was also an authorized purpose. Much of the work has been completed, however, relief well rehabilitation is currently under contract and cleanout of the upper portion of Canteen Creek is about to get underway. A supplemental report with additional rehabilitation items has been prepared.

Finally, after a large rainfall event in May 1995, significant interior flooding occurred throughout the bottoms area. This disaster reiterated the need to rehabilitate the deteriorated condition of the interior flood protection channels that were choked with vegetative growth and sediment. FEMA funded a $5 million cleanout of many of the major ditches in the bottoms. $4 million more has spent on rehabilitation of many of the major ditches under the Corps Rehabilitation Project.

Related Studies and Reports by Others. In 1950, the Illinois Department of Public Works and Buildings' Division of Waterways issued a report entitled, "Proposed Hillside Diversion Project, Madison and St. Clair Counties, Illinois." The report included a recommendation for a project that included a bluff-line diversion channel, floodway enlargements, pumping station improvements, and run-off impoundments within the bottoms area of their study area.

In 1970, the Illinois Department of Transportation's Division of Water Resource Management completed a draft report entitled, "Flood Control Project For East St. Louis and Vicinity, Illinois," which incorporated the most desirable features of the 1950 report and added to this earlier plan, a reservoir on Prairie Du Pont Creek at the bluff line and the proposed deepening and widening of the Prairie Du Pont Diversion Channel.

In November 1972, the Illinois Department of Transportation issued a report entitled "Request for Public Law 99 Assistance, Dobrey Slough Flood Water Conduit". This report proposed a floodwater conduit to reduce flooding in the Dobrey Slough area.

In August 1975, the Southwestern Illinois Metropolitan and Regional Planning Commission issued a report entitled "Plan for Major Drainage: The American Bottoms and Hillside Drainage Area Planning Basin". The report proposed alternatives for reducing stormwater flooding in both the Cahokia Canal and Harding Ditch watersheds.

In December 1978, the Illinois State Water Survey issued a report on the analysis of the inflow hydrology of Horseshoe Lake. The report describes the drainage history of the lake, its hydrologic modeling, inflow frequency analysis, and hydrologic budget.

In August 1986, Hurst-Rosche Engineers, Inc. completed a report commissioned by the Metro-East Sanitary District (MESD) to identify the scope of rehabilitation and improvements needed to restore the flood control facilities under MESD operational control. The MESD's commissioning of the report was prompted by the failure of the roller gate at the East St. Louis Pumping Station in October 1986. The Hurst-Rosche report was used as a starting point to get the Corps' involved in the rehabilitation of the project.

Between 1990 and 1995 the Natural Resource Conservation Service (NRCS) in Madison and St. Clair Counties completed 6 planning studies that were designed to address flooding and sedimentation caused by erosion in the project area. However, no projects resulted from these studies:

Little Canteen Creek/Harding Watershed, May 24, 1995
Big Canteen Creek Hydrologic Unit Resource Plan February 9, 1995
Schoolhouse Branch Watershed Resource Inventory and Alternative Evaluation, September 15, 1995
Long Lake Watershed Resource Inventory and Alternative Evaluation, July 25, 1995
Judy's/Burdick Branch Watershed Resource Inventory and Alternative Evaluation, September 1, 1995

RESOURCE SIGNIFICANCE IN STUDY AREA

Aquatic resources of national and regional significance are found in the Project area. They include aquatic features such as 2,000-acre Horseshoe Lake, over 6,000 acres of various wetlands on the Mississippi River's floodplain, and over 200 miles of streams in small tributary watersheds. The national and regional level of significance attributed to these resources comes from institutional and technical sources. Sources of significance for the Project area's aquatic resources are described below.

North American Waterfowl Management Plan. Because the study area's aquatic resources are within a waterfowl habitat area of major concern designated under the North American Waterfowl Management Plan, and within a joint venture area approved under the Plan, their institutional significance is recognized from both a national and international perspective. Additionally, the study area's aquatic resources exist within a priority or focus area designated in the Upper Mississippi River/Great Lakes Region Joint Venture Implementation Plan, which recognizes their institutional significance from a regional perspective. Based on technical recognition, Horseshoe Lake and surrounding wetlands are significant from a state perspective because they are important resources for migratory waterfowl in terms of connectivity. At the landscape level, the lake and its surrounding wetlands serve as an important link in a chain of habitats used by migratory waterfowl along the Mississippi flyway. Based on public recognition, Horseshoe Lake is locally significant because of the hunting opportunities it offers to the public, and because the Illinois Chapter of Ducks Unlimited, Inc., supports wetland enhancement opportunities at the lake.

Upper Mississippi River System Environmental Management Program. Because the study area's aquatic resources on the Mississippi River's floodplain are located within the floodplain of the Upper Mississippi River System, they can be recognized as part of a nationally significant ecosystem. Also, because these resources are within an area of the UMRS targeted for habitat restoration under the Upper Mississippi River Environmental Management Program, its natural resources can be recognized as institutionally significant from a regional perspective. In addition, floodplain prairies, hardwood forests, marshes, and deep backwaters within the study area can be recognized as technically significant from a regional perspective based on status and trends as described in the UMRS-EMP's recent Habitat Needs Assessment.

Clean Water Action Plan. The small watersheds within the Study area are designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan and are recognized as institutionally significant from a national perspective.

Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Because the study area is located on the floodplain of the Mississippi River north of the Ohio River, it occurs in an area highlighted by the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force as potentially important to contributing to the Action Plan's goals of reducing nitrogen loads to the Gulf of Mexico and improving waters within the river's basin. As such, the study area and its aquatic resources can be recognized as institutionally significant from a regional perspective.

Given the potential to implement one of the Action Plan's recommended actions in the study area, namely the restoration of floodplain wetlands, further significance is associated with the study area and its aquatic resources.

Conservation Initiatives for Bird Species of Concern. Aquatic resources within the Study area serve as migratory, wintering, or breeding habitat for 34 bird species of concern. The cause of concern is the species' declining population levels. The Study area's aquatic resources also support two Federally threatened species (a bird and a plant). The listing of certain migratory birds as species of concern by the U.S. Fish and Wildlife Service illustrates that the Federal government recognizes them as highly significant. Their institutional significance is further supported by various international agreements the Federal government has entered into with Canada, Mexico, and other countries to foster continental and regional bird conservation strategies. Technical significance is supported because aquatic habitats in the study area and along the Mississippi River also serve as habitat for these 34 bird species of concern as well as the two federally threatened species.

PRE-DEVELOPMENT STUDY AREA CONDITIONS

This section provides an overall characterization of the conditions that existed in the Project area about two hundred years ago (ca. 1800), prior to construction of the Mississippi River levee system and prior to drainage and development activities in the East St. Louis floodplain. The Project Team determined that it was important to understand how the ecosystem of the Project area functioned prior to recent human development in order to realize how the functioning of the natural ecosystem has been impacted by human activity. This information provides a key to guide potential ecosystem restoration.

Topography. Erosional and depositional forces have shaped the natural topography of the Project area over the last 7,000 years. The area has three main topographic areas: the relatively level alluvial flood plain of the Mississippi River; the upland bluff area of steep erodible slopes and narrow valleys; and the rolling hills of the uplands.

The Project area is primarily located within a portion of the Mississippi River floodplain known locally as the "American Bottom", and includes western portions of Madison and St. Clair Counties. The American Bottom extends beyond the Project area boundaries going farther north up to Alton and south into Monroe County near Dupo. The American Bottom covers approximately 175 square miles (112,000 acres). The area is approximately 30 miles long and 11 miles wide at its widest point. The topography in the floodplain is nearly level bottomland. The floodplain generally slopes to the south and drops in elevation approximately 0.5-foot per mile mirroring the Mississippi River surface profile. The floodplain typically exhibits river meander scars, abandoned channel oxbow lakes, low-relief ridges, and swales. The average elevation to the north near Alton is 415 feet above the National Geodetic Vertical Datum (NGVD) and to the south near Dupo is 405 feet NGVD. In the northern portion, there are terraces located along the foot of the bluff between East Alton and Roxana. The terraces are approximately 25 to 35 feet above the floodplain with elevations between 440 and 450 feet NGVD. The Project area north of Horseshoe Lake is typically higher than the adjacent floodplain with elevations between 420 and 435 feet NGVD.

The topography near the Illinois bluff on the eastern edge of the floodplain is generally higher than the adjacent floodplain with elevations between 435 and 465 feet NGVD. The bluff rises steeply between 150 to 200 feet above the floodplain. The bluff has a rather rugged topography with the drainage channels forming valleys with steep slopes. Beyond the bluff line the topography consists of rolling hills and valleys with elevations ranging between 500 and 600 feet NGVD.

System Hydrology/Watershed Characteristics. Two major rivers, the Mississippi and Missouri, carried drainage from major portions of the North American continent past St. Louis. The drainage area of the Mississippi River at St. Louis is nearly 700,000 square miles, and that of the Missouri River is about 530,000 square miles. Flooding from the Mississippi and Missouri Rivers frequently inundated large areas of the American Bottom.

Over 500 square miles of tributary or bluff watersheds drained into the study area in pre-settlement times (Figure 2, Table 1). Cahokia Creek was the major tributary watershed. Tributary streams emptied onto the bottoms. Drainage generally flowed toward the Mississippi River and was intercepted by swales, creeks, and major channels. The naturally flat topography in the bottoms was a major factor for the existence of wide meandering creeks and overland flows across the Project area. Abandoned river channels and swales held water that formed large lakes and wetlands. The natural channels had very little slope and were not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River.

Three distinct natural watersheds were present on the floodplain of the Mississippi River in the American Bottom. The Cahokia Creek watershed was larger than either the Wood River or Prairie du Pont watersheds. Figure 3 displays these three watersheds, along with streams and floodplain lakes.

Sediments were transported during predevelopment times into and out of the Mississippi River floodplain. Flows from the tributary streams carried eroded sediments from the uplands and bluffs onto the American Bottom. Where each tributary discharged onto the floodplain, a colluvial fan consisting of heavier sediments formed. Finer grained sediments were carried further out into the floodplain, and eventually dropped out in the meandering channels or on adjacent lands during overland (out-of banks) flows. Flood events from the Mississippi and Missouri Rivers also deposited alluvial materials on the floodplain. Large high-velocity flood events from these major rivers also periodically scoured out portions of the floodplain. A dynamic balance existed between aggradation (filling) due to sediment deposition and degradation (deepening) due to scouring. Although some low areas represented by lakes, sloughs, or wetlands filled up over time with sediments, new ones were created concurrently at other locations.

Figure 2 Historic Tributary Watersheds of the American Bottom

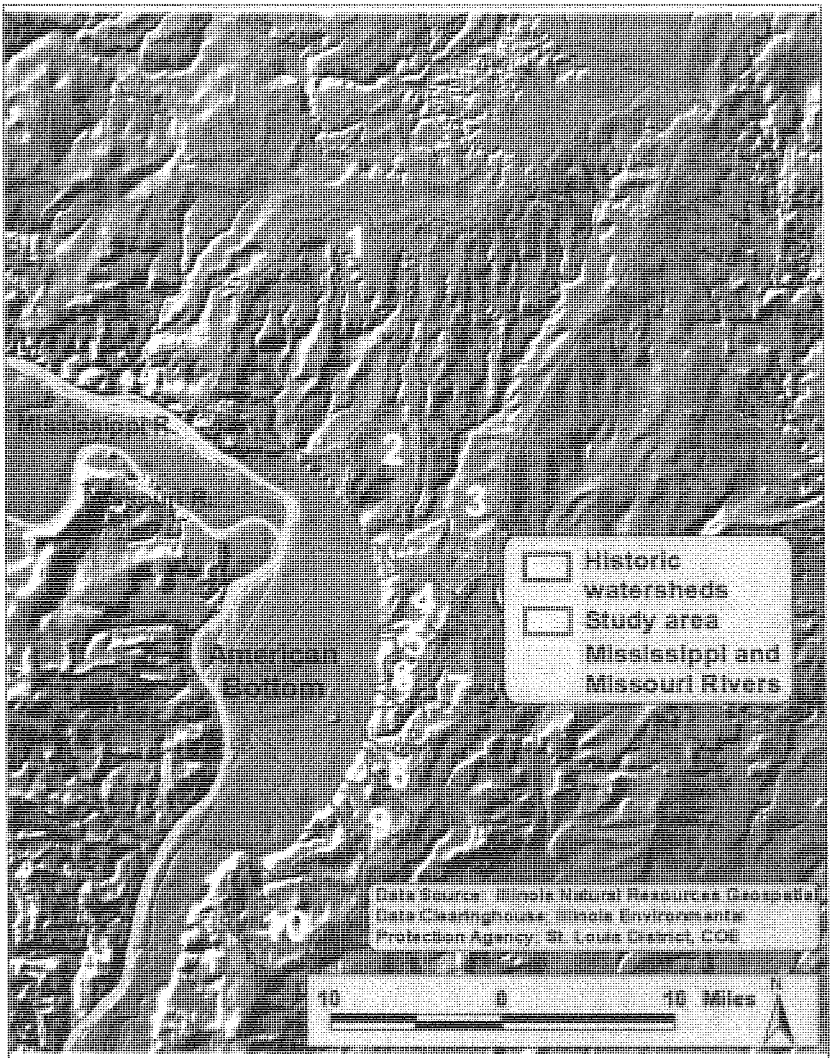
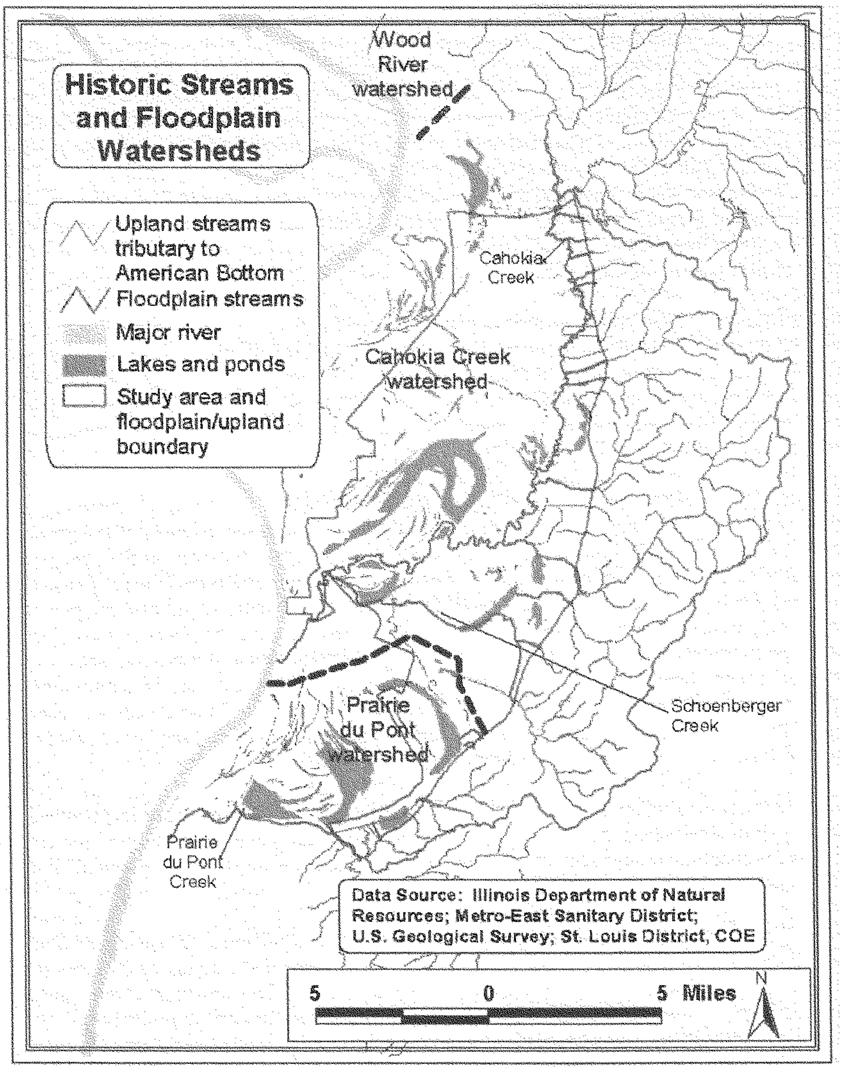


Table 1 Tributary Watersheds that Historically Drained into the American Bottom

Watershed number (Figure 2)	Name of Watershed	Area (sq. miles)	Percent of all watersheds
1	Wood River	121.4	23.8
2	Indian Creek	40.2	7.9
3	Cahokia Creek	217.0	42.6
	Bluff 1	4.5	0.9
4	Judy's Branch	8.5	1.7
5	Burdick Branch	2.9	0.6
	Bluff 2	1.0	0.2
6	Schoolhouse Branch	7.1	1.4
	Bluff 3	1.6	0.3
	Bluff 3/4	<0.1	<0.1
7	Canteen Creek	22.7	4.5
8	Little Canteen Creek	7.9	1.6
	Bluff 4	1.5	0.3
9	Schoenberger Creek	12.1	2.4
	Bluff 5	1.5	0.3
(10)	Powdermill Creek	1.3	0.3
(10)	Bluff 6	1.8	0.4
10	Prairie du Pont Creek (including Hickman Creek)	56.2	9.0
Total		509.4	100.0

Figure 3 Historic Streams and Floodplain Watersheds



Geomorphology. Locally, the Mississippi River is quite old, and probably was established during the Mesozoic Era, and at the very latest during the Tertiary Period of the Cenozoic Era. The Mississippi River maintained its course at the eastern edge of the Ozark Plateaus (uplift) and eroded a broad bedrock valley bottom ranging in elevations between 290 and 310 feet NGVD with an average elevation of 300 feet NGVD, some 300 feet below the surrounding uplands. The eastern bluff has exposed bedrock outcroppings consisting of hard limestone deposits and softer deposits of shale, coal, and some sandstone. The limestones were formed during the Mississippian Period and are located north of Alton, Illinois, and south of Dupo, Illinois. Between Alton and Dupo, soft Pennsylvanian Period shales, coals, and some sandstones extend westward into St. Louis, Missouri, much like a tongue. It is this tongue of weaker shales and coals that enabled the young Mississippi River to cut a wider floodplain (11 miles wide at its widest point), which it was unable to do either upstream and downstream through harder limestone deposits.

Physiography. The Project area is located in part in two geological provinces, Ozark Plateau on the west, and Central Lowlands on the east. The uplands are in the Springfield Till Plain of the Central Lowlands. The Springfield Till Plain was formed by Illinoisan glacial drift that formed a nearly level surface, except where stream dissection has taken place. Narrow flat-topped divides, V-shaped valleys, and slopes of up to 35 percent characterize the bluff. The area has a mean slope of eight degrees and an average local relief of 132 feet.

Stratigraphy. The geologic history of the Project area is divided into three main periods: (1) bedrock formations formed during the Paleozoic Era; (2) deposition of the unconsolidated glacial materials occurring during the Pleistocene Series; and (3) erosion and deposition of the unconsolidated materials occurring, and modern soils formed during the Recent Epoch. During the Paleozoic Era, the Project area, as well as most of the Midwest, was intermittently submerged beneath the sea. Responding to continental tectonic activity with continental plate movements in the nearby Ozark Plateaus and the more distant Appalachian Mountains to the east, the seas alternately advanced, depositing sedimentary rocks, and retreated from the area. This migration of seas brought periods of marine deposition, followed by times of erosion. These events are recorded in some 1,500 to 3,000 feet of sedimentary rocks, mostly limestone, shale and sandstone, which underlie the glacial and Recent Epoch aged sediments.

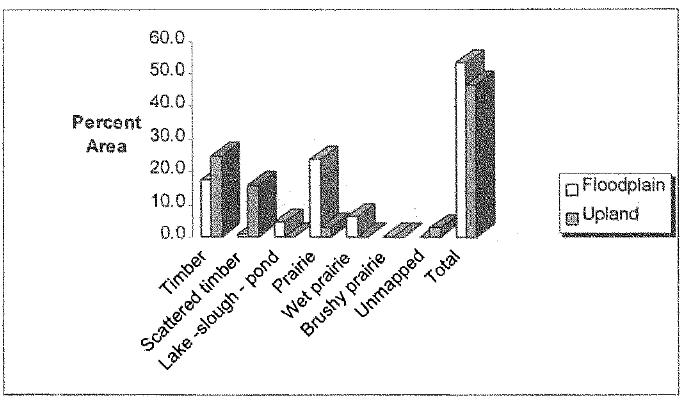
The upland areas of the Project area are covered with glacial till and outwash of sands, gravels, and silts that vary in thickness from zero to over one hundred feet. The Banner Formation of the Kansan Stage probably overlies much of the bedrock of the Project area. The extent and thickness of this formation is unknown.

The Recent Epoch generally is accepted to begin at the end of the last ice age, Wisconsinan Stage. It defines all deposits younger than the top of the Wisconsinan Stage and extends 7,000 years B.P. to the present. The upper portions of the surficial soils within the Project area were formed during the Holocene Stage. However, the lower portion of some of the surficial soil deposits were aggrading during the Wisconsinan Stage since as soon as the glaciers melted away, an assortment of soils were being deposited. In many areas the soils were intermixed, overlapped, and intertongued. The boundaries between Wisconsinan Stage and Recent Epoch deposits are blurred.

Ecological Conditions. Before Europeans settled the study area about 200 years ago, the Study area's ecosystem was vibrant and diverse. Water played a significant role in sustaining the ecosystem and its resources. Mississippi River floods, overflows from tributary streams, rainfall and local runoff all provided periodic disturbances in the form of flooding at various times of the year. These actions, coupled with the occurrence of fire, provided the natural system with the maintenance necessary to ensure its biological integrity. The historic dynamics that contributed to the functioning of the predevelopment ecosystem provide an insight into ways in which improvements can be made to reintroduce missing components, improve habitat quality and ecological function, and recreate a sustainable ecosystem.

Prairie and forest were the dominant forms of land cover during predevelopment times. Land cover of the historic ecosystem has been reconstructed using notes taken by General Land Office surveyors that worked in the area in the early 1800s to establish the public land survey system on the ground. Figure 4 is a map showing six types of land cover in the Project area. They include timber, scattered timber, lake-slough-pond, prairie, wet prairie, and brushy prairie. Nearly 60 percent of the Project area was forested while about 33 percent consisted of different kinds of prairie (Table 2). Aquatic areas, including lakes, sloughs and ponds, covered about five percent of the Project area. About two-thirds of all forest in the Project area occurred in the uplands. Over 90 percent of all kinds of prairie were in the floodplain. All of the lakes, sloughs, and ponds were in the bottoms. A large floodplain lake (called Horseshoe Lake today) comprised most of this water. Additionally, nearly all of the scattered timber was in the uplands, and all the wet and brushy prairies were in the bottoms.

Table 2 Predevelopment Land Cover in the Project area



A better understanding of historic plant and animal communities has been obtained by determining the kinds of natural communities that most likely existed, using the classification system recently developed by the Illinois Natural Area Inventory. Historic community classes included forest, prairie, wetland, lake and pond, stream, cultural, and possibly savanna (Table 2). About 25 kinds of natural communities probably were present in the study area, excluding cultural ones. At least a dozen different natural communities occurred in both the Mississippi River floodplain and tributary watersheds (uplands). The wetland, lake and pond, and stream community classes represent aquatic resources that were present, along with those natural communities in the forest and prairie community classes that occurred on hydric or wetland soils. In addition to marshes, shrub swamps, and ponds, there were variants of forests and prairies that were wetlands, and they are marked in Table 3 with an asterisk. The various kinds of natural communities were associated with differences in geomorphology, topography, and soils. Many of them were influenced by periodic disturbances in the form of flooding and wildfire.

Figure 4 Predevelopment Land Cover of the Study Area

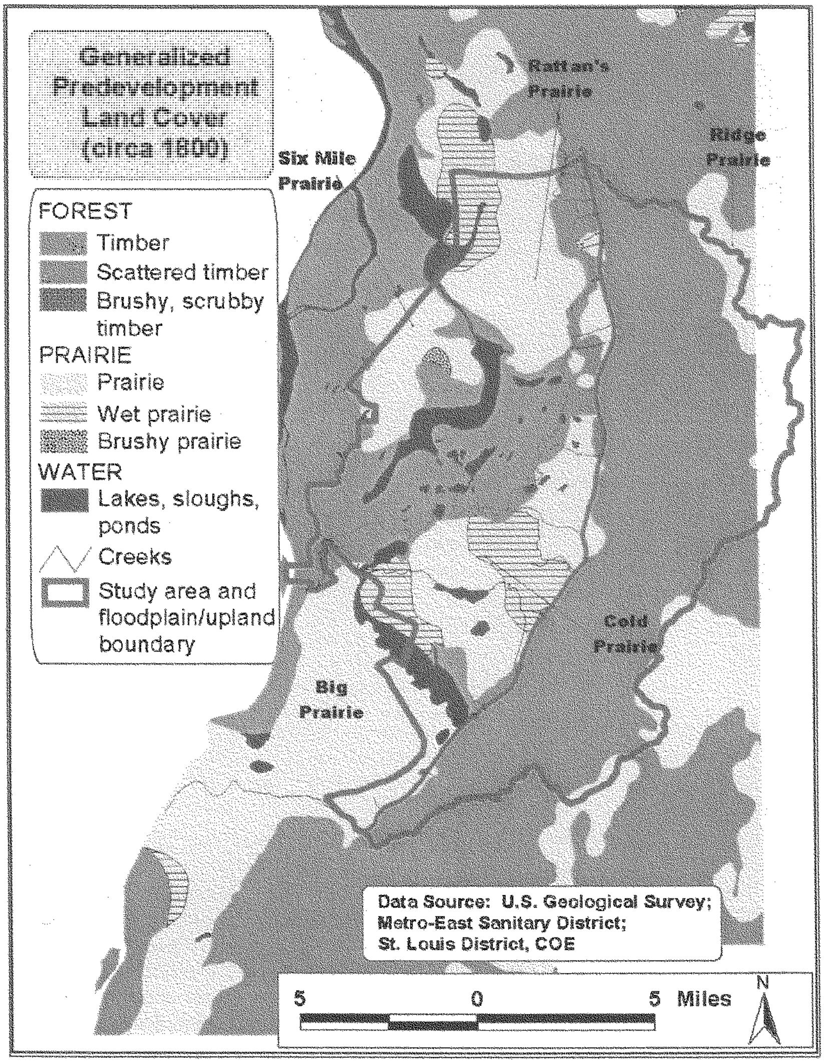


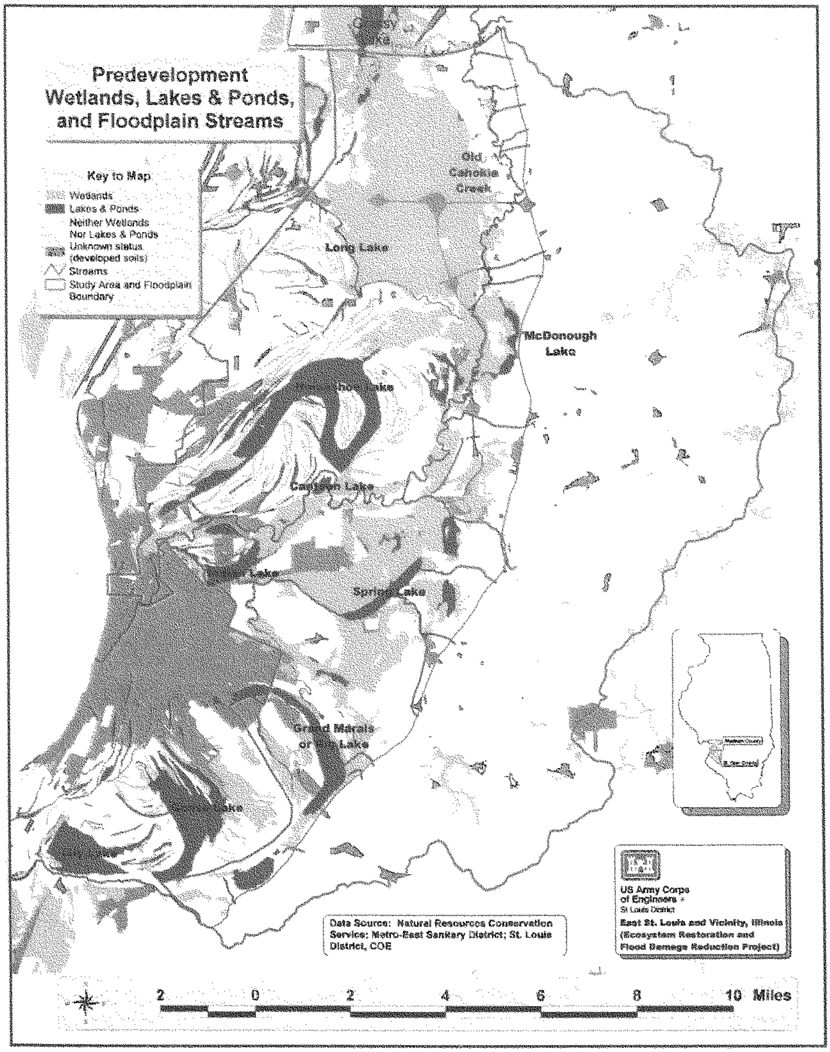
Table 3. Community Classes and Natural Communities of the Predevelopment Study Area (ca. 1800), using the Illinois Natural Areas Inventory Classification System. (1)

Community Class	Natural Community (2)	Mississippi River floodplain	Adjacent tributary watersheds
Forest	Dry upland forest		?
	Dry-mesic upland forest		√
	Mesic upland forest		√
	*Wet-mesic upland forest		√
	Mesic floodplain forest	√	√
	*Wet-mesic floodplain forest	√	√
	*Wet floodplain forest	√	?
	Mesic sand forest	√	
Prairie	Dry prairie		?
	Dry-mesic prairie		√
	Mesic prairie	√	√
	*Wet-mesic prairie	√	√
	*Wet prairie	√	?
	Mesic sand prairie	√	
	Loess hill prairie		√
Savanna	Dry-mesic savanna		?
	Mesic savanna		?
Wetland	*Marsh	√	
	*Shrub swamp	√	
Lake and Pond	*Pond	√	
	Lake	√	
Stream	High-gradient creek		√
	Medium-gradient creek		√
	Low-gradient creek	√	√
	Low-gradient river	√	
	Major river	√	
Cultural	Pastureland	?	?
	Successional land	?	?
	Developed land	?	?
	Cropland	?	?

(1) Questionable communities indicated by "?"
(2) Natural communities that are wetlands preceded by "*"

Wetlands were a significant component of the historic ecosystem. The spatial extent of presettlement wetlands is displayed in Figure 5. Wetland soils comprised nearly 23 percent of the Project area, as determined from digital modern soil surveys. About 95 percent of these wetland soils occurred in the floodplain. Two-thirds of the Project area was comprised of non-wetland soils, and nearly 66 percent of those occurred in the uplands. About 40 percent of the bottoms consisted of wetland soils, and another seven percent of water. In the uplands, nearly 95 percent consisted of nonwetland soils, roughly two percent of wetland soils, and about one percent of water.

Figure 5 Predevelopment Wetlands, Lakes & Ponds, and Floodplain Streams



Flora And Fauna. A high level of species diversity was characteristic of the Project area and its vicinity. The juxtaposition of two major landforms, floodplain and uplands, and the localized physical variations in each, created the setting for an abundance of life forms to exist.

"Mammals" included more than 45 species which lived in the area, including opossum, rabbit, and various shrews and moles, bats, rodents, carnivores, and ungulates (those with hoofs). They utilized all habitats, from forests, prairies, and herbaceous wetlands, to creeks and lakes. Other than a few bat species that migrated, they lived there year-round.

"Birds" included about 285 species that inhabited the Project area and environs. They belonged to many taxonomic groups, included the loons, grebes, pelicans and cormorants, egrets and herons, geese and ducks, hawks and falcons, gallinules, rails, shorebirds, gulls and terns, doves, parakeets, cuckoos, owls, nighthawks, swifts and hummingbirds, woodpeckers, and the diverse songbirds. Like mammals, they made use of all terrestrial, wetland, and aquatic habitats. Many bird species reproduced and stayed throughout the year. Others also raised young but then left before winter to migrate to warmer climates, returning the following year. Still other species passed through the area seasonally, on their way to distant breeding or wintering areas. The Mississippi River corridor was an important flyway for many migratory bird species.

"Fishes" included over 90 species that lived in the various creeks, rivers, ponds, and lakes in the Project area, including the Mississippi River. They were very diverse taxonomically, representing 24 families. Some species lived in the Mississippi River only, while others also used the adjacent standing waters on the floodplain. A few species were restricted to the small tributary streams. Many had broad ecological tolerances and inhabited tributary creeks, floodplain habitats, and the Mississippi River. During seasonal flooding, fishes were carried to aquatic areas on the floodplain, where some species spawned. Backwaters on the floodplain also served as winter refuges from cold, swift, main channel currents.

"Reptiles and Amphibians" included at least 65 species that occurred in the Project area. Reptiles consisted of various salamanders, toads, and frogs, and amphibians included a variety of turtles, lizards, and snakes. For these species as a whole, every habitat in the floodplain and uplands was exploited. Amphibians as a group needed some kind of aquatic habitat, such as a wetland, pond, lake, creek, or river, for breeding, yet the adults of many species also used nonaquatic areas, such as drier forests and prairies, for their other activities. Most turtles also required some type of aquatic habitat for survival. A number of lizards and snakes did not, and instead existed in terrestrial habitats such as forests and prairies. Some reptiles and amphibians made seasonal short-distance migrations between breeding habitats on the floodplain and drier habitats in the uplands.

"Plants" included a variety of vascular species that were found in the Project area. They included all the trees, shrubs, vines, forbs, grasses, and sedges. They formed the preponderance of vegetation that constituted the various natural communities described previously. Plants grew in all habitats, except for those places where either flowing or standing water prevented the establishment of either emergent or rooted floating water-tolerant species.

Ecosystem Disturbance Dynamics. A variety of natural disturbances, such as flooding, wildfire, drought and windstorms, occurred periodically during predevelopment times. Disturbances disrupt ecosystem, community, or population structure and change resources, substrate availability or the physical environment. Disturbances are important to some ecosystems, including those prone to flooding and fire because they are necessary in order to maintain biological growth and productivity. The flooding and wildfire disturbances that were common influences on the ecosystem around 1800 have been largely eliminated from today's environment.

Flooding Disturbances. Flooding varied on a continuum from small to very large, in terms of depth and duration. Because the watershed of the Mississippi River at St. Louis was so immense relative to the combined area of all the tributary watersheds that drained into the American Bottom, it was the primary source of flood pulses that inundated large portions of the floodplain. Flooding from the Mississippi River varied by season and from year to year. Floods could happen during any month, but they usually occurred in the spring (April-June) and fall (September-October). Springtime events were often higher and greater in duration. Low flow periods typically coincided with summer and winter. In many years, the Mississippi River rose and gently overflowed its banks, spreading out over the adjacent floodplain to a minor degree. On an infrequent basis it inundated much of the American Bottom.

Flood pulses are important to wetlands and other floodplain habitats for a variety of reasons. In riverine wetlands, they drive processes such as sediment deposition and nutrient transport. Flood pulses also serve as a temporary connection or link between the floodplain and river channel.

Wildfire Disturbances. Like flooding, wildfire also was a cyclical phenomenon during predevelopment times. Fires started naturally, as from lightning strikes, but they also were set by people, whether Native Americans or early settlers. When intentional, fire could be used to facilitate the hunting of wild animals, or to clear open areas under invasion from woody encroachment. Fires occurred any time of the year, depending on how dry conditions were, but were most prevalent in the fall and early winter.

Fire is important ecologically for maintaining the overall biological integrity of natural habitats adapted to it. In prairies and other herbaceous plant communities, fall or winter burning removed the build-up of dead aboveground plant parts such as leaves and stems, while underground root systems were protected and dormant until the next spring. Without periodic elimination of dead growth, the amount of each year's new growth would be reduced. Other effects of fire on prairie grasses include increased flowering, improved seed germination, and earlier emergence of new growth in the spring. Fire also suppressed the encroachment of trees into prairies. In forests, fire maintained plant species composition and diversity, and variably aged populations of trees. In all areas, nutrients bound in plant materials were released by fire to the soil as ash.

Ecosystem Function. The physical, chemical, and biological processes that occurred in the predevelopment ecosystem were necessary for self-maintenance, such as primary production, nutrient cycling, and decomposition. These processes reflected dynamics within the uplands, floodplain, and Mississippi River, and between these spatial entities. Seven functions described below serve as a foundation for understanding how wetlands were a vital component of the historic ecosystem. This knowledge can be applied in developing solutions to today's environmental and flooding problems and opportunities in the Project area.

Temporary Storage of Surface Water. In light of the flooding problems facing the Project area today, perhaps the most important wetland function intrinsic to the historic ecosystem was the ability to temporarily store floodwater. Due to properties such as width, slope, and roughness, riverine wetlands in the American Bottom routinely detained riverine overflow from the Mississippi River and adjacent tributary watersheds, and released it slowly back to the creeks and river. Aquatic areas (sloughs, lakes, ponds) associated with these riverine wetlands also received overbank floodwaters, and they performed this function. Likewise, nonwetland areas in the American Bottom that became inundated during the larger flood events also temporarily stored floodwater. Wetlands detaining overbank flows dissipate energy, and reduce the velocity of moving water. From a flood damage perspective, the capacity for erosion is reduced. Similarly, storage of riverine overflow in wetlands prolongs the passage of a flood event, and thereby reduces the peak discharge downstream.

Maintenance of Plant Community Characteristics. Another important wetland function was the maintenance of its own characteristic plant community, like that of forest, prairie, or marsh, which are distinct in terms of species composition and physical characteristics. Large areas of these various wetland plant communities existed in the American Bottom. They created much primary production in the form of plant biomass. The type of plant community affected other functions, such as wildlife habitat.

Provision of Wildlife Habitat. The various wetland plant communities served as habitat for many kinds of animals, ranging from macroinvertebrates to vertebrates. The composition and spatial complexity of the vegetation above ground affected the kinds of animals living there and their abundance. Forested wetlands exhibited vertical stratification (understory, subcanopy, overstory), and this structural complexity offered various opportunities for animals to find sites for shelter, nesting, breeding and foraging. Prairies and marshes had simpler structure, which offered opportunities for other species. At the landscape scale, the heterogeneity of wetland types in the American Bottom helped maintain higher levels of species diversity. The extensive spatial distribution of wetlands, and the linkages or connections that existed between different wetland types, facilitated the movement and dispersal of animals. Movements between wetlands, between wetlands and uplands, and between uplands (via relatively small, irregularly shaped wetlands) occurred, in addition to those between wetlands and aquatic areas. Nonwetland areas in the American Bottom also provided wildlife habitat.

Nutrient Cycling. Cycling of nutrients, a fundamental ecosystem function, consists of the abiotic and biotic processes that convert elements from one form to another; primarily recycling processes. In one process, nutrients are taken up from the soil in inorganic form by plants and transformed into organic forms during photosynthesis and growth. In another process, after the plant dies, these organic nutrients are converted back into inorganic form through microbial decomposition, for renewed uptake by plants. In ecological terms, the function is represented by net primary productivity and detritus turnover. Wetlands in the American Bottom performed this function. Nutrient cycling was also a fundamental process in nonwetland areas.

Removal of Elements and Compounds. Surface water can import natural nutrients (like nitrogen, phosphorus, or potassium), present-day contaminants (such as herbicides and pesticides), and other elements and compounds into wetlands. Once there, wetlands can permanently remove these materials from the water column, or immobilize them. The avenues by which they are removed or immobilized include sorption, sedimentation, denitrification, burial, decomposition to inactive forms, uptake and incorporation into long-standing woody and long-lived perennial herbaceous biomass, and similar process. Practical applications of this function are the current use of artificial or natural wetlands to "clean" partially treated wastewater or sewage effluent. As purifiers, wetlands improve the quality of water as it moves downstream. Wetlands in the American Bottom had performed this function, as did aquatic areas.

Particulate Retention. Floodplain wetlands naturally retain organic and inorganic particulates carried in by overbank floodwater. When moving floodwater enters a wetland, its velocity is reduced by the wetland's roughness and increased cross-sectional area. As velocity is reduced, the capacity of the water to carry suspended particulates is reduced, and particulates drop out of the water column and settle. Sedimentation is a common example of this physical process. Deposition of silt is often observed in wetlands after floodwaters recede. Sedimentation raises ground or substrate surface elevations, creates topographic variability, and augments nutrient levels; the accumulation of organic particulates supports decomposition, nutrient cycling, and detrital food webs. Wetlands and aquatic areas in the American Bottom naturally retained organic and inorganic particulates.

Organic Carbon Exportation. Organic carbon in the form of dead and live plant material is exported from wetlands by moving water. Carbon material is either dissolved or particulate. Dissolved forms include organic materials leached out of litter and surface soil during periods of surface inundation. Particulates include living biomass, leaf litter, and fine and coarse woody debris. Organic carbon is typically flushed out of riverine wetlands by overbank floodwater. Downstream aquatic areas usually receive this material. The microbial food web, which forms the base of the detrital food web in aquatic ecosystems, is fueled in large part by the energy in this organic carbon. Given their proximity to the Mississippi River and floodplain lakes and ponds, wetlands in the American Bottom would have been significant sources of organic carbon. Adjacent nonwetland areas on the floodplain would also have been sources of organic carbon, but their rates of carbon export are lower than those of wetlands.

EXISTING STUDY AREA CONDITIONS

Urbanization has had a profound impact on the Project area since pre-development days. The ecosystem has been significantly disturbed and the Project area's flooding patterns, which historically helped create, develop, and sustain habitat quality, have been significantly altered in order to minimize agricultural and structural damages.

Land Cover. The study area lies within the largest concentration of industrial, commercial, and residential land use on the Mississippi River floodplain north of New Orleans. As of the early 1990s, about 68 percent of the Project area consisted of urban/built-up, cropland, and grassland areas (Figure 6). The largely "natural" cover types - forested, wetland, and open water areas - made up the remaining 32 percent. Row crops comprised most cropland, and accounted for about 25 percent of the Project area. Figure 7 displays recent land cover.

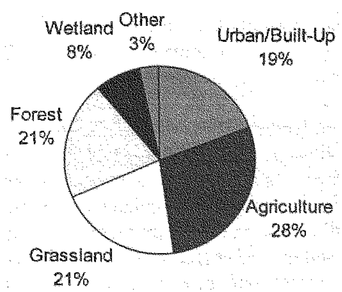
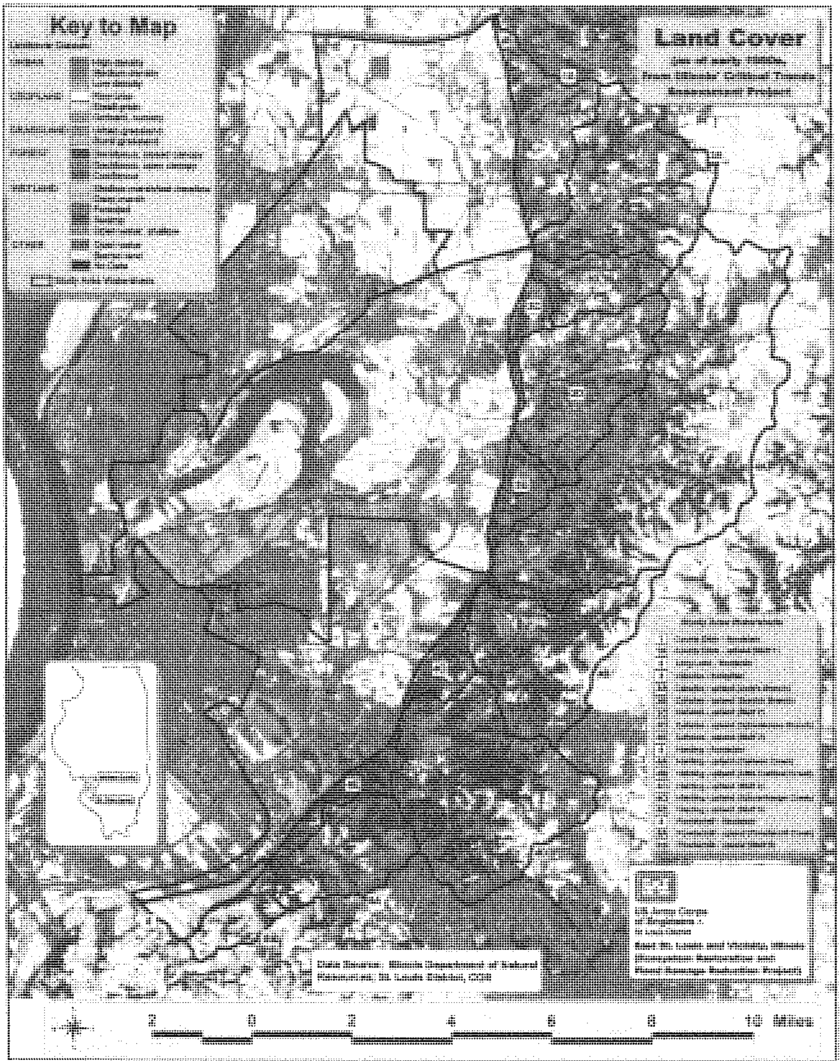


Figure 7 Land Cover Data for Project Area (early 1990s).



Topography. Existing topography has not substantially different from the pre-development period. Changes to topography on the floodplain since pre-settlement times are man made. The area is crisscrossed with railroad beds that form small levee systems across the surface of the area. Mine subsidence in the last 100 years has created some shallow surface depressions less than 5 feet deep east of the bluff line in the uplands.

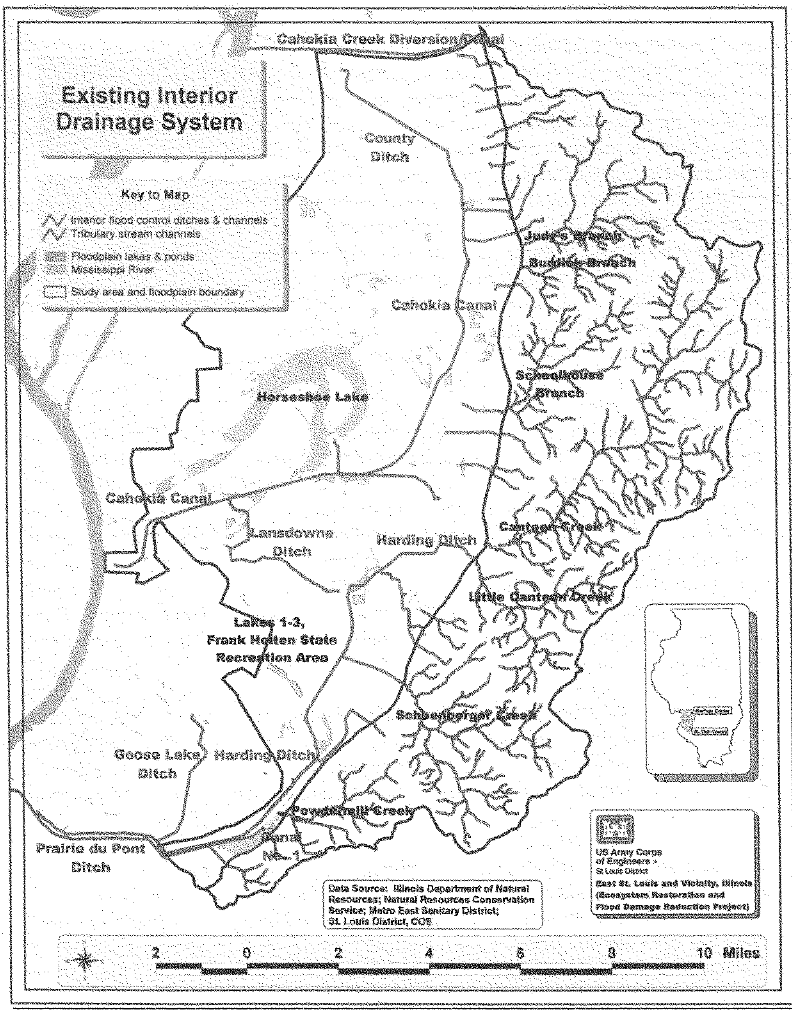
Drainage. By the 1800's, changes to topography from development of the railroad lines traversing the area had altered the natural drainage patterns of the area. Likewise, man-made levee systems designed to protect cropland from flooding changed the natural drainage. Later in the 1900's, as a result of increased development in the area, drainage districts were formed for the sole purpose of managing the drainage of the floodplain. By 1904, engineering plans were underway for the construction of a system of canals and drainage ditches designed to carry water as quickly and directly as possible to the River. The construction of this system eliminated the creek system that originally flowed across the Project area. By this time, a levee system had been constructed along the Mississippi River to protect the area from River flooding and in 1910, the tributary drainage area of Cahokia Creek was eliminated from the floodplain and diverted into a large diversion canal on the northern end of the Project area for the purpose of having the creek flow directly into the River. All flow was diverted into the Cahokia Creek Diversion Canal and levees were constructed along the northern boundary of the newly formed East Side Levee and Sanitary District. The Diversion Canal that is approximately 4.5 miles long flows directly west into the Mississippi River at Mile 195. The levee system continued to be improved and today an urban design (500-year) flood control system protects the Project area within the floodplain with large earthen levees and floodwalls. On the northern Project boundary, a levee is located on the left descending bank of the Cahokia Creek Diversion Canal and ties into the bluff west of Edwardsville. On the southern Project boundary, a levee is located on the right descending bank of the Prairie Du Pont Creek and ties into the bluff. While this mainline protection system has continually been improved over time, the original interior drainage canals and ditches remain as originally constructed in the early 1900's. The interior drainage system is shown in Figure 8.

The natural topography is still a major factor contributing to storm drainage and flooding problems within the Project area. The manmade drainage channels have very little slope and are not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River. Surface water moves slowly in the ditch system to the Mississippi River or remains in numerous natural depressions. Additionally, the carving up of the natural drainage areas by railroad and road embankments makes drainage of the floodplain areas even more difficult.

Surface drainage problems are made worse because groundwater has historically been very shallow in many areas within the floodplain. The combination of shallow groundwater and poor draining alluvial soils of alternating layers of clays, silts, and sands further promoted the need for the development of the extensive drainage system of levees and varying sizes of drainage ditches, channels, and canals. During the height of the industrial period to until the mid 20th century, the groundwater surface was generally lowered between 2 and 12 feet with localized reductions as a result of extensive ground water pumping in ten areas for industrial and municipal purposes.

When this pumping stopped, groundwater returned to its historical level and areas that were constructed with dry basements in the 1950's, suffer groundwater flooding today as a result of the cessation of groundwater pumping for industrial purposes.

Figure 8 Existing Interior Drainage System



Surficial Soils. The surficial alluvial soils that cover the American Bottom are related to their mode of river deposition. Glacial deposits from the Pleistocene Epoch underlie the alluvial soils. Five alluvial soil types are identified by their depositional fluvial geomorphic process: abandoned channel, backswamp, point bar, and chutes and bar deposits. The bluffs and uplands within the Project area are predominately glacial drift deposits and aeolian (wind deposited) loess deposits.

Geomorphology. The last major Mississippi River flood experienced by the American Bottom occurred in 1903. Construction of a levee system along the river following that flood event prevented Mississippi River overflow from inundating the American Bottom, and halted the historic depositional and scouring processes that periodically reworked the floodplain's surface. The deep loess mantle in the uplands is highly erodible, and development in the tributary watersheds has produced increased runoff, with higher peak flows due to the increased amount of impervious surfaces. As a result, the tributary stream channels have become unstable. These instabilities have adversely impacted floodplain drainage, as well as infrastructure and stream quality. Excessive levels of sediment are reaching the bottom. Sedimentation is occurring in the floodplain ditch and canal system, and in aquatic resources where storm water flows. For example, a delta of sediment has formed in Horseshoe Lake where storm water enters it from Cahokia Canal. With the scouring forces of the Mississippi River no longer present, sediments deposited by tributary streams cannot be carried out of the American Bottom. The result is a net gain of sediments accumulating in the bottoms.

Climate and Weather. Because of its central U.S. location, St. Louis feels the effects of warm moist air moving north from the Gulf of Mexico and the cold air masses moving south from Canada. The conflict along the frontal zones of these invading air masses provides a variety of weather conditions. Winters are brisk with temperatures dropping to zero or below generally only two or three days per year. Snowfall averages about 20 inches per season. Daily temperatures of 32 degrees or less occur less than 25 days per year, while temperatures of 90 degrees F or higher occur about 35-40 days a year. Temperatures exceeding 100 degrees F occur every other year generally, although some years may see 15 or more days with temperatures exceeding 100 degrees F. The prevailing wind direction is from the south for May through November and from the northwest for December through April.

Precipitation averages about 36 inches per year. The winter months are the driest while the months of May through July are the wettest. Rainfall can be severe at times with as much as eight inches of rain recorded in a 24-hour period in 1957. Thunderstorms occur between 40 and 50 days per year, with a few being severe, causing hail and damaging winds. Tornadoes have produced damage and loss of life in the St. Louis area.

An important condition affecting precipitation in the Project area of Madison and St. Clair counties in Illinois is the St. Louis urban effect. Studies by the Illinois State Water Survey have shown substantial increases in rainfall downwind of the City of St. Louis. The increases tend to be the largest in relatively heavy rainstorms and most pronounced in spring and summer when most of the large rainstorms occur. Frequency rainfall values for Madison and St. Clair Counties used in this Project have been adjusted to account for the St. Louis urban effect.

Air Quality. Air quality information was prepared under a cooperation agreement, by the USEPA Region 5. The Project area is located to the east of St. Louis, within the Metropolitan St. Louis Interstate Air Quality Control Region (AQCR). This AQCR covers part of Missouri and Illinois. Areas within the AQCR are further defined according to the attainment status of criteria pollutants. The Metropolitan St. Louis AQCR includes the Illinois counties of Madison, Monroe, and St. Clair, which are referred to as the Metro-East Nonattainment Area (IEPA, 1995). The Metro-East Nonattainment Area is a moderate nonattainment area for ozone. The Project area is in attainment for most of the criteria pollutants, sulfur dioxide, particulate matter, carbon monoxide, nitrogen dioxide, and lead. The area is "nonattainment" for the pollutant ozone and is classified as moderate. A portion of the area is also a "maintenance" area for particulate matter. The townships of Granite City and Nameoki are "maintenance" for PM10.

Noise. Noise is not considered to be an issue in the preparation of this General Re-evaluation Report.

Surface Water. Floodplain management has been a challenge for the inhabitants of the bottoms since the early 1900s when the push began in earnest to farm the rich land and develop for industry and commerce the area that sits on the river at the crossroads of the nation. With the diversion of Cahokia Creek and the construction of the Mississippi River levee system, the challenge of taking the remaining surface water from the bluffs to the river, while protecting the intermediate area from flooding, has yet to be met. As early as 1905, the problem of managing interior flooding was sited as being key to the future development of the area. By 1908, construction had begun on a canal system that was designed to manage this surface water as it traveled from the bluff to the river. The system instituted during this period is the same system that is in service today with only minor changes. Past urbanization of the area and climactic changes have increased significantly the peak volume this original system is now expected to contain.

The result is severe flooding across the bottoms when rainfall events of moderate intensity occur. At the bluff line a system of man made ditches and channels take the flows from tributary streams across the floodplain to the levee where the water enters the Mississippi River. When rainfall events exceed the capacity of this interior drainage system, whose size has not been altered since constructed, the water typically breaks out immediately downstream of the bluff line. They instead damage the urban and agricultural areas that hug the bluff line of the project area.

Floodplain Management. Floodplain management is divided among the four drainage districts on the floodplain that have responsibility for the operation and maintenance of the canal and ditch system as well as the pumping facilities associated with them. Additionally, the county for unincorporated areas and each municipality have responsibility for floodplain management within their area of responsibility. This management responsibility takes the form of ordinance enforcement and the issuance of permits for any disruptive activity (such as construction) that occurs within the drainage system, all within the context of the regulation of the federal flood insurance program.

The Federal and State Emergency Management Agencies also form a review and approval tier in the floodplain management process, as does the Corps of Engineers with its oversight responsibility for the Section 404 permit program. As in any urban setting where watersheds cross county and municipal boundaries, the effective management of the floodplain is a constant challenge. The formation of the Metro East Regional Stormwater Committee has been an attempt on the part of the floodplain communities to address these challenges. The Metro East Regional Storm Water Committee charter envisions a region in which properly managed storm water leads to a higher quality of life for the residents and better protection for the overall environment. With the implementation of Phase II Stormwater Regulations by the USEPA, both Madison and St. Clair Counties have pursued the establishment of ordnances and best management practices to address the problems associated with the increased stormwater runoff created by the addition of impermeable surfaces that come with urbanization.

Water Quality. The streams, lakes and river in the Project area have been assessed by the Illinois Environmental Projection Agency for a wide variety of water quality parameters over time. Because none of the streams, lakes or river segments is pristine, the causes of water quality impairment and the possible sources of impairment have been evaluated. Overall general causes of impairment in the Project area include the following: Priority Organic Contaminants; Metals Contaminants; Nutrient Enrichment (i.e., phosphorus, nitrogen, nitrates); Siltation; Organic Enrichment/Low Dissolved Oxygen; Habitat Alteration; Suspended Solids; Excessive Algae; and, Noxious Aquatic Plants. Detailed information concerning water quality conditions is in Appendix B of the main report.

The sources of impairment to water quality within the Project area vary widely from urban to industrial to agricultural. The following impairment sources are commonly found to be associated with most of the watersheds in the Project area: Agricultural Operations; Construction/Land Development/Commercialization/Urbanization; Urban/Stormwater Runoff; Hydrologic/Habitat Modification via Channelization; Land disposal/Septic Tanks and, Streambank Erosion.

Ecological and Natural Resources. Despite extensive local losses of various historic natural resources, and degradation of remaining resources, the Project area lies in a belt of existing "resource rich areas" strung along the Mississippi River in southwestern Illinois. "Resource rich areas" are relatively large areas in Illinois where current biologically significant resources are concentrated. Thirty such areas have been identified statewide. They were delineated and evaluated by the Illinois Natural History Survey as part of the Critical Trends Assessment Project and Ecosystems Program of the Illinois Department of Natural Resources. They often occur along the state's major streams and rivers. Two resource rich areas are found in the vicinity of the Project area. "Big Rivers" lies just north, and "Karst/Cave Area" overlaps partially with the Project area.

Forest. Estimates of forest losses in the Project area range from about 60 to 70 percent. This level of loss has occurred in both floodplain and upland areas. Similar losses of forest have occurred in Illinois at the state and county level. Loss of historic forest for the state is estimated to be about 63 percent, and about 58 percent and 67 percent for Madison and St. Clair Counties. All wet-mesic upland forest that occurred on the flat drainage divide in the headwater reaches of the Project area's tributary watersheds during pre-development times appears to be gone.

Prairie. The most striking loss in the Project area is the virtual disappearance of prairie. Roughly 35,000 acres of historic prairie have been reduced to about 33 acres, which are confined to the floodplain. This equates to an overall loss of about 99.9 percent. At least half of Madison and St. Clair Counties was once prairie and countywide losses are also at the same level. Of the eight types of prairie natural communities that were present historically, six have disappeared – two from the floodplain and four from the uplands.

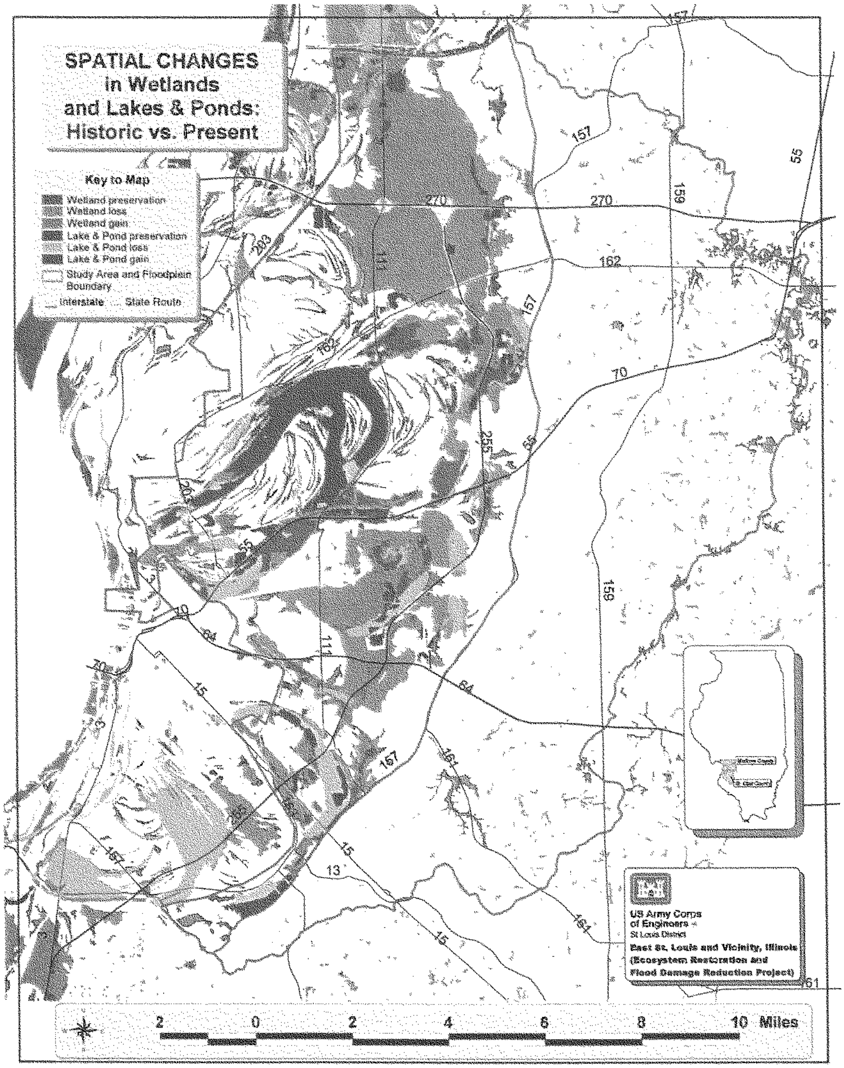
Savanna. Savanna is not currently known from the Project area. It is mentioned because it may have been present in predevelopment times in the uplands. If any remnants survived, they would have since changed into forest. Because periodic wildfires enabled this type of vegetation to persist in historical times, the suppression of wildfire that came with settlement caused vegetational changes in savanna. Tree density became greater and open savanna converted to closed forest. Other factors have led to the loss of savanna in addition to fire absence and destruction. These include fragmentation, degradation of the ground cover from intense grazing, and invasion by exotic plant species.

Wetland. Estimates of wetland losses in the Project area range from about 65 to 85 percent. For Madison and St. Clair Counties, estimates of wetland losses are 61 and 63 percent, respectively. Wetland diversity has declined because of the loss of three of ten historic wetland natural communities: wet-mesic upland forest and wet-mesic prairie in the uplands, and wet prairie in the floodplain. Wetland losses are displayed in Figure 9. Flooding from tributary streams caused by "out of bank" flows do not provide a beneficial disturbance to remaining wetland or other habitat resources, as they are too far removed from the bluff line to receive these flows.

Lake and Pond. Estimates of lake and pond loss range from about 35 to 50 percent in the Project area. Because lakes and ponds still occur in the Project area today, diversity of natural communities within this class has not been reduced. Losses of lakes and ponds due to development are shown in Figure 9.

Stream. The overall loss of all floodplain streams by length in the Project area is estimated to be about 66 percent. About 62 percent of the historic channel of Cahokia Creek in the Project area has been filled in for development or modified into ditches. The isolated remnants no longer convey flowing waters.

Figure 9 Losses of lakes and ponds due to development



Existing Species.

Plants. Roughly 1,000 plant species consisting of various trees, shrubs, vines, grasses, sedges, forbs, and ferns occur, or are likely to occur, in the Project area. About 18 percent of the Project area's flora, consisting of 173 species, is not native to Illinois. Exotic species occur in all kinds of natural communities, but, excluding cultural areas, are most prevalent in remnant prairies and savannas.

Invertebrates. Roughly 350 relatively common macroinvertebrate species consisting primarily of beetles, worms, water bugs, midges, caddisflies, mayflies, damselflies, dragonflies, damselflies, leeches, mosquitoes, clams, crayfish, mussels, and snails occur, or are likely to occur, in the Project area.

Fishes. The existing fish fauna is much reduced from what it was historically, and today has little relationship to the original fauna. Native species are wide-ranging, and are characteristic of habitats that have been heavily modified and subjected to considerable environmental fluctuations, such as in water temperature, flow, turbidity, and dissolved oxygen. Thirty-six species of fish have been collected since 1984 during fish surveys of channels and lakes within the Project area. Thirty-three species inhabit floodplain channels, and twenty-one species occur in lakes. None of the 36 species are federally or state protected. Three species, the gold fish, common carp, and grass carp, are exotic or non-native.

Reptiles and Amphibians. A total of 65 species of reptiles and amphibians occur or may occur in the Project area. Various kinds of salamanders and toads and frogs comprise the 22 amphibian species, of which 12 have documented occurrences. Forty-three species of reptiles include a number of turtles, lizards, and snakes; twenty-four of these species have been documented from the area. All species are native. None have been introduced. Reptiles and amphibians are found in all communities of the Project area. In cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, they are less diverse than in forest, prairie, wetland, creek and river, and lake and pond habitats. The alligator snapping turtle has become locally extinct. One species of frog and three species of snakes are either state or federally protected species.

Birds. Numerous species of birds occur regularly or occasionally in the Project area. There are 126 species that occur regularly. Birds are the most diverse group of vertebrates living in the Project area and consist of species from over 40 families. Herons, waterfowl, sandpipers, woodpeckers, flycatchers, swallows, warblers, sparrows, and blackbirds are bird families that are represented by numerous species. When bird species that occasionally use the Project area are added to those that are regular inhabitants, the total number of species increases to 288. Of the 288 species, one dove, one starling, one finch, and two sparrows are exotic or non-native.

Mammals. There are 41 mammal species that occur or are likely to occur in the Project area. The most diverse groups include the shrews and moles, bats, rodents, and carnivores. The remaining groups of mammals are represented by single species of opossum, rabbit, and deer. Twenty-five of the species have documented occurrences in the Project area.

Two species of bats are federally protected. Two species are not native, the Norway rat and house mouse. Mammals are found in all habitats of the Project area. Many species inhabit forest, including both upland forests as well as floodplain forests. Most species use a variety of habitats. About half use forests and prairies as well as nonwoody wetlands, such as marshes. Only two species are restricted to prairies and grasslands. Mammals found in cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, are rather diverse. Since settlement, a number of species have been extirpated from Illinois or on a regional basis within the state. Most of them are carnivores, and/or they require large home ranges.

Endangered and Threatened Species. Ten federally listed and 47 state-listed endangered and threatened species do occur or may occur within the Project area.

Federally-Listed Species. The U. S. Fish and Wildlife Service identified eight federally-listed species, and one candidate species for listing, that may be present in the Project area in a letter dated March 10, 1999 (see Appendix G of the main report). The piping plover (*Charadrius melodus*) has been added to this list by the Corps because it has been recently sighted within the Project area. In its letter, the USFWS indicated that no designated critical habitat exists within the Project area for any of these species. Similarly, there is no designated critical habitat for the piping plover. The potential or documented occurrences of federally-listed species in the Project area are discussed in a biological assessment included in Appendix B of the main report. In Illinois, these ten federally-listed species are also state-listed species. The bald eagle and decurrent false aster are known to occur in the project area.

State-Listed Species. The potential or documented occurrences of state-endangered species in the Project area are discussed in a biological assessment included in Appendix B of the main report.

Natural Areas, Natural Preserves and Endangered Species Sites. The Project area includes ten examples of natural areas, nature preserves, or endangered species sites.

Natural Areas – Bohm Woods (5 acres, dry mesic and mesic upland forest); Poag Railroad Prairie (33 acres, mesic sand and wet mesic prairie); Levee Lake (230 acres, pond shrub swamp, and marsh)

Nature Preserves – William & Emma Bohm Memorial (7 acres, dry mesic and mesic upland forest)

Endangered Species Sites – Chouteau Catchfly Site (2 acres, royal catchfly); Poag Railroad Prairie (33 acres, spring ladies' tresses); Precision Habitat (475 acres, Illinois chorus frog); Eagle Park Marsh (105 acres, common moorhen, pied-billed grebe, yellow-headed blackbird); Fairmont City Site (38 acres, decurrent false aster); East St. Louis (Alorton) Heron Colony (2 acres, snowy egret, little blue heron, black crowned night-heron).

Cultural Resources. The American Bottom portion of the Project area is arguably the richest, most complex, archaeological region in all of North America. Native American occupation of the Project area began at least 12,000 years ago and continued up until the early nineteenth century when the last groups of Native Americans were displaced from the area by ever-increasing numbers of Euro-American settlers. The crown jewel of this archaeological legacy is the Cahokia Mounds World Heritage Site, located near the center of the Project area. Eight centuries ago this site covered 5 square miles of the Mississippi River floodplain and was, in turn, surrounded by hundreds of supporting communities. These settlements ranged in size from large towns and villages to individual farmsteads. Even today, more than six centuries after the last of these prehistoric residents of the Central Mississippi River valley mysteriously abandoned the area, fragments of their discarded tools are commonly observed throughout the Project area by the trained eye of archaeologists.

The cultural value of these prehistoric remains to the Nation was recognized but not well protected until well into the twentieth century. By then, the remains of many of these sites had been significantly damaged, or destroyed. The preponderance of professional archaeological investigations conducted within the project area during the late twentieth century was administered by the Illinois Department of Transportation. For the most part these investigations were associated with interstate highway construction - the largest of those being Interstate 255. The right-of-way for this highway traverses the entire length of the American Bottom portion of the East St. Louis Ecosystem Restoration Project area. Scores of archaeological remains, some deeply buried and dating back more than 4000 years, were identified and excavated in advance of construction related to that project.

Only a small portion of the American Bottom has been systematically surveyed for the presence of archaeological remains. Therefore, it is impossible to reliably estimate the number of archaeological sites that have been lost as a result of commercial and residential development. However, it is safe to assume that the number is large. The scientific value (and corresponding loss to the Nation) of the information once contained in these destroyed archaeological sites is incalculable. Present-day land use within the areas being considered for potential ecosystem restoration includes agricultural fields, former residential and commercial tracts, lakes / sloughs, and public land. The preservation and enhancement of significant archaeological remains within these contexts is a priority of this Project.

Outdoor Recreational Resources. The voters of Madison and St. Clair Counties approved a metropolitan park and recreation district in November of 2000. The objectives of this park district, which will be supported by tax revenues, are to preserve natural lands adjacent to waterways, filter pollutants and protect wildlife habitat, provide safe places for families and children to play by repairing worn equipment and improving maintenance in existing parks, create trails and paths for walking, biking and other compatible uses, create new parks in newer communities, and, provide expanded disabled and public access to recreational areas. Within the Project area, the State of Illinois owns and maintains Horseshoe Lake State Recreation Area, Cahokia Mounds State Historic and World Heritage Site, and Frank Holten State Park. The two parks are managed for both recreational activities and as wildlife management areas. Horseshoe Lake provides seasonal duck hunting opportunities within sight of the Arch.

While there are fishing opportunities, they are limited for consumption purposes because of existing contamination. Likewise, the interior drainage canal and borrow sites along the I-55/I-70 highway route provide informal fishing opportunities. Frank Holten provides a more urban recreational experience with the inclusion of an 18-hole golf course while Horseshoe Lake provides both primitive and supported overnight campsite facilities. Within the local communities there are small city parks as well as school and neighborhood recreational areas that support those living in the immediate vicinity with basic recreational facilities.

Aesthetics. The Project area's aesthetic (visual) characteristics run the gamut from less attractive, heavily urbanized/heavy industrial sites to natural areas with pristine-like qualities. The landscape exhibits a wide variety of visual stimuli, including upland and bottomland forests, lakes, rivers, canals, marshes, ponds, small and large cities, farmland, and parks. The topographic features include remarkably flat expanses of bottomlands as well as bluff areas in the uplands. Man-made features abound in the form of flood control structures, interstates, highways, roads, utility structures, communication facilities, buildings, signs, billboards, and many other things normally associated with a heavily urbanized area. Unique to this area is the ancient man-made Cahokia Mounds World Heritage Site, and Monks Mound, its primary feature, can be seen from a distance. Also prominent is the highly visible St. Louis Gateway Arch located just across the Mississippi River.

Hazardous, Toxic and Radioactive Waste. Over 80 hazardous waste sites have been identified in the vicinity of the Project area through the Superfund program. Many of the sites are related to former industrial or landfill operations. These sites fall into four Superfund categories. First, there are 29 CERCLIS sites at which clean up is being considered, and they are listed in the U.S. EPA's Comprehensive Environmental Response, Compensation, and Liability Information System. Secondly, two sites are on EPA's National Priorities List, and involve long-term remedial response actions. Thirdly, two sites have been proposed for inclusion on the NPL. Lastly, 49 sites have been archived. Archived sites include those for which an assessment has been completed and EPA has determined no steps will be taken to designate the site as a priority by listing it on the NPL, and no further remedial action is planned under the Superfund Program. Thirteen hazardous waste sites occur within the Project area. Of these, six occur in Madison County and seven in St. Clair County. Nine are CERCLIS sites, and four are archived sites. None of the sites in the Project area are NPL sites or proposed for listing on the NPL. Most sites are outside the Project area to the southwest, in the vicinity of East St. Louis and Sauget.

FUTURE WITHOUT PROJECT STUDY AREA CONDITIONS

The future without project condition describes selected characteristics within the Project area over the next 50 years if no action is taken. The Federal regulations implementing the National Environmental Policy Act of 1969 require that the no action plan be considered as an alternative in assessing the potential effects of all Federal actions.

Climate and Weather. No significant climatological changes are expected to occur over the 50-year planning period used for this Project.

Ecological Resources.

Forest. The amount of forest in the Project area has declined significantly since presettlement times. This trend is expected to continue. Given the projections for greater population growth in the Bluff Corridor, the rate of forest loss in tributary watersheds is expected to substantially exceed that on the floodplain in the American Bottom Corridor.

Forest in Tributary Watersheds. Future rates of upland forest loss are expected to vary by major watershed. The two central watersheds, Cahokia and Harding, are expected to show considerably greater rates of loss than the two peripheral watersheds to the north and south. The two central watersheds, Cahokia and Harding, are expected to show considerably greater rates of loss than the two peripheral watersheds to the north and south. Remaining forest is expected to be concentrated on the steepest slopes of upland ravines and along narrow creek bottoms.

Ecological Problems of Forest in Tributary Watersheds. Upland forests in the Project area are expected to exhibit further loss of ecological integrity due to additional fragmentation, habitat degradation, introduction of exotic species, and a continued absence of fire.

Wildlife Habitat of Forest in Tributary Watersheds. Wildlife species diversity in shrinking areas of upland forest is expected to decrease and remaining species are expected to consist mainly of those adapted to human disturbances and suburban/urban conditions. Compared to mammals, reptiles and amphibians, the decline in bird species diversity is expected to be high, especially among breeding species.

Forest in the Bottoms. The rate of loss for forested wetlands in the bottoms over the 50-year project life was assumed to be 25 percent on privately owned lands and no loss on publicly owned lands. Forecasted rates of loss for forested wetlands and forested non-wetlands in the bottoms do not reflect any future implementation of tree preservation or "green space" requirements on development by local government.

Ecological Problems of Forest in the Bottoms. Additional fragmentation and habitat degradation caused by sedimentation and the introduction of exotic species are expected to lead to further loss of ecological integrity in bottomland forests. In addition, forested wetlands will continue to exhibit hydrological regimes that depart from natural conditions either because changes in hydrology have resulted in stabilized water levels, or timing of floods have shifted, either of which may depart too drastically from any natural cycle to permit an adapted forest community to remain or develop on a site.

Wildlife Habitat of Forest in the Bottoms. Wildlife species diversity of bottomland forests is expected to decline with decreasing area of forest. However, because most forested non-wetland is already extremely fragmented, this effect should be most noticeable in forested wetlands.

Prairie. Given that most prairies in the Project area are on public lands (and consist of restorations), the amount of prairie in the future is expected to remain relatively constant. There are no known plans for future restorations of prairie on public lands.

Ecological Problems of Prairie. The only known remnant of natural prairie in the Project area is expected to experience further fragmentation. Continuing invasion by exotic species and habitat degradation related to railroad maintenance is expected. Unless additional plant species are added, most existing areas of prairie restorations will continue to show little floristic similarity to historic prairies because of their low plant species diversity.

Wildlife Habitat of Prairie. Existing restorations will continue to be too small to attract many species of area sensitive grassland-adapted animals, including breeding birds. Although these areas of prairie may not decline in extent, anticipated development in their vicinity is expected to cause a small decline in diversity of species using them as habitat.

Wetlands. Wetlands occurring on private lands are expected to decline in area by 25 percent over the 50-year project life whereas no loss is anticipated for those found in public areas. This assumption applies equally to all kinds of wetlands - forested wetlands, marshes, and scrub-shrub.

Ecological Problems of Wetland. Continuing problems in marshes and scrub-shrub swamps include altered hydrologic regimes, addition of sediments and agricultural chemicals or urban runoff, encroachment by exotic plant species, and disturbance-tolerant native plant species dominating the local plant community. Continuing ecological problems associated with forested wetlands are discussed above and those associated with ponds are given below.

Wildlife Habitat of Wetland. Wildlife species diversity of marshes and scrub-shrub swamps is expected to decline to a small degree because of decreasing area of these habitats as well as increasing development surrounding wetlands. A decline of wetlands in the Project area, either forested or herbaceous, is expected to adversely affect numerous listed birds and some other species. Fewer nesting or feeding opportunities would be available to as many as twenty-one listed bird species known or likely to occur in the Project area. Among other listed species, the Illinois chorus frog, Indiana bat, and decurrent false aster would also be potentially adversely affected.

Functional Capacity of Wetlands. Sources of hydrology driving existing wetland functions are not expected to change in the future. Overbank flooding from the Mississippi River will continue to be excluded from the Project area and overflow from tributary streams will remain confined to floodplain channels of the interior flood control system under normal circumstances. On occasions when storms in tributary watersheds overtop the floodplain flood control system, overflow into adjacent wetlands is expected to continue occurring in a random manner with respect to location and season. Consequently, flooding in wetlands historically adapted to riverine overflows is expected to continue to come primarily from direct rainfall and local runoff.

Lake and Pond. Future development in the Project area was not assumed to affect lakes and ponds directly. However, lakes and ponds receiving regular inputs of stormwater from the interior flood control system were assumed to decrease in surface area by 1.5 percent every 10 years, or a total of 7.5 percent during the 50-year project life. Reduction in area was expected because of the accumulation of sediment carried by stormwater originating from tributary streams. Lakes and ponds remaining constant in area were assumed to be those that are relatively isolated from stormwater carried by the interior flood control system.

Examples of waterbodies experiencing future losses in surface area include Horseshoe Lake and Grand Marais Lake (lake 3) at Frank Holten State Recreation Area.

Ecological Problems of Lake and Pond. Ongoing siltation and habitat degradation will continue to cause problems at lakes and ponds. Not only does siltation cause loss of surface area, but it also causes a gradual decrease in average water depth. Since many natural lakes are only several feet deep, decreasing water depths may at some point threaten fish populations during periods of drought when water levels are low. Local watersheds carrying runoff into lakes and ponds are expected to become less agricultural and more urbanized. Major pollutants in storm water are expected to shift from agricultural chemicals to transportation related pollutants such as oil, antifreeze, and gasoline. An overall lack of natural aquatic and emergent plant growth in these water bodies, the presence of fish species such as carp that uproot such plants, summer algal blooms that can cause fish mortality, and a general lack of habitat structure are problems that will continue to affect lakes and ponds.

Wildlife Habitat of Lake and Pond. Expected reductions in surface area of some lakes and ponds and continuing ecological problems probably will lead to small reductions in diversity of animal species using these communities as habitat. Increasing urbanization surrounding lakes and ponds is anticipated to also contribute to this effect.

Streams. The area or extent of floodplain streams has been assumed to remain constant in the future. Periodic maintenance of the floodplain's interior flood control system, including cleanout of ditches and canals that carry storm water, is expected to maintain existing channel dimensions. Future development in the tributary watersheds is expected to directly affect headwater reaches of many tributaries, but not downstream reaches. In order to maximize the amount of developable land in the uplands, headwater streams are expected to be lost by either channelization or replacement by underground pipe over which fill material would be placed. Additional channelization of floodplain streams is unlikely in the future.

Ecological Problems of Streams. Floodplain channels will continue to be affected by the lack of riparian vegetation, transport of sediment into channels, inflows of agricultural and urban runoff, and encroachment by exotic plant species, such as Japanese hops. In the uplands, additional urbanization is expected to continue encroaching upon streams and their adjacent floodplains. Existing instability of stream banks and channel bottoms is expected to continue and become more widespread as additional stream reaches are indirectly impacted by adjacent development. Sediments and polluted runoff entering tributary streams are expected to continue.

Wildlife Habitat of Streams. Expected adverse changes in physical and chemical characteristics of streams are expected to be greater in tributary watersheds than on the floodplain. Consequently, the capacity of tributary streams to serve as habitat for fish and other wildlife is expected to decline to a greater degree than that of floodplain channels.

Cultural. Due to anticipated development, new cultural habitats consisting of residential, commercial, and industrial areas will arise from future losses of forests, prairies, and various wetlands. Similarly, these kinds of cultural habitats will come from future losses of agricultural land. To conduct the habitat assessment for this Project, the interagency biology team assumed that 75 percent of existing floodplain agricultural areas would be developed in 50 years. Therefore, the ongoing shift in cultural habitats, from agricultural to suburban and urban, is expected to continue.

Wildlife Habitat of Cultural Areas. Over the next 50 years, wildlife species using cultural habitats in the Project area are expected to gradually shift in composition from a mixture of agricultural and suburban-urban species to mainly suburban-urban species. The overall number of species is expected to decline.

Water Quality. The surface water quality within the project area has a wide variety of impairments with causes originating from agricultural uses, urban-runoff, stream bank erosion, point source discharges (industrial and public/private treatment works) and land development. New stormwater ordnances and attention by the counties to EPA Phase II regulations can address future problems. However, the degradation that has begun from past practices in the tributary streams will not be fixed without direct intervention. If action is not taken in tributary streams they will continue to experience increasing destabilization of stream banks and put heavier sediment loads into the system and further degrade their quality. The general trend in population and commercialization/industrialization is increasing within the project area. Based upon the increasing trend the surface water quality would most likely have additional impairment loads placed upon it over time. The surface water quality would degrade with an increased impairment load. Downstream receiving water would then have an increased impairment load which decreases water quality within those regions. The degrading water quality condition, with time, within the project area would result in a decreased amount of possible designated uses.

Physical Facilities and Operations. The current capacity of the interior ditching system in the Bottoms area has been re-established through the recent channel cleanouts that were performed using either Corps of Engineers' Rehabilitation funding or FEMA funding. These cleanouts occurred after the 1995 through 1997 flooding. Under the future without project condition, continued sedimentation in the Bottom's channels and degradation of the bluff stream channels is expected. Any loss of channel capacity as a result of inadequate maintenance will reduce future flood protection. Degradation of bluff stream channels will continue to adversely impact existing infrastructure. It is assumed that the channel cross-sections attained after the recent Corps of Engineers' and FEMA cleanouts will be maintained by MESD or other responsible parties thereby continuing an expensive operation and maintenance program in the future.

Outdoor Recreational Resources. Greenways offer opportunities to creatively preserve open space in rapidly developing areas, protect important natural resources such as wetlands and wildlife corridors, and provide opportunities for outdoor activities such as bicycling and walking. Greenways and trails have been one of the top public concerns identified through the Statewide Comprehensive Outdoor Recreation Plan (SCORP) Public Participation program for years. Southwestern Illinois offers tremendous greenway opportunities.

Currently, the Metro East region has three of the 16 National Millennium Trails designated in 1999 and there are three major greenway systems proposed for the region. The Millennium Trails program is an initiative of the White House Millennium Council in partnership with the U.S. Department of Transportation and the Rails-to-Trails Conservancy.

Millennium Trails will recognize, promote and support trails as a means to preserve open spaces, interpret history and culture, and enhance recreation and tourism. The majority of the systems are located in Madison County where they are expected to be expanded to form a comprehensive regional network.

As urban growth continues, the demand for open space preservation and the development of outdoor recreational opportunities is expected to increase.

PROBLEMS AND OPPORTUNITIES

The identification of problems and opportunities and the development of clear operational objectives was the initial challenge in the formulation process for the Project team. The identification of problems and opportunities began with the assessment of the information compiled for the preparation of the pre-development, existing, and future without project conditions in addition to the input received during the public involvement process.

During the identification and validation process of problems facing the Study area, it became clear that there was a logical connection between these problems and the degradation of the natural ecosystem from a variety of causes. In every instance, there appeared to be a compelling reason to address Project area problems as environmental opportunities. As the Project team delved into the history of the area and the operation of the natural system during pre-settlement times, the picture that evolved provided a focus for the plan formulation process.

Ecological Resources. A recent report on trends in Illinois' environmental and ecological conditions concluded that the condition of natural ecosystems in Illinois is rapidly declining as a result of fragmentation and continual stress. Over the last two centuries, the historic natural ecosystem of the Project area has been reduced to a fraction of what it once was. Ecological problems that are identified and addressed include loss of biodiversity, fragmentation of natural systems, loss of historic ecosystem disturbances, loss of habitat quality, and degradation of water quality.

Loss of Biodiversity. Much of the historical biodiversity of the Project area, consisting of numerous natural communities and their constituent plant and animal species, has been lost due to intensive economic development. The loss of much of the natural heritage within the Project area is illustrative of a larger pattern in Illinois that indicates a trend toward simpler natural systems. The once complex historical natural environment has been replaced with one that is fairly simple biologically. Spatial losses in the Project area due to habitat destruction are significant. Only about 30 percent of the Project area, collectively, now consists of remnant forests, prairies, wetlands, lakes and ponds, and streams. Built-up areas, agriculture, and non-native grassland represent the remaining 70 percent, which supports low levels of biodiversity as compared to natural habitats.

Losses also consist of declines in the diversity of natural communities. Some types of forest, prairie, and stream natural communities have disappeared entirely. The case of prairie losses is the most extreme. About 99.9% of the historic prairie is gone. Once extending over roughly 35,000 acres and consisting of seven distinct communities, only about 35 acres comprising two communities remain. Widespread natural disturbances, such as flooding and wildfire, added a temporal dimension to the spatial complexity of the historic ecosystem that is gone today. Biodiversity losses also include the loss of some native plant and animal species that once inhabited the Project area as a result of the presence of introduced or exotic species that can out-compete native plants and animals. This shift in species composition illustrates another broader pattern in Illinois that is a trend toward non-native species. Continuing urbanization is expected to be the chief cause of future losses of biodiversity, especially to forests in the uplands.

Opportunities exist within the Project area to restore some of the lost and diminished components of the historic ecosystem. These include floodplain prairies, forests, marshes, and streams. Economic and agricultural activities prevent the re-creation of an entire stream traversing the floodplain, but there are locations where partial restorations could occur. Likewise, undeveloped areas exist where natural areas such as forests and prairies could be restored. Restoration of such features would replicate, albeit on a much reduced scale, the historic natural ecosystem.

Fragmentation of Natural Systems. As a result of development, natural areas within the Project area have become highly fragmented and remnants are generally too small to support all plant and animal species characteristic of functional ecosystems. The fragmented character of natural areas within the Project area is illustrative of a broader pattern in Illinois, which exhibits a trend toward fragmented natural systems. Fragmentation is the transformation of continuous areas of natural ecosystems into smaller and smaller pieces as a result of development. Along with habitat destruction, fragmentation is considered by many ecologists to be among the chief causes of loss of biodiversity worldwide. Requirements for the establishment and maintenance of self-sustaining and functional natural ecosystems in Illinois have yet to be defined.

Opportunities exist within the Project area to restore some forested areas and to create prairie restorations that are large enough to support animals sensitive to habitat fragmentation, including birds.

Loss of Historic Ecosystem Disturbances. Remaining natural areas cannot be expected to retain much similarity to their former structure and function if periodic ecosystem disturbances are not introduced to mimic historic flooding and wildfire. Natural flooding and wildfire sustained the historic natural ecosystem. With the elimination of these natural forces, today's remaining natural areas cannot maintain much similarity with their former historic condition without intervention. Fragmentation of natural areas and the loss of linkages between wetlands, streams, and rivers in the Project area have reduced the ability of many wetlands to perform historic functions, such as to temporarily store overland flows of water, or to remove natural nutrients and other elements and compounds from floodwaters.

The elimination of disturbance factors such as flooding and fire from much of today's environment has also diminished the ability of wetlands to serve as support systems for some plant and animal species. For example, the decurrent false aster, a federally threatened species, is an herbaceous plant that historically occurred in open habitats on the floodplain of the Illinois and Mississippi Rivers, such as wet prairies, shallow marshes, and the shores of rivers, creeks, and lakes. It is found within the Project area today in old or mowed fields, marshes, and at the edges of active fields, farm facilities, golf courses, and a railroad. The plant requires high levels of light to survive. Riverine flooding apparently benefits this species by disbursing seeds to new areas for colonization and suppressing the encroachment of woody vegetation that would create shady conditions. Likewise, wildfire would also have maintained open habitats in areas such as wet prairies and marshes.

Opportunities exist within the Project area to re-establish lost linkages between wetlands and tributary streams and re-introduce periodic flooding to existing floodplain natural areas. Such flooding could mimic the predevelopment flood pulse. Although the Mississippi River is no longer a feasible source, storm water from tributary watersheds could serve as the basis for the desired flood pulse. Prescribed fire is currently used to maintain some small prairie restoration areas within the Project area. Its use could be expanded into other natural areas to provide the same ecological benefits.

Loss of Habitat Quality. Many areas of fish and wildlife habitat in the urbanizing Project area are poor to fair in quality as a result of human activities and influences. Habitat quality in the Project area ranges from poor to good, and most habitats rank as poor to fair. This assessment is based on data gathered for this Project in the spring of 1999 by an interagency group of biologists studying 228 individual sites in floodplain (terrestrial, wetland, aquatic) and tributary stream (terrestrial) habitats. These quality ratings represent the ability of sampled habitats to fulfill the food, cover, or reproductive needs of eight fish and wildlife species occurring in the Project area. These species, which include the black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, and wood duck, were selected to serve as representatives of a broad number of other species that are present or desirable and that also use forest, marsh, prairie, lake, stream, and cultural habitats. These animals, and the current quality of habitats they use, serve in this Project as the benchmark against which the expected effects of alternative solutions for ecosystem restoration can be compared. Further details about the habitat assessment method are found in Appendix A of the main report.

Opportunities exist within the Project area to make numerous improvements to habitat quality. Native plant communities can be restored in existing forests by introducing historically occurring tree species that are now lacking or underrepresented. Oaks can be planted in developed areas to benefit birds. Lakes and ponds can be improved for fishes by creating deep-water areas to serve as overwintering habitat. Emergent vegetation can be increased along the margins of these water bodies to benefit resident fishes, birds that feed in such areas, and enhance the production of macroinvertebrates that serve as food sources for such animals. Buffer zones of natural vegetation can be added around the perimeter of natural areas to minimize human disturbances. Wetlands can be improved by restoring native grassland around them or by adding wooded buffers. Invasions of exotic plant species in the Project area can be controlled or eliminated.

Existing narrow riparian zones along streams can be widened to benefit greater numbers of species. Connections or linkages consisting of natural vegetation can be established between various habitats to provide corridors for animal movements. Levels of sediment and chemicals carried by runoff into natural areas can be reduced.

Degradation of Surface Water Quality. The surface water quality within the Project area has a wide variety of impairments with causes originating from agricultural uses, tributary stream bank erosion, urban-runoff, point source discharges (industrial and public/private treatment works) and land development. In particular, sediment makes a significant contribution to the degradation of water quality that adversely impacts aquatic habitats, such as streams and lakes. Likewise, water quality is adversely impacted by non-point source water pollution that enters the tributary streams, the interior drainage system, and then on to the Mississippi River. Water passing over the land, either from rain, car washing, watering of crops, or lawns, picks up an array of contaminants including oil from roadways, agricultural chemicals from farmland, and nutrients and toxic materials from urban and suburban areas. This runoff is defined by the Water Resource Advisory Council as non-point source water pollution and finds its way into waterways either directly or through storm drain collection systems.

The general trend in population/urbanization/ industrialization and tributary stream degradation for the Project area and vicinity is increasing. Based upon this increasing trend, it is concluded that increased degradation of water quality will continue to be a problem. The adverse effects of this degraded water quality are not limited to large lakes or rivers but can be found in local streams and ponds and natural areas.

Opportunities exist within the Project area to improve surface water quality for the benefit of restoring and protecting important aquatic habitat. Measures implemented in the tributary streams could reduce impairments with upland origins and reduce sediment loads by stabilizing degraded streams before they reach the bottoms via tributary streams. Natural areas such as existing or constructed wetlands could be protected from the debilitating affects of degraded water quality while serving as an additional filtration systems to improve water quality before it is released into the Mississippi River.

Erosion and Sedimentation. Erosional processes occurring in the Project area related to rain events, increased peak flows due to storm water runoff, and head cutting and rotational bank slumping in tributary streams. These processes are causing excessive sedimentation in the bottoms and degradation of tributary stream resources. Community leaders and the local people who participated in the public involvement program ranked sedimentation and erosion problems on a par with flooding problems. Urban sprawl and the loss of greenspace and open space were believed to contribute to both the flooding and sedimentation problems. Federal and State resource agencies that participated in the study expressed concern about the adverse environmental effects of the sediment and erosion problems.

In general, the runoff from the hillside creeks enters the canals in the Bottoms area at a high velocity capable of transporting heavy loads of sediment out of the bluffs. However, when these high velocity flows reach the Bottoms, the velocity of the water drops substantially because the gradient flattens and the water in the canal is no longer able to transport the sediment load. This sediment is then transported through follow-on storm events through the drainage canal system eventually finding its way to the Mississippi River or remaining captured in the canal system reducing its capacity. Approximately 202,700 tons of sediment per year are being generated from gross erosion from the uplands. Very little sediment is found to originate from the bottomland sources because of the flat topography and sluggish runoff velocities.

Sedimentation creates several serious problems in the bottomlands of the Project area. As sediment collects in the already undersized drainage channels, the flow area is reduced even further so that a given amount of runoff is more likely to overflow the channel or break through the spoilbank levees. Sediment has also degraded the environmental quality of numerous wetland and aquatic areas in the bottomlands, including Horseshoe Lake and the lake resources at Frank Holten State Park. Sedimentation of Horseshoe Lake has dramatically impacted its fisheries quality. It is now approximately two feet deep on average and provides less than desired habitat for aquatic resources. Sediment also has degraded the quality of tributary streams in the Project area. Aquatic habitat no longer supports the variety of species that were present during pre-settlement times. Urban development has increased the volume, duration, and frequency of stormwater entering the stream system and has affected the stability and habitat functions of streams. This degradation once begun will continue to adversely impact stream functions. Sediment left behind in drainage canals also contributes to loss of flood conveyance capacity. Following the severe flooding experienced by the area between 1996 and 2001, approximately $10,000,000 in federal, state and local funds have been expended in removing sedimentation from the interior drainage system. This is a continuing effort and expense.

Opportunities exist within the Project area to reduce sedimentation. Measures sited within the tributary watersheds would be located closest to the "problem" and address both the problem of sediment transfer to the floodplain and degradation of stream quality and function. Measures could also be implemented in the Bottoms to detain sediment.

Tributary Steam Channel Instability. Tributary stream channels in the Project area have responded to growing development in their watersheds with bank instability and head cutting. Increasing areas of developed, impermeable land surfaces in tributary watersheds has allowed greater amounts of storm water to pass through stream systems per unit time. These increased flows have lead to channel instability by creating unstable bank lines. In addition, base flows in some watersheds have increased due to the addition of effluent from septic systems in some subdivisions. Increased base flow can also lead to channel bottom instability and headcutting. Head cutting in tributary streams and tributaries has contributed to some dramatic losses and destabilization of banks throughout the system. This situation not only contributes large volumes of sediment to the system that ultimately reaches the floodplain, but it also degrades stream quality, threatens bluff infrastructure, existing developments, and habitat quality.

In spite of actions being taken today to manage stormwater runoff and future problems associated with urbanization, the destabilization process that has begun in the streams will continue to worsen if not addressed. For this reason, solving these tributary stream problems on a systematic watershed basis became an important facet of the overall Project focus.

An opportunity exists within the Project area to address the instability of tributary streams. For the purposes of this Project, this opportunity could beneficially address the sediment problem in a way that could provide increased and sustainable environmental viability for the tributary streams while protecting the restored floodplain habitat resources from unwanted sediment deposition. The NRCS was brought in to analyze the problems associated with sediment and to explore opportunities to address this problem. Appendix E of the main report includes the detailed findings and recommendations from these analyses. For purposes of this Project, the ability to find solutions for loss of sediment from the tributary streams was viewed as an environmental opportunity to improve water quality and aquatic habitat. Evaluation of potential measures to reduce sediment and stabilize and restore tributary streams became a focus of the plan formulation process.

Flooding and Flood Damages. Flooding that currently occurs when storm water overtops the existing water conveyance system in the bottoms will continue to cause significant flood damages. As discussed earlier, the Project area bottomlands are protected from direct flooding from the Mississippi River by a series of levees and floodwalls. However, the Project area has a history of serious interior flooding which is caused by storms producing interior flows that exceed the capacity of the canals in the bottomlands area.

At the bluff line the system of man-made ditches and channels take the flows from tributary streams across the floodplain to the levee where the water enters the Mississippi River. When rainfall events exceed the capacity of this interior drainage system, whose size has not been altered since constructed, the water typically breaks out immediately downstream of the bluff line. These "out of bank" flows do not provide a beneficial disturbance to wetland or other habitat resources as they are too far removed from the bluff line to receive these flows. They instead damage the urban and agricultural areas that hug the bluff line of the project area. Additionally, when the interior drainage system is full, floodplain areas cannot remove ponded water quickly enough, allowing these waters to damage urban areas away from the bluff line.

Interior flooding associated with large rainfall events producing widespread damages across the floodplain occurred in the Project area as a result of the storms of August 1915, July 1942, August 1946, July 1952, June 1957, May 1961, and May 1995. Perhaps the most damaging event occurred in August 1946 when approximately 19½ inches of rain fell over Madison and St. Clair Counties during an eight-day period. This storm produced an average depth of 15.1 inches over the entire Project area. Flood damage from this event was estimated to be $56,800,000 (2001 dollars) and the event was estimated to be rarer than the 100-year storm in terms of inches of rainfall. Flooding caused by a 14-inch rainfall over a two-day period in June 1957 caused approximately $25,000,000 (2001 dollars) in damages. This event and the 1995 event produced approximately a 100-year rainfall with average depths of over 8 inches across the Project area.

Unlike the other problems identified in this Study, the problem of interior flooding in the Study area has been the subject of numerous reports prepared by a number of different local, state and federal agencies. However, to date, no definitive solution has proved to be economically viable to address the situation and as a result, the cycle of flooding and disaster relief continues. Nevertheless, an opportunity exists to address flood damage reduction as part of the efforts to restore the historic flood pulse to the Project area. This opportunity to provide incidental flood damage reduction benefits occurs because of the multi-objective nature of the flood pulse restoration measures.

Cultural Resources. Literally hundreds of prehistoric and historic archeological resources are located throughout the Project area and are under constant threat from the pressures of development. The most well known site is the world-renowned Cahokia Mounds which is a World Heritage Site recognized by the United Nations. Despite the fact that more than 2,000 acres of the Cahokia Mounds site are publicly designated, more than one third of the site is still in private hands and is highly vulnerable to commercial or residential development.

The Project Team has concluded that if present growth rates throughout the Project area continue unabated during the twenty-first century, virtually all of the archaeological sites not currently in public ownership will be destroyed by commercial and residential development. If that is allowed to occur, the loss of the information contained in these sites will have a profound effect upon the ability of future generations to accurately interpret the prehistory of the Project area; one of the most significant prehistoric regions in all of North America.

An opportunity exists where feasible to incorporate the locations of archeological sites present in the Project area into the boundaries of the habitat areas developed for this Project. In this manner, the irreplaceable information contained within these sites will be protected and available for the benefit and enjoyment of future generations of all Americans.

Outdoor Recreation. The area is fortunate to have both the Horseshoe Lake and Frank Holten State Park systems and a start in implementing a "rails to trails" program. However, as the Project area continues to develop, there will be a growing need for additional outdoor recreation areas. As the surrounding land becomes increasingly urbanized, additional pressure is placed on the wildlife areas managed in the Horseshoe Lake State Park. Each of the counties have plans to enhance their outdoor recreational resources to attempt to keep pace with the growing population and ever expanding interest in outdoors activities.

Opportunities exist within the Project area to improve outdoor recreational opportunities through the restoration, protection and enhancement of existing ecosystem resources. Eco-education and related tourism is a new pastime of a society chiefly separated from natural areas and environmental resources. The opportunity also exists to adapt the existing flood protection system to meet outdoor recreational needs while the restoration and expansion of natural areas could create connectivity to augment and expand existing outdoor recreational opportunities.

Summary. The main problems within the Study area are the loss of ecological resources primarily caused by urbanization, sedimentation (which contributes to loss of water quality and aquatic environmental quality), and persistent recurring flooding. After looking at the cause and effect of these problems in depth, it becomes clear that they are inter-related and require an inter-related watershed based focus in the search for potential opportunities and resultant solutions. Natural ecosystem areas must be preserved now in order to protect them from loss on the floodplain. Likewise tributary streams must be restored now in order to protect them from being lost. Stormwater is the only viable floodplain hydrology source that remains to restore and revitalize the natural ecosystem. The beneficial uses of this water provide the possibility of identifying numerous environmental opportunities that could not otherwise be realized. An investigation of the pre-settlement hydrology of the area provides a picture of a vibrant natural ecosystem sustained by over-bank flooding coming from the Mississippi River as well as from the tributary watersheds. This investigation, coupled with an inventory of existing natural areas, provides a roadmap for restoration possibilities.

For the purposes of this Study, the interior flooding problems were viewed as an ecosystem service opportunity and the evaluation of the use of stormwater events to restore a flood pulse necessary to mimic pre-settlement ecosystem conditions as a foundation of the formulation process. The restoration of watershed functions appeared to be the best way to address the problems of the study area while capitalizing on the opportunities available. It is believed that through the identification of the ecosystem services gained from environmental restoration actions, the cost of ecological restoration activities can be competitive with other demands for limited public financial resources. By clearly demonstrating the many contributions to social well being that ecosystem restoration achieves, a restoration project can become the focal point of an area's master plan. From the onset of this Study, the potential mitigation of floods by the natural ecosystem has been highlighted as the most important service to provide social well-being for the Project area.

PLAN DEVELOPMENT

Planning Assumptions. The following assumptions were made in order to help guide the plan development effort:

The existing levee system and interior flood control system will remain functional and operational.

The existing pump station capacities are adequate and will not be impacted by Study recommendations.

Pre-development conditions can be used to guide the development of ecosystem restoration plans in order to address multiple problems.

Ecosystem restoration can provide incidental flood damage reduction and be competitive for scarce sponsor financial resources.

Watershed based solutions will be essential based on the Study area characteristics and the limited remaining resources.

Planning Constraints. Every planning process has constraints placed upon it. Below are those that were identified during this Study effort:

Limitations within the Corp of Engineers' program prevent the investigation of problems associated with combined sewers under the flood control and environmental restoration authority and thus presents a constraint to this study's ability to address problems of combined sewer overflow, as expressed by the citizens in areas like East St. Louis.

Limitations within the Corps of Engineers' program prevent the investigation of interior drainage problems impacting less than one square mile and thus presents a constraint to this study's ability to address floodplain flooding caused by the ponding of stormwater falling within many of the smaller drainage areas of the floodplain itself.

Limitations established by the existing flood protection system and drainage canal system.

Limitations of available land suitable for ecosystem restoration.

Planning Objectives. Specific objectives for this Study have been developed in response to the problems and opportunities identified during the scoping, public involvement, and early Project research efforts. The analysis of pre-settlement land cover and conditions in the Project area became the guide to establishing restoration planning targets for the Project. The comparison of historic land cover mapping with today's existing conditions also provided insight into restoration possibilities.

In general, planning objectives are specific operational statements that provide the direction for the development of specific alternative plans. The planning objectives for this Project are identified below, in no particular order of importance. Planning targets were developed for each objective based on an analysis of pre-settlement conditions and existing conditions in order to provide information to the team during the iterative evaluation and assessment process. These planning targets served as guideposts for developing alternative plans, and for comparing the desired restoration level to the level of restoration expected to be achieved through the implementation of any alternative plan formulated to address the corresponding planning objective.

Planning Objective 1 - Restore Natural Areas. Increase the overall spatial extent of under-represented natural communities by restoring and expanding existing natural areas wherever possible. Planning target: natural areas to be established by the Project should contain ten percent of the historic amount of Mississippi River floodplain forest in the Project area (1,880 acres), five percent of the historic amount of floodplain prairie in the Project area (1,612 acres), and 100 acres of created (new) floodplain marsh. Floodplain forest is to consist of one-third existing forest (627 acres) and two-thirds new forest (1,253 acres).

Planning Objective 2 - Restore Flood Pulse. Reintroduce a flood pulse into floodplain natural areas that mimics the historic hydrological condition. Planning target: the maximum flood pulse will not exceed the depth of the Mississippi River flood of 1844 at St. Louis, or 14 days in duration.

Planning Objective 3 – Restore Habitat Quality. Restore habitat quality in existing and re-created natural areas. Planning target: develop and maintain, at a minimum, moderate habitat quality for all evaluation species in existing and re-created natural areas.

Planning Objective 4 - Improve Water Quality. Improve the quality of surface waters. Planning target: reduce levels of sedimentation in as many surface tributaries as possible.

Planning Objective 5 - Reduce Erosion. Reduce erosion in the tributary watersheds. Planning target: Reduce the total amount of sediment reaching the bottoms by 70 percent.

Planning Objective 6 – Restore Tributary Streams. Improve the stability of tributary streams in order to restore stream quality and aquatic functions.

Planning Objective 7 - Restore Floodplain Streams. Restore floodplain streams and associated riparian corridors. Planning target: recreate flowing floodplain streams with associated riparian corridors for a distance equivalent to 10 percent of the floodplain length of historic Cahokia Creek (four miles) and establish three miles of riparian corridor linkages between existing or proposed natural areas.

Planning Objective 8 - Incidental Social Objectives. The interrelationship between problems and opportunities that was identified through the public involvement process dictated the need to identify and measure incidental Project contributions to the social well being of the area. As previously discussed, it was deemed important to quantify the ecosystem services that would be provided as a natural by-product of the restoration Project in order to ensure the public had a full appreciation of the many positive benefits to be realized from an ecosystem restoration project. Objectives designed to focus on these issues were developed to ensure that ecosystem services incidentally provided by the Project could be tracked and quantified.

Planning Objective 8a - Reduce Flood Damages in Urban and Agricultural Areas. Planning target. To the maximum extent possible within the planning target to restore a floodplain flood pulse.

Planning Objective 8b - Enhance Outdoor Recreation. Increase and enhance outdoor recreational opportunities within natural areas. Planning target: Provide passive outdoor recreational opportunities at as many sites as possible.

Planning Objective 8c - Protect Cultural Resources. Protect cultural and archeological resources and enhance their values. Planning target: Envelop known archaeological sites into Project lands rather than attempt to avoid them.

Measures to Address the Planning Objectives. The Project Team identified and developed a number of measures that could be implemented to address each planning objective:

Objective 1. Expand natural areas. Measures: 1-Obtain land (existing or new habitats); and, 2-Create habitats (forest, prairie, marsh).

Objective 2. Restore flood pulse. Measures: 1-Modify existing channels; 2-Construct new channels; 3-Divert surface flow into habitat areas; 4-Construct earthen berms to contain flood pulse in habitat areas; and, 5-Detain surface flow in habitat areas.

Objective 3. Maintain habitat quality. Measures: 1-Increase tree species diversity and abundance in existing upland and floodplain forests (implement tree stand improvements, or selective clearing and planting of underrepresented species, such as oaks); 2-Install nesting boxes in existing marshes and floodplain forest (i.e., wood duck); 3-Add flood pulse to existing floodplain wetlands, lakes, ponds, borrow pits; 4-Remove standing water from areas of "drowned" forest; 5-Create overwintering areas for fish in existing floodplain lakes and ponds; 6-Add woody debris in floodplain lakes and ponds; 7-Add shoreline plantings in existing floodplain channels, lakes, ponds, borrow pits; 8-Augment base flow in existing floodplain channels with new pump station; 9-Add riffle and pool complexes in tributary streams; and, 10-Protect natural areas by restricting them to compatible uses.

Objective 4. Improve water quality. Measures: 1-Construct buffer strips and tile outlet terraces to control erosion in upland agricultural areas; 2-Construct in-stream sediment detention basins in tributary streams or dry sediment detention basins on the floodplain in habitat areas to capture sediment; 3-Create riffle and pool complexes in tributary streams to restore in-stream habitat; 4-Construct in-channel grade control structures in tributary streams to prevent headcutting; and, 5-Plant grassy or prairie buffers in floodplain swales to capture sediment.

Objective 5. Reduce erosion. Measures: 1-Construct tributary stream sediment detention basins; and, 2-Construct terraces in the uplands; 3-Construct underground outlet & subsurface drains in the uplands; 4-Construct water and sediment control basins in the uplands; 5-Install critical area plantings in the uplands; 6-Construct diversions in the uplands; 7-Install filter strips in the uplands; 8-Install grass waterways in the uplands; 9-Stabilize banks of tributary streams; 10-Install grade control structures in tributary streams; 11-Create riffle and pool complexes in tributary streams; 12-Allow for natural deposition of sediment on alluvial fans; and, 13-Construct lowland dry sediment detention basins.

Objective 6. Restore tributary streams. Measures: 1-Stabilize banks of tributary streams; 2-Create riffle and pool complexes; 3-Construct in-channel grade control structures; and, 4-Implement bio-erosion control techniques.

Objective 7. Restore floodplain streams. Measures: 1-Obtain land; 2-Reconnect historic stream channel fragments; 3-Plant natural vegetation; 4-Create connectivity corridors between natural areas that are centered along existing streams, by planting natural vegetation; 5-Create connectivity corridors between natural areas that are centered along existing ditches, by modifying existing ditch system (set back one or both levees) and planting natural vegetation within levees; and, 6-Create connectivity corridors between natural areas that are centered along existing ditches, by planting natural vegetation outside levees.

Objective 8. Incidental Social Objectives

8a. Reduce flood damages. Measures: 8a-1-Modify existing channels; 8a-2-Construct new channels; 8a-3-Divert surface flow into temporary storage areas; 8a-4-Construct earthen berms; and, 8a-5-Detain surface flow in temporary storage areas.

8b. Enhance recreation. Measures: 8b-1-Construct trails; 8b-2-Provide interpretive areas; 8b-3-Provide signage; and, 8b-4-Provide access areas.

8c. Protect cultural resources. Measures: 8c-1-Obtain selected sites; 8c-2-Plant historic natural vegetation; 8c-3-Add historic flood pulse; and, 8c-4-Provide interpretive areas.

Identification of Potential Restoration Sites. The initial array of possible restoration sites for each watershed was next developed based upon insight provided by analysis of the pre-settlement land cover and hydrology, project restoration planning targets, public outreach, previous reports, identification of existing habitat sites and the knowledge of agency personnel. In this manner the Project Team developed a list of potential sites for the Project area which were organized and identified in relation to the five area watersheds: Long Lake; County Ditch; Cahokia Canal; Harding Ditch; and, Powdermill. The item in parentheses below is the potential restoration sites' unique identifier.

Long Lake. Borrow Pits near Long Lake, south (LO-23); Borrow pit between Rte 162 and Long Lake (LO-27); Wetland along railroad track Granite City (LO-28); Dobrey Slough (LO-29); Dobrey Slough Agricultural land east of tracks; Wetland near Horseshoe Lake, Route 162, west (LO-47); Wetland West side of Lake Road Route 162, east (LO-48); Long Lake; Mitchell Ditch; Dobrey Slough Canal (concept); and, Legacy Golf Course.

County Ditch. Wetland near Rte. 111 (CO-18); Wetland along Old Cahokia Creek, north (CO-20); Wetland along Old Cahokia Creek, south (CO-21); Wetland along County Ditch, north (CO-24); Wetland along County Ditch, south (CO-25); County Ditch; and, Bluff 1 Tributary Watershed.

Cahokia. McDonough Lake (CA-30); Wetland Edelhardt Meander Scar, Rte. 111 west (CA-31); Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32); Agricultural land Edelhardt Meander Scar, middle (CA-33); Wetland Edelhardt Meander Scar, east (CA-34); Arlington Subdivision Wetland Edelhardt Meander Scar, south (CA-35); Arlington Subdivision area Wetland Horseshoe Lake, delta at Cahokia Diversion Canal (CA-36); Wetland Horseshoe Lake, west fringe (CA-37); Wetland Horseshoe Lake, Rte. 203 east (CA-37.1);

Wetland Horseshoe Lake, east fringe (CA-38); Wetland Horseshoe Lake, northeast fringe (CA-38.1); Wetland Horseshoe Lake, Walker Island (CA-39); Wetland, Milam mitigation site, Horseshoe Lake (CA-40); Horseshoe Lake Wetland Brushy Lake (CA-41); Agricultural land, Brushy Lake North; Wetland Eagle Park west (CA-42); Wetland Eagle Park east (CA-43); Wetland Cakokia Canal borrow pits along I-55/70 (CA-44); Wetland at Indian Lake, Fairmont City (CA-45); Wetland East of Route 203, North of I-55/70 (CA-46); Wetland Lansdowne Ditch (CA-49); Lansdowne Ditch Wetland Canteen Creek (CA-54); State Park Place; Judy's Branch Watershed; Burdick Branch Watershed; Agricultural land Judy's/ Burdick; Schoolhouse Branch Watershed; Canteen Creek Watershed; National City Stockyard; Cahokia Canal; and, Bluff 3 Watershed.

Harding. Wetland Cahokia Mounds (HA-50); Cahokia Mounds State Historic Site; Wetland Spring Lake meander scar, north (HA-51); Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52); Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53); St. Clair Farms; Farmed wetland along Harding Ditch, Bunkum Rd. (HA-54); Wedgewood; Centerville; Wetland Crooked Lake (HA-55); Wetland East St. Louis (HA-59); Wetland Holten State Park, north (HA-60); Wetland Holten State Park, northwest (HA-60.1); Wetland, Holten State Park, south (HA-61); Lakes 1 and 2, Holten State Park Lake; ALCOA Site; Wetland Canal No. 1, north (HA-62); Wetland Mary Spencer (HA-63); Wetland near Mary Spencer (HA-64); Farmed wetland North of Sterling Place; City of Caseyville (HA-68.5); Farmed wetland by Crooked Lake (HA-68.1); Farmed wetland by Crooked Lake (HA-68.2); Farmed wetland along Harding Ditch, south (HA-68.3); Area along Harding Ditch, north near Centerville (HA-68.6); Area along Harding Ditch, south near Centerville (HA-68.7); Farmed wetland East of I-255 South of I-64 (HA-68.8); Little Canteen Creek Watershed; Schoenberger Creek Watershed; Bluff 2, Watershed; Bluff 4, Bluff 5 Watershed; and, Harding Ditch.

Powdermill. Wetland Mullen Slough (PO-66); Wetland Fishing Pond (PO-67); Wetland Canal No. 1 (PO/HA-67); Agricultural Land Mullens Slough; Powder Mill Creek Watershed; and, Bluff 6 Watershed.

Identification of Potential Measures. In the spring of 1999, numerous sites throughout the Project area were visited to establish baseline habitat conditions. In all, some 112 sites were evaluated using the HydroGeoMorphic Approach to assessing wetland functions (HGM), and 160 sites were evaluated using the Habitat Evaluation Procedures (HEP) as apart of the initial baseline assessment process. Floodplain sites and bluff sites were subjected to a baseline evaluation using HEP, and wetland sites were additionally assessed using HGM. Tributary streams were assessed at 17 sites using the Qualitative Habitat Evaluation Index (QHEI) method. The first-hand experience gained from the HEP/HGM analysis at each site assisted in the identification of potential measures at these sites.

A detailed discussion showing the full array of objectives and measures that could potentially be applicable to each of the sites identified in the five watersheds is beyond the scope of this Summary Report but is contained in the more detailed General Reevaluation Report.

Screening of Potential Restoration Sites. Following the assessment and evaluation of measures, the Team began the evaluation of restoration sites and restoration site combinations based on location, topography, area hydrology, soils, and existing conditions to contribute to Project planning objectives. This next iteration of assessment and evaluation addressed each restoration site's ability to stand alone or work effectively in combination with others to address the planning objectives. Based upon the large number of potential sites, the Team agreed that in order to formulate viable alternative plans, the focus had to be on the identification of a few areas that could contribute in a meaningful way to the planning objectives. It was infeasible to develop a large number of small fragmented sites across the Project area that contributed to only to a few objectives and still hope to achieve restoration planning targets. Therefore, thc Team determined that sites or combination of sites needed to meet multiple objectives to have a chance of making a meaningful change in the existing conditions of the Project area. Sites were evaluated based on their ability to contribute individually or in combination to multiple project objectives and also have the potential to meet planning targets. In this way, potential action areas were to be identified. The following identifies by watershed, the restoration areas that survived the screening process. This screening process is detailed in Section 6 of the main report.

Restoration Site Survivors:

Long Lake. Dobrey Slough (LO-29); Dobrey Slough Agricultural land east of tracks; Long Lake; and, Mitchell Ditch.

County Ditch. Wetland along Old Cahokia Creek, north (CO-20); Wetland along Old Cahokia Creek, south (CO-21); Wetland along County Ditch, north (CO-24); Wetland along County Ditch, south (CO-25); County Ditch; and, Bluff 1 Tributary Watershed.

Cahokia. McDonough Lake (CA-30); Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32); Agricultural land Edelhardt Meander Scar, middle (CA-33); Wetland Brushy Lake (CA-41); Agricultural land, Brushy Lake North; Wetland Cakokia Canal borrow pits along I-55/70 (CA-44); Wetland at Indian Lake, Fairmont City (CA-45); Lansdowne Ditch Wetland Canteen Creek (CA-54); State Park Place; Judy's Branch Watershed; Burdick Branch Watershed; Agricultural land Judy's/ Burdick; Schoolhouse Branch Watershed; Canteen Creek Watershed; National City Stockyard; Cahokia Canal; and, Bluff 3 Watershed.

Harding. Cahokia Mounds State Historic Site; Wetland Spring Lake meander scar, north (HA-51); Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52); Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53); St. Clair Farms; Farmed wetland along Harding Ditch, Bunkum Rd. (HA-54); Wedgewood; Wetland Crooked Lake (HA-55); Wetland Canal No. 1, north (HA-62); Farmed wetland North of Sterling Place; City of Caseyville (HA-68.5); Farmed wetland by Crooked Lake (HA-68.1); Farmed wetland by Crooked Lake (HA-68.2); Little Canteen Creek Watershed; Schoenberger Creek Watershed; Bluff 2, Watershed; Bluff 4, Bluff 5 Watershed; and, Harding Ditch.

Powdermill. Wetland Mullen Slough (PO-66); Wetland Fishing Pond (PO-67); Wetland Canal No. 1 (PO/HA-67); Agricultural Land Mullens Slough; Powder Mill Creek Watershed; and, Bluff 6 Watershed.

Identification of Potential Action Areas. Restoration sites screened and identified to be carried forward as having potential for meeting project objectives were put through further engineering and biological analysis in order to identify the relative effectiveness of restoration sites and site combinations. These analyses are detailed in the Hydraulic, Geotechnical, and Sediment Appendixes of the General Reevaluation Report. The purpose was to eventually assemble "action areas" using one or more of the restoration areas so as to take advantage of their inherent synergistic characteristics. The action areas then would become the focus and would be the areas within which specific plans would be developed.

At this point, restoration sites were assembled into potential action areas and screened for having the ability to achieve multiple project goals and objectives and to make a significant contribution to attaining planning targets. Habitat restoration and the ability to reasonably attain hydraulic reconnection for flood pulse restoration to enhance ecosystem functions were key to the assessment process. The potential action areas determined to have inadequate potential were not carried forward. Those that did were carried forward and are identified below along with their components. The action areas carried forward from this assessment next were to be put through the alternative plan development process. They are displayed in Figure 10.

Action Areas Surviving the Screening Process:

Dobrey Slough Action Area. Consists of the Dobrey Slough (LO-29) and Dobrey Slough Agricultural land east of tracks restoration areas.

Old Cahokia Creek Action Area. Consists of the Wetland along Old Cahokia Creek north (CO-20), Wetland along Old Cahokia Creek south (CO-21), Bluff 1, and Cahokia Canal restoration areas.

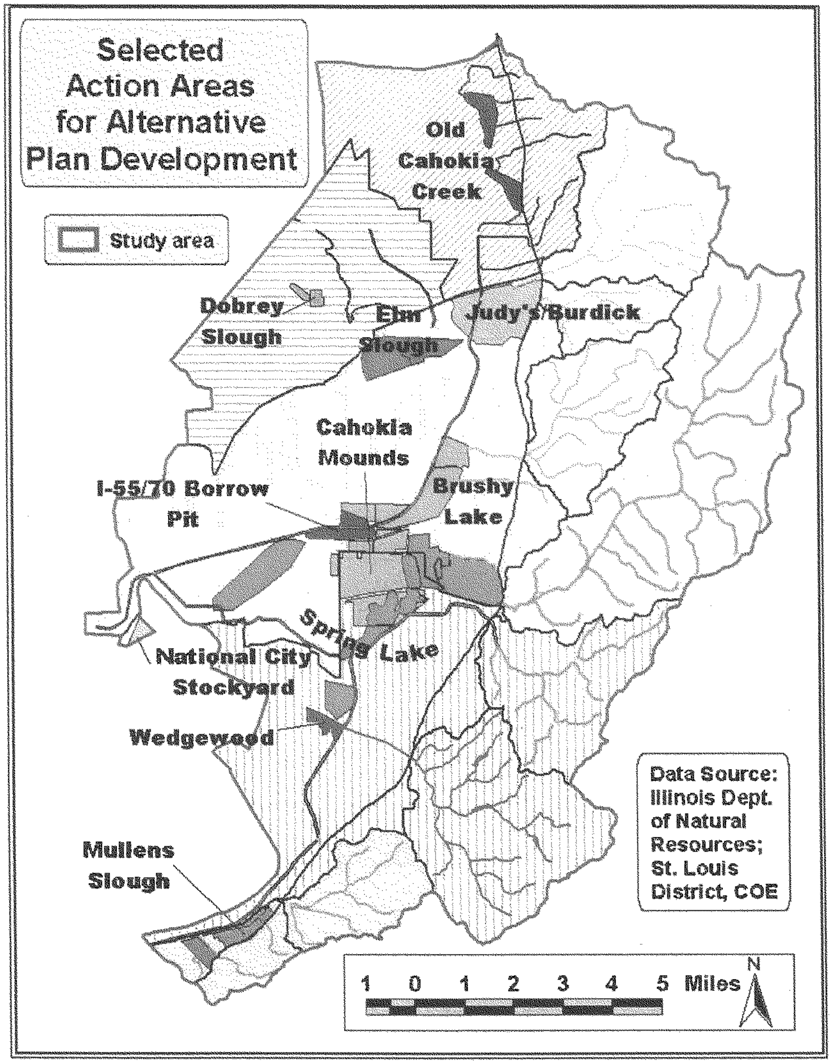
Elm Slough Action Area. Consists of the Long Lake, Mitchell Ditch, Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32), and Agricultural land Edelhardt Meander Scar, middle (CA-33) restoration areas.

Judy's/Burdick Branch Action Area. Consists of the Judy's Branch, Burdick Branch and Agricultural land Judy's/Burdick restoration areas.

Brushy Lake Action Area. Consists of the Wetland Brushy Lake (CA-41), Agricultural land Brushy Lake North, Bluff 3 Watershed, and Schoolhouse Branch restoration areas.

Cahokia Mounds Action Area. Consists of the Cahokia Mounds and CA-50 restoration sites.

Figure 10 Action Areas Selected for Alternative Plan Development



Spring Lake Action Area. Consists of the Canteen Creek, Harding Ditch, Little Canteen Creek, Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53), Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52), St. Clair Farms, Landsdowne Ditch, Wetland at Indian Lake, Fairmont City (CA-45) and, Wetland at Indian Lake restoration areas.

Wedgewood. Consists of the Harding Ditch, Schoenberger Creek and Wedgewood restoration areas.

Mullens Slough. Consists of the Wetland Mullens Slough (PO-66); Wetland Fishing Pond (PO-67); Wetland Canal No. 1 (PO/HA-67); Agricultural Land Mullens Slough; Powder Mill Creek Watershed; and, Bluff 6 Watershed restoration areas.

Alternative Plan Development. Preliminary alternative plans were next formulated for each action area. A variety of combinations of measures were developed at each site that could be evaluated for their effectiveness and cost efficiency in addressing planning objectives.

By this stage of the plan development process, the Team had determined the combination of species that would be used to predict habitat outputs for the various alternative plans. Appendix A of the main report provides detailed information regarding the rationale and selection process for these predictor species which are used to measure habitat outputs for the different combinations of measures in an alternative plan. The potential array of measures was developed based upon the analyses of pre-settlement land cover and hydrology, and project restoration planning targets. As described previously, the selected action areas were initially screened for their existing habitat, soils, hydraulic connectivity and spatial area. In this manner, the Team was able to develop a full array of ecosystem and social measures for efficiency and effectiveness competition at each action area. In the development of alternative plans for each action area, several conclusions from engineering and biological analysis were used to assist in guiding the process. It had been determined during the action area screening process that each of the designated project action areas could receive hydraulic input with the potential to provide disturbance depths having limited durations that would be considered beneficial for biological purposes (defined as meeting Objective 2, Flood Pulse Restoration) and could accept storm water for flood damage reduction purposes (Objective 8a, Reduce Flood Damages). Varying hydraulic events were analyzed at each site to determine the optimum for a site based upon planning targets and cost factors. A more detailed discussion of this analysis is contained in Appendix C of the main report.

Tributary stream sediment detention measures and creation of riffle and pool complexes recommended by NRCS were considered together within each watershed as an "all or nothing" unit for alternative development. This was necessitated by the inability to attribute improvements to the system in any smaller increments of action. This is in concert with the NRCS' study, which is further detailed in Appendix E of the main report. Based on the NRCS' analysis, land treatment measures were eliminated in alternative plans. These measures proved to be unreliable because of their voluntary nature, and uneconomical because of the rapid urbanization projections for the bluff, which meant these measures would be temporary in nature. This analysis is further discussed in Appendix E.

Tributary stream and lowland sediment detention measures were retained and analyzed during this iteration as a method for the removal of sediment and improvement of water quality for each action area that had a tributary stream connection. Appendices C and E of the main report provide more detail on tributary stream and lowland sediment detention measure analysis that determined the acceptability of measures designed to meet the Planning Target established for Objective 5 (Reduce Erosion) and Objective 4 (Improve Water Quality).

The measures at this stage of formulation had attained more specificity based upon additional hydraulic, geotechnical and sediment analyses performed. From these preliminary plans, cost curves were developed for measures that were required at multiple sites. These cost curves were utilized to identify those measures providing a similar benefit that proved less effective. This allowed for the initial reduction of alternative plans prior to running action area alternative plans through the HEP/ ICA analysis. The chart below shows the number of alternatives carried through to more detailed iterations of assessment and evaluation.

Watershed	Action Area	Alternative Counts		
		Conceived	Dropped	Evaluated
County Ditch	Old Cahokia Creek	24	12	12
Cahokia	Judy's-Burdick Branches	40	20	20
Cahokia	Brushy Lake	30	24	6
Cahokia	Elm Slough	6	1	5
Cahokia/Harding	Spring Lake	126	117	9
Harding	Wedgewood	6	2	4
Harding	Cahokia Mounds	12	6	6
Powdermill	Mullins Slough	6	0	6
Long Lake	Dobrey Slough	6	3	3
	Totals:	256	185	71

Alternative Plan Assessment. Planning level cost estimates were developed for each alternative plan within an action area. These estimates included lands, construction (including environmental treatments) and operation and maintenance costs and were annualized at the current interest rate over the 50-year project life. These estimates were to be used in the incremental cost analysis. Using this methodology, the predicted average annual habitat unit benefits (effectiveness) could be compared to the predicted annualized costs (efficiency) in order to generate a comparison of alternative plans for assessment and evaluation purposes. Appendix A of the main report describes these procedures in detail and provides data on results obtained. This process resulted in the final set of alternatives for each action are that was carried through the final incremental cost analysis process.

Final Array of Alternative Plans by Action Area. The screening process used on the alternative plans resulted in a final set of alternatives for each action area that were analyzed using the incremental cost effectiveness analysis process. The following is a recap of final alternatives that were competed through the incremental cost effectiveness analysis. Appendix A of the main report provides complete detail on this process.

Dobrey Slough. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages in the residential neighborhoods adjacent to Dobrey Slough, in the Long Lake watershed. A total of 3 different alternatives are being evaluated.

Common measures:

1. The establishment of a habitat area with the existing "slough" (marsh-based vegetation) serving as its core.

2. The restoration of existing marsh, and the creation of new marsh, inside the habitat area supported by utilization of the stormwater events delivered by local runoff. Excavation would be necessary to support the creation of the new marsh as well. In addition, modification of the existing drainage structures, located under the railroad embankment, will be necessary.

Variable measures:

1. The creation of a forested corridor, inside the habitat area, surrounding the existing marsh. Trees would be planted (where they currently do not occur) on the west side of the railroad embankment in undeveloped areas. The forested corridor would provide habitat, and serve as a filter strip to enhance water quality in the marsh. The width of the forested corridor was considered when developing alternatives. Three corridor size options [i.e., 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters)] were designed for this site. These corridor widths would be created on both sides of the channel/ditch.

Old Cahokia Creek. The purpose of this action area is to restore a portion of Cahokia Creek on the floodplain to a free-flowing stream, with an adjacent forested corridor supporting natural plant and animal communities, and a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the "Bluffl" watershed and to incidentally reduce flood damages in the bottoms in the County Ditch watershed, with a focus on Sand Road and vicinity. A total of 18 different alternatives are being evaluated.

Commonly shared measures:

1. The reopening of a portion of the Cahokia Creek channel on the floodplain. Segments of historic channel that were filled over the years would be reopened under these alternatives, and existing channel areas would be excavated to remove accumulated sediment to recreate a floodplain stream that once flowed from north to south.

2. The creation of a continuous forested corridor along the reopened channel. In all alternatives, trees would be planted on both sides of the creek where they currently do not occur.

3. The construction of an earthen hydraulic feature along the west side of the reopened channel. This feature, located along the west edge of the forest on the west side of the creek, would allow for a riverine overflow regime to be reestablished, while restricting overflow from the creek to the forested corridor and adjacent lands to the east.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 10 new tributary stream sediment detention basins in the "Bluff 1" watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 6 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.

2. Length of channel restoration – two lengths of channel restoration were considered. From the south end of the project area, the shorter channel option would extend north along the creek for a distance of approximately 2.9 miles. The longer channel option would extend the length of the diversion channel for a distance of approximately 4.2 miles.

3. Augmentation vs. no augmentation of stream flows – for the longer channel alternatives, a new pump station could be installed at the diversion channel, and would be used to augment low stream flows to enhance environmental returns.

4. Width of forested corridor – on each side of the creek, widths of approximately 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters) were considered.

Elm Slough. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages within the Long Lake watershed. Much of the project area is an old meander scar of the Mississippi River, and forest was the predominant type of vegetation two centuries ago. A total of 5 different alternatives are being evaluated.

Commonly shared measures:

1. The creation of a 670-acre forested habitat area to utilize stormwater events delivered by Long Lake and Mitchell Ditch. Trees would be planted in areas where they do not currently occur. The construction of earthen hydraulic features around the perimeter of the habitat area would also be included in this option, as well as the simulation of hydrologic conditions (in a large area of the newly planted wetland forest), similar to those of the existing wetland forest. Excavation of an area approximately 175 acre in size, will be necessary to temporarily store water.

2. The replacement of the two "funnel-shaped" waterways referred to as Mitchell Ditch and Long lake Ditch on the south side of Route 162. Stormwater from these two floodplain tributaries will be carried south into Elm Slough in a sheet-flow manner. Earthen hydraulic features constructed along the edges of these waterways will restrict stormwater to the habitat area. Culverts under Route 162, and the adjacent railroad embankments, will be modified as well.

3. Grassy vegetation will be planted inside the "funnel-shaped" drainage ways to act as filters that intercept sediment carried by stormwater.

Variable measures:

1. Replacement of under-represented tree species - two levels of management will be considered (i.e., simple vs. intensive activities). Simple improvements will focus on of selective thinning and planting of mast tree species in the existing forest. Intensive improvements will involve the removal of existing dead (drowned) timber, and the planting of appropriate tree species. The "No Action" management strategy defers improvements.

2. Presence or absence of a prairie-based vegetative buffer - the proposed buffer would be created at the location where sheet flows are anticipated to enter Elm Slough, in front of the main forested habitat area. The buffer will be designed to intercept sediment carried by flows from Long Lake and Mitchell Ditch.

Judy's-Burdick. The purpose of this action area is to create an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Judy's, Burdick, and "Bluff 1" watersheds and to incidentally reduce flood damages in the bottoms within the Cahokia watershed. The floodplain component lies at the southern end of historic Rattan's Prairie, a 15,000-acre wet prairie once located in the northeast part of the American Bottoms. A total of 16 different alternatives are being evaluated.

Commonly shared measures:

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Judy's and Burdick Branches combined.

2. The modification of the existing levee, along the south side of Burdick Branch, to ensure delivery of stormwater events from the Judy's and Burdick tributaries into the new habitat area.

3. The creation of a 330-foot (100-meter) wide prairie buffer surrounding the perimeter of the habitat area's earthen hydraulic feature.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 28 new tributary stream sediment detention basins- 23 in the Judy's Branch, 4 in the Burdick Branch and 3 in the "Bluff 1" watersheds and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 32 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.

2. Size of habitat area – given existing urban constraint, three options are being considered to provide a variety of habitat options and hydrologic regimes (the "small" option would restore 131 acres, the "medium" option would restore 230 acres and a "large" option would restore 350 acres). Under the small and medium size, options, a moderate-extensive excavation activity will support the development of a new marsh. For the larger option, prairie would be created with little or no excavation needed.

3. Restoration of the historic Cahokia Creek channel within the habitat area – a channel would be excavated to replace the historic channel that has degraded over time - in over time in an effort to recreate the floodplain stream similar to that which once flowed from north to south across the site.

4. Create a 330-foot (100-meter) wide forested corridor along the north side of Burdick Branch extending from Cahokia Canal to Route 157.

5. Restoration of Tributary Streams a series of riffle and pool complexes would be constructed in the streams to stabilize streams and improve habitat quality.

Brushy Lake. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to minimize restore stream resources in the Schoolhouse Branch and "Bluff 3" watersheds, and to incidentally reduce flood damages within the Cahokia watershed. Much of the floodplain component is an old meander scar of the Mississippi River. Two centuries ago, Cahokia Creek flowed through this area, and forest was the predominant type of vegetation. A total of 6 different alternatives are being evaluated.

Common measures:

1. The creation of a 710-acre forested habitat area on the floodplain to utilize stormwater events delivered by both Schoolhouse Branch and Snyder Creek that will include planting of trees where they do not currently exist.

2. The restoration of the historic Cahokia Creek channel within the habitat area. Segments of channel that have been filled, will be reopened, and existing remnants will be excavated to remove accumulated sediments. These actions will recreate a floodplain stream similar to that which once flowed from north to south across the site.

3. Modification of the existing channels and levees of Schoolhouse Branch and Snyder Ditch to ensure delivery of stormwater events from these two bluff tributaries into the new habitat area. The current channel conditions (i.e., grassy side-slopes and earthen bottom) will be utilized.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 15 new tributary stream sediment detention basins- 14 in the Schoolhouse Branch watershed and 1 in the "Bluff 3" watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 25 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.

2. Presence or absence of a prairie filter – under the Bottomland sediment detention option, a 330-foot (100 meter) wide vegetative buffer would be established in the habitat area outside the detention basin. The buffer would consist of prairie plantings to intercept sediment carried by stormwater overtopping the basin.

Spring Lake. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Canteen and Little Canteen Creek watersheds, and to incidentally reduce flood damages within the Cahokia and Harding watersheds. The three floodplain areas lie in separate historic meander scars of the Mississippi River.

Two centuries ago, the principal type of vegetation occurring in these areas appears to have been marsh (Cell 1), prairie (St. Clair Farms), and forest (Indian Lake). A total of 9 different alternatives are being evaluated.

Common measures:

1. The establishment of three floodplain areas, namely Cell 1 (370 acres), St. Clair Farms (180 acres) and Indian Lake (620 acres), as habitat areas that will utilize stormwater events from Canteen and Little Canteen Creeks with the construction of earthen hydraulic features around these areas, when necessary. At Indian Lake, remnants of Cahokia Creek would be reopened to create a flowing floodplain stream, and trees would be planted along both sides of the channel (where they currently do not exist), to create a continuous forested corridor 330 feet (100 meters) wide. Impaired drainage at the northern end would be improved and standing water removed, to allow the forest to become reestablished.

2. The creation of a 330-foot (100-meter) wide forested corridor on both sides of Harding Ditch between Cell 1 and St. Clair Farms.

3. The re-establishment of a forest in the dead timber area[1] north of Forest Boulevard, within the Cahokia Mounds State Historic Site. The permanent standing water within a 35-acre tract of dead (drowned) timber would be drained and appropriate tree species planted under this option.

4. The construction of a new Canteen Creek relief channel to ensure that stormwater from the Canteen Creek watershed enters into the Harding Ditch system, and ultimately into the habitat areas. The channel would have concrete sides, a concrete bottom and earthen levies along both banks.

5. The modification of Harding Ditch, from Route 157 to Cell 1, and from Cell 1 to St. Clair Farms, in order to ensure the transference of stormwater events from Canteen and Little Canteen Creeks to the habitat areas. The channels would have grassy sides, an earthen bottom and an earthen levee along both banks.

6. The construction of a new "Fairmont City Ditch," from Cell 1 to Indian Lake, which will provide the hydraulic connection from Canteen Creek back to Cahokia Canal. The channel would have grassy sides, an earthen bottom and an earthen levee along both banks in low elevations.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 58 new tributary stream sediment detention basins- 37 in the Canteen Creek watershed and 21 in the Little Canteen Creek watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 99 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.

2. Presence or absence of a new "floodplain" along "Reach 3B" of Harding Ditch. By setting back the existing levees along a 2,000-foot long reach of Harding Ditch, a "floodplain" area will be re-established.

3. Vegetative cover across the habitat areas – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site. In Cell 1, a restoration marsh option that requires extensive excavation was compared to an option that produced a combination of marsh and forested habitat with minimal excavation required. In the St. Clair Farms area, an option that restores prairie and forested habitats to the site with no excavation activities was compared to the restoration of marsh habitat requiring minimal excavation. In "Reach 3B" of the Harding Ditch, a prairie restoration option implemented in the floodplain was evaluated. Throughout the evaluation of options, the habitat conditions in the Indian Lake area were held constant.

4. Restoration of Tributary Streams - a series of riffle and pool complexes would be constructed in the streams to stabilize streams and improve habitat quality.

Wedgewood. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Schoenberger Creek watershed and to incidentally reduce flood damages within the Harding watershed. The area of the floodplain component is located in the southern portion of historic Cold Prairie that interfaced with forest. A total of 4 different alternatives are being evaluated.

<u>Common measures:</u>

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Schoenberger Creek.
2. The modification of the existing levee, along the west side of Harding Ditch, to ensure delivery of stormwater events from Schoenberger Creek into the new habitat area.
3. The enclosure of Summit Avenue in the new habitat area, extending from Kings Highway on the west, to Harding Ditch on the east, to form a contiguous habitat area.

<u>Variable measures:</u>

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 24 new tributary stream sediment detention basins in the Schoenberger Creek watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 36 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.
2. Vegetative cover across the habitat area – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site, wet supported by excavation activities.

Mullens Slough. The purpose of the restoration at the Mullen's Slough action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Powdermill and "Bluff 6" watersheds and to incidentally reduce flood damages within the Powdermill/Canal No. 1 watershed. In the floodplain, much of the project area lies in an old meander scar of the Mississippi River. The historic Pittsburg or Big Lake occupied this area, and Mullens Slough now lies within its footprint. Prairie once extended south and west of this historic backwater lake. A total of 6 different alternatives are being evaluated.

Common measures:

1. The establishment of a 310-acre floodplain habitat area to utilize stormwater events delivered by the Powdermill watershed.

2. The creation of overwintering fisheries habitat in Mullens Slough. To accomplish this, a series of deep pools (water depth greater than 8 feet) would be created (by excavation), to provide suitable conditions for winter survival.

3. The creation of islands in Mullens Slough. Material excavated to create overwintering habitat would, in turn, be placed in the slough to create a series of islands. These would be planted to prairie habitat.

4. The improvement of habitat structure in Mullens Slough. Woody debris would be added to the slough, and various aquatic plant species would be planted around its perimeter.

5. The restoration of historic floodplain prairie habitat. Within the new habitat area, prairie would be planted on a 31-acre floodplain area south of Mullens Slough.

6. The creation of a 17-acre marsh area (Cell 1). Stormwater from Powdermill Creek would be passed through this area on its way to Mullens Slough.

7. The improvement of tree species diversity in the existing forests along Canal No. 1 and Mullens Slough by selective thinning and planting of mast tree species.

Variable measures:

1. Tributary stream vs. Bottomlands sediment detention – sediment would be detained either by constructing 20 new tributary stream sediment detention basins),
Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 20 new tributary stream sediment detention basins - 14 in the Powdermill watershed and 6 in the "Bluff 6" watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 15 miles of tributary streams, or sediment would be detained in the Bottoms in a 17-acre detention basin (Cell 1) and in a second 23-acre detention basin (Cell 2), downstream of the habitat area itself.

2. Maintenance of prairie vegetation – three maintenance options were considered: Burning, Burning/Mowing, and Mowing.

Cahokia Mounds. The purpose of this action area is to restore an area on the floodplain that supports prairie plant and animal communities as similar to presettlement (ca. 1800) conditions as practicable. The project area lies within historic Cold Prairie, a 15,000-acre prairie once found in the southeast part of the American Bottoms. A total of 6 different action alternatives are being considered.

Variable measures:

1. Replacement of hay production areas with prairie plantings that would be completed within a 5 or 10- year time period. In terms of area, these rates corresponded to either ~105 or ~52.5 acres planted per year.

2. Three maintenance plans were designed to maintain the integrity of prairie plant communities by periodically removing dead plant materials.

a. Burning - the entire prairie would be burned every three years on a rotational cycle (a portion would be treated every year).

b. Burning and mowing - the entire prairie would be mowed once every two to three years, and burned once every ten years. Both treatments would be implemented on a rotational cycle.

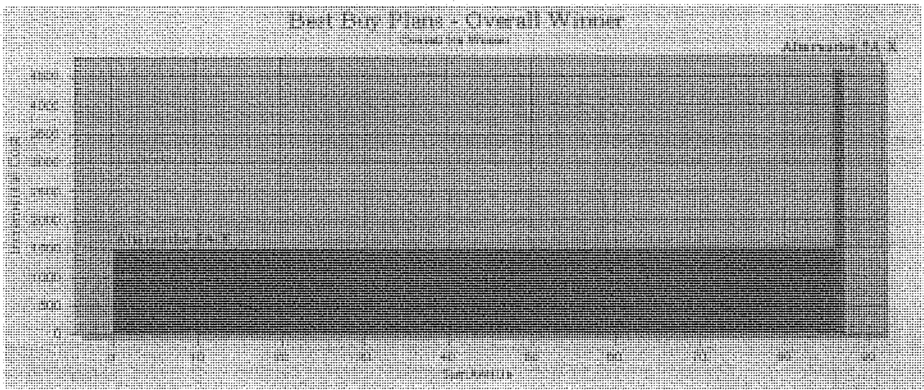
c. Mowing only - the entire prairie would be mowed once every three years on a rotational cycle.

Review and Evaluation of Incremental Cost Analysis (ICA). The ICA results for each action area's array of alternative plans provided comparable information that could be used in the evaluation and assessment process of selecting a preferred plan. Detailed information pertaining to this analysis and its results are contained in Appendix A and Section 6 of the main report. From this documentation, the Team used a two-phase recommended plan selection process. The Team evaluated incremental differences between plans in order to determine which alternative at each site achieved the best results in relation to planning objectives and restoration planning targets. Each action area was addressed and ICA results systematically reviewed and compared in order to select the alternatives that would form the preferred plan. Following the Team's assessment, the Local Sponsor representatives went through the full assessment and evaluation process to identify their preferred plan. The following presents information on the team assessments for each action area. The process utilized to assess ICA results was to look at each action sites results, make an evaluation of these results and recommend an alternative that would be carried into the Recommended Project Plan. In each case the analysis of the No Action Alternative found it to be unacceptable and therefore it was eliminated from consideration.

Dobrey Slough. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 5A-Y as the most cost effective and incrementally effective alternative (ICA winner). This plan includes a restored marsh buffered in part by a 75-meter wide forested corridor. Alternative 5A-X, with a 100-meter wide corridor, was labeled as the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 5A-Y (ICA winner) provides 86 AAHUs at an average cost of $1,491 per AAHU, whereas alternative 5A-X (HEP winner) produces an additional increment of 1 AAHU at an average cost of $4,611 per AAHU. Of the three evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.

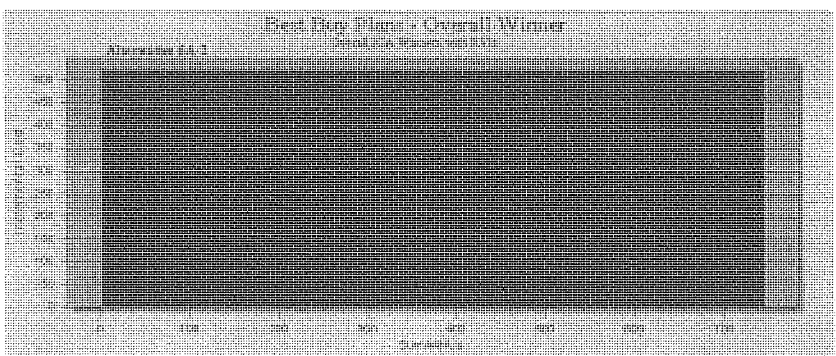
During the selection process it was determined that alternative 5A-Y met the planning objectives and was the most effective alternative based on cost and output. Alternative 5A-Y was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.



Elm Slough. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 6A-2 as the most cost effective and incrementally effective alternative (ICA winner), as well as the alternative producing the greatest number of habitat units (HEP winner). This alternative involves restoration of wetland forest in a floodplain habitat area by improving tree species diversity in existing wetland forest, restoring former wetland forest adjacent to existing wetland forest, and establishing prairie buffers between floodplain tributaries that are proposed to supply a restored flood pulse (Long Lake and Mitchell Ditch) to wetlands in the habitat restoration area. Alternative 6A-2 was carried forward as the preferred alternative.

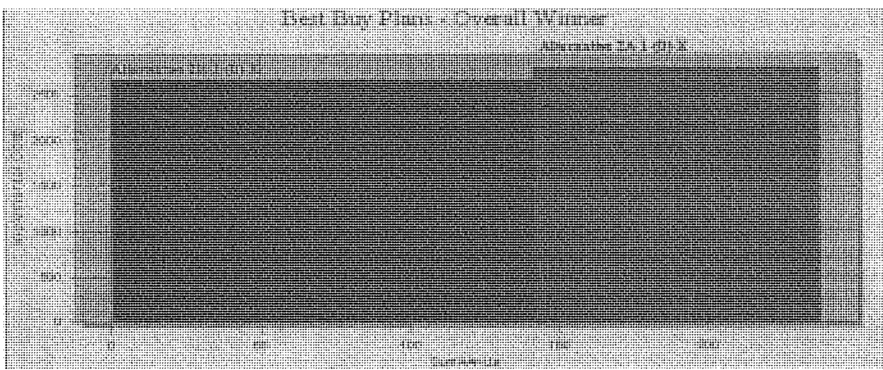
The following chart shows the best buy alternative and its increment of cost versus output difference.



Old Cahokia Creek. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 2B-1-(0)-X as the most cost effective and incrementally effective alternative (ICA winner). Alternative 2A-1-(0)-X was identified as the plan producing the greatest number of environmental outputs (HEP winner), and was second most cost effective. Under both alternatives, a floodplain habitat area of 314 acres would envelop 3.4 miles of restored floodplain stream and a 328-foot (100-meter) wide forested corridor along both sides of the restored creek channel. Under alternative 2A-1-(0)-X (HEP winner), restoration of floodplain aquatic habitat would be coupled with restoration of about seven miles of tributary streams in the Bluff 1 watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include ten sediment detention basins and creation of pool and riffle complexes.

During the selection process it was determined that Alternative 2A-1-(0)-X best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 2A-1-(0)-X was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.

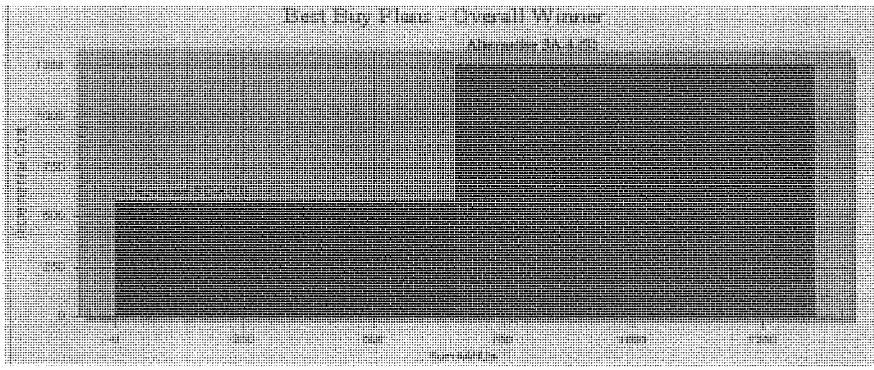


Judy's/Burdick Branch. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 3C-4-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 3A-4-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of wet prairie in a 507-acre habitat area would occur on the floodplain. Under alternative 3A-4-0 (HEP winner), the floodplain habitat area would include 0.8 miles of stream restoration, and would be coupled with restoration of about 32 miles of tributary streams in the Judy's and Burdick Branch watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 28 sediment detention basins and creation of pool and riffle complexes.

Alternative 3C-4-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

During the selection process it was determined that Alternative 3A-4(0) best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 3A-4(0) was carried forward as the preferred alternative.

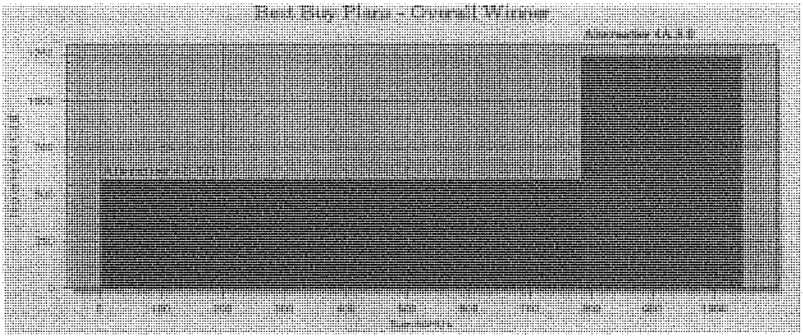
The following chart shows the best buy alternatives and their increment of cost versus output difference.



Brushy Lake. The cost analysis process (as presented in Appendix A) identified alternative 4C-3-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 4A-3-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of forested wetland in a 717-acre habitat area would occur on the floodplain. Under alternative 4A-3-0 (HEP winner), the floodplain habitat area would include 3.5 miles of stream restoration, and would be coupled with restoration of about 25 miles of tributary streams in the Schoolhouse watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 15 sediment detention basins and creation of pool and riffle complexes. Alternative 4C-3-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

During the selection process it was determined that Alternative 4A-3-0 best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 4A-3-0 was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.

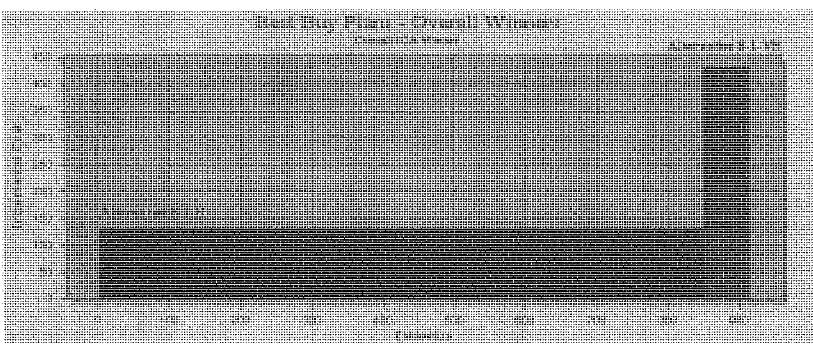


Cahokia Mounds. Of the six plans evaluated for Cahokia Mounds, the incremental cost analysis identified alternative 8-1-(H) as the most cost effective alternative (ICA winner). Alternative 8-1-VH was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs).

Both plans are considered to be least cost plans that produce alternative levels of environmental output.

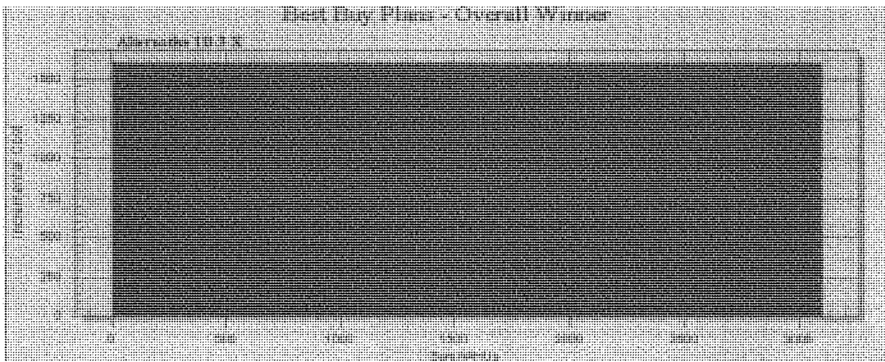
During the selection process it was determined that alternative 8-1-(H) met the planning objectives and was the most effective alternative based on cost and output. Alternative 8-1-(H) was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.



Spring Lake. The cost analysis process (as presented in Appendix A) identified alternative 1B-3-X as the most cost effective and incrementally effective alternative (ICA winner). Of the 6 evaluated alternatives, only 1B-3-X was determined to be a least cost plan, as shown in the bar chart below. It produces 3,105 AAHUs at an average cost of $1,602 per AAHU. A 1,364 acre floodplain habitat area consisting mainly of marsh and forested wetlands is to be established at three separate locations adjacent to Harding and Lansdowne Ditches. Under this alternative, the floodplain habitat area would include 3.1 miles of stream restoration, and would be coupled with restoration of about 99 miles of tributary streams in the Little Canteen and Canteen Creek watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 58 sediment detention basins and creation of pool and riffle complexes.

Alternative 1B-3-X was carried forward as the preferred alternative. The following chart shows the best buy alternative and its increment of cost versus output difference.



Wedgewood. As a result of comments received during public review of the draft report, which occurred between 28 February and 7 May 2003, this Action Area was eliminated and is not carried forward into the Recommended Plan. Additional information regarding this process is contained in Appendix G of the main report.

Mullens Slough. The cost analysis process (as presented in Appendix A) identified alternative 7B-2 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 7A-2 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was the second-most cost effective plan. Under both alternatives, a 312-acre floodplain area consisting of lake, prairie, and herbaceous wetland habitats is to be established adjacent to the confluence of Powdermill Creek and Canal No. 1. Under alternative 7A-2 (HEP winner), the floodplain habitat area would be coupled with restoration of about 16 miles of tributary streams in the Powdermill Creek watershed, which drains into the proposed habitat area.

Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 20 sediment detention basins and creation of pool and riffle complexes. Alternative 7B-2 (ICA winner) would include two floodplain sediment detention basins within the habitat area, and no tributary stream restoration.

During the selection process it was determined that Alternative 7A-2 best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 7A-2 was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.

Review and Evaluation of Plans. This section assesses the performance of the Biological (HEP), Incremental (ICA), and the Preferred plans with respect to the planning objectives described in Section 5. The summary of performance of each plan with respect to the planning objectives and targets is displayed below in Table 5. Table 6 provides an overview of the cost effectiveness of each plan. The No-Action Plan is displayed in Tables 5 and 6, and as it makes no contribution to any of the planning objectives it will not be further addressed in this context. Section 4 of the main report - Without Project Conditions addresses the effects of a No-Action Plan recommendation. The performance of the plans (Biological, Incremental, Preferred, and No Action) has also been assessed using results of incremental cost analyses that are presented in the Habitat Assessment of Appendix A and Section 6.12 of the main report and are displayed in Tables 7 through 9. The evaluation of plan performance against the objectives and a cost effectiveness analysis of the plans facilitate the selection of one of these plans as the Recommended Plan.

Table 5 Summary of the performance of each plan with respect to each of the planning objectives.

Objective	Target	Biological Plan	Incremental Plan	Preferred Plan	No-Action Plan
1 – Restore natural areas	Total area of habitat restored (acres)	4,885	4,440	4,830	0
2 – Restore flood pulse	% of action areas with depth of design flood < depth of 1844 flood	83	83	83	N/A
3 – Restore habitat quality	% of action areas with at least moderate habitat quality (average for 9 species)	75	60	76	N/A
4 – Improve water quality	Relative area affected	tributaries & floodplain	floodplain	tributaries & floodplain	N/A
5 – Reduce tributary erosion	% estimated sediment reduction	70	0	70	N/A
6 – Restore tributary streams	Total length of restored streams (miles)	178	99	178	N/A
7 – Restore floodplain streams	Total length of restored stream (miles)	10.8	9.7	10.8	N/A
8a – Reduce flood damages	Damages reduced by design event incidental to restoration of flood pulse (dollars)	$1,300,000	$1,300,000	$1,300,000	N/A
8b– Enhance outdoor recreation	Relative area affected	floodplain	floodplain	floodplain	N/A
8c – Protect cultural resources	Total area of known archaeological sites within action areas (acres)	999	990	989	N/A

Table 6 Summary of Cost Effectiveness Analysis of the Plans.

		Biological Plan	Incremental Plan	Preferred Plan	No Action Plan
Environmental output	Average annual habitat units generated by plan	8,399	7,093	8,332	0
Average cost of one unit of output	Average annual dollars per average annual habitat unit	$1,306	$995	$1,091	0
Total cost	Total dollars to implement plan	$136,570,000	$105,740,000	$136,120,000	0

The primary difference between the alternatives producing the higher habitat units (Biological Plan) and the alternatives that proved to be the least costly (ICA winners) is the measures used to restore tributary stream resources and reduce sediment. The Preferred Plan combines the alternatives producing the best results for this project as determined by the Biological Team and Sponsor Representative Team. In each instance where a higher cost alternative was selected the increment of cost for the higher producing habitat alternative was determined to provide additional value to the overall plan that justified the increased increment of cost.

The HEP Plan has the highest first cost of the plans compared but produces the highest habitat unit outputs. While the ICA plan produces the least habitat unit outputs its first cost is significantly less than either the HEP or Preferred Plans. Rationale for alternatives selected for the Preferred Plan is addressed in detail in the General Reevaluation Report.

The Preferred Plan has a first cost slightly lower than the HEP Plan with lower habitat unit outputs and significantly higher first cost and habitat unit output as compared to the ICA Plan. The following tables display the cost effectiveness analysis for each of the plans for comparative purposes.

Table 7 Cost Analysis for Incremental Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2B-1-(0)-X	141	$377,000	$2,671	X		5.65
Brushy: 4C-3-0	782	$459,800	$588	X		6.95
Judy's: 3C-4-(0)	655	$379,500	$579	X		5.68
Cahokia: 8-1-(H)	849	$113,300	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7B-2	730	$234,700	$322	X		3.51
TOTAL	7093	$7,056,975	$995	8	2	$105.68

*After relative value indexing **Based on planning estimates

Table 8 Cost Analysis for Biological Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-X	87	$134,200	$1,539		X	2.0
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3-(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(VH)	915	$141,700	$155		X	2.05
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	8399	$9,124,875	$1,086	2	8	$136.57

* After relative value indexing **Based on planning estimates

Table 9 Cost Analysis for Preferred Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(H)	849	$113,200	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	8332	$9,090,275	$1,091	4	4	$136.12

*After relative value indexing **Based on planning estimates

Plan Development Conclusions. Of the three plans, the Preferred Plan is more effective in achieving the planning objectives. It is efficient because it consists of only "best buy" alternatives. The Preferred Plan is acceptable to state and federal resource agencies. It provides and accounts for all necessary investments needed to ensure the realization of the planned restoration outputs. Four state and federal agencies that partnered with the Corps during the study have indicated that the Preferred Plan best meets their desires and concerns. The plan is reasonable because non-Federal sponsors are willing to share study and project costs, and state and federal resource agencies support it. The Preferred Plan would provide significant restoration benefits to aquatic resources of national and regional institutional significance. The Preferred Plan provides a watershed level approach to addressing the problems and captializing on the opportunities of the project area. This plan re-establishes important linkages between tributary watersheds and floodplain ecosystems that best ensures future bio-diversity and sustainability. Based on these conclusions, the Preferred Plan is justified for selection as the Recommended Plan.

RECOMMENDED PLAN

Overview. The Recommended Plan consists of the alternative selected from each of the eight Project action areas as identified in Section 6. To recap, these Project action areas are: Old Cahokia Creek; Judy's and Burdick Branch; Brushy Lake; Spring Lake; Mullens Slough; Dobrey Slough; Elm Slough; and Cahokia Mounds Prairie. The alternative selected to be a part of the Recommended Plan from each of these areas was the one that best addressed study objectives and planning targets within each respective Project action area.

In general, the Recommended Plan consists of the following measures: the restoration of bottomland forest habitat (1,705 acres), prairie habitat (1,111 acres), marsh and shrub swamp habitat (843 acres), lake habitat (460 acres), upland forest (379 acres), floodplain stream restoration (10.4 miles or 161 acres), placement of wood duck boxes (651 boxes) and prairie bird perches (870 perches), creation of over wintering holes and shoreline plantings (20 acres), and construction of tributary stream detention basins (131), riffle and pool complexes in 178 miles of streams, earthen embankments (15.5 miles), and hydraulic control devices (culverts, flap gates, and new channels). Currently a total of 4,916 acres are included in the Project footprint, of which 4,468 acres are in the Mississippi River's floodplain and 448 acres are along streams in the tributary watersheds. The 178 miles of tributary stream restoration are not reflected in this Project area footprint.

Figure 11 displays the recommended plan. The eight proposed floodplain habitat restoration areas are outlined by various colors, the 178 miles of proposed tributary stream restoration are represented by various colors of line networks, and the 131 proposed sediment detention basins are shown as small circles along the tributary streams.

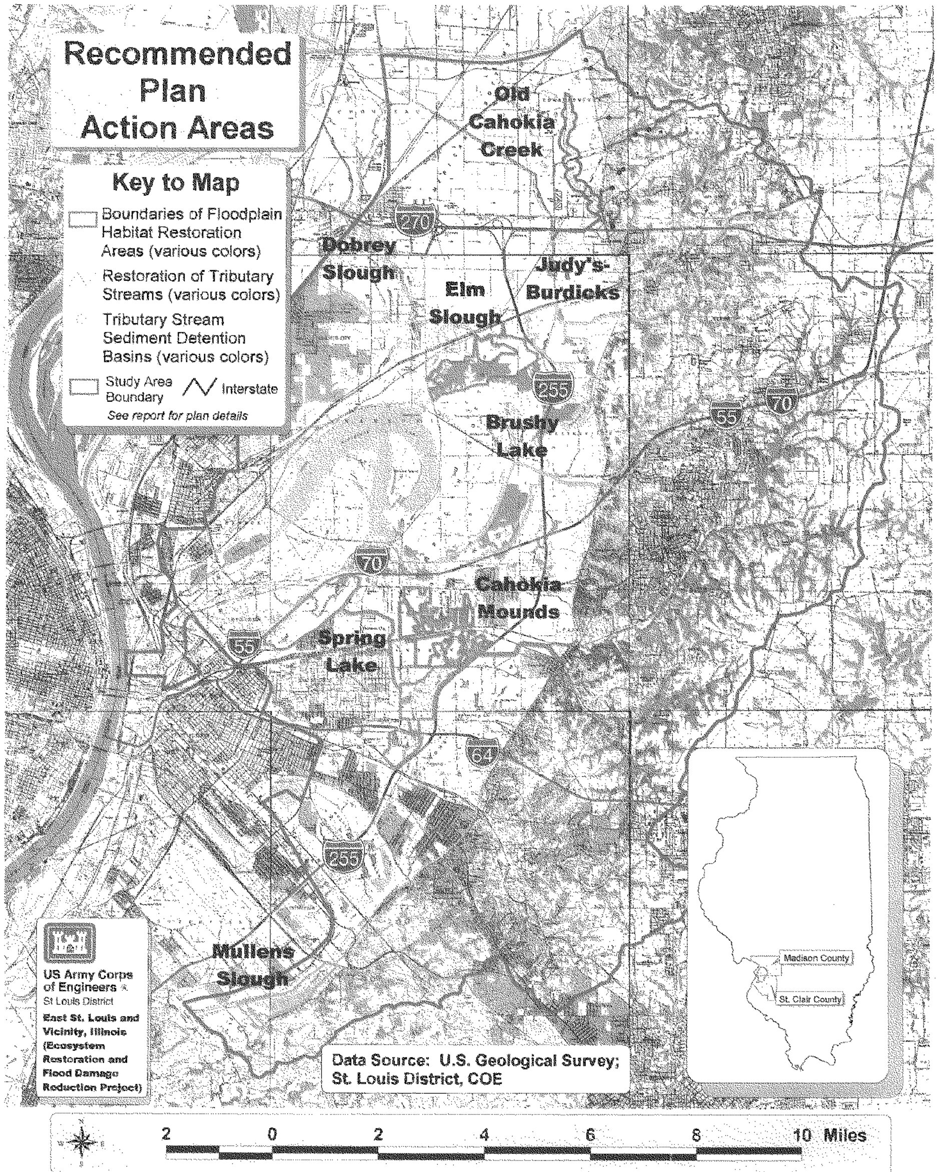


Figure 11 Recommended Plan

Features By Action Area.

Old Cahokia Creek. The Old Cahokia Creek action area consists of features to restore aquatic and terrestrial habitat in the floodplain and tributary stream watersheds. In the floodplain, about 3.4 miles of historic Cahokia Creek are to be restored to a flowing condition, and a 328-foot (100-meter) wide forested corridor is to be established along both sides of the restored creek channel. Together the restored creek and adjacent forest form a habitat area. About 6.6 miles of tributary streams in the Bluff 1 watershed are to be restored by constructing a series of riffle and pool complexes and building ten tributary stream sediment detention basins at scattered locations. The total footprint of all features is 314 acres, excluding restoration of tributary streams.

Judy's-Burdick Branch. The Judy's-Burdick action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary steams. A 507-acre floodplain habitat area of prairie is to be established at the confluence of Cahokia Canal, Judy's Branch, and Burdick Branch. About 32 miles of tributary streams in the Judy's, Burdick, and Bluff 1 watersheds are to be restored by constructing a series of riffle and pool complexes and building 28 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 600 acres, excluding restoration of tributary streams.

Dobrey Slough. The Dobrey Slough action area consists of features to preserve, restore, and enhance aquatic, wetland, and terrestrial habitats in the floodplain. A 75-acre habitat area consisting principally of marsh and forest is to be established north of Pontoon Road and east of Maryville Road.

Elm Slough. The Elm Slough action area consists of features to preserve, restore, and enhance aquatic, wetland and terrestrial habitats in the floodplain. A 670-acre habitat area consisting principally of forested and scrub-shrub wetland is to be established. Il Route 111 bounds the habitat area on the west, Il Route 162 on the north, and I-255 on the east.

Brushy Lake. The Brushy Lake action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary streams. A 717-acre forested floodplain habitat area is to be established at the confluence of Cahokia Canal and Schoolhouse Branch. About 25 miles of tributary streams in the Schoolhouse and Bluff 3 watersheds are to be restored by constructing a series of riffle and pool complexes and building 15 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 746 acres, excluding restoration of tributary streams.

Cahokia Mounds Prairie. The Cahokia Mounds action area consists of the restoration of 525 acres of floodplain prairie within the Cahokia Mounds State Historic Site. The action area is bounded by Collinsville Road on the north, Black Lane on the east, Forest Boulevard on the south, and railroad tracks on the west. Prairie plantings are to be established in eight separate tracts currently used as hay lease areas. Native plant species consisting of a variety of grasses and herbs and some sedges and shrubs are to be used. Flooding at this site was limited to rainfall and local run off in predevelopment times except when the Mississippi River was flooding the area, as was the case in 1844.

Under the recommended plan, no additional water would be brought to this site. While soils of the area are relict hydric soils, indicating that they historically supported a wetland plant community, additional investigation will be undertaken during design, such as the installation of piezometers at the site, to ensure there is currently sufficient hydrology at the site to support this prairie complex.

Spring Lake. The Spring Lake action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary streams. A 1,364-acre floodplain habitat area consisting mainly of marsh and forested wetlands is to be established at three separate locations adjacent to Harding and Lansdowne Ditches. About 99 miles of tributary streams in the Canteen Creek and Little Canteen Creek watersheds are to be restored by constructing a series of riffle and pool complexes and building 58 tributary stream sediment detention basins at scattered locations. Spring Lake is the largest of all action areas, and the total footprint for all features is 1,615 acres, excluding restoration of tributary streams.

Mullens Slough. The Mullens Slough action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary streams. A 312-acre floodplain habitat area consisting predominantly of a lake (known as Mullens Slough) is to be established adjacent to the confluence of Powdermill Creek and Canal No. 1. About 16 miles of tributary streams in the Powdermill Creek and Bluff 6 watersheds are to be restored by constructing a series of riffle and pool complexes and building 20 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 371 acres, excluding restoration of tributary streams.

Operation and Maintenance. Each of the action areas will operate independently. None of the features of the Recommended Plan have any manual or automated operational components (such as slide gate and stop log closures or pumping stations). Also, no changes in the operation of the remaining flood control features such as canals and pumping plants will be necessary. Features of the Recommended Plan will require periodic inspection and maintenance to include: the removal of collected vegetative and woody debris at all control structures and upland dry detention basins; installation of sediment panels in upland dry detention basing; periodic erosion repair; periodic inspection to maintain smooth operation of all flap gates; and, and the mowing or burning, as necessary, of berms and prairie areas.

Real Estate. The Project will require the acquisition of approximately 5,398 acres of land. It will affect approximately 1,049 land parcels and 677 landowners. Eight areas in the floodplain and 131 upland sites are a part of this Project. Fee title is required on most of the land in the floodplain to allow the Sponsors to control the environmental restoration, habitat development and operation maintenance of the land. Permanent easement will be required to construct, to access, and to operate and maintain the 131 sediment detention basins. Flowage easement will be required for a ponding area at both Old Cahokia Creek and Judy's-Burdick Branch. Flowage easement will also be required for the 131 detention basins to allow water to temporarily pond during storm events. In summary, 4,468 acres in fee, 66 acres in permanent easement, and 864 acres in flowage easement will be acquired. Temporary Easements for access and construction are required and will be determined when the Engineering Design Reports are prepared for each Project action area. The temporary construction easements for this type of project are not considered out of the ordinary.

Adaptive Assessment and Monitoring. The Recommended Plan includes post-construction monitoring to determine if predicted environmental outputs will be achieved following construction, and to provide feedback for future ecosystem restoration projects. During the study's formulation process, it was uncertain whether specific proposed measures would achieve their restoration objectives. Consequently, the monitoring program reflects the incorporation of adaptive management. Adaptive management is a technique for addressing uncertainty in restoration projects. Under this approach, restoration measures are implemented and monitored, feedback is provided based on new insights gained from the response of the system and its resources, and adjustments are made to the Project as necessary and feasible. An example of this process is the Judy's Branch demonstration project that has been established on Judy's Branch, one of the tributary watersheds. To test whether tributary stream sediment detention basins and in-stream restoration measures will perform as expected, a demonstration project was initiated in early 2000 with the implementation of sediment monitoring by the USGS on Judy's Branch. This pilot project is described in greater detail in Appendix E of the main report. With the information gained from this monitoring process, preliminary plans for stream sediment detention and in-stream restoration measures will be developed and implemented in this tributary first. The performance of these measures will be analyzed over an approximate 3-year period to determine their effectiveness in restoring stream quality, stabilizing stream banks and slowing the transfer of sediment to the floodplain. Results from this pilot project will be used to make the adaptive changes required to achieve anticipated Project outputs.

Fish and Wildlife Mitigation. Since the purpose of ecosystem restoration is to provide environmental benefits, this Project was formulated and designed to avoid and/or minimize adverse effects to environmental resources.

Cultural Resources Mitigation. Prior to the discussion of any potential Project feature locations, the State of Illinois Historic Preservation Officer (SHPO) provided the design team with the locations of all previously recorded archaeological sites within the study area. The Team used this information throughout the plan formulation phase so as to avoid impacts to any known archaeological sites.

Outdoor Recreation. During the latter study stages, local interests made formal requests to the Team to investigate water and related land resources outdoor recreation opportunities, especially as they tie-in with the existing infrastructure and the potential to be derived from the Recommended Plan. The Recommended Plan currently contains a bike trail. However, there are many other outdoor recreation opportunities that could be pursued under separate action after authorization of this project. The opportunities are due, in part, to the scenic views of natural areas with interpretive potential and in their proximity for easy connection to the regional trail network that is being developed by local organizations and agencies. Trails also could be planned not only in the levied areas, but also along the streams and greenways. Ecosystem restoration measures of the Recommended Plan such as wetlands, would also lend themselves to outdoor recreational pursuits. The development of boardwalks at the wetlands would provide a close up view of wildlife. These boardwalks also would be useful for rest stops along the trail. Any recreation or interpretive opportunities will have to be consistent with the intent of the project and not interfere with the achievement of restoration objectives.

Economics. The total first cost is estimated to be $189,266,000. The average annual project implementation cost is $11,799,000. This average is computed using the current interest rate of 5.875% over the anticipated 50-year project life. Project benefits have been quantified by means of identifying habitat units incrementally compared to their cost of production. The Recommended Plan produces approximately 8,332 annualized habitat units at an average annual cost of $1,416.

In summary, this Project was formulated as a single purpose Ecosystem Restoration project in accordance with Corps' engineering regulations which states that: "Monetary gains (e.g., incidental recreation or flood damage reduction) and losses (e.g., flood damage reduction or hydropower) associated with the project shall also be identified." In an attempt to quantify these benefits, a risk-based analysis was performed. This analysis determined that $1,366,000 in average annual flood damage reduction is incidental to plans considered. Recreation benefits are also incidental to the Project. The Cahokia Creek Bike Trail has an estimated first cost of $258,000 with an annualized cost of $16,084 producing a benefit to cost ratio of 1 to 1.7, using the Facility Capacity Method.

Cost Sharing. The Corps of Engineers, on behalf of the Federal government, and the non-Federal Sponsors for the construction project, the Counties of Madison and St. Clair, Illinois, will share in the responsibilities for implementing the Recommended Plan. The Counties will participate in a third party agreement with the State of Illinois who will provide monetary support to the Counties for the implementation of the Project.

The Corps will be responsible for designing the Project and administering all government construction contracts to implement it. The Counties and the State will share in the design and construction costs. The Counties will furnish the necessary lands, easements, rights of way, relocation, and disposal areas as well as operate and maintain the completed Project. Rules that determine how project responsibilities are shared are established in Federal law and related Administration implementing policies.

RECOMMENDED PLAN'S EFFECT ON NATURAL RESOURCES OF SIGNIFICANCE

The Study area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area will contribute greatly to national, regional and local systems. Significant Study area characteristics and contributions include the following.

Aquatic resources of national and regional significance are found in the Project area. They include aquatic features such as 2,000-acre Horseshoe Lake, over 6,000 acres of various wetlands on the Mississippi River's floodplain, as well as over 200 miles of streams in small tributary watersheds.

North American Waterfowl Management Plan. The recommended plan will contribute to the North American Waterfowl Management Plan's goals for conservation and management of waterfowl species and habitat by protecting and restoring mid-migrational and breeding habitat along the Mississippi River flyway.

The proposed habitat restoration on the Mississippi River's floodplain will occur within one of the Plan's waterfowl habitat areas of major concern on the North American continent, and within a migratory focus area designated at the regional scale under the Upper Mississippi River/Great Lakes Region Joint Venture's Implementation Plan. This habitat restoration will contribute to the Joint Venture Implementation Plan's goal of increasing wetland habitats by about 36,000 acres in migratory focus areas along the Mississippi River in Illinois. The plan will contribute significantly by providing about 1,350 acres of new wetlands through reestablishment of historic vegetation and functions to former wetlands. It will also restore about 1,325 acres of existing wetlands by improving natural conditions and returning historic functions to degraded wetlands. About 30 species of migratory swans, geese, and ducks should benefit from the restoration of these 2,700 acres of affected wetlands.

The recommended plan will also provide additional benefits to migratory and resident waterfowl species at lake and pond habitats. Within the proposed habitat restoration areas, improving natural conditions and replacing historic functions will restore about 460 acres of lake and pond habitat, which is expected to provide more feeding opportunities for waterfowl by increasing production of aquatic organisms. In addition, indirect benefits to lake and pond habitat are expected outside the proposed restoration areas at the 2,000-acre Horseshoe Lake at Horseshoe Lake State Park. The proposed restoration of 178 miles of tributary streams is expected to reduce excessive sediment loads carried from the bluffs into Horseshoe Lake by the study area's interior drainage system during storm events, and similarly improve feeding opportunities for migratory and resident waterfowl.

Upper Mississippi River System Environmental Management Program. The recommended plan will contribute to the goal of the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program of increasing by about 100,000 acres the amount of prairie, marsh, and forest on the Mississippi River's floodplain within the river reach extending from St. Louis to Cairo. The plan will significantly increase the area of prairie, marsh, and forest in this river reach by about 2,365 acres. The plan is also expected to meet the need for three specific habitat improvements identified in the Habitat Needs Assessment. First, the plan is expected to restore existing degraded habitats by improving natural habitat conditions, thereby improving habitat quality. Second, the plan will restore a flood pulse to floodplain habitats, thereby returning the current hydrological regime to a closer approximation of pre-development conditions. Lastly, the plan will restore historically typical floodplain habitats that are now uncommon, such as floodplain prairies and streams, thereby increasing floodplain habitat diversity.

Clean Water Action Plan. The recommended plan will contribute toward the goals of the Clean Water Action Plan by restoring 178 miles of streams in five small watersheds identified as priority watersheds for restoration in Illinois. The plan's proposed restoration of tributary streams in these five watersheds is expected to correct silt and sedimentation problems that have degraded in-stream habitat.

Improving the quality of in-stream habitat should restore conditions that can support a diverse food web of animals by improving substrate quality, restoring channels and pool and riffle complexes, and encouraging recolonization by benthic invertebrates.

Restoration of riparian forest along tributary streams at the 131 proposed sediment detention basins is expected to improve degraded habitat conditions by reintroducing uncommon native tree species such as oaks. Under the plan, storm water carried by the tributary streams proposed for restoration is to serve as the source of the flood pulse to be reintroduced into the proposed habitat restoration areas on the Mississippi River's floodplain. An expected secondary effect of tributary stream restoration is improvement of conditions in the floodplain habitats, by reducing excessive sediment loads currently reaching the floodplain.

Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The plan's proposed restoration of wetlands on the Mississippi River's floodplain in Illinois supports the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The proposed restoration of about 2,700 acres of floodplain wetlands is expected to promote nitrogen retention within the study area's watersheds, reduce nitrogen loads of inflow from the interior drainage system to the Mississippi River, and contribute to the eventual improvement of the hypoxic condition in the northern Gulf of Mexico.

Conservation Initiatives for Bird Species of Concern. The recommended plan is expected to benefit 34 priority species of birds and two federally threatened species (one plant and one bird) through the restoration of about 4,300 acres of aquatic habitats on the Mississippi River's floodplain, 178 miles of tributary streams, and about 380 acres of riparian forest along the tributary streams. Migratory and breeding habitat for 10 priority species of ducks is expected to be provided by the proposed restoration of 2,700 acres of wetlands and 460 acres of lake habitat within eight proposed floodplain habitat restoration areas. The proposed plan will support the North American Waterbird Conservation Plan by providing migratory and breeding habitat for four heron and rail species of concern through the proposed wetland restoration, along with the proposed restoration of about 11 miles of floodplain streams. Feeding opportunities for two of these heron species are also expected to improve from the proposed restoration of 178 miles of tributary streams. The recommended plan will contribute to the U.S. Shorebird Conservation Plan by providing migratory habitat to eight sandpiper species of concern through the proposed floodplain wetland restoration. Horseshoe Lake at Horseshoe Lake State Park, recognized under the Shorebird Plan as an important stopover in Illinois for migratory shorebird species, is expected to indirectly benefit from the proposed plan through reduced levels of sedimentation, which is expected to provide improved feeding opportunities to shorebirds. The Neotropical Migratory Bird Conservation Program (Partners in Flight) and 11 landbird species of concern are expected to benefit from the recommended plan through the proposed restoration of forested wetlands, marshes, wet prairies, and floodplain and tributary streams, and restoration of riparian forest along tributary streams. Restoration of forested wetland habitat at the proposed Brushy Lake action area is expected to meet the size requirements for breeding habitat of some area-sensitive landbird species of concern, such as the Acadian flycatcher and Louisiana waterthrush. Similarly, area-sensitive grassland breeding species of concern like the grasshopper sparrow and sedge wren are expected to benefit from restoration of floodplain prairie at the Judy's-Burdick and Cahokia Mounds Prairie action areas.

The federally threatened bald eagle is expected to benefit from improved feeding opportunities through proposed restoration of 460 acres of lake habitats. The proposed plan will contribute to the recovery plan of the federally threatened decurrent false aster through restoration of about 1,500 acres of marsh and wet prairie habitats where it can be introduced.

IMPLEMENTATION PLAN

Implementation Process. As mentioned earlier, this Project originally was authorized to address flood damage reduction but as a result of the Water Resources Development Act of 2000, ecosystem restoration was added as a Project purpose thus permitting the formulation of alternatives for this Project using the Administration Policy Guidelines for an incrementally justified National Environmental Restoration Project. In accordance with the National Environmental Policy Act (NEPA) requirements, this report has been, and will continue to be coordinated with the public and appropriate resource agencies to seek their input. The Project Team has received public and review agency comments to the Draft Report, and this final report reflects the consideration and as appropriate incorporation of those comments. This final report is submitted to the Corps of Engineers' Mississippi Valley Division Headquarters for review and processing. After follow-on review at the Corps of Engineers' main headquarters in Washington D.C., the Chief of Engineers will release this report through the Assistant Secretary of the Army for Civil Works, who in-turn will refer it to Congress for authorization. Congressional authorization will permit a construction new start for the Project.

The Corps of Engineers will prepare the first set of plans and specifications as a part of the existing scope of the PED agreement. Based on consultation with the Sponsors, the first alternative to be undertaken outside the demonstration project will be the restoration of an area that does not have an upland component. In this manner, the analysis of stream restoration techniques can be completed on an alternative having those components prior to the completion of the design. Prior to the acquisition of Project lands and the subsequent initiation of the first item of construction, a Project Cooperation Agreement (PCA) will be executed for the entire Project effectively bringing the PED phase to a conclusion. Work under the PCA will begin with the Sponsors' acquisition of lands, easements, rights-of-way, relocations and necessary disposal areas (LERRD's) in advance of the advertisement and award of the first construction contract.

Implementation Reports. An Engineering Design Report (EDR) will be prepared to validate each recommended action plan. These reports will develop the detail for each alternative that was not accomplished during the restudy effort. Each EDR will detail the full spectrum of technical analyses required to support engineering considerations as well as assessing the validity of assumptions made during the ecosystem restoration evaluation. These EDR's will include comparisons to the original Habitat Evaluation Procedure outputs. If differences in the alternative design are required as a result of significant changes in the existing conditions that impact acreage, basic restoration concepts, or hydrology, the incremental cost analysis of outputs will be re-validated. Each EDR also will include a real estate report that verifies costs and estates required for the Project and an overall detailed cost estimate referred to as an "MCACES" estimate. Based upon these findings, an environmental assessment or supplemental environmental impact statement will be completed in accordance with NEPA requirements.

Following public review and comment, the EDR, will be approved within the Corps' chain of command. The design of alternative features will not begin until it is determined that the proposed action plan still supports original Project objectives and thus, continued action. Designs will be packaged in units appropriate to support efficient contract work on a specific alternative and sequenced as required to maintain Project progress in a logical manner.

As a result of these actions, the integrity of the Project objectives will be maintained. It will be unlikely that any of the restoration focus will be lost or diluted over time. The institution of this rigorous process as a part of Project implementation is deemed appropriate based on the uniqueness of this Project and its underlying concepts.

Project Management. The Project will be managed in accordance with all applicable laws, regulations, and policies. Information that outlines the philosophy of project management within the Corps of Engineers is contained in Engineering Regulation 5-7-1. There will be a lead Corps of Engineers person designated to manage the Project during its life cycle. This person will be responsible for managing the programmatic and the technical aspects of the Project as well as coordinating all issues related to the Project between the Sponsors, the stakeholders, and the public.

Implementation Schedule. A Project schedule has been developed based upon the assumption that a positive Chief of Engineers' report will be forwarded to the Assistant Secretary of the Army for Civil Works during calendar year 2003 and that Congressional authorization will occur in time to program construction new start funds for FY 2005. The Project schedule sequences the reporting, design, and construction activities as they move from the simple to the complex. In this manner, there will be ample time to complete sediment analyses and to review demonstration project results so that analytical data and practical lessons learned can be incorporated into action plan execution. Additionally, the schedule has been prepared in a manner to have new EDR's prepared simultaneously, with the designing and/or constructing of action areas covered in approved EDR's. This helps to ensure that project momentum is maintained and that the necessary experts remain engaged throughout the process. The development of this schedule assumes funding is available in the years required and that the real estate and relocations actions are completed on schedule. As mentioned, initiation and completion of EDRs are independent of one another for the various action plans. However, design and construction activities are dependent upon their respective EDR's approval. A copy of the proposed schedule is included in Appendix K of the main report. The Project schedule will be evaluated and updated continuously, based upon future funding levels and the results of the EDR studies.

The recommended schedule reflects the information currently available and the current departmental policies governing execution of projects. It does not reflect program and budgeting priorities inherent in either the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the schedule recommended in Appendix I of the main report may be modified before it is transmitted to higher authority for authorization and/or implementation funding. Under current plans, this schedule begins with PED activities in FY 2003 and concludes in FY 2005 with the advertisement and award of the first item of construction.

Funding. In order to support the planning and budget development process for the Project, Table 11 depicting the necessary funding stream required to support the Project schedule is presented below. This table identifies the resource requirements by year and details non-Federal requirements for Project implementation. This Table identifies both cash requirements and the requirements estimated by year for LERRD's.

Table 11 Project Funding Stream

FY	Phase	Total Project Implementation Cost	LERRDs	PED or Construction	%	Additional Non-Fed Cash	Federal Cash Schedule
Prior FY's	PED	2407.000	0.000	2407.000		601.750	1805.250
FY03	PED	800.000	0.000	800.000		200.000	600.000
FY04	PED	793.000	0.000	793.000		198.250	594.750
FY05	Constr	4865.430	3343.890	1521.540	0.011	371.993	1149.547
FY06	Constr	1348.910	130.470	1218.440	0.009	308.347	910.093
FY07	Constr	5276.770	2074.020	3202.750	0.020	799.843	2402.907
FY08	Constr	11589.600	4182.300	7407.300	0.048	1607.902	5799.398
FY09	Constr	12626.800	6880.120	5746.680	0.038	1259.200	4487.480
FY10	Constr	12242.210	6881.970	5360.240	0.035	1178.055	4182.185
FY11	Constr	18987.800	6230.540	12757.260	0.082	2731.302	10025.958
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FY14	Constr	22284.470	968.570	21315.900	0.136	3528.471	17787.429
FY15	Constr	16491.590	791.190	15700.400	0.100	3349.312	12351.088
FY16	Constr	14666.300	469.800	14196.500	0.091	3033.518	11162.982
FY17	Constr	13120.500	0.000	13120.500	0.084	2807.577	10312.923
FY18	Constr	11529.210	0.000	11529.210	0.074	2473.433	9055.777
FY19	Constr	8845.000	0.000	8845.000	0.057	1909.795	6935.205
FY20	Constr	193.260	0.000	193.260	0.003	93.077	100.183
Total		**193266.100**	**34207.400**	**159058.700**	**1.000**	**33474.435**	**125584.265**

*Displayed in $1,000s

Financial Analysis. Madison and St. Clair Counties are expected to serve as Sponsors and thus, share in the non-Federal costs of this Project. They are being joined in a separate third party agreement with the Illinois Department of Natural Resources, who is committing to provide a minimum cash contribution of $10,000,000.

The Sponsors' share of the Project cost is estimated to be $67,681,835 of which $1,000,000 has already been contributed during PED. The Illinois Department of Natural Resources has committed to providing funds totaling approximately $10,000,000. The estimated $34,207,400 in LERRD's costs will be borne by Madison and St. Clair Counties. The remainder of the Sponsors' share estimated to be $23,474,435 will be a divided among the State and the two counties. These figures include the restoration project costs that are shared at a 35% -65% rate and recreation features that are shared at a 50%-50% rate. Madison and St. Clair Counties and the State of Illinois have the capability of performing some of the required work themselves.

During the development and negotiation of the Project Cooperation Agreement (PCA) these possibilities will be further examined.

The Sponsors have the capability to finance this Project. Additionally, they have the financial resources to accomplish future OMRR&R requirements currently estimated to be $93,000 a year. They each have taxing authority and an annual budget that supports their estimated individual share of estimated Project costs.

CONCLUSIONS

This Report presents a summary of the work that the St. Louis District, Corps of Engineers and its partners have accomplished to advance the East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project. This work progressed from the identification of the Study Area's problems and opportunities to the development, assessment, and evaluation of alternative plans to address the problems and opportunities. Based upon rigorous evaluation and assessment, a Recommended Plan was selected.

The conclusions reached from this effort are that the implementation of the Recommended Plan will greatly improve and restore the ecosystem within the Study Area as well as provide the basis for the permanent preservation and protection of these invaluable ecosystem resources.

POST AUTHORIZATION CHANGE REPORT

A Post Authorization Change Report (PAC) has been prepared to accompany the General Re-evaluation Report based on the change in project outputs, the increase in cost estimate and period of apportionment. This report provides information identified in ER1105-2-100 comparing the authorized Project and recommended plan in detail. The conclusion of this report is that additional congressional authority is required to implement the plan recommended in the Final General Re-evaluation Report.

COMMANDER'S RECOMMENDATION

The Project area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area will contribute greatly to national, regional and local systems. The Study area's ecosystem significance relates directly to contributions towards the: North American Waterfowl Management Plan; Upper Mississippi River System Environmental Management Program; Clean Water Action Plan; Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; and, federal government's list of "Species of Concern".

I have carefully considered the significant factors related to the problems and associated opportunities identified within the Project Area, as well as the numerous alternative plans that were developed to address these problems and opportunities.

These factors include: the severity of the environmental, social and economic consequences of ecosystem degradation and its related land and water resources problems within this significant, internationally known and valued environmental/cultural resource area; the probability of more severe conditions in the future; the ability of each alternative plan to address the ecosystem restoration and related problems and opportunities; the costs of the plans and the relationship of the costs to their associated outputs; and the acceptability of the plans to the non-Federal interests and partner Resource agencies. In consideration of these important factors, I have determined that the following recommendation is in the public's interest.

I recommend that East St. Louis and Vicinity, Illinois project authorized by the Section 204 of the Flood Control Act of 1965 and amended by Section 310 of the Water Resources Development Act of 2000 be modified to implement the National Environmental Restoration Plan identified in this Report as the Recommended Plan, as a Federal project with further modifications as necessary, in the discretion of the Commander, USACE, that may be advisable in accordance with the cost sharing and financing arrangements satisfactory to the President and the Congress. Based on October 2003 price levels, the total cost of the recommended plan is currently estimated to be $193,266,100 including PED activities. The Federal and non-Federal shares are estimated at $125,584,265 and $67,681,835, respectively. These costs reflect a 65-35% cost share of the environmental features and a 50-50 cost share for the recreation features. The non-Federal operation, maintenance, repair, rehabilitation and replacement costs are estimated at $93,000 annually. This recommendation is made with the provision that prior to Project implementation, the non-Federal interests must:

a. Provide a minimum of 35 percent of project costs allocated to ecosystem restoration and 50 percent of the project costs allocated to recreation, as further specified below:

(1) Enter into an agreement to provide, prior to execution of the project cooperation agreement, 25 percent of design costs;

(2) Provide during construction, any additional funds needed to cover the non-Federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the Project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the Project;

(5) Provide during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of total project costs allocated to ecosystem restoration and 50 percent of the total project costs allocated to recreation.

b. Provide 35 percent of the cost for that portion of total cultural resource preservation mitigation and data recovery costs attributable to ecosystem restoration that are in excess of one percent of the total amount authorized to be appropriated for the Project;

c. Provide 50 percent of the cost for that portion of total cultural resource preservation mitigation and data recovery costs attributable to recreation that are in excess of one percent of the total amount authorized to be appropriated for the Project;

d. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

e. Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

f. Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence construction of any water resources project or separable element thereof until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

g. Hold and save the Government free from all damages arising for the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

h. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extend and in such detail as will properly reflect total project costs;

i. Perform, or cause to be performed, any investigations for hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government;

j. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

k. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA;

l. Prevent future encroachments on project lands, easements, and rights-of-way, which might interfere with the proper functioning of the Project;

m. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), as amended by Public Law 102-240, Section 1055 (re: rural electrification), as amended by Public Law 105-117, Section 104 (re: Alien not lawfully present in United States), and the Uniform Regulation contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

n. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable federal labor standards requirements, including, but not limited to, the Davis-Bacon Act (40 U.S.C. 276a et. seq.), the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et. seq.) and the Copeland Anti-Kickback Act (40 U.S.C. 276c).

o. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

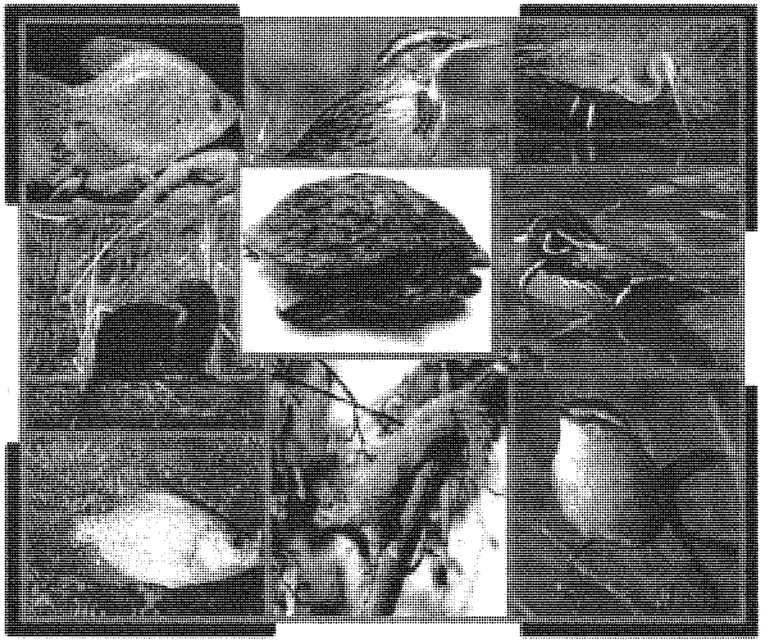
The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. Consequently, this recommendation may be modified before it is transmitted to Congress as proposals for authorization and implementation funding. However, prior to transmittal to Congress, the State of Illinois, Madison and St. Clair Counties, Illinois, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

C. Kevin Williams

C. KEVIN WILLIAMS
COL, EN
Commanding

East St. Louis and Vicinity, Illinois Ecosystem Restoration And Flood Damage Reduction Project

General Reevaluation Final Report with Integrated Environmental Impact Statement



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US Army Corps
of Engineers ®
St Louis District

November 2003

East St. Louis and Vicinity, Illinois
Ecosystem Restoration And Flood Damage Reduction Project

General Reevaluation Final Report with Integrated Environmental Impact Statement (EIS)

Lead Agency:

U.S. Army Corps of Engineers
St. Louis District
1222 Spruce Street
St. Louis, Missouri 63103-2833

Cooperating Agencies:

U.S. Environmental Protection Agency
Region 5
77 W. Jackson Blvd.
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EAST ST. LOUIS AND VICINITY, ILLINOIS, ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION

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Note: The asterisk (*) denotes information required by the National Environmental Policy Act

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EXECUTIVE SUMMARY

1. AUTHORITY AND PURPOSE. The East St. Louis and Vicinity, Illinois Flood Protection Project was authorized through Congressional actions in 1965 under Section 204 of the Flood Control Act of 1965, (Public Law 89-298). Section 137 of the Water Resources Development Act of 1976 (Public Law 94-587) modified the Flood Control Act of 1965 by authorizing construction of the Blue Waters Ditch segment independently of the other authorized segments. A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Blue Waters Ditch in 1976. The Blue Waters Ditch portion of the authorized project was economically justified and subsequently constructed and completed in 1989.

Major flooding in the study area resulted in four disaster declarations during the period 1993 to 1996. As a result of these disasters, the 104th Congress, 2d Session added funding for a reevaluation of the authorized project be conducted via House Report 104-782, Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1997.

The Water Resource Development Act of 2000 (Public Law 106-541) again modified the project authorization. Section 304 of this Public Law contains the following wording: "The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

The purpose of this reevaluation was to re-examine the East St. Louis and Vicinity, Illinois Project under current conditions, existing authorities, and Executive Branch priorities with a view towards looking for new solutions to old problems. The principal goal was to identify potential improvements to the natural watershed system, that would restore biodiversity with the reintroduction of an historic flood pulse to select portion of the floodplain, to enhance habitat quality and sustainability while providing incidental ecosystem services, such as flood damage reduction.

2. LOCATION AND SIGNIFICANCE. The East St. Louis and Vicinity, Illinois Flood Protection Project is located in Madison and St. Clair Counties, Illinois, along the left bank of the Mississippi River between river miles 175 and 195 above the Ohio River (see Figure ES-1). Between these river miles the Project area includes approximately 55,000 of the 86,000 floodplain acres that are protected by a levee system along the Mississippi River, the Chain of Rocks Canal, the Prairie du Pont canal, and the Cahokia Creek diversion channel. An additional 51,000 acres of upland area are tributary and drain into the bottomlands. Flows from the uplands have been diverted between flank levees to reduce upland flow into the bottomlands. The uplands portion of the Project area contains the municipalities of Edwardsville, Maryville, Glen Carbon, Collinsville, Fairview Heights, Belleville, and Swansea while Pontoon Beach, Granite City, Venice, Madison, Brooklyn, East St. Louis, Fairmont City, Washington Park, Sauget, Centreville, East Carondelet, Caseyville, Alorton, Cahokia and Dupo are located in the Bottoms.

In terms of environmental and cultural significance, the Project area lies at the confluence of the Mississippi and Missouri Rivers, which as a river system is the fourth longest in the world and of national and international importance. The Mississippi flyway, one of four major flyways for migratory birds on the North American continent, is centered on the Mississippi River corridor. Many species of migratory waterfowl and songbirds are supported by aquatic, wetland, and terrestrial habitats within the Project area and adjacent river corridor.

The Study area is located within an extremely valuable and strategic ecosystem resource area. The Study area's resources contribute to the: North American Waterfowl Management Plan; Upper Mississippi River System Environmental Management Program; Clean Water Action Plan; Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; and, to the needs of some 34 "Species of Concern".

More than just unique for its physical features - this confluence has drawn people to it since man inhabited this country, becoming a crossroads in the middle of the continent. As far back as 12,000 years ago it was home to the ancient Cahokia civilization and contained great expanses or wetland, prairies and forests when European man arrived in the area in the 1700's. In 1982 a 2,000-acre portion of the Project area was designated by the United Nations as a World Heritage Site because of the areas significance. This designation places it in the company of such areas as the Grand Canon and the Mesa Verde. At the time of European settlement, this floodplain was essentially vacant, and supported great expanses of forests and prairies that were punctuated by scattered lakes and ponds, herbaceous wetlands, and meandering streams. Today the Project area provides essential habitat for waterfowl and migratory songbirds alike sitting at the heart of the major migratory flyways for both.

As a result of development over the last two centuries, the Project area now lies in the second largest concentration of residential, commercial, and industrial land use on the Mississippi River floodplain, after New Orleans. Yet open space still exists, including agricultural lands. About two-thirds of the world's supply of horseradish is grown locally on this Mississippi River floodplain and most horseradish fields are found in the Project area. This confluence area as indicated supports resources of national and regional importance.

3. NON-FEDERAL SPONSORSHIP AND STUDY PARTICPATION. The non-Federal sponsor for the re-evaluation study was the Metro East Sanitary District (MESD), who entered into a cost shared PED agreement in May 1998. The MESD was joined in this study cost share effort in a separate four party agreement with the State of Illinois' Department of Natural Resources (IDNR), Madison County, Illinois, and St. Clair County, Illinois. These entities served jointly on a Metro East Regional Stormwater Committee that solicits input and participation from the public and private sector in identifying problems and opportunities for meeting the challenges of stormwater management across their areas of responsibility. This Committee provided a monthly forum for sharing study progress, identifying additional study issues and receiving input across the spectrum of study concerns. Madison and St. Clair Counties, Illinois, have indicated their intent to serve as the non-Federal sponsor for the construction project and have received a pledge of backing from the Illinois Department of Natural Resources for cost share funding totaling some $10,000,000.

The Environmental Protection Agency (EPA) and the Natural Resource Conservation Service (NCRS) agreed to participate with the Corps as cooperating agencies on the Environmental Impact Statement (EIS) for the study. This effort is a natural extension of their on-going efforts in the Metro East area to improve the quality of life and protect valuable natural resources. Each agency provided a biologist to participate throughout the Habitat Evaluation Procedures analysis and also provided supporting technical expertise from their respective agencies. The EPA's Region 5 assisted in assessing water quality, air quality, hazardous and toxic waste plus environmental justice issues. The NRCS prepared extensive evaluations and analyses of sedimentation and stream erosion concerns in order to better define problems and opportunities. The IDNR provided a biologist to the study team and provided technical support from their Office of Water Resources for hydraulic/hydrologic issues. The U.S. Fish and Wildlife Service provided a biologist to the study team and ensured that their resource issues and concerns were addressed throughout the process. Because unique archeological resources occur in the study area, coordination was maintained with the Illinois State Historic Preservation Office during the formulation of alternative plans and subsequent plan evaluations.

4. PROBLEMS AND OBJECTIVES. The primary water and land resource problems identified are ecosystem degradation, sedimentation and recurring interior flooding. Ecosystem degradation is characterized in the study area by: the loss of biodiversity and the fragmentation of natural systems caused primarily by intensive urbanization over the years; the loss of historic ecosystem disturbances such as natural flooding and wildfires; the loss of habitat quality; and the degradation of tributary stream resources. Ecosystem degradation has occurred primarily because of the exclusion of Mississippi River overflows and upland stream flooding of the Project area, changes to the interior hydraulic system, and the significant pressures which urban development has placed upon the ecosystem. The elimination of effects from the Mississippi River and channelization of the floodplain streams has severed the natural connection between wetlands and river/stream hydrology.

Significant sedimentation is occurring as a result of erosional processes occurring in the tributary streams. Stream destabilization has occurred as a result of past urbanization that has increased the base flow rate within the streams. Urban sprawl and the loss of greenspace/open space are considered to be the major contributors to this problem. The runoff from the hillside creeks enters the canals on the floodplain at a high velocity capable of transporting heavy loads of sediment out of the bluffs. However, when these high velocity flows reach the bottoms, the velocity of the water drops substantially because the gradient flattens, and the water in the canal is no longer able to transport the sediment load. The desire to re-establish watershed functionality by reconnecting tributary streams and floodplain wetland resources makes the issue of sediment transport key. Currently sediment is either removed manually from the ditch/canal system, is deposited in connected water bodies such as Horseshoe Lake or is carried through a succession of storm events out to the Mississippi River.

Interior flooding currently occurs when bluff storm water entering the floodplain from streams overtops the floodplain canal system. This overtopping typically occurs close to the bluff line damaging surrounding structures and crops. This man made collector system will continue to contribute to significant flood damages if left alone. Interior flooding associated with large rainfall events produced widespread damages across the floodplain as a result of storms in 1915, 1942, 1946, 1952, 1957, 1961, and 1995. In 1993, 1994 and 1996 localized flooding caused major damages in specific areas.

Based upon the problems and opportunities identified for the study area, eight planning objectives were identified to guide the plan formulation effort: 1.) restore natural areas; 2.) restore the flood pulse; 3.) restore habitat quality; 4.) improve water quality; 5.) reduce erosion; 6.) restore tributary streams; 7.) restore floodplain streams; and 8.) address the incidental social objectives of reducing flood damages, enhancing outdoor recreation opportunities, and protecting cultural resources. The incidental social objectives were included to measure the ecosystem services provided by the restoration project.

5. DEVELOPMENT OF PLANS. Once the problems and planning objectives were identified and established, the next step in the formulation process was to develop plans to address the planning objectives. The study area has a number of remaining degraded wetland remnants that together create one the largest areas of urban wetlands in the state.

The period prior to the diversion of the natural stream system and construction of the levee along the Mississippi (ca.1800's) provided a picture of how the floodplain operated and natural communities prospered. Mapping of cover types reflecting historic vegetation and analysis of historic Mississippi River flood events became an essential ingredient in the formulation process. It was during this investigation that it became apparent that the re-creation of a floodplain flood pulse that mimics the pulse experienced on the undisturbed floodplain was essential for restoring a natural regimen that could sustain an ecosystem restoration plan for this floodplain area.

In order to ensure the broadest focus possible for the formulation of this restudy effort, the St. Louis District partnered with the U.S. Environmental Protection Agency Region 5, the Natural Resource Conservation Service in Illinois, the U.S. Fish and Wildlife Service Region 3, the Illinois Department of Natural Resources, and the U.S. Army Engineer Research and Development Center (previously Waterways Experiment Station).

The Project area was divided into five watersheds: Long Lake; County Ditch; Cahokia Canal; Harding Ditch; and Powdermill. An initial array of possible restoration sites was developed for each of the five watersheds, and these were selected based upon insight provided by the analysis of the pre-settlement land cover and hydrology, project restoration planning targets, public outreach, previous reports, identification of existing habitat sites, and the knowledge of agency personnel. After these sites were identified, baseline environmental conditions were established using Habitat Evaluation Procedure (HEP) on 89 floodplain and 71 tributary stream sites, Hydrogeomorphic Model (HGM) on 112 floodplain sites, and Qualitative Evaluation Habitat Index (QEHI) on 17 tributary stream sites within the Study area.

Restoration measures were developed for each site to meet the planning objectives. After a series of iterative evaluations and screenings, the initial array of sites was reduced to nine "clusters" of sites (Action Areas) that provided the best potential for meeting the planning objectives.

An array of alternatives was developed for each of the nine Action Areas, yielding a total of about 256 alternatives. These 256 alternatives were reduced to 71 through an iterative process of analysis and evaluation of measures designed to meet the planning objectives. Habitat benefits or environmental outputs for each of the 71 plans were estimated using HEP, and cost estimates for each plan were developed. An incremental cost analysis (ICA) was then performed on these 71 alternatives to compare the cost effectiveness and efficiency of the array of alternatives at each Action Area. Through a two-step review and evaluation process, one conducted by the biological team and one by the Sponsors' planning team, a preferred plan was identified.

The review and public comment period for the Draft Report that was conducted between 28 February and 7 May of 2003. As a result of this process the Wedgewood action area was eliminated from the preferred plan.

6. RECOMMENDED PLAN. In general, the Recommended Plan consists of the following measures: the restoration of bottomland forest habitat (1,705 acres), prairie habitat (1,111 acres), marsh and shrub swamp habitat (843 acres), lake habitat (460 acres), upland forest (379 acres), floodplain stream restoration (10.4 miles or 161 acres), placement of wood duck boxes (651 boxes) and prairie bird perches (870 perches), creation of over wintering holes and shoreline plantings (20 acres), and construction of tributary stream detention basins (131), riffle and pool complexes in 178 miles of streams, earthen embankments (15.5 miles), and hydraulic control devices (culverts, flap gates, and new channels).

Currently a total of 4,916 acres are included in the Project footprint, of which 4,468 acres are in the Mississippi River's floodplain and 448 acres are along streams in the tributary watersheds. The 178 miles of tributary stream restoration are not reflected in this Project area footprint. Specific sites, at which stream restoration measures would be implemented, other than the tributary sediment detention basins, have yet to be determined.

Figure ES-2 shows the location of the eight habitat areas and 178 miles of tributary stream restoration that comprise the Recommended Plan that includes: Old Cahokia Creek, Judy's-Burdicks, Elm Slough, Dobrey Slough, Brushy Lake, Cahokia Mounds, Spring Lake, and Mullens Slough.

The Recommended Plan will use storm water from upland watersheds to substitute for historic riverine overflow from the Mississippi River. The introduction of periodic "flood pulses" of storm water into the restored forests, prairies, and marshes of the floodplain Action Areas and the restoration of tributary streams will return the existing ecosystem to a more natural condition. A major source of historic surface hydrology will be restored to affected floodplain wetlands and aquatic areas. By receiving flood pulses, affected areas would once again be under the influence of a fundamental type of natural disturbance typical of floodplains.

The capacity of wetlands to temporarily store floodwater as they did historically would be restored. Storm water would then be released from these areas back into the interior flood control system and eventually to the Mississippi River. Restoring flooding to floodplain habitats and linking these areas to the interior flood control system would reintegrate the landscape and create a more naturally functioning watershed ecosystem.

The Recommended Plan re-establishes a surface hydrologic regime that was "engineered" out of the floodplain in the 1900's. The reconnection of the upland streams to the 4,916 acres of restored floodplain habitat areas will provide incidental flood damage reduction for the surrounding area as an ecosystem service.

The total project cost, including PED, is estimated to be $189,266,100. Project outputs have been captured by means of identifying habitat units and the dollar value of producing these units. Qualitative factors such as Habitat Suitability Index were utilized during plan assessment and evaluation to ensure that quantitative measures were maintaining qualitative standards. Cost data gathered after the selection of the Recommended Plan, which included the gross appraisal and other pertinent real estate and engineering information, was used to develop the baseline Project cost estimate. Average annual Project costs were computed to be approximately $11,798,851 using the current interest rate of 5.875% over the 50-year Project life. Annualized outputs for the Recommended Plan total some 8,332 habitat units. The Recommended Plan therefore produces these habitat units for an average annualized cost of approximately $1,416 per unit. Project benefits have been quantified by means of identifying habitat units incrementally compared to their cost of production.

This Project was formulated as a single purpose Ecosystem Restoration project, in accordance with ER1105-2-100 (3-5c.): "Monetary gains (e.g. incidental recreation or flood damage reduction) and losses (e.g., flood damage reduction or hydropower) associated with the project shall also be identified." In an attempt to quantify these benefits, a risk-based analysis was performed. This analysis determined that $1,366,000 in average annual flood damage reduction is incidental to plans considered. The Project includes a bike trail at the Old Cahokia Creek action area. This bike trail extends an existing trail and was justified using the Facility Capacity Method having an annualized cost of $16,084. At the current interest rate this trail has a benefit to cost ratio of 1.7 to 1.

7. IMPLEMENTATION. The non-Federal Sponsors for the construction project will be the Counties of Madison and St. Clair Illinois who have provided their letters of intent and have demonstrated the financial ability to cost share, operate, and maintain the project. The State of Illinois Department of Natural Resources has also provided their letter of intent to financially support the Project. A fifteen-year schedule (see Table ES-2 below) has been developed for project implementation beginning in FY05 with a construction new start. This schedule allows the flexibility needed to implement a project of this size and with the amount of land acquisition required.

The first set of plans and specifications will be undertaken during planning, engineering and design (PED), which are a part of the existing Design Agreement's scope. Prior to the acquisition of Project lands and the subsequent initiation of the first item of construction, a Project Cooperation Agreement (PCA) will be executed for the entire Project effectively bringing the PED phase to a conclusion.

Work under the PCA will begin with the Sponsors' acquisition of applicable lands, easements, rights-of-way, relocations and necessary disposal areas (LERRD's) in advance of the advertisement and award of the first construction contract. The Sponsors have sophisticated engineering staffs with construction capability. Their ability to contribute to project execution will be negotiated during the development of the Project Cooperation Agreement.

Table ES-2 Funding Stream Restoration Project.

		2	3	4	5	7	9
		Total Project		**PED or**		**Additional**	**Federal Cash**
FY	**Phase**	**Implementation Cost**	**LERRDs**	**Construction**	**%**	**Non-Fed Cash**	**Schedule**
Prior FY's	PED	2407.00	0.00	2407.00		601.75	1805.25
FY03	PED	800.00	0.00	800.00		200.00	600.00
FY04	PED	793.00	0.00	793.00		198.25	594.75
FY05	Constr	4865.43	3343.89	1521.54	0.01	371.99	1149.55
FY06	Constr	1348.91	130.47	1218.44	0.01	308.35	910.09
FY07	Constr	5018.77	2074.02	2944.75	0.02	670.84	2273.91
FY08	Constr	11589.60	4182.30	7407.30	0.05	1607.91	5799.39
FY09	Constr	12626.80	6880.12	5746.68	0.04	1259.20	4487.48
FY10	Constr	12242.21	6881.97	5360.24	0.04	1178.06	4182.18
FY11	Constr	18987.80	6230.54	12757.26	0.08	2731.31	10025.95
FY12	Constr	16344.35	1620.66	14723.69	0.09	3144.23	11579.46
FY13	Constr	18853.90	633.87	18220.03	0.12	3878.40	14341.63
FY14	Constr	22284.47	968.57	21315.90	0.14	4528.48	16787.42
FY15	Constr	16491.59	791.19	15700.40	0.10	3349.32	12351.08
FY16	Constr	14666.30	469.70	14196.60	0.09	3033.55	11163.05
FY17	Constr	13120.50	0.00	13120.50	0.08	2807.58	10312.92
FY18	Constr	11529.21	0.00	11529.21	0.07	2473.44	9055.77
FY19	Constr	8845.00	0.00	8845.00	0.06	1909.80	6935.20
FY20	Constr	193.26	0.00	193.26	0.00	93.08	100.18
Total		**193008.10**	**34207.30**	**158800.80**	**1.000**	**33345.54**	**124455.27**

*Displayed in $1,000s

This report consists of an Environmental Impact Statement (EIS) integrated with the general reevaluation report. Because implementation is expected to occur over a 15-year period, the Recommended Plan could be modified to reflect future changes at proposed Action Areas (such as new private development), or changes due to refinement of designs developed during the PED process.

Prior to implementation of any action area, follow-up NEPA compliance documentation will accompany the detailed design reports. This documentation will be prepared as either a Supplement to the EIS, or as a series of Environmental Assessments. Public involvement will continue during the preparation of future NEPA documentation.

8. PROJECT RECOMMENDATION. We have carefully considered the significant factors related to the problems and associated opportunities identified within the Project Area as well as the numerous alternative plans that were developed to address these problems and opportunities. These factors include: the severity of the environmental, social and economic consequences of ecosystem degradation and its related land and water resources problems within this significant, internationally known and valued, environmental/cultural resource area; the probability of worsening conditions in the future; the ability of each alternative plan to address the ecosystem restoration and related problems and opportunities; the costs of the plans and the relationship of the costs to their associated tangible and intangible outputs; and, the acceptability of the plans to the non-Federal interests. In consideration of these important factors, we have determined that the following recommendation is in the public's interest.

We recommend that East St. Louis and Vicinity, Illinois project authorized by the Section 204 of the Flood Control Act of 1965 and amended by Section 310 of the Water Resources Development Act of 2000 be modified to implement the National Environmental Restoration Plan identified in this Report as the Recommended Plan, as a Federal project with further modifications as necessary, in the discretion of the Commander, USACE, that may be advisable in accordance with the cost sharing and financing arrangements satisfactory to the President and the Congress. Based on October 2003 price levels, the total cost of the recommended plan is currently estimated to be $189,266,100.

The Sponsors' share of the Project cost is estimated to be $67,681,840 of which $1,000,000 has already been contributed during PED. The Illinois Department of Natural Resources has committed to providing funds totaling approximately $10,000,000. The estimated $34,207,400 in LERRD's costs will be borne by Madison and St. Clair Counties. The remainder of the Sponsors' share estimated to be $22,474,440 will be a divided among the State and the two counties. These figures include the restoration project costs that are shared at a 35% -65% rate and recreation features that are shared at a 50%-50% rate. Madison and St. Clair Counties and the State of Illinois have the capability of performing some of the required work themselves. During the development and negotiation of the Project Cooperation Agreement (PCA) these possibilities will be further examined.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding.

Figure ES-1. Project Area.

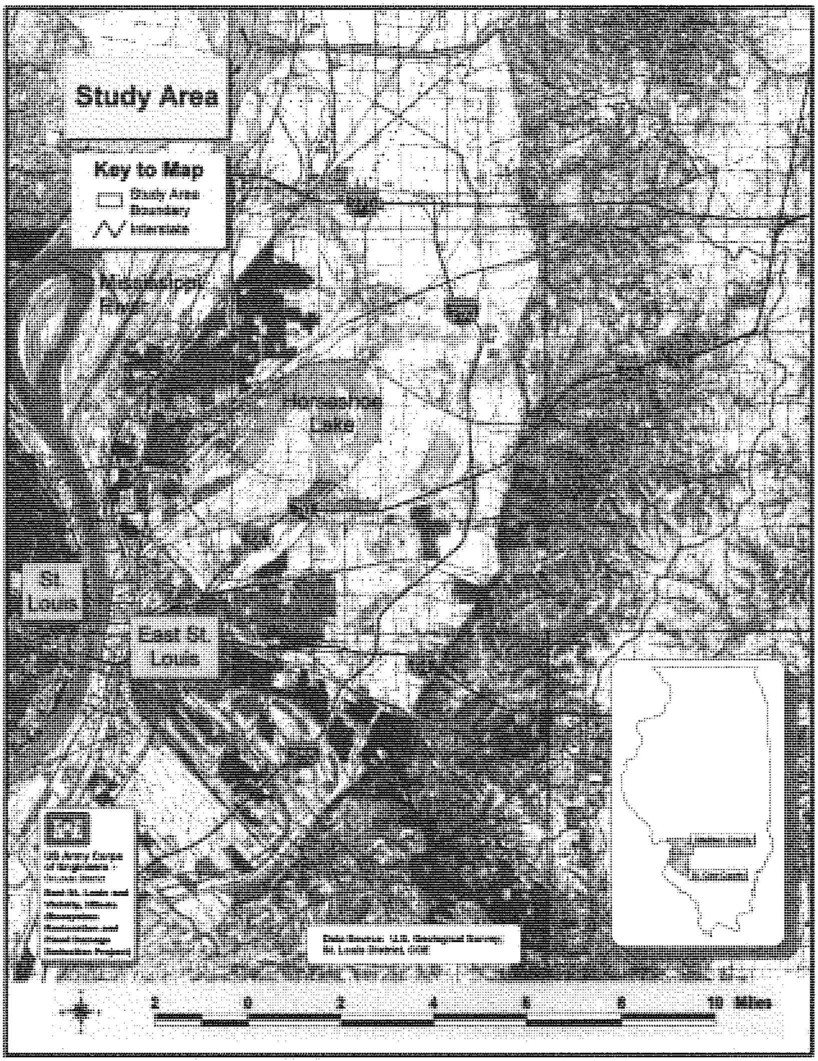

Figure ES-2. Action Areas comprising the Recommended Plan.

SECTION 1 - INTRODUCTION

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SECTION 1 - INTRODUCTION

1.1 PROJECT AUTHORITY

1.1.1 Background. The East St. Louis and Vicinity, Illinois Flood Protection Project was specifically authorized (and modified) through Congressional actions in 1965 under Section 204 of the Flood Control Act of 1965, (Public Law 89-298) and subsequently under the Water Resources Development Act of 1976 (Public Law 94-587). Section 204 of the Flood Control Act of 27 October 1965 (Public Law 89-298) provides that:

"The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein. The necessary plans, specifications, and preliminary work may be prosecuted on any project authorized in this title with funds from appropriations hereafter made for flood control so as to be ready for rapid inauguration of a construction program. The projects authorized in this title shall be initiated as expeditiously and prosecuted as vigorously as may be consistent with budgetary requirements. Penstocks and other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this Act for construction by the Department of the Army on the recommendation of the Chief of Engineers and the Federal Power Commission."

UPPER MISSISSIPPI RIVER BASIN

"The project for flood protection at East St. Louis and Vicinity, Illinois, (East Side Levee and Sanitary District), is hereby authorized substantially, as recommended by the Chief of Engineers, in House Document Numbered 329, Eighty-eighth Congress, at an estimated cost of $6,180,000."

The Water Resources Act of 1976 (Public Law 94-587) provides that:

"An Act

"Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,"

"Sec. 137. The project for flood control in East St. Louis and Vicinity, Illinois, authorized by Section 204 of the Flood Control Act, approved October 27, 1965, is hereby modified to authorize the Secretary of the Army, acting through the Chief of Engineers, to construct the Blue Waters Ditch segment of the overall project independently of the other project segments. Prior to initiation of construction of the Blue Waters Ditch segment, appropriate non-Federal interests shall agree, in accordance with the provisions of section 221 of the Flood Control Act of 1970, to furnish non-Federal cooperation for such segment."

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Blue Waters Ditch in 1976. The results showed that the Blue Waters Ditch portion of the authorized project was still economically justified with a benefit to cost ratio of 1.35 to 1. Blue Waters Ditch was completed in 1989 and includes 4.4 miles of new/improved drainage channels and a 600 c.f.s. pump station that eliminates flooding from an estimated 700 acres of approximately 136,000 acres of the original project area.

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Cahokia Canal and Harding Ditch Areas in 1984. This evaluation found the recommendations contained in the authorized project to not be economically justified under the existing interest rate at that time of 8 1/8 percent.

Major interior flooding in the project area resulted in four disaster declarations during the period 1993 to 1996. As a result, the 104th Congress, 2d Session provided funding via House Report 104-782, Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1997, to initiate a reevaluation of the authorized project.

The Water Resources Development Act of 1996 (WRDA) 1996 provided funding to initiate the General Re-evaluation Report for the East St. Louis and Vicinity, Illinois project.

1.1.2 Current Project Authority. The current project was authorized as part of the Water Resource Development Act of December 2000 (Public Law 106-541).

Water Resources Act of 2000 (Public Law 106-541) Title III Project - Related Provisions

"Sec. 310. EAST SAINT LOUIS AND VICINITY, ILLINOIS.

The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

This expanded project purpose provides the opportunity for a fresh look at solutions across a broader spectrum for the Project area and permits new authorities and administration priorities to be incorporated into the planning process for this reevaluation effort.

1.2 PROJECT PURPOSE, SCOPE, AND REPORT ORGANIZATION

1.2.1 Project Purpose. The purpose of this reevaluation study is to re-examine the Cahokia Canal and Harding Ditch areas of the authorized East St. Louis and Vicinity, Illinois Project under current conditions, existing authorities, and Administration priorities with a view towards looking for new solutions to old problems. The principal goal is to identify potential improvements to the natural system for ecosystem restoration, which would restore the historic flood pulse to the floodplain in a manner, which could also provide, needed flood damage reduction. Using this approach, it is believed that bio-diversity in the bottomlands can be restored and serious watershed degradation problems can be addressed. This document presents the results of this extensive reevaluation effort and recommends a plan which will best serve the needs of the area when compared to the future without project condition.

1.2.2 Project Scope. This project follows the Corps' methodology for the reevaluation of a feasibility report. In general, the previous study information was examined and updated to current and future without project conditions for such things as land use, existing damages, hydraulic changes, and climate changes impacting hydrology. Additionally, an analysis of the pre-levee condition (ca. 1800) was made in order to understand the functions of the natural system and to permit a full array of ecosystem alternatives to be understood and explored that might best achieve project goals. Previous studies looked for strictly engineering solutions to the interior flooding problems experienced by the local population for nearly 100 years; it is believed that an analysis of the naturally functioning system prior to construction of the existing drainage canals could provide new solutions to old problems.

Through a series of public and agency involvement activities, goals for the project were identified and existing baseline data gathered for use in alternative formulation and analysis. As an outgrowth of utilizing existing Corps' policy guidance and extensive coordination among project partners, environmental restoration benefits were utilized to measure, evaluate and compare alternative plans through the application of an incremental cost analysis methodology. The Waterways Experiment Stations (WES) Integrated Biological Evaluation Procedure (IBEP) model was used in conjunction with the Institute for Water Resources' (IWR) plan for the determination of total National Environmental Restoration benefits and selection of the recommended plan. In addition to Corps' expertise, the Project Team included biologists from partnering agencies. They included representatives from: the U.S. Environmental Protection Agency, Region 5; the U.S. Fish and Wildlife Service, Region 10; the Natural Resource Conservation Service, Illinois; and, the Illinois Department of Natural Resources. The Project Team was augmented throughout the reevaluation process by technical experts from respective resource agencies as needs arose. Since a feasibility report does not include a design level of detail and thus, includes an inherent level of uncertainty, this reevaluation report documents the resultant uncertainties involved with plan selection and with the future tasks, which will be needed to minimize these uncertainties.

Engineering and real estate cost estimates have been based upon the analyses and assumptions made during the process of formulating and developing components of the recommended plan. Uncertainties in design details could impact future alternative analyses and subsequent design and cost estimates. Following release of the draft report, consultation with the Environmental Protection Agency and the U.S. Fish and Wildlife Service determined that the document as prepared fulfilled the requirements for an Environmental Impact Statement and that follow-on project documentation should follow the traditional tiered review approach. Use of a tiered approach was determined to be most appropriate for this project because of its size, the potential length of time required to implement it and the complexity of ecosystem features. Based upon recent Corps' emphasis, an integrated General Reevaluation Report and Environmental Impact Statement and Appendices report has been prepared.

The reevaluation of the project began with the execution of the Preconstruction Engineering and Design Agreement in May 1998 between the Corps and the local sponsor, the Metro East Sanitary District. As with all feasibility level reports, the recommended plan will be designed in greater detail after this report has been reviewed and approved. A follow-on Project Cooperation Agreement with the project sponsor will be required for the construction of the project.

1.2.3 Report Organization. This report consists of a General Reevaluation Report with an integrated Environmental Impact Statement and Appendices. The main portion of the General Reevaluation Report provides an overview of the project effort and summarizes information found in its Appendices. The Appendices provide supporting information for the investigations and the tasks conducted for the study.

The following is a synopsis of the information contained in this document that should help the reader focus attention to the sections of most interest or concern:

SECTION 1 - INTRODUCTION. Provides the overall project authority, a description of the project area and information on previous project efforts and portions of the originally authorized project that have been constructed.

SECTION 2 - PRE-DEVELOPMENT CONDITIONS. Describes the physical character of the floodplain from its development through actions of the glacial period and historic movement of the Mississippi River. The pre-development ecological conditions are described to include the wide variety of natural communities that thrived in the area and the disturbance dynamics that ensured their health and diversity. A discussion of the wetland functions is included that explores the importance of the disturbance dynamic on the sustainability of ecosystem diversity. This section provides the roadmap that was used in the formulation of the project. It was during the assessment of the predevelopment hydrologic disturbance dynamics on the floodplain from both Mississippi River and interior stream action that it became clear that an environmental project formulated to reestablish hydraulic interconnectivity and healthy disturbance dynamics to recreate quality habitat areas would provide flood damage reduction as a natural consequence. It was also clear that based on the character of the floodplain a naturally functioning ecosystem that did not require extensive mechanical augmentation should be able to be achieved.

SECTION 3 - EXISTING CONDITIONS. Provides an overview of the project area as it exists today both from a socio-economic and environmental quality point of view. This section describes a project area that still contains significant acreage dedicated to agricultural endeavors that is surrounded by urban development. It provides information regarding development patterns that show the bluff communities exploding in growth and increasing economic prosperity and floodplain communities growing but not at the same pace or with the same economic benefit. It describes a cycle of urban sprawl that is not unlike many other areas in the nation with the often-resultant loss of environmental quality, green space and open space. While numerous trail related recreation initiatives completed or underway are described, none of the current local plans address the loss of wildlife habitat, ecosystem diversity and environmental sustainability that is facing the area.

SECTION 4 - FUTURE WITHOUT PROJECT CONDITIONS. Describes what the project area is likely to look like fifty years into the future without the benefit of a project. This information is based on growth predictions as well as predictions of environmental decline developed by the restudy team. As with any projection of future conditions, these are based on past and present trends in the area. Continued rapid development of the bluffs is expected, as is the expansion of development on the flood plain. During the study period alone, 1998-2002, significant development has occurred on the floodplain. Based on the past and present trends of wetland losses, habitat segmentation and loss of diversity and quality the future conditions are not predicted to improve. The floodplain that sits at the confluence of the nations two great rivers that was the home of the ancient Cahokia civilization some 12,000 years ago and contained great expanses of wetlands, prairies and forests when European man arrived in the area, stands to loose its natural character if action is not taken today.

SECTION 5 - PROBLEMS AND OPPORTUNITIES. Provides a description of the problems facing the project area that have been gathered from extensive public involvement and the numerous prior studies conducted over the last half-century. Problems facing the ecological resources remaining in the project area are detailed providing a categorization of negative influences such as loss of bio-diversity, loss of disturbance dynamics, loss of habitat quality, fragmentation of existing resources and deteriorating water quality due to high sediment loads. These are coupled with problems centering on erosion and sedimentation, tributary stream channel instability, flooding and flood damages, loss of cultural resources and future outdoor recreation opportunities. Planning objectives and their related planning targets developed by the Project team from benchmarking the predevelopment condition are explained. This section establishes the criteria upon which formulation will proceed.

SECTION 6 - FORMULATION. Presents the measures developed for the planning objectives established in Section 5 and details the process used to identify the floodplain and tributary stream sites that were assessed using HEP and HGM methods to establish baseline conditions of the project area. A description of the iterative process used to ultimately identify the action areas that are taken through alternative plan development and evaluation is given. A description of each action areas predevelopment history is included along with its problems and opportunities.

The iterative process of alternative plan development that began with the identification of 256 potential alternatives that were eventually narrowed to 71 is explained along with their evaluation using an incremental cost analysis process. Results of the incremental cost analysis and plan selection procedures is also described with rationale for selection of the selected alternatives.

SECTION 7 - ENVIRONMENTAL CONSEQUENCES. Provides a discussion of the environmental consequences of the recommended plan.

SECTION 8 - RECOMMENDED PLAN. Describes the environmental features of the recommended plan as well as the construction features required to achieve the plan. The real estate plan is provided in summary along with a description of required PED activities designed to validate assumptions made during the planning process. A summary of the project cost estimate is also included.

SECTION 9 - IMPLEMENTATION. Describes the process that will be utilized to design and construct the project. This process will center on the development of an Engineering Design Report (EDR) for each recommended action area that will serve as the future decision document for the initiation of construction activities. The development of an Environmental Impact Statement as a part of this re-evaluation report makes the future use of the EDR a logical way to ensure future project outputs match those anticipated and that environmental impacts are revisited prior to the completion of design. Based on the size and complexity of this project a tentative fifteen-year construction schedule is used to develop the project-funding stream and construction features are divided into eight categories. Financial analysis of the sponsors indicates their ability to cost share the project.

SECTION 10 - PUBLIC INVOLVEMENT. Provides an overview of the multi phased public involvement process used for this project that demonstrates the collaboration that was used to accomplish the restudy effort.

APPENDIX A - HABITAT EVALUATION. Details the environmental analysis that supports the project process. This appendix provides the details of the gathering of baseline conditions, selection of predictor species, projection of future without and future with conditions and alternative development and analysis procedures through use of the incremental cost analysis process. This appendix also describes the results of the HEP and HGM procedures used in project analysis.

APPENDIX B - ENVIRONMENTAL. Provides supplemental information, charts, tables and illustrations required to further document environmental information presented throughout the report. This appendix also includes the Environmental Justice analysis prepared for the recommended plan by Region 5 of the USEPA.

APPENDIX C - HYDROLOGY AND FLOOD DAMAGE. Provides information related to the predevelopment and existing condition hydrology of the project area. An explanation of the formulation process used for the evaluation of hydrologic inputs to the action areas is provided and the modeling used for development and analysis of alternative plans is detailed.

APPENDIX D - GEOTECH. Provides supplemental information, charts, tables and illustration required to further document geotechnical information presented throughout the report.

APPENDIX E - SEDIMENT TRANSPORT. Details the studies conducted and formulation process used to determine the measures and alternatives viable for addressing the erosion and sedimentation problems of the project area. This appendix establishes the planning target applied to the project objectives and presents a demonstration project currently being undertaken by the State and USGS to validate project assumptions that will be used during the PED phase.

APPENDIX F - WATER AND AIR QUALITY. Provides information on water quality in the project area and future conditions predicted with and without the project. Information on air quality prepared by Region 5 of the USEPA in support of the project provides information on the existing condition and future with project analysis.

APPENDIX G - PUBLIC INVOLVEMENT. Documents the process of obtaining public input to the restudy effort and provides supporting information for Section 10 of the report

APPENDIX H - REAL ESTATE PLAN. Documents the real estate requirements of the selected plan and provides the cost estimate and estates required to execute the project.

APPENDIX I - LOCAL COOPERATION. Documents the intent of the sponsors to cost share the project.

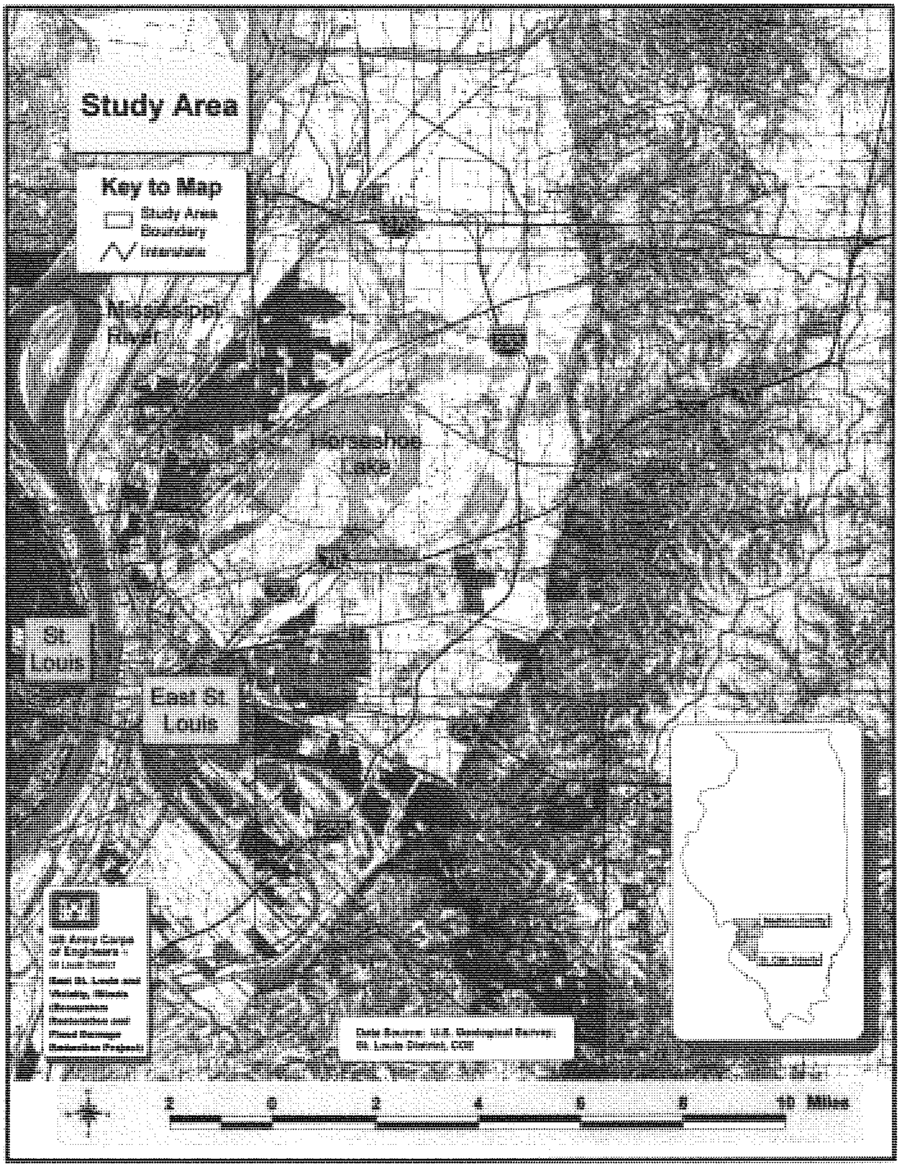
APPENDIX J - MCACES ESTIMATE. Provides the project estimate for project execution.

1.3 PROJECT AREA

1.3.1 Location. The East St. Louis and Vicinity, Illinois Project is located in Madison and St. Clair Counties, Illinois, along the left bank of the Mississippi River between river miles 175 and 195 above the Ohio River. It includes a portion of the bottomlands between the bluffs on the east and the Mississippi River and Chain of Rocks Canal on the west. It extends from the Prairie Du Pont canal on the south to the Cahokia Creek diversion channel on the north.

The project area includes approximately 55,000 acres of the 86,000 acres of floodplain that is protected by a levee system along the Mississippi River, the Chain of Rocks Canal, the Prairie Du Pont canal, and the Cahokia Creek diversion channel. An additional 51,000 acres is tributary to and drains into these bottomlands are also apart of the project area. Figure 1-1 depicts the project area.

Figure 1-1 Project/Study Area



1.3.2 Site Significance. The Study area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area would contribute greatly to national, regional and local systems. The Study area's ecosystem significance relates directly to contributions towards the: North American Waterfowl Management Plan; Upper Mississippi River System Environmental Management Program; Clean Water Action Plan; Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; and, federal government's list of "Species of Concern".

This area lies at the center of the world's fourth longest river system and is of national and international importance. It includes the largest urbanized floodplain north of New Orleans and sits at the confluence of the great rivers of North America, the Mississippi and the Missouri, which are among the nation's foremost natural and cultural resources.

This confluence has drawn people to it since man inhabited this country, becoming a crossroads in the middle of the continent. As far back as 12,000 years ago it was home to the ancient Cahokia civilization and contained great expanses or wetland, prairies and forests when European man arrived in the area in the 1700's. In 1982 a 2,000-acre portion of the Project area was designated by the United Nations as a World Heritage Site because of the areas significance. This designation places it in the company of such areas as the Grand Canon and the Mesa Verde.

The area provides essential habitat for waterfowl and migratory songbirds alike sitting at the heart of the major migratory flyways for both.

1.3.3 Organized Drainage and Levee Districts.

1.3.3.1 Introduction. Numerous drainage and levee districts have organized to provide local flood protection within the Project area since the late 1800's. These organizations are independently operated. However, discharges from each District drain into the canal system operated by the Metro East Sanitary District that extricates the water through a series of pumping stations and gravity drains through the main line levee into the Mississippi. The majority of these Districts operate on limited funding and in many instances are dependent upon the actions of only one or two participants. The following is a summary of each and their area of interest and current status. It should be noted that the area maintained by the various levee districts is larger than the area covered by this project.

1.3.3.2 The Metro East Sanitary District. The Metro East Sanitary District was originally organized as the East Side Levee and Sanitary District in 1907 and includes approximately 62,900 acres of bottomland or approximately 73 percent of the total bottomland within the Project area. The District extends approximately from the Cahokia Diversion Canal to the Prairie Dupont flank levee. The District also contains the principal urban and industrial developments in the area and operates and maintains all of the flood control facilities as well.

1.3.3.3 Chouteau, Nameoki, and Venice Drainage and Levee District. This District was organized in 1888 and includes a total of 4,066 acres located in the northeastern part of the Project area. The District extends generally from the Chain of Rocks Canal on the west to the Metro-East

Sanitary District on the east, and from the Cahokia Creek diversion channel on the north, to the Melvin Price Support Center on the south. The District maintains a system of ditches for interior drainage and also operates one pumping station along the Chain of Rocks Canal. The pumping station is used to remove runoff when gravity drainage is blocked.

1.3.3.4 County Ditch Drainage District. This District consists of about 4,740 acres within the northern portion of the of the Project area. It was organized as a drainage district in 1912. The District has an improved drainage channel that is designated as County Ditch. The ditch drains the District into the Cahokia Canal in the vicinity of the New York Central Railroad. In recent years, the local landowners adjoining the channel have handled channel maintenance.

1.3.3.5 Canteen Creek Drainage and Levee District. The District was organized in 1910 and includes an area of 1,349 acres along Canteen Creek. In recent years, the District has participated under a joint partnership with MESD and the Corps to rehabilitate this portion of the overall flood control system. Approximately half of the project is complete and work is ongoing.

1.3.3.6 Other Areas. Approximately 5,500 acres of the bottomland area are located between the eastern boundary of the Metro East Sanitary District, the bluffs to the west, the northern boundary of the district and to Interstate 55/70 on the south. There currently are no organized programs for maintenance of drainage facilities in these areas. Seven creeks, which originate in the uplands traverse this bottomland area and carry the runoff into the conveyance channels within the Metro East Sanitary District's area of responsibility.

1.3.4 Political Units of Interest. The project area is located in portions of Madison and St Clair Counties, Illinois and contains approximately 22 incorporated municipalities. The uplands portion of the Project area contains the municipalities of Edwardsville, Maryville, Glen Carbon, Collinsville, Fairview Heights, Belleville, and Swansea while Pontoon Beach, Granite City, Venice, Madison, Brooklyn, East St. Louis, Fairmont City, Washington Park, Sauget, Centreville, East Carondelet, Caseyville, Alorton, Cahokia and Dupo are located in the bottoms. Figure 1-2 and 1-3 depicts these areas. Figure 1-4 depicts the congressional boundaries of the project area.

Figure 1-2 Project/Study Area -Township Boundaries

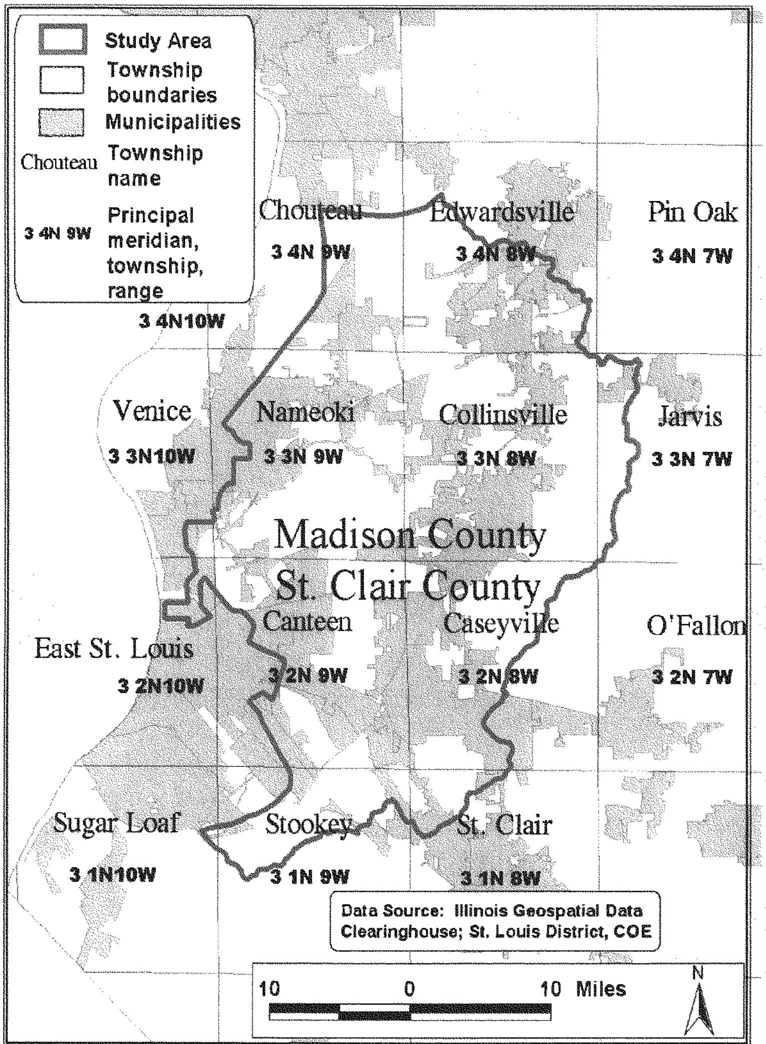


Figure 1-3 Project/Study Area - Municipal Boundaries

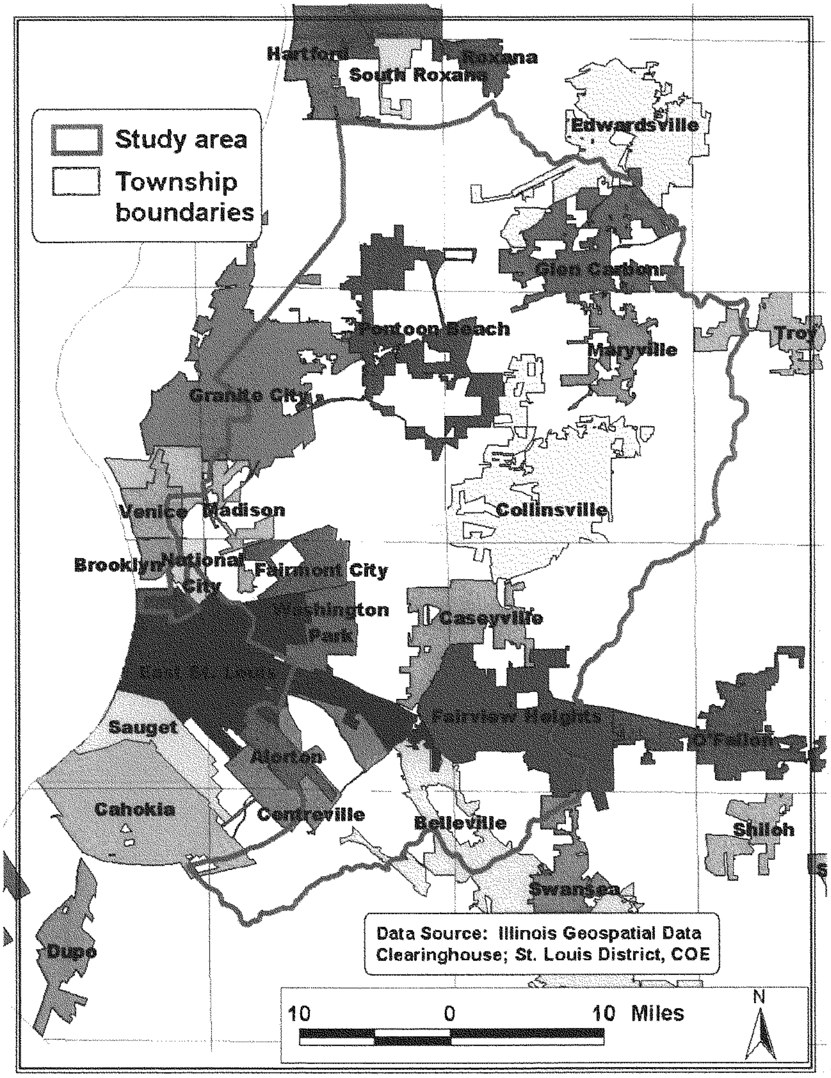
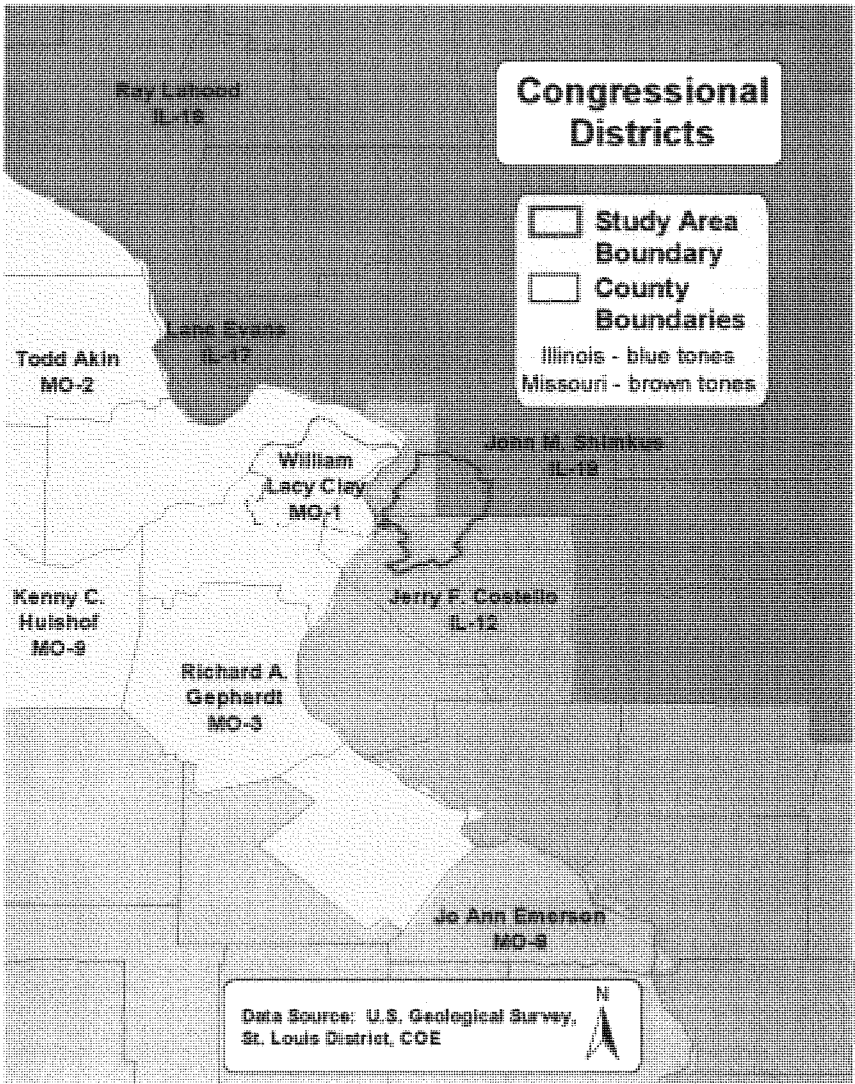


Figure 1-4 Project/Study Area - Congressional Boundaries



1.3.5 Major Sub-Basins and Watercourses. There are three principal basins within the Project area: the Cahokia Canal basin which drains approximately 74,300 acres; the Harding Ditch basin which drains approximately 27,439 acres; and, the Powdermill Creek/ Canal No. 1 basin which drains approximately 4,907 acres.

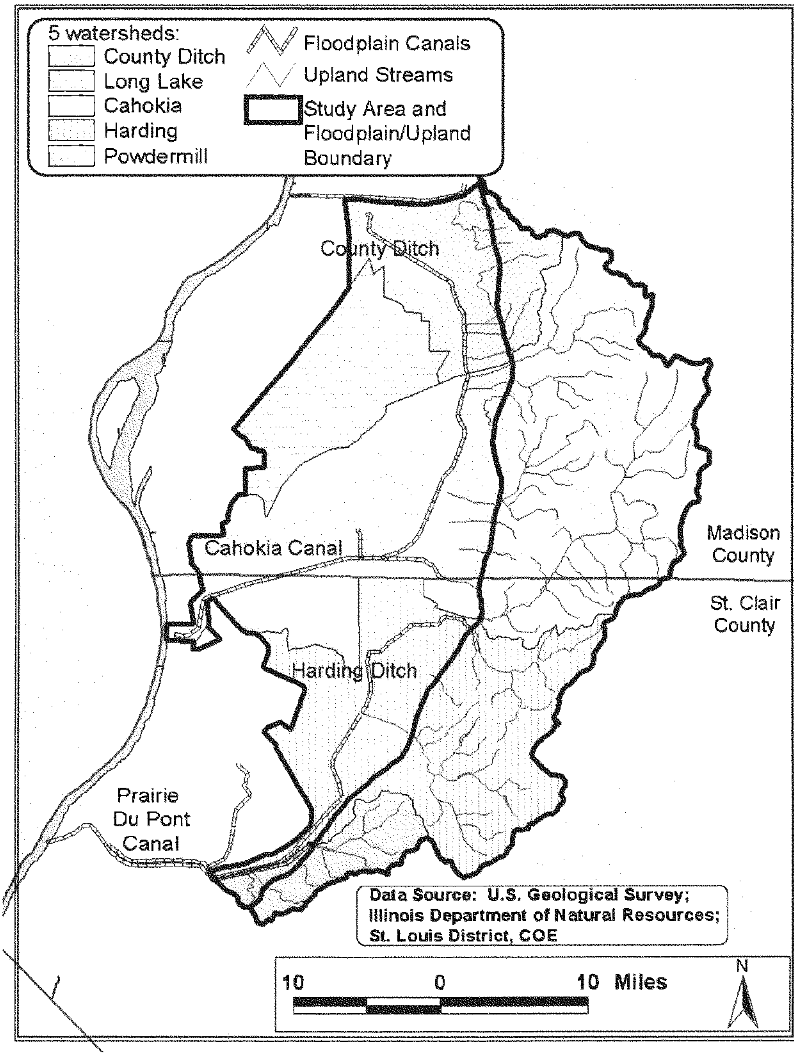
The Cahokia basin is comprised of four tributaries: Judy's Branch; Burdick Branch; Schoolhouse Branch; and, Canteen Creek. Cahokia Canal, County Ditch, the Horseshoe Lake Diversion Channel and Lansdowne Ditch form the floodplain tributaries of this basin. For study purposes this watershed was subdivided into three sub-basins, the County Ditch, which drains approximately 11,721 acres, Long Lake, which drains approximately 10,228 acres and Cahokia accounting for the remainder of the basin.

The Harding Basin is formed in the uplands and consists of Little Canteen Creek and Schoenberger Creek. Once formed, it then flows across the bottomland floodplain as "Harding Ditch".

Powdermill Creek is the only stream that drains into Canal No. 1. and thus, is responsible for forming this floodplain tributary.

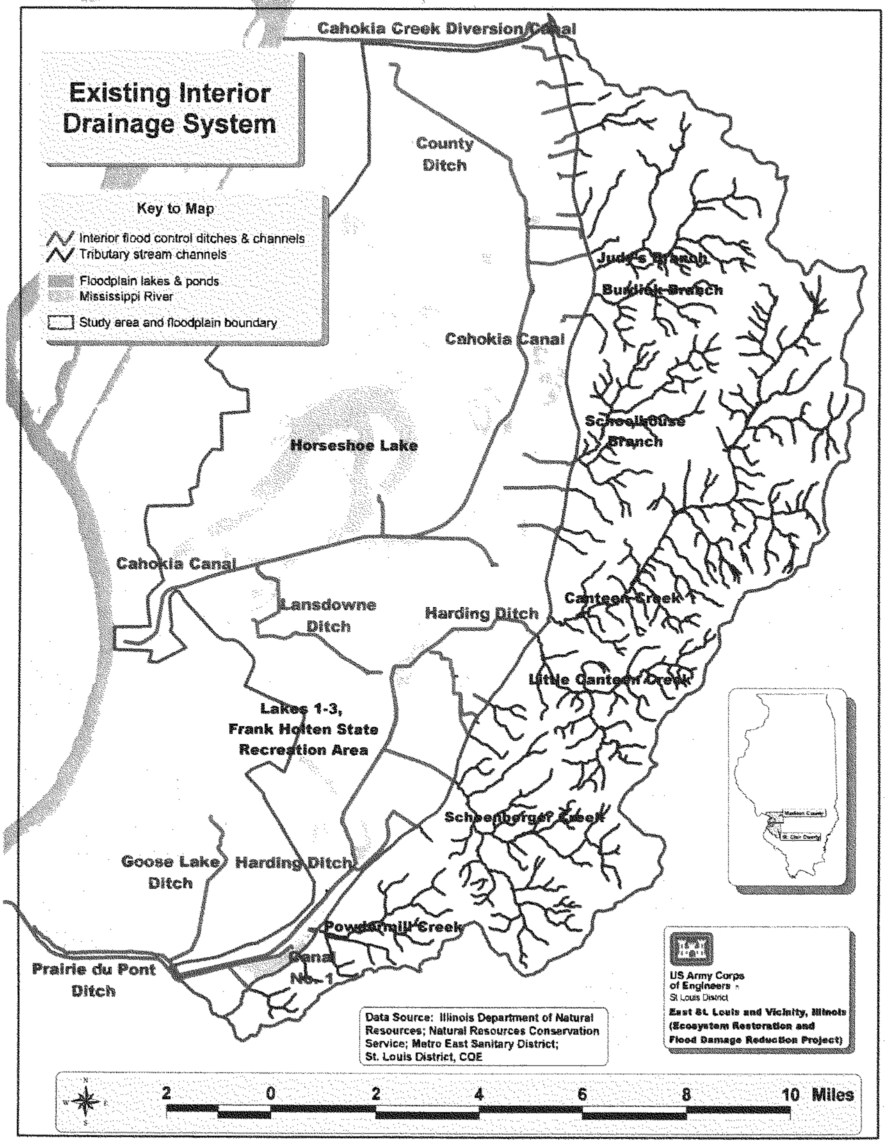
The tributaries streams are in a more natural, but somewhat degraded state, while on the floodplain watercourses have been channelized over time. The floodplain drains to the Mississippi River through levee gravity drains when river levels permit or through pumping plants when river levels do not. Figure 1-5 depicts the major sub-basins and watercourse, which make up the 5 watersheds of the project area.

Figure 1-5 Project Area Watershed Divisions



1.3.6 Existing Interior Flood Control Features. The interior floodplain is drained by a series of altered tributaries, which are now canals. These canals consist of some 40 plus miles of spoil bank ditches that capture water and carry it to the Mississippi River directly, or to the Mississippi River via the Prairie Du Pont Diversion Channel. These canals form the interior "flood control" system. Figure 1-6 depicts this interior drainage system.

Figure 1-6 Project Area Interior Drainage System



The main floodplain tributaries were formed when man altered existing streams to develop a system that was originated to serve agricultural needs. This system has not been significantly improved over time to accommodate either the urbanization or climactic changes experienced across the basins. These changes have dramatically increased interior flood control requirements since the mid 1900s.

The floodplain ditches are fed directly from tributary streams and smaller bottomland drainage systems. The ditches carry water from the bluffs, farm ditches, and localized pumping stations that extract water from the floodplain and place it into this interior flood control system. It is then carried to the Mississippi River. An urban levee and a full complement of interior pumping plants protect the floodplain from the Mississippi River.

1.4 NATIONAL ENVIRONMENTAL POLICY ACT REQUIREMENTS

1.4.1 Background. The National Environmental Policy Act (NEPA) of 1969, as amended, is the Nation's charter for environmental protection. The NEPA establishes policy, sets goals, and provides the means for carrying out the policy. Section 102(2) of the NEPA contains action-forcing provisions to ensure that federal agencies act in accordance with its letter and spirit, including a provision to prepare a detailed environmental report on the effects of a proposed federal action called an Environmental Impact Statement (EIS). The federal regulations for implementing the procedural provision of NEPA were published by the Council on Environmental Quality (CEQ) in the Code of Federal Regulations (CF) as 40 CFR Parts 1500-1508 (43 Federal Register 55978-56007, November 29, 1978).

1.4.2 Current Project Approach. This report documents the Corps of Engineers' investigations of potential modifications to the East St. Louis Interior Flood Control project for the purposes of ecosystem restoration and reduction of flood damages due to interior flooding all in compliance with the requirements of the NEPA. This report employs the integration concept established in the CEQ's NEPA regulations. Integration is based on the CEQ provision to combine documents such that "any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork" (40 CFR 1506.4). The Corps of Engineers' regulations implementing NEPA (ER 200-2-2) permit an EIS to be either a self-standing document combined with, and bound within an agency decision document, or an integrated document which contains NEPA-required discussions in the text of the decision document.

The St. Louis District has elected to integrate the General Reevaluation Report and Environmental Impact Statement into one report, for several reasons. First, the ecosystem restoration features and the flood damage reduction features of the proposed project are completely inter-related and must be presented in an integrated document. Secondly, this approach will reduce paperwork, redundancies, and allow the documentation of project formulation, plan selection, and plan impacts in one consistent report. Sections of the integrated report that include discussions required by the NEPA are marked with an asterisk in the Table of Contents to assist readers in identifying and locating this material.

1.5 PROJECT PROCESS

1.5.1 Plan Formulation. The project process followed the six step planning process as described in Engineering Regulation 1105-2-100, Planning Guidance Notebook, dated 22 April 2000. Even though this is a Re-evaluation Report, the full spectrum of plan formulation alternatives were developed in order to address the addition of ecosystem restoration as a project purpose. The guidance provided by Engineering Circular 1105-2-219, Cost Allocation For Multipurpose Projects Including Ecosystem Restoration dated 01 October 2000 was applied in order to accomplish the incremental analysis of the recommended plan.

1.5.2 Non-Federal Sponsor And Other Cooperating Agencies Involvement. While the Design Agreement identifies the non-Federal sponsor for the PED phase of the project as the Metro East Sanitary District (MESD), they are joined for this reevaluation effort in a separate four party agreement with the State of Illinois Department of Natural Resources (IDNR), Madison County, Illinois, and St. Clair County, Illinois. These entities serve jointly on a Metro East Regional Stormwater Committee that solicits input and participation from the public and private sector in identifying problems and opportunities for meeting the challenge of stormwater management across their areas of responsibility. This Committee provides a monthly forum for sharing project progress, identifying additional project issues and receiving input across the spectrum of project concerns.

The Environmental Protection Agency (EPA) and the Natural Resource Conservation Service (NRCS) agreed to participate with the Corps as cooperating agencies on the EIS for this project. This effort is a natural extension of their on-going efforts in the Metro East area to improve the quality of life and protect valuable natural resources. Each agency provided a biologist to participate throughout the Habitat Evaluation Procedures analysis and the Integrated Biological Evaluation Procedure (IBEP) for this project and also provided supporting technical expertise from their respective agencies. The EPA's Region 5 assisted in assessing water quality, air quality, hazardous and toxic waste plus environmental justice issues. The NRCS prepared extensive evaluations and analyses of sedimentation and stream erosion concerns in order to better define problems and opportunities.

The IDNR provided a biologist to the project team and provided technical support from their Office of Water Resources for hydraulic/hydrologic issues. The U.S. Fish and Wildlife Service provided a biologist to the project team and ensured that their resource issues and concerns were addressed throughout the process. Because unique archeological resources occur in the project area, close coordination was maintained with the Illinois State Historic Preservation Office during the formulation of alternative plans and subsequent plan evaluations.

1.6 PRIOR STUDIES, REPORTS AND EXISTING FLOOD CONTROL PROJECTS

1.6.1 Existing Project Accomplishments. The East St. Louis main line flood protection system, authorized by the Flood Control Act of 1936, has been complete for many years. Its features are approximately 19.8 miles of levee: floodwall improvements including: 6.1 miles of reconstructed riverfront levee, 4.8 miles of upper flank levee; 4.9 miles of lower flank levee; 0.9 miles of new riverfront levee; and 3.1 miles of riverfront floodwall. Complementary appurtenant works consist of gravity drainage structures at highway crossings, alterations and reconstruction of existing pumping plants, construction of new pumping plants, servicing of access roads on the levee crown, seepage corrective measures, and alterations to railroad tracks and bridges at levee crossings. The project levee grade (52 feet on the Market Street gage) affords protection against a flood with a 500-year return period.

1.6.2 Results of Prior Corps' Studies. In 1957, the Corps was authorized to study the engineering and economic feasibility of improvements to the interior flooding problem in the project area. Completion of the study and a recommended plan were documented in a Survey Report published in 1962. The Survey Report plan recommended 14 separate features: improvement of four channel systems; the construction of five bottomland detention areas; the construction of one upland reservoir on Little Canteen Creek; the use of two existing lakes for storage; the construction of one new channel; and, the construction of a new pump station for the Blue Waters Ditch area.

Based on the 1962 Survey Report, modification of the interior flood control system was authorized by the Flood Control Act of 1965 and had four major components: Blue Waters Ditch, Cahokia Low Water Dam, Harding Ditch drainage area, and the Cahokia Canal drainage area. The Water Resources Development Act (WRDA) of 1976 modified the 1965 Act by authorizing construction of the Blue Waters Ditch segment of the overall project independently of the other project segments. The Blue Waters segment was constructed in the 1980s.

Major repair work was done on the Cahokia Low Water Dam after the 1993 flood. The success of the repair will likely preclude the need to replace the low water dam as was originally authorized. The Harding Ditch and Cahokia Canal segments, the subject of this reevaluation study, were studied in the 1980s and resulted in a revised unpublished draft report in 1985. The conclusion stated in the document was that there is no economic justification for these two segments. The recommendation in the report was for those segments to be reclassified as inactive. However, due to severe flooding in 1995 through 1997 on the Harding Ditch and Cahokia Canal segments, a new Congressional appropriation in 1997 initiated a re-start of a general reevaluation of the interior area.

1.6.3 Other Related Projects (e.g., rehabilitation project, FEMA ditch clean-out). Due to the continuation of flooding problems, the State of Illinois became involved in the Dobrey Slough area. Flooding in this area was a problem from both surface water and from a rising groundwater table. In 1974, the State provided a solution for the more frequent surface water flooding by installation of a small pump station, which discharged into the Nameoki Ditch system.

During a Mississippi River flood event, which occurred in October 1986, a roller gate failed at the East St. Louis Pumping Station, resulting in river water backing into East St. Louis. This caused 1200 persons to be evacuated from their homes, and flood damages estimated at $35 million. This disaster focused attention on the need for rehabilitation of the deteriorated flood protection system, and led to the authorization of the Corps' "East St. Louis Flood Protection Rehabilitation Project." The majority of the rehabilitation took place along the mainline Mississippi River protection, but channel rehabilitation in the bottoms was also an authorized purpose. Much of the work has been completed, however, cleanout of the upper portion of Canteen Creek has not yet been completed. A supplemental report with additional rehabilitation items has been prepared.

After a large rainfall event in May 1995, significant interior flooding occurred throughout the bottoms area. This disaster reiterated the need to rehabilitate the deteriorated condition of the interior flood protection channels that were choked with vegetative growth and sediment. FEMA funded a $5 million cleanout of many of the major ditches in the bottoms. An additional $5 million dollars has spent on rehabilitation of many of the major ditches under the Corps Rehabilitation Project.

1.6.4 Relevant Studies, Reports, and Projects by Others. In 1905 a paper presented to the Association of Engineering Societies, provided a definitive look at the "Levee and Drainage Problem of the American Bottoms." This report discusses in detail the drainage problems facing the area in 1905 and proposes a number of potential solutions and costs. In many ways the organizational problems facing the area that was divided between two counties then, are still reflected today with respect to interior drainage problems.

In 1950, the Illinois Department of Public Works and Buildings' Division of Waterways issued a report entitled, "Proposed Hillside Diversion Project, Madison and St. Clair Counties, Illinois." The report included a recommendation for a project that included a bluff-line diversion channel, floodway enlargements, pumping station improvements, and run-off impoundments within the bottoms area of their project area.

In 1970, the Illinois Department of Transportation's Division of Water Resource Management completed a draft report entitled, "Flood Control Project For East St. Louis and Vicinity, Illinois," which incorporated the most desirable features of the 1950 report and added to this earlier plan, a reservoir on Prairie Du Pont Creek at the bluff line and the proposed deepening and widening of the Prairie Du Pont Diversion Channel.

In November 1972, the Illinois Department of Transportation issued a report entitled "Request for Public Law 99 Assistance, Dobrey Slough Flood Water Conduit." This report proposed a floodwater conduit to reduce flooding in the Dobrey Slough area.

In August 1975, the Southwestern Illinois Metropolitan and Regional Planning Commission issued a report entitled "Plan for Major Drainage: The American Bottoms and Hillside Drainage Area Planning Basin". The report proposed alternatives for reducing stormwater flooding in both the Cahokia Canal and Harding Ditch watersheds.

In December 1978, the Illinois State Water Survey issued a report on the analysis of the inflow hydrology of Horseshoe Lake. The report describes the drainage history of the lake, its hydrologic modeling, inflow frequency analysis, and hydrologic budget.

In August 1986, Hurst-Rosche Engineers, Inc. completed a report commissioned by the Metro-East Sanitary District (MESD) to identify the scope of rehabilitation and improvements needed to restore the flood control facilities under MESD operational control. The MESD's commissioning of the report was prompted by the failure of the roller gate at the East St. Louis Pumping Station in October 1986. The Hurst-Rosche report was used as a starting point to get the Corps' involved in the rehabilitation of the project.

Between 1990 and 1995 the Natural Resource Conservation Service (NRCS) in Madison and St. Clair Counties completed 6 planning studies that were designed to address flooding and sedimentation caused by erosion in the project area. However, no projects resulted from these studies:

Little Canteen Creek/Harding Watershed, Pre-Authorization Plan, May 24, 1995
Big Canteen Creek Hydrologic Unit Resource Plan February 9, 1995
Schoolhouse Branch Watershed Resource Inventory and Alternative Evaluation, September 15, 1995
Long Lake Watershed Resource Inventory and Alternative Evaluation, July 25, 1995
Judy's/Burdick Branches Watershed Resource Inventory and Alternative Evaluation, September 1, 1995

SECTION 2 - PRE-DEVELOPMENT CONDITIONS

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SECTION 2 - PRE-DEVELOPMENT CONDITIONS

2.1 INTRODUCTION

This section of the report provides an overall characterization of the conditions that existed in the Project area prior to construction of the Mississippi River levee system and prior to drainage and development activities in the East St. Louis floodplain. The Project Team determined that it was important to understand how the ecosystem of the Project area functioned prior to human development in order to realize how the functioning of the natural ecosystem has been impacted by human activity. This information provides a key to guide potential ecosystem restoration designed to beneficially utilize storm water as a replacement for the hydrology engineered out of the floodplain. In this manner ecosystem structures and functions can be better understood.

Three major topics are discussed in this section - structure, disturbance dynamics, and function of the predevelopment ecosystem. Structure is represented by the physical and biological conditions that existed in the ecosystem. Physical conditions include the predevelopment geology, stratigraphy, and hydrology. Biological or living resources include the communities, populations, and species that flourished, and these resources are described from three vantage points: as various types of land cover, as natural communities, and as species of flora and fauna.

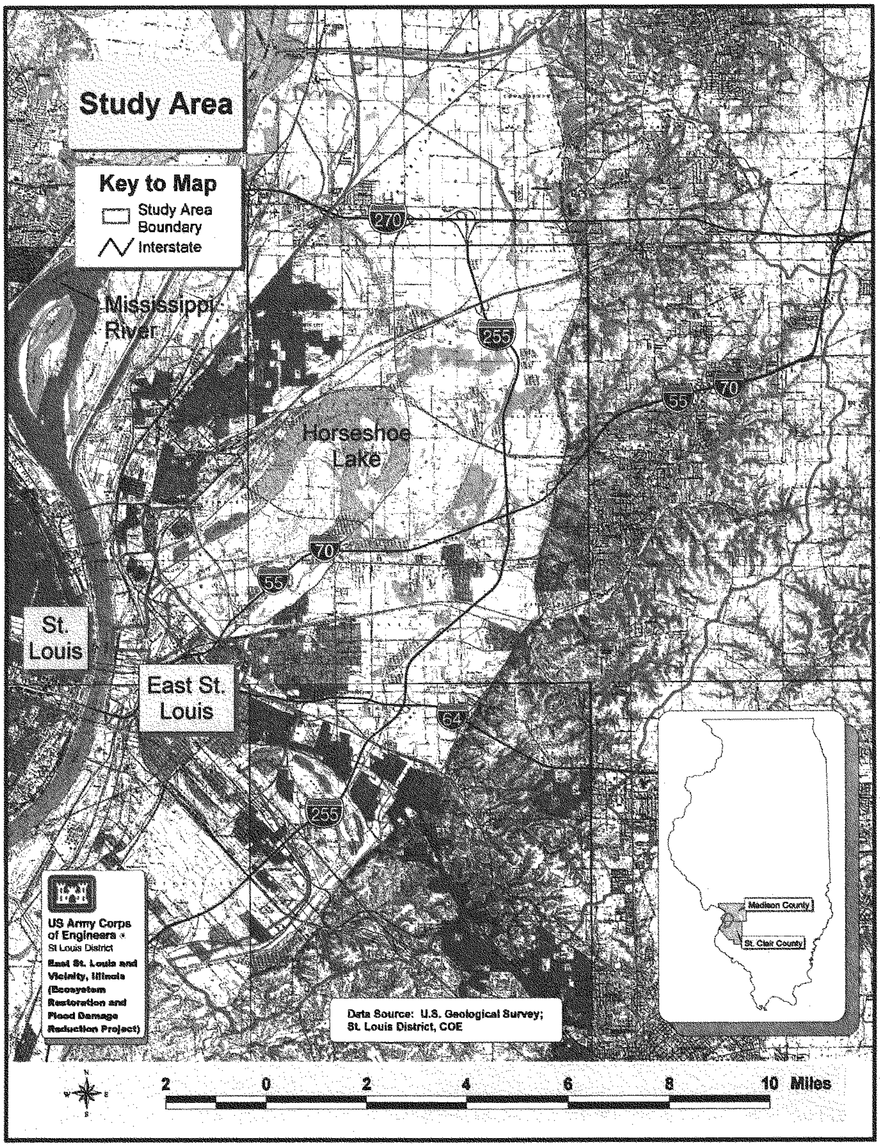
The discussion of disturbance dynamics describes the periodic episodes of flooding and wildfire that occurred in the ecosystem, and their importance in maintaining overall biological integrity. The final discussion describes ecosystem function, and focuses on wetlands and the functions they performed. These concepts are essential to the understanding of the inter-relationship between disturbance and the ecosystem of the floodplain and adjacent uplands.

2.2 PREDEVELOPMENT PHYSICAL CONDITIONS

2.2.1 Predevelopment Topography. Erosional and depositional forces have shaped the natural topography of the Project area over the last 7,000 years. The area has three main topographic areas: the relatively level alluvial flood plain of the Mississippi River, the upland bluff area of steep erodible slopes and narrow valleys, and the rolling hills of the uplands. The Project area is primarily located within a portion of the Mississippi River floodplain area known locally as the "American Bottom", and includes western portions of Madison and St. Clair Counties. The American Bottom extends beyond the Project area boundaries going farther north up to Alton and south into Monroe County near Dupo. The Project area is depicted in Figure 2-1. The American Bottom covers approximately 175 square miles (112,000 acres). The area is approximately 30 miles long and 11 miles wide at its widest point. The topography in the floodplain is nearly level bottomland. The floodplain generally slopes to the south and drops in elevation approximately 0.5-foot per mile mirroring the Mississippi River surface profile. The floodplain typically exhibits river meander scars, abandoned channel oxbow lakes, low-relief ridges, and swales.

Ancient Indian mounds rise above the American Bottom with the largest being Monks Mound that rises 85 feet above the adjacent floodplain and is located east of Fairmont City. The average elevation to the north near Alton is 415 feet above the National Geodetic Vertical Datum (NGVD) and to the south near Dupo is 405 feet NGVD. In the northern portion, there are terraces located along the foot of the bluff between East Alton and Roxana. The terraces are approximately 25 to 35 feet above the floodplain with elevations between 440 and 450 feet NGVD. The Project area north of Horseshoe Lake is typically higher than the adjacent floodplain with elevations between 420 and 435 feet NGVD. The topography near the Illinois bluff on the eastern edge of the floodplain is generally higher than the adjacent floodplain with elevations between 435 and 465 feet NGVD. The bluff rises steeply between 150 to 200 feet above the floodplain. The bluff has a rather rugged topography with the drainage channels forming valleys with steep slopes. Beyond the bluff line the topography consists of rolling hills and valleys with elevations ranging between 500 and 600 feet NGVD. Natural drainage patterns have carved steep narrow channels through the troughs and valleys. The Project area extends east beyond the American Bottom and into the adjacent uplands. The natural flat topography in the American Bottom is a major factor for widely meandering creeks and overland flows across the Project area. Abandoned channels and swales held water that formed large lakes and wetlands. The natural channels had very little slope and were not efficient in moving surface water from either the bluff or the American Bottom to reach the outlets to the Mississippi River. Surface water meandered slowly to the Mississippi River or remains in numerous natural depressions. These large flows from the bluffs and uplands created flood pulses that carried eroded sediments from the uplands and bluffs. The flows out of the bluffs enter the American Bottom with high velocities and are able to suspend more sediments than slower moving waters. Once sediment-loaded waters reached the nearly flat slopes, the slower moving waters allowed the sediments to aggrade (deposit sediments) in the creeks, swales, lakes, depressions, and adjacent lands with overland (out-of banks) flows.

Figure 2-1 Project Area



2.2.2 Predevelopment Geomorphology. Locally, the Mississippi River is quite old, and probably was established during the Mesozoic Era, and at the very latest during the Tertiary Period of the Cenozoic Era. The Mississippi River maintained its course at the eastern edge of the Ozark Plateaus (uplift) and eroded a broad bedrock valley bottom ranging in elevations between 290 and 310 feet NGVD with an average elevation of 300 feet NGVD, some 300 feet below the surrounding uplands. The eastern bluff has exposed bedrock outcroppings consisted of hard limestone deposits and softer deposits of shale, coal, and some sandstone. The limestones were formed during the Mississippian Period and are located north of Alton, Illinois, and south of Dupo, Illinois. Between Alton and Dupo, soft Pennsylvanian Period shales, coals, and some sandstones extend westward into St. Louis, Missouri, much like a tongue. It is this tongue of weaker shales and coals that enabled the young Mississippi River to cut a wider floodplain (11 miles wide at its widest point), which it was unable to do either upstream and downstream through harder limestone deposits.

2.2.2.1 Glacial Periods. Since the beginning of the Pleistocene Series (Ice Age) of the Quaternary Period, the character of the Mississippi River changed substantially. Investigations of Pleistocene Series deposits show a more complex history of multiple glaciation and interglacial period than previously surmised. For this Project the age and correlation of Nebraskan Stage and Kansan Stage glaciation are identified as pre-Illinoian Stage. Several deposits of old till that have been found are thought to be pre-Illinoian Stage glacial deposits, and probably the leading edge of the ice sheet lay somewhere within the Project area. The Liman Substage (first substage) of the Illinoian Stage glaciation (third glacial stage) moved across the Mississippi River, and a portion of the moraine is located in St. Louis County, Missouri (Bergstrom and Walker 1956). The Mississippi River probably flowed under the ice, but ponding probably took place upstream, and some of the results are preserved today in outstanding terraces along the lower Illinois River. Large boulders are occasionally struck by exploration drilling and sampling and well drilling in the American Bottom several feet below the deposits of till resting on the old riverbed. The Wisconsinan Stage glaciation (fourth stage) approached the Project area from the northeast, but stopped some seventy-five miles to the north of the Project area. However, these ice sheets had a major impact on the American Bottom, because the Mississippi, Missouri, and Illinois Rivers were major drainage ways for the heavily sediment-laden melt waters. The river channel began to aggrade to an estimated level of 445 feet NGVD, which is 35 feet above the current typical floodplain ground surface elevation of 410 feet. Heavy deflation took place during Wisconsinan Stage winters when westerly winds blew across the exposed glacial outwash consisting of materials of various sizes. The small, fine-grained materials, such as silts, fine sands, and rock flour, were carried by the winds and deposited on adjacent lands as loess (aeolian) deposits. The lighter particles were deposited on the upland as loess, attaining a thickness of 50 feet in places adjacent to the floodplain with a progressive decline in thickness as one moves eastward. As the Wisconsinan Stage glaciation retreated from the Mississippi River basin, the river began to degrade and remove some of the Pleistocene deposits within the Mississippi River valley fill.

2.2.2.2 Fluvial Geomorphology of the American Bottom. The Pre-development fluvial geomorphology of the American Bottom surficial geology was shaped by the succession of meandering former channels of the Mississippi River and its related flooding. Continuous cycles of degradation (erosion) and aggradation (deposition) of the Mississippi River and its tributaries meandering across the American Bottom floodplain during the past 7,000 years (Recent Epoch), have had great effects upon the configuration of the topography and environment. Most of the migration of the meandering Mississippi River occurred between the end of the Wisconsinan glaciation period and the 1800's. The continuous meandering of the Mississippi River across the American Bottom created abandoned channel deposits, backswamp deposits, sand and gravel point bar deposits, chutes and bar deposits, as shown in Figure 2-2 and described in more detail below.

Abandoned Channel Deposits. Abandoned channel deposits are the result of the gradual aggradation of fine-grained sediments within oxbow lakes formed by the lateral migration of the river. These deposits are thickest near the outside edge of the old channel meander loops. There are numerous abandoned channel deposits as shown in Figure 2-2. Present wetlands are located in these deposits since they drain so slowly.

Point Bar Deposits. Point bar deposits formed on the inside of the meander loops during the horizontal migration of the river channel. The river migrates laterally by depositing bars of sand and sometimes gravel on its inside edge of the old channel meander loops and shifting to the outside cutting the bank through periodic failures of the outside bank. The building of these series of bars results in a corrugated surface of sand ridges and clay-filled depressions or swales. These deposits create the ridge and swale topography common throughout areas near the river, such as portions of Cahokia, Madison, and Granite City.

Chute and Bar Deposits. Chute and bar deposits were formed in a manner similar to the point bar deposits except that the surface was frequently changed by the cut and fill action of fast flowing floodwaters. Many of the resulting chutes have characteristics similar to the abandoned channel deposits.

Backswamp Deposits. Backswamp deposits consist of fine-grained sediments laid in broad shallow basins during periods of flooding. The sediment rich floodwaters were ponded between natural levee ridges on separate meander belts or between natural levees and the bluffs.

Surface meander scars, shorelines, creeks, sloughs, and oxbow lakes are shown in Figure 2-2, such as Cahokia Creek, Pittsburg Lake, Cahokia Lake, and Horseshoe Lake. The topographic and soil patterns show a definite orientation related to the cutting and filing of the adjacent river. In the past it is possible that during periods of greater precipitation cycles that Pittsburg and Cahokia Lakes were connected, while during periods of drought the lakes almost completely dried up. Also, it may be interpreted that because of elevational differences, topographic breaks and abrupt termination of surface patterns, the former lakes differ in age. A geological cross section cut down to bedrock and across the American Bottom along with the different formations and the above described deposits are illustrated in Figure 2-3. The Mississippi River valley fill ranges in thickness from more than 120 feet in places, and feathers down to nothing near the bluff within the Project area. The surface deposits within the American Bottom are typically part of the Cahokia alluvium, which consists of up to 60 feet thick silty clay deposits on abandoned meanders, oxbow lakes, and point bar deposits (Grimley 2000).

Figure 2-2 Geological Map of the American Bottoms

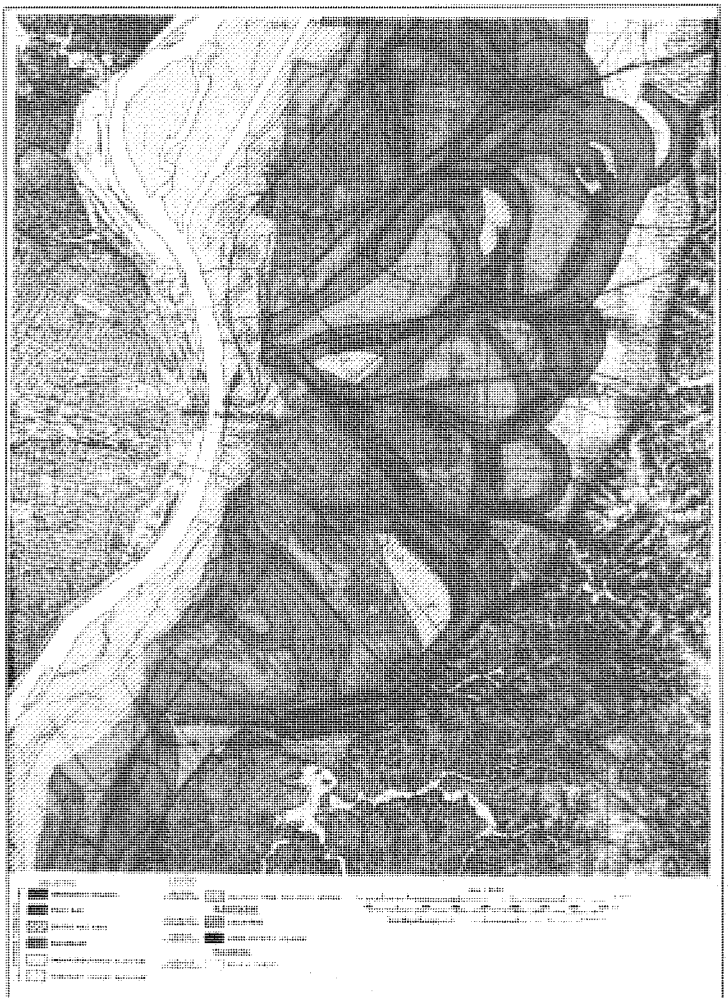
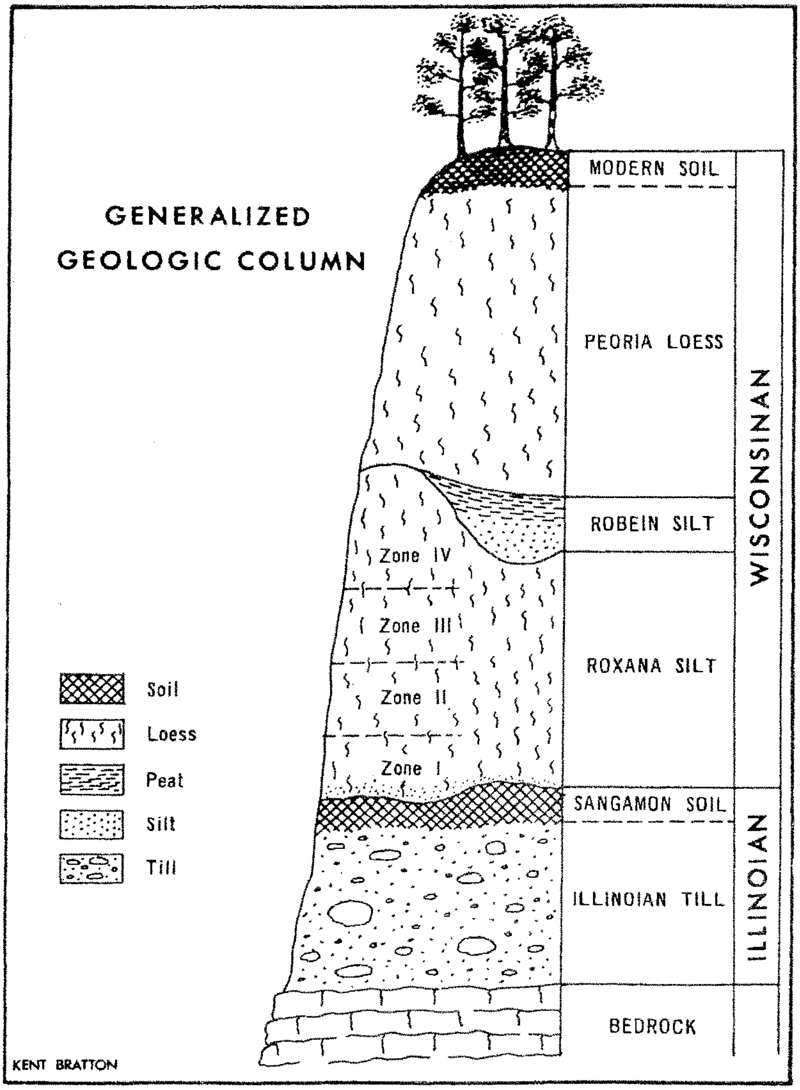


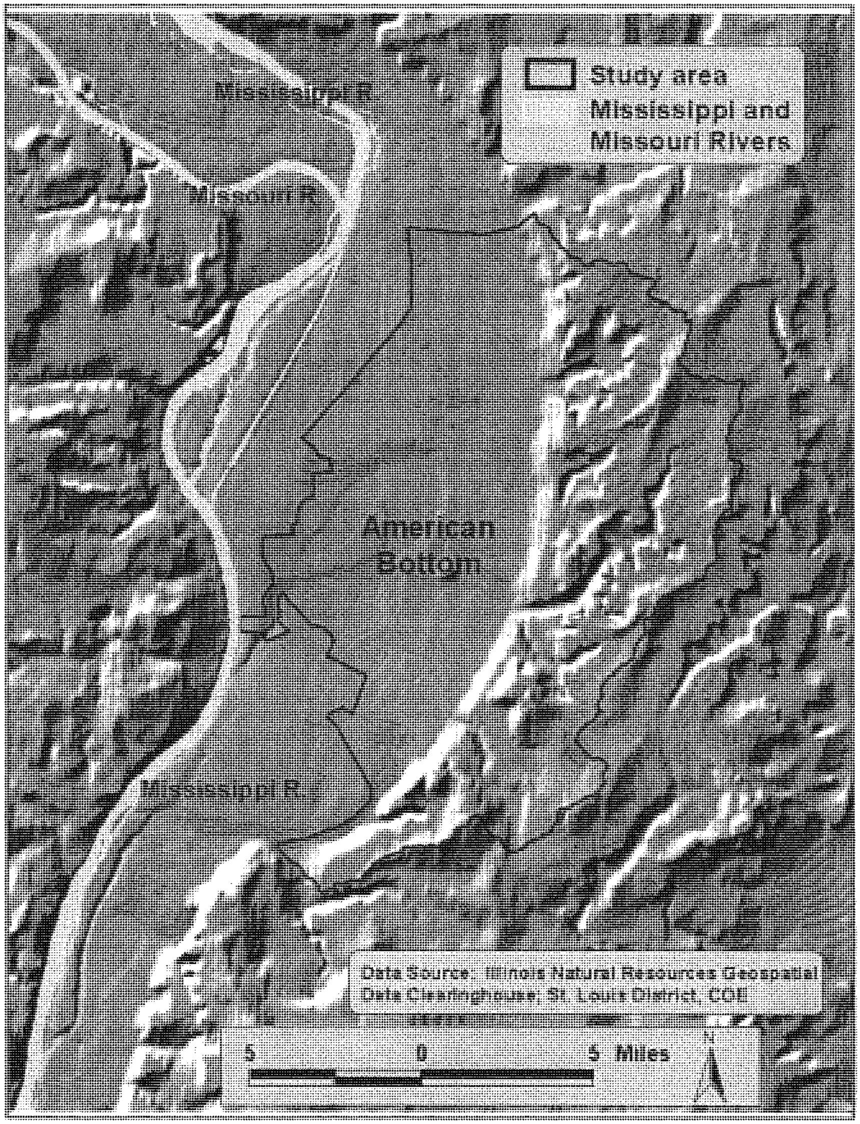
Figure 2-3 Geologic Cross Section



2.2.2.3 Pre-Development Upland Geomorphology. Loess is the dominant surficial soil in the upland and bluff areas. Loess consists of wind-deposited silt-sized particles carried by the wind from the glacial outwash as valley terrain along the Mississippi River. The glacial outwash came from the melting ice sheets to the north and consists of gravels, sands, silts and clays, which were deposited in the aggrading river valley. The prevailing westerly winds picked up the smaller particles of silts and clays and deposited them on the upland as loess. As a result of this major source area, the American Bottom, the thicker deposits are located in juxtaposition to the alluvial valley and thin to the east. Also, the loess is coarser in texture along the floodplain and becomes finer as one proceeds eastward. The level uplands are the remnants of a glacial plain formed by the deposition of a nearly flat, surficial body of lodgment till, over which a mantle of loess was deposited by the wind. The stream valleys and the slopes are a reflection of the pre-Pleistocene Series topography. The valleys were probably only partly filled with drift or were eroded by post-Illinoisan Stage streams. Most of the streams have eroded to bedrock somewhere along the valleys and have narrow floodplains, with the exception of the Schoenberger Creek, the longest stream on the upland section of the Project area. Roxana Silt was deposited during the Altonian Substage of the Wisconsinan Stage, and has been dated as extending from 70,000 Before Present (B.P.) to about 28,000 years B.P. The Roxana usually composes about one half of the total loess deposits. However, in some portions of the upland the overlying Peoria has been removed by erosion and the modern soil profile is developed in the Roxana Silt. Robein Silt is a localized formation, which was deposited during the Farmdalian Substage from 28,000 to 20,000 B.P. Farmdalian time was a period of warming during the Wisconsinan Stage. Peoria Loess was deposited during the period from 20,000 to 7,000 years B.P. It is the more dominant surficial material in the Project area, as can be seen in the prominent loess pits along the Mississippi River Valley and bluffs.

2.2.3 Physiography. The Project area is located in part in two geological provinces, Ozark Plateau on the west and Central Lowlands on the east. The uplands are in the Springfield Till Plain of the Central Lowlands. The Springfield Till Plain was formed by Illinoian glacial drift that formed a nearly level surface, except where stream dissection has taken place (Ekblaw and Horberg 1948). Narrow flat-topped divides, V-shaped valleys, and slopes of up to 35 percent characterize the bluff. The area has a mean slope of eight degrees and an average local relief of 132 feet (Sandy 1971; Schoen 1972). Figure 2-4 shows the general physical relief of the Project area.

Figure 2-4 Physical Relief of Project Area



2.2.4 Predevelopment Stratigraphy.

2.2.4.1 General. The geologic history of the Project area was divided into three main periods. The periods are: (1) bedrock formations were formed during the Paleozoic Era; (2) deposition of the unconsolidated glacial materials occurred during the Pleistocene Series; and (3) erosion and deposition of the unconsolidated materials occurred and modern soils formed during the Recent Epoch.

2.2.4.2 Paleozoic Stratigraphy. During the Paleozoic Era the Project area, as well as most of the Midwest, was intermittently submerged beneath the sea. Responding to continental tectonic activity with continental plate movements in the nearby Ozark Plateaus and the more distant Appalachian Mountains to the east, the seas alternately advanced, depositing sedimentary rocks, and retreated from the area. This migration of seas brought periods of marine deposition, followed by times of erosion. These events are recorded in some 1,500 to 3,000 feet of sedimentary rocks, mostly limestone, shale and sandstone, which underlie the glacial and Recent Epoch aged sediments. The bedrock formations underlying the Project area were primarily formed during the Pennsylvanian and Mississippian Periods of the Paleozoic Era. Rocks of the Mississippian Period underlie the western floodplain and strata of the Pennsylvanian Period underlie the eastern bluff and uplands of the Project area. The Mississippian Period materials are chiefly limestone and shale of the Chesterian and Meramecian Series. The Pennsylvanian Period materials include shale, coals, sandstone, and shale interbedded limestone. The Pennsylvanian Period materials occasionally outcrop along some of the more deeply incised valleys on the upland. The seas withdrew from the Project area after the Pennsylvanian Period, after which a long period of erosion occurred until the ice sheets appeared in the Midwestern United States about one million years ago; thereafter began the depositional history of the Pleistocene Series on the uplands and the Mississippi River valley.

2.2.4.3 Pre-Wisconsinan Stage, Pleistocene Series Stratigraphy. The upland areas of the Project area are covered with glacial materials that vary in thickness from zero to over one hundred feet. The Banner Formation of the Kansan Stage probably overlies much of the bedrock of the Project area. The extent and thickness of this formation is not known. This geological unit consists of glacial till and outwash of sands, gravels, and silts. (Willman and Frye 1970). Overlying the Banner Formation is the Glasford Formation of the Illinoisan Stage. It includes glacial tills and outwash deposits (Willman and Frye 1970). The material is overlain by the Sangamon Soil that developed in the formation during the Sangamonian Stage interglacial stage (Sangamonian Stage ended about 75,000 years B.P.) The till represents deposits laid down directly by the ice and consists of particle sizes ranging from clays to large boulders. Overlying the earlier glacial tills are different ages of loess deposited during the Wisconsinan Stage.

2.2.4.4 Wisconsinan Stage Stratigraphy.

2.2.4.4.1 General. The Wisconsinan Stage deposits may be divided into three geologic formations: Roxana Silt, Robein Silt, and Peoria Loess. The Roxana and Peoria are composed mostly of silts of varying mineral composition while the Robein Silt consists of peat, and organic-rich and deoxidized silts deposited in water. The Robein occurs only locally and in rather small deposits, which have not been adequately mapped (Bratton 1971).

2.2.4.4.2 Roxana Silt. The most distinctive characteristic of the Roxana Silt is the red color, caused by the rare iron mineral lepidocrocite (Layne-Western 1965) and the weathered surface at the Roxana-Peoria contact. This contact surface is high in clay content and as a result gravitational waters tend to slide laterally along the surface. Lutzen (1970) reported that about fifty percent of the gravitation water flowed along this contact. This condition may cause construction problems related to the water seeps and the possibility of slab failures in the loess deposits on steep slopes.

2.2.4.4.3 Robein Silt. This formation consists of peat, tree limbs, roots and high organic silts that are probably reworked sheet wash from the Roxana Silt. The Robein Silt appears to be localized in old stream valleys or lakes on the Roxana Silt surface. This is apparent because the deposition occurred in water-saturated conditions.

2.2.4.4.4 Peoria Loess. The Peoria Loess is prominent as the upland surficial deposit in western Illinois. The particle size distribution of the Peoria Loess is about 80 percent silt-sized material (0.05-0.002 mm). The most important aspect of the mineralogy of the Peoria is the 20 per cent or so of clay. Seventy per cent of the clay minerals are montmorillonite or expanding clays (Frye and Glass 1962).

2.2.4.5 Recent Epoch Stratigraphy.

2.2.4.5.1 General. The Recent Epoch generally is accepted to begin at the end of the last ice age, Wisconsinan Stage. It defines all deposits younger than the top of the Wisconsinan Stage and extends 7,000 years B.P. to the present. The upper portions of the surficial soils within the Project area were formed during the Holocene Stage. However, the lower portion of some of the surficial soil deposits were aggrading during the Wisconsinan Stage since as soon as the glaciers melted away, an assortment of soils were being deposited. In many areas the soils were intermixed, overlapped, and intertongued. The boundaries between Wisconsinan Stage and Recent Epoch deposits are blurred.

2.2.4.5.2 Cahokia Alluvium. The Cahokia Alluvium (Willman and Frye 1970) is named after the village of Cahokia that is within the Project area. The Cahokia Alluvium consists of soil materials deposited in the floodplains and channels. The formation consisted of poorly sorted silt, clay, and silty sand with lenses of sands and gravels. The formation thickness varies considerably but rarely exceeds 50 feet. The Cahokia Alluvium rests on the Henry Formation of the Wisconsinan Stage.

2.2.4.5.3 Peyton Colluvium. The Peyton Colluvium (Willman and Frye 1970) is named after Peyton Creek in Peoria County located at the base of the Illinois River bluff. The formation is sometimes described as slope wash and alluvial fans (Wanless 1957). The formation consists of narrow bands located at the base of the bluff, and consists of poorly sorted materials from bluff slope failures and eroded materials from the uplands and bluff areas. The materials have accumulated on the lower slopes and at the base of the slopes by erosion, soil creep, slope instability failures, slope wash, and mudflows. Numerous alluvial fans and cones developed at the mouths of streams and gullies, and are deposited on floodplain areas and terrace surfaces. The Peyton Formation is a surficial deposit and possibly intertongued with the Cahokia Alluvium.

2.2.5 System Hydrology/Watershed Characteristics. The naturally flat topography in the American Bottom (Bottom) is a major factor for the existence of wide meandering creeks and overland flows across the Project area. Abandoned river channels and swales hold water that form large lakes and wetlands. The natural channels have very little slope and are not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River. Surface water meanders slowly to the Mississippi River or remains in numerous natural depressions. These large flows from the bluffs and uplands create flood pulses that carry eroded sediments from the uplands and bluffs. The flows out of the bluffs enter the Bottom with high velocities and are able to suspend more sediments than slower moving waters. The slower moving surface waters allow the sediments to drop out and be deposited (aggrade) in the creeks and deposited on adjacent lands during overland (out-of banks) flows

Drainage prior to settlement in the early 1900's generally flowed toward the Mississippi River and was intercepted by swales, creeks, and major channels. Flooding from the Mississippi River and its major tributaries frequently inundated large areas of the floodplain.

The natural over bank drainage and meandering creeks flowing into the Mississippi River became blocked beginning in the early 1900's by the flood protection systems that were constructed. Prior to 1910, the original Cahokia Creek channel in the Bottoms received 260 square miles of upland drainage area. The channel extended approximately 51 miles north of the Project area and about 40 miles across the American Bottom. The mouth of Cahokia Creek was located south of East St. Louis near Mississippi River Mile 179.0. Under pre-development conditions, all the hillside streams in the Project area except for Powdermill Creek, drained to Cahokia Creek as it meandered through the Bottom. Cahokia Creek flowed naturally through McDonough Lake, Brushy Lake, Horseshoe Lake and Indian Lake as it skirted the western edge of East St. Louis before entering the Mississippi River. The original Cahokia Creek channel flowed closer to the bluff line than the man-made Cahokia Canal that was built in the 1900's. Little Canteen Creek also flowed through Brushy Lake as it entered Cahokia Creek. Schoenberger Creek flowed northwesterly out of the bluff, through the Crooked Lake and Spring Lake areas, and then westerly to Cahokia Creek downstream of Indian Lake. Powdermill Creek flowed into Pittsburg Lake, which became the Grand Marais Lakes in Frank Holten State Park. From Pittsburg Lake flow eventually entered Prairie Du Pont Creek. Figures 2-5a and 2-5b depict these presettlement floodplain watershed characteristics. Numbered watersheds in Figure 2-5a are identified in a hydraulic history of the Project area that appears in Section C.1 of Appendix C.

Figure 2-5a Historic Bluff Watersheds of American Bottom

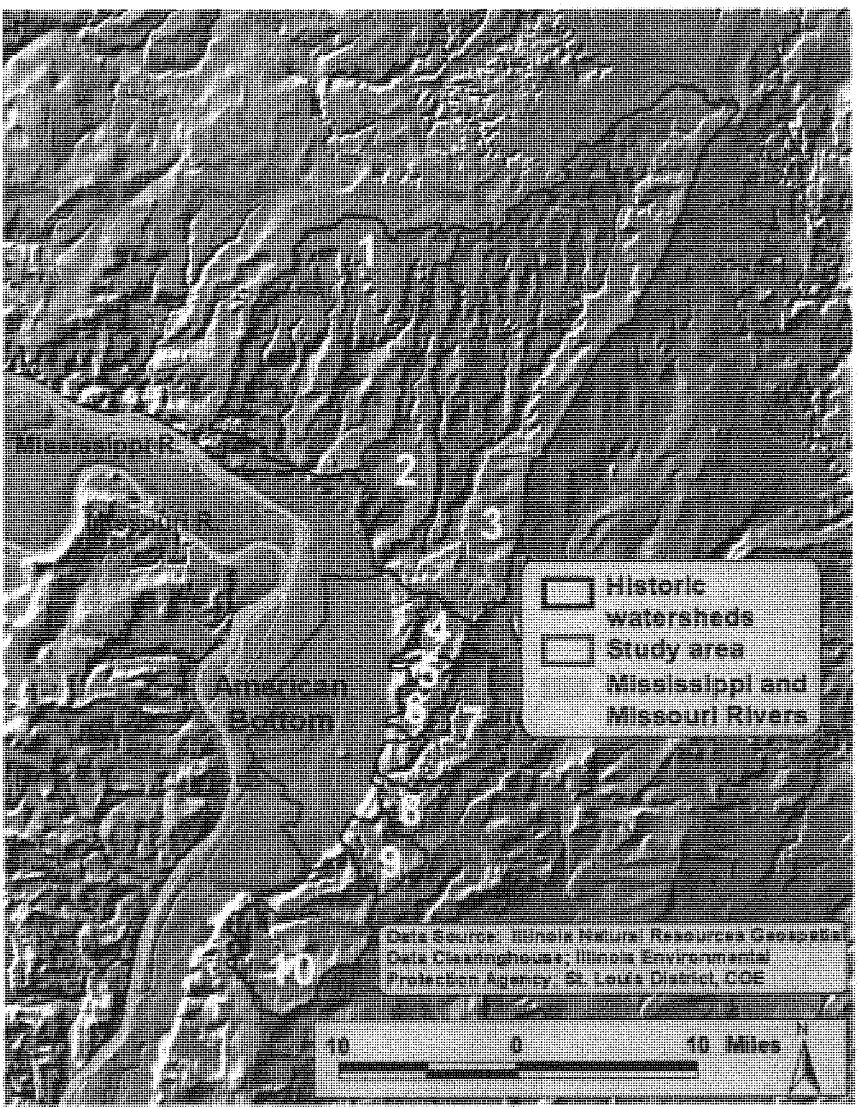
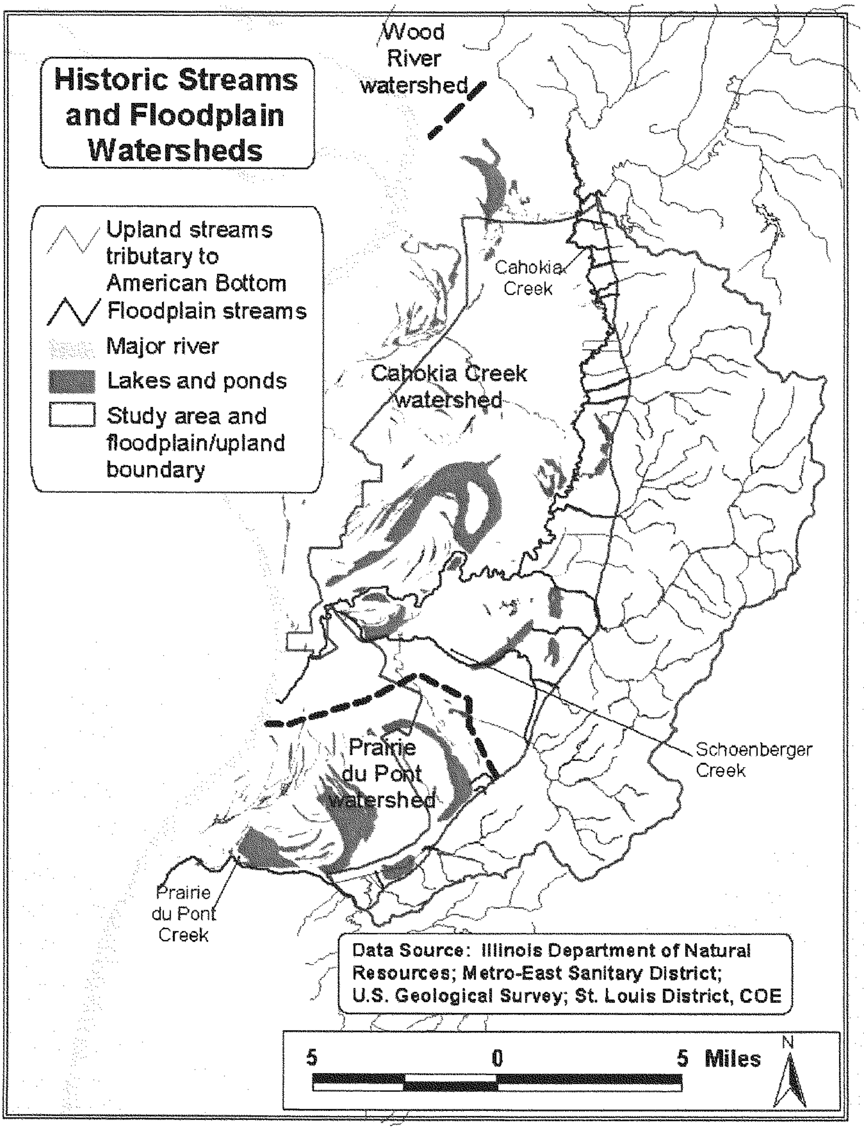


Figure 2-5b Historic Streams and Floodplain Watersheds



2.3 PREDEVELOPMENT ECOLOGICAL CONDITIONS

Two hundred years ago, the Project area and vicinity supported a great diversity of living resources. Vast expanses of forest and prairie occurred there. On the Mississippi River floodplain, complexes of backwater lakes, sloughs, and marshes punctuated the forests and prairies. Streams beginning in the uplands meandered across the floodplain to discharge into the Mississippi.

Prior to describing these resources, it is helpful to know that the two major landforms in the Project area – the Mississippi River floodplain and the adjacent uplands – each correspond to a distinct ecological or natural division in Illinois.

2.3.1 Illinois Natural Divisions. Illinois has been classified into fourteen natural divisions or distinct regions that share similar geologic history, soils, topography, plant and animal distributions, and presettlement vegetation (Schwegman 1973). This classification of natural divisions formed the framework for the classification of natural communities used by the Illinois Natural Areas Inventory in the mid-1970s to survey Illinois for high quality remnants of its natural heritage (White 1978). Two natural divisions occur in the Project area.

The Lower Mississippi River Bottomlands Division is represented by the relatively flat Mississippi River floodplain in southern Illinois, reaching from Alton (Madison County) at the north to Thebes (Alexander County) at the south. Tree species diversity in this Division is higher than that of the Mississippi River floodplain to the north because of the presence of some southern species (White and Madaney 1976). The Northern Section, one of two subdivisions in this division, extends from Alton to about the midpoint of the division at Chester (Randolph County). Presettlement vegetation in this Section consisted of forests, prairies, and marshes (White and Madaney 1976).

The upland portion of the Project area is found in the Middle Mississippi Border Division. This region is represented by a relatively narrow band of bluffs and dissected uplands overlooking the Mississippi River in the middle third of the state. Forest was the predominant kind of presettlement vegetation, and some prairie occurred also. The Glaciated Section of this Division, one of two subdivisions, extends into the Project area from the north, and terminates at about the Prairie Du Pont Creek watershed, just outside the southern limit of the Project area.

In the vicinity of the American Bottom, a third division, the Southern Till Plain Division, lies east of the Middle Mississippi Border Division, and just east of the Project area's uplands. This Division consists of dissected Illinoisian glacial till plain covered in presettlement times with forest and prairie (White and Madany 1978).

2.3.2 Predevelopment Living Resources. The predevelopment living resources that occurred in the Project area consisted of the communities, populations, and species of plants and animals that flourished there. In this section, these resources are described from three perspectives. First, the land cover is characterized to provide a broad description of environmental conditions. Second, natural communities that were present are portrayed, offering a more detailed view. Lastly, the flora and fauna as distinct species are summarized.

2.3.3 Land Cover. Figure 2-6 displays a reconstruction of land cover conditions from about 1800. The map is a visual interpretation of unpublished field notes made in 1811 by surveyors from the General Land Office (GLO) of the Federal government, and was created recently by biologists with the Illinois Natural History Survey (INHS 1998). The GLO surveyors established our rectilinear survey system consisting of townships, ranges, and sections. They marked the location of section and quarter section corners on the ground. While surveying, they made notes about their work, and often included comments about changes in topography and vegetation as they progressed. From the surveyors' notes, various kinds of land cover were consistently mentioned. Six of these occur in the Project area, and they include timber, scattered timber, lake-slough-pond, prairie, wet prairie, and brushy prairie.

Figure 2-6 displays these six types of land cover. Nearly 60 percent of the Project area was forested, and about 33 percent consisted of different kinds of prairie (Table 2-1). Aquatic areas, including lakes, sloughs and ponds, covered about five percent of the land's surface. Only three percent of the Project area is not reflected in Figure 2-6.

Figure 2-6 Predevelopment Land Cover of the Project Area

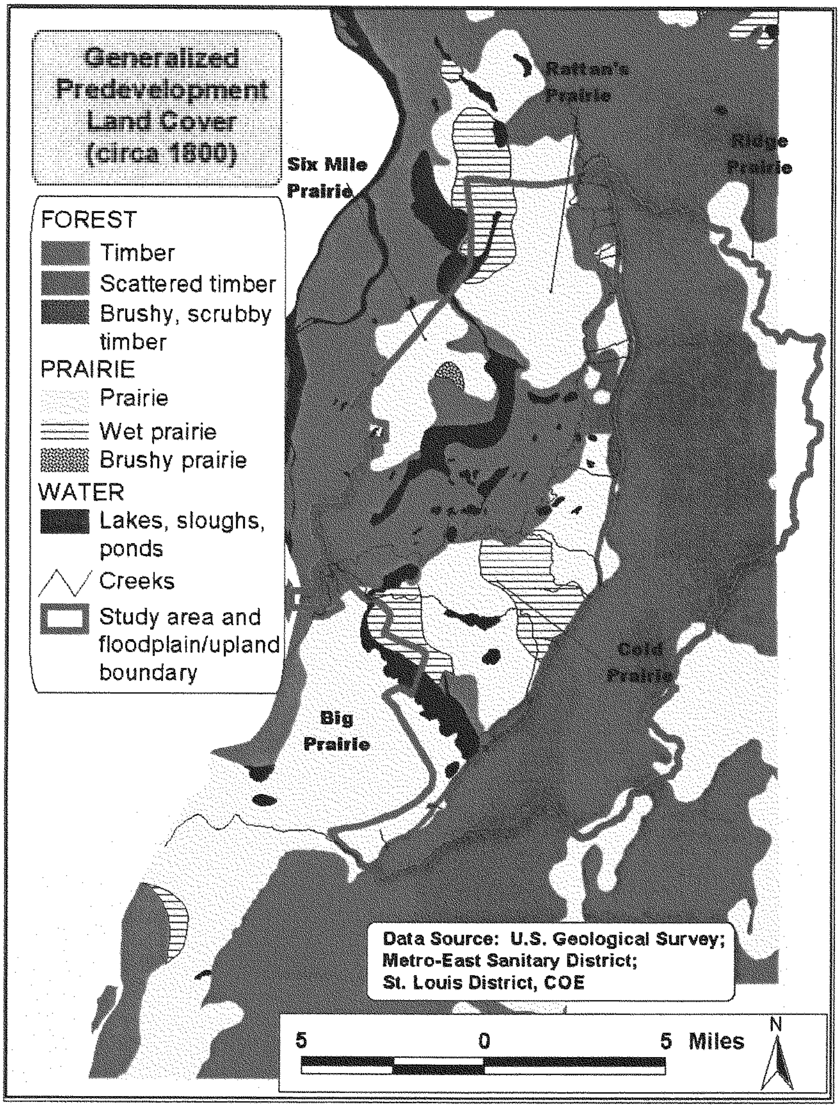


Table 2-1 Predevelopment Land Cover Within the Project area

Land Cover Classes	Area (acres)	Percent of Project Area
Timber	45,300	42.5
Scattered timber	17,600	16.5
Subtotal "forested"	*62,900*	*59.0*
Lake -slough – pond	4,950	4.6
Prairie	28,700	26.9
Wet prairie	6,650	6.2
Brushy prairie	200	0.2
Subtotal "prairie"	*35,550*	*33.3*
Unmapped	3,200	3.0
Total	**106,600**	**100.0**

With respect to the distribution of these cover classes in the Project area by landform, about 69 percent of all forest in the Project area occurred in the uplands (Table 2-2). Over 90 percent of all kinds of prairie were in the floodplain. All of the lakes, sloughs, and ponds were in the bottoms. Additionally, nearly all the scattered timber was in the uplands, and all the wet and brushy prairies were in the bottoms.

Table 2-2 Predevelopment Land Cover Within the Project area by Landform

Land cover classes	Area (acres)		Percent of Project Area		Percent of Land Cover Class	
	Floodplain	Upland	Floodplain	Upland	Floodplain	Upland
Timber	18,800	26,500	17.6	24.9	41.5	58.5
Scattered timber	750	16,850	0.7	15.8	4.3	95.7
Subtotal "forested"	*19,550*	*43,350*	*18.3*	*40.7*	*31.1*	*68.9*
Lake -slough - pond	4,950	0	4.6	0.0	100.0	0.0
Prairie	25,400	3,300	23.8	3.1	88.5	11.5
Wet prairie	6,650	0	6.2	0.0	100.0	0.0
Brushy prairie	200	0	0.2	0.0	100.0	0.0
Subtotal "prairie"	*32,250*	*3,300*	*30.2*	*3.1*	*90.7*	*9.3*
Unmapped	50	3,150	<0.1	3.0	1.6	98.4
Total	**56,800**	**49,800**	**53.3**	**46.7**		

The land cover map in Figure 2-6 actually extends further south, to the mouth of the Kaskaskia River. A similar pattern of forests and prairies in the uplands and on the floodplain can be seen along this 60-mile reach of the Mississippi River.

Figure 2-6 is currently the best approximation of predevelopment land cover conditions in the American Bottom, but it is only a generalized view. Detail is lacking because the surveyors went about establishing a grid system consisting of 1-mile squares and traversed the landscape along section boundaries. Since their method did not require them to cross the interior of each section, their notes mainly reflect the vegetation conditions they saw along the lines they surveyed, and not within each 1-mile square section. The map also includes discrepancies.

One example is the shape of Horseshoe Lake. Its portrayal in Figure 2-6 does not resemble its actual shape. The reason for this is not known, but may reflect difficulties the surveyors had in maintaining straight survey lines while traversing (or skirting around) this large water body.

2.3.4 Predevelopment Natural Communities. The description of predevelopment natural communities in this section is based on the classification system of the Illinois Natural Areas Inventory (INAI). In the mid-1970s, biologists systematically inventoried all of Illinois to locate, identify, and assess the condition of the state's remaining natural heritage (White and Madaney1978). The inventory or classification system they employed divides the earth's surface of land and water into nine community classes. They are forest, prairie, savanna, wetland, lake and pond, stream, primary, cave, and cultural. Rocky areas, such as cliffs, glades, and lakeshores, make up the primary class, and areas of human disturbance, such as cropland, pastureland, and developed land, represent the cultural class.

Two hundred years ago, six classes were found in the Project area - forest, prairie, wetland, lake and pond, creek and river, and cultural; a seventh, savanna, may have occurred also. Although cliffs and glades and caves were never present, they occurred not far away to the south and to the north.

The INAI hierarchy subdivides most of these classes into subclasses, and each of these subdivisions consists of a number of similar yet discrete natural communities. A natural community is "a group of organisms that are interrelated with each other and their environment" (White and Madaney 1978:316). Communities are distinguishable from each other by a set of unique characteristics, such as topographic position, soil moisture, vegetation structure, and species composition. Soil moisture is often a key characteristic, and is reflected in the names of many communities. For example, soil moisture categories include xeric (excessively drained), dry (somewhat excessively drained), dry-mesic (well drained), mesic (moderately well drained), wet-mesic (somewhat poorly drained), wet (poorly drained), and hydric (very poorly drained).

It is noteworthy that although most names of natural communities are based on the dominant type of vegetation present, each community represents not just the plants it supports, but also all the animals and other organisms living there. In addition, the transition between two adjacent communities may be abrupt or very gradual, reflecting how quickly or slowly factors such as topography, soil type, and soil moisture change across the landscape.

Twenty-six different natural communities occurred or may have occurred in the Project area. They are described below for each of the seven classes. Identification of these communities was facilitated using White and Madaney (1978) and IDNR (1998e). Overlaying the land cover map of Figure 2-6 upon the digital soil surveys for Madison and St. Clair Counties (NRCS 2000a,b) also assisted in the identification process. The description of each community includes plant and animal species that are typical or characteristic.

2.3.4.1 Forest. Trees dominate forests, and their canopy coverage averages 80 percent or more. Below the overstory or canopy layer, most forests have understory trees and shrubs and a ground layer of herbaceous plants. Seven different forest natural communities probably occurred within the Project area, and they fell into two forest subclasses – upland forest and floodplain forest. It is important to note that these communities did not occur in isolation one from the other, but they "fit together" in a mosaic to create large continuous expanses of "forest."

As many as seven types of forest natural communities occurred in the Project area. In the uplands, four upland communities probably were present. "Dry upland forest" was limited to the dry south and southwest facing slopes of ridge crests and upper portions of bluffs overlooking the Mississippi River. "Dry-mesic upland forest" appears to have been common, and occurred in the dissected terrain behind the bluffs, specifically on the upper slopes of ravines and ridges adjacent to upland streams. It also extended onto the flatter ground east of this dissected terrain. (Rather than "dry-mesic upland forest", savanna may have actually occurred here – see the savanna discussion below). "Mesic upland forest" was also common, and occurred in the dissected terrain on the lower slopes along upland streams, in ravines, and on high terraces adjacent to these stream channels. "Wet-mesic upland forest" occurred on the flat drainage divide where there were small, irregularly shaped areas that ponded rainfall.

Two types of floodplain forest occurred in the uplands. Ribbons of "mesic floodplain forest" occupied the narrow floodplains of upland streams. A few localized concentrations of "wet-mesic floodplain forest" were found where the underlying soils had impaired drainage and were relatively impermeable to ponded surface water. Examples of this community probably occurred in the Schoenberg Creek watershed.

On the Mississippi River floodplain, three kinds of communities were present. "Mesic floodplain forest" was typically confined to terraces or higher ground consisting of permeable soils. This community experienced infrequent or rare flooding from the Mississippi River, and depending on location, occasional flooding from upland tributaries. "Wet-mesic floodplain forest" was common, and occupied lower elevations that were somewhat poorly drained and had slowly permeable soils. This community experienced seasonal surface inundation or ponding from rainfall and local runoff, as well as periodic flooding from the Mississippi River and upland tributaries. "Wet floodplain forest" occupied the lowest topography of the forested communities. It was supported by poorly drained soils, overland flooding was more pronounced, and depth and duration of surface inundation were greater than that of the "wet-mesic" community.

Typical tree canopy and animal species are listed in Table 2-3 for each of the seven forest communities. The plants in this table are a small fraction of the total number of canopy, subcanopy, shrub, woody vine, and groundcover species. Appendix B contains a more complete plant list for many of these communities. Likewise, the animals included in this table, as well as the other tables in this section for each community, are not meant to represent all animals that are typical or characteristic for that community type, but only as examples of some of them.

Table 2-3 Typical Plants and Animals from Seven INAI Forest Natural Communities that Occurred or May Have Occurred in the Predevelopment Project area.

INAI Community	Plants (canopy trees)*	Animals*
Dry upland forest	pignut hickory, false shagbark hickory, shagbark hickory, mocker nut hickory, white ash, white oak, northern red oak, post oak, chinquapin oak, black oak	Reptile: eastern fence lizard, five-lined skink, ground skink Bird: summer tanager
Dry-mesic upland forest	false shagbark hickory, shagbark hickory, white ash, white oak, chinquapin oak, northern red oak, post oak, black oak	Reptile: broad head skink Mammal: white-footed mouse, fox squirrel
Mesic upland forest	sugar maple, false shagbark hickory, shagbark hickory, white ash, white oak, northern red oak, basswood, American elm	Amphibian: tiger salamander Bird: wood thrush Mammal: fox squirrel
Wet-mesic upland forest	silver maple, hackberry, sweet gum, bur oak, pin oak, American elm, big shellbark hickory, green ash	Mammal: meadow jumping mouse
Mesic floodplain forest	silver maple, river birch, green ash, Kentucky coffee tree, hackberry, sweet gum, cottonwood, sycamore, pecan, black walnut, white oak, bur oak, black oak, chinquapin oak, pin oak, northern red oak, basswood, American elm	Mammal: eastern mole
Wet-mesic floodplain forest	silver maple, pecan, big shellbark hickory, bitternut hickory, hackberry, honey locust, green ash, black walnut, pin oak, swamp white oak, American elm	Bird: pileated woodpecker, wood duck
Wet floodplain forest	silver maple, pecan, big shellbark hickory, green ash, honey locust, sycamore, cottonwood	Bird: great blue heron Mammal: mink

*Plants from IDNR (1998e), animals primarily from White and Madany (1978)

2.3.4.2 Prairie. Tall grasses and a variety of other herbaceous plants dominate natural prairies in the Midwest. Woody plants, including trees and shrubs, are minor elements, and tree canopy coverage averages 10 percent or less. Similar to forests, the prairie class is subdivided into smaller groupings of prairie natural communities, and the subclasses that apparently were represented within the Project area include the tallgrass prairie, sand prairie, and hill prairie groups. Most of the five communities comprising the tallgrass prairie group – dry, dry-mesic, mesic, wet-mesic, and wet – probably occurred in the Project area. These kinds of prairie were supported by fine-textured soils.

As many as six kinds of prairie communities occurred in the Project area. In the uplands, "dry-mesic prairie" and "mesic prairie" probably made up the bulk of Ridge Prairie, which extended east of the "dry-mesic forest" located behind the bluff. On the flat drainage divide, there were numerous, small, irregularly shaped areas that ponded rainfall. "Wet-mesic prairie" probably occurred here as an additional component of Ridge Prairie.

On the Mississippi River floodplain, "wet-mesic prairie" was very extensive. Most of Rattan's Prairie consisted of this community. Because this area was broad and flat, it had somewhat poor drainage conditions, and its soil was slowly permeable to ponded rainfall. Similarly, "wet-mesic prairie" also made up a substantial part of Cold Prairie. "Mesic prairie" most likely formed Six-Mile Prairie, which occupied relatively high ground. This community also must have formed parts of Cold Prairie and Big Prairie, at a minimum those portions on the alluvial fans along the bluff. "Wet prairie" may have been found where prairies and floodplain lakes and sloughs came into contact, or where localized ponding occurred for very prolonged periods within "wet-mesic prairie".

Sand prairies are distinct from tallgrass prairies because of the coarse, sandy soils on which they are found. Like tallgrass prairies, soil moisture in sand prairies ranges from dry to wet. "Mesic sand prairie" probably occurred on either side of the "mesic floodplain forest" that bordered Cahokia Creek as it entered the Mississippi River floodplain, as reflected in Figure 2-6.

Hill prairies in Illinois are classified according to the type of substrate that supports them, such as loess, glacial drift, dolomite, or sand. They were found on west or south-facing slopes of river bluffs. Because loess comprises the mantle covering the uplands within the Project area, any hill prairies that were present probably would have been "loess hill prairie". Figure 2-6 displays a relatively small area of upland prairie along the bluff top just north of where Canteen Creek enters the floodplain. This prairie most likely was "loess hill prairie".

The "brushy prairie" reflected in Figure 2-6 as part of Six-Mile Prairie may have been an area of "mesic prairie" that was being invaded by young trees and shrubs. "Shrub prairies" are another distinct but minor group of prairies in Illinois, and they are known to have occurred only in the northern part of the state (White and Madany 1978). Table 2-4 provides the names of plants and animals that are typical of all six prairie natural communities.

Table 2-4 Typical Plants and Animals from Six INAI Prairie Natural Communities that Probably Occurred or May Have Occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
Dry-mesic prairie	Dominant: little bluestem, Indian grass, needle grass Characteristic: lead plant, pale purple coneflower, rough blazing star	Bird: upland sandpiper
Mesic prairie	Dominant: big bluestem, Indian grass, northern drop seed Characteristic: cream wild indigo, shooting star, rattlesnake master, prairie blazing star, hoary puccoon, white prairie clover, sand prairie phlox, compass plant, prairie dock	Reptile: plains garter snake, prairie king snake Bird: dickcissel, eastern meadowlark, grasshopper sparrow Mammal: prairie vole, short-tailed shrew

Table 2-4 Continued

INAI Community	Plants*	Animals*
Wet-mesic prairie	Dominant: big bluestem, blue joint grass, prairie switch grass, Indian grass, prairie cord grass Characteristic: prairie sundrops, Culver's root, golden alexanders	Reptile: massasauga Bird: bobolink
Wet prairie	Dominant: blue joint grass, prairie cord grass, various sedges Characteristic: prairie Indian plantain, southern blue flag, winged loosestrife, water parsnip	Bird: American bittern
Dry-mesic sand prairie	Dominant: little bluestem, Indian grass, needle grass Characteristic: flax-leaved aster, rough blazing star, showy goldenrod, bird's foot violet	Amphibian: Illinois chorus frog Reptile: bull snake Bird: lark sparrow, savannah sparrow, vesper sparrow Mammal: plains pocket gopher
Loess hill prairie	Dominant: little bluestem, side-oats grama, Indian grass Characteristic: green milkweed, false boneset, grooved yellow flax, fringed puccoon, pale beard tongue, scurfy-pea, prairie blue-eyed grass, great plaines ladies' tresses	Reptile: six-lined racerunner

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.3 Savanna. Savannas are a class of natural communities intermediate in structure between forest and prairie. Trees are common, but grow spaced far enough apart not to create a closed canopy. A few species of oaks typically dominate the canopy, and the ground is covered by herbaceous plant species often found in prairies. The savanna class is subdivided into three subclasses – savanna, sand savanna, and barrens – and each subclass is divided into two or more communities based upon degree of soil moisture. Unlike the forest and prairie classes, there are no remnants of savanna communities within the Project area or surrounding region today, and whether savanna actually occurred remains to be verified. White and Madany (1978:337), in describing where savannas were found in Illinois, state, "Savannas occurred as an ecotonal belt along streamside forests, as 'islands' in prairie or forest, and on extensive areas of hilly land."

Two types of savanna may have been found within the Project area. Indirect evidence for their occurrence may be the "scattered timber" land cover class shown in Figure 2-6. The GLO surveyors noted large expanses of this cover type in the rugged uplands, and smaller areas on the floodplain. These areas may represent the "dry-mesic savanna" and "mesic savanna" natural communities. Plants and animals typical of these two communities are shown in Table 2-5.

Table 2-5 Typical Plants and Animals from Two INAI Savanna Natural Communities that may have Occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
Dry-mesic savanna	Dominant: white oak, burr oak, post oak, black oak, little bluestem, Indian grass, needle grass Characteristic: American filbert, wild quinine, common carrion flower, starry campion	Bird: eastern bluebird, red-headed woodpecker, northern flicker, field sparrow, white-eyed vireo, indigo bunting Mammal: deer mouse, fox squirrel
Mesic savanna	Dominant: white oak, burr oak, big bluestem, little bluestem, Indian grass Characteristic: golden alexanders	Mammal: fox squirrel

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.4 Wetland. The wetland class as used by the Inventory includes "natural communities that are flooded or have hydric soils and that have a vegetative cover" (White and Madanay 1978:340). The class is subdivided into six subclasses (marsh, swamp, bog, fen, sedge meadow, panne, seep and spring) according to differences in vegetation. The subclasses marsh and swamp probably were represented. The term "wetland" as used today also includes forests and prairies with seasonally wet soils. In terms of the natural community classification system, "wet-mesic floodplain forest", "wet floodplain forest", "wet-mesic prairie", and "wet prairie" would also be considered wetlands. An additional form of wetland would be the "pond" natural community, described below as part of the "lake and pond" class.

Following the INAI classification, two kinds of wetland natural communities probably were present in the Project area. The "marsh" natural community represented the marsh subclass. Tall, grass-like plant species dominate "marsh", and the ground is either saturated or inundated by shallow water during most of the year. This natural community would have been restricted to the Mississippi River floodplain, where it occurred in low depressions. Although the GLO surveyors apparently did not distinguish marsh from wet prairie, there was a large marsh north of Six-Mile Prairie at the location in Figure 2-6 shown as wet prairie. This is historic "Grassy Lake". The shallow fringe of floodplain lakes, ponds, and sloughs (described below under the lake and pond class) most likely consisted of the "marsh" natural community.

The swamp subclass consists of the "swamp" and "shrub swamp" natural communities. True forested swamps are found in extreme southern Illinois, and did not occur within the Project area around the year 1800. "Shrub swamp" was restricted to the Mississippi River floodplain, where it was associated with ponds (described below under the lake and pond class) located in wet floodplain forest. Coverage by trees is less than 20 percent, and by shrubs more than 50 percent. An example of this community was found in proximity to a small pond located in a meander scar just north of Cold Prairie.

Table 2-6 Typical Plants and Animals from Three INAI Wetland Natural Communities that Occurred or may have Occurred in the Predevelopment Project area.

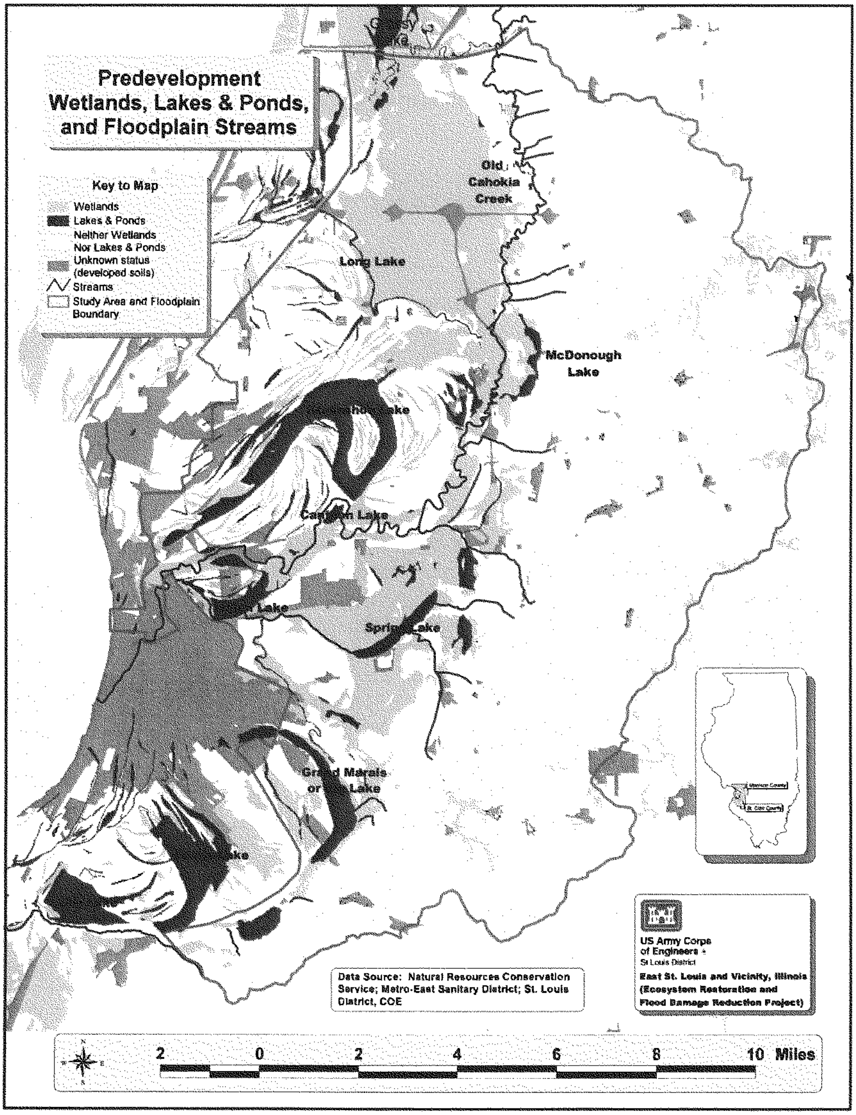
INAI Community	Plants*	Animals*
Marsh	Dominant: common lake sedge, common reed, water knotweed, river bulrush, great bulrush, broad-leaved cattail Characteristic: common water plantain, false aster, mermaid weed, common arrowhead	Bird: red-winged blackbird, yellow-headed blackbird, marsh wren, rails, bitterns, many waterfowl Mammal: muskrat
Shrub swamp	Dominant: buttonbush, sandbar willow	Reptile: red-eared slider turtle

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.4.1 Wetland Distribution and Extent. Figure 7-2 displays the location and extent of predevelopment wetlands, along with lakes and ponds and floodplain streams. According to this mapping, historic wetlands were largely confined to the Mississippi River floodplain, and most of these floodplain wetlands occurred away from the river in a broad band adjacent to the bluff.

The digital soil surveys for Madison and St. Clair Counties (NRCS 2000a,b) were used to develop the spatial extent of wetlands in Figure 2-7. These surveys are useful because soil properties observed today reflect historic conditions, and soil scientists have classified each kind of mapped soil as either possessing wetland (hydric) properties or not. Wetland soils can be contrasted with nonwetland soils, and this difference serves to distinguish between historic wetlands and historic nonwetland areas.

Figure 2-7 Predevelopment Wetlands, Lakes & Ponds, Floodplain Streams



A limitation of this method is that it reveals no information about the historic wetland status of areas already developed at the time of the soil survey. Activities such as excavation, filling, and dumping have extensively disturbed surface soils in many areas to the point that these sites no longer reflect historic conditions. To display the spatial extent of man-made disturbances, "developed" soils have been distinguished from soils that have not been developed. Among the "developed" soils, some experienced lesser disturbances than other more developed soils. These lesser-disturbed soils, called urban land complexes, still exhibit hydric or nonhydric properties, whereas the more disturbed soils do not. Therefore, wetlands shown in Figure 2-7 consist of undeveloped wetland soils, as well as urban land complex soils exhibiting hydric conditions.

Wetland soils comprise nearly 23 percent of the Project area (Table 2-7). About 95 percent of these wetland soils occur in the floodplain. Two-thirds of the Project area is comprised of nonwetland soils, and nearly 66 percent of those occur in the uplands. Less than five percent of the Project area is mapped as water, and about 90 percent of water is mapped on the floodplain. "Urban complex soils" account for about 11 percent of the Project area. Although development has occurred in these soils, they have not been so disturbed as to lose their hydric or nonhydric soil status. Almost six percent of the Project area is made up of developed soils that have been greatly disturbed, and about 83 percent of them occur on the floodplain.

Table 2-7 Distribution of Soil Types within the Predevelopment Project area.

Type of Soil	Area (acres)			Percent of Project Area		
	Floodplain	Uplands	Total	Floodplain	Uplands	Total
Wetland	20,953.9	1,131.9	22,085.8	19.7	1.1	20.7
Wetland/Urban land complex	2,210.0	0.0	2,210.0	2.1	0.0	2.1
Nonwetland	18,717.2	42,989.1	61,706.3	17.6	40.3	57.9
Nonwetland/Urban land complex	5,697.2	3,984.6	9,681.8	5.3	3.7	9.1
Water	4,054.8	456.1	4,510.8	3.8	0.4	4.2
Developed	5,276.2	1,068.4	6,344.6	5.0	1.0	6.0
Not mapped	4.9	97.2	102.1	<0.0	0.1	0.1
TOTALS	**56,914.1**	**49,727.3**	**106,641.4**	**53.4**	**46.7**	**100.1**

From the perspective of each major landform, about 40 percent of the bottoms consists of wetland soils, and another seven percent of water (Table 2-8). Nearly 43 percent of the floodplain has nonwetland soils, and another 10 percent has highly developed soils. In the uplands, nearly 95 percent consists of nonwetland soils, roughly two percent of wetland soils, and about one percent of water.

Table 2-8 Distribution of Soil Types by Major Landforms within the Predevelopment Project area.

Type of Soil	Percent within Floodplain	Percent within Uplands
Wetland	36.8	2.3
Wetland/Urban land complex	3.9	0.0
Nonwetland	32.9	86.4
Nonwetland/Urban land complex	10.0	8.0
Water	7.1	0.9
Developed	9.3	2.1
Not mapped	0.0	0.2
TOTALS	**100.0**	**99.9**

This analysis based on modern soil mapping demonstrates that 47 percent or nearly one-half of the Mississippi River floodplain within the Project area consisted of wetland and aquatic habitats. Of that area, about 85 percent was wetlands.

2.3.4.4.2 Wetland Hydrology. Water has always been the "life-blood" of wetlands. Wetlands within the Project area were supplied by a variety of sources, including 1) rainfall and local runoff; 2) overbank flooding from rivers and creeks, 3) adjacent lakes and ponds, and 4) groundwater. By virtue of their topographic position, water gravitated towards wetlands. Their flat or depressional topography naturally impeded surface drainage. Once water got there, it was inhibited from soaking down into the ground because of naturally impermeable surface soils. Figure 2-7 shows the historic floodplain.

When it rained, direct rainfall collected in wetlands, and if storm intensity and duration were sufficient enough to saturate the landscape, rainwater would sheet flow as surface runoff into wetlands from adjacent higher ground. When the Mississippi River began to rise, its waters backed up into the floodplain segments of the upland tributary channels and entered floodplain lakes. This occurred in two principal tributaries, Cahokia Creek and Prairie Du Pont Creek. As the river continued rising, water levels in these aquatic features spread out to inundate adjacent wetland areas. During bigger floods, the Mississippi River spilled out of its banks to inundate the floodplain. During very large events, most of the American Bottom was under water, and relatively little ground remained exposed. Such great events were typically of long duration.

Of all the upland tributaries, Cahokia Creek was the chief source of upland drainage. Because it traversed the entire Project area, floodwaters from Cahokia Creek spilled across a large area, beginning at the bluff. Duration of these events would have been less than that of large Mississippi River floods, at least when the river was low enough not to impede Cahokia Creek drainage into it. Conditions were similar for the other upland tributaries, except that they contributed lesser amounts of floodwaters that affected more localized areas. With respect to the other sources of wetland hydrology, water in lakes and ponds was the source for wetlands located at their fringe. Groundwater was also a source for those wetlands located in the lowest depressions on the floodplain, during times when the groundwater table raised up high enough to reach the wetland's bottom.

For many wetlands in the American Bottom, water or hydrology typically came from more than one source, and for some, all sources contributed at one time or another. Which sources were contributing at a particular time depended on local rainfall and flood conditions as well as groundwater elevations. However, from day to day and year-to-year, specific sources were the driving force of wetland hydrology for certain wetlands (i.e., Brinson 1993). Some were located close to creek or river channels and received frequent overflows. Others were found at the fringes of lakes or ponds. Still others occurred in either depressions or on relatively broad flat areas that primarily received rainfall and local runoff.

2.3.4.5 Lake and Pond. Bodies of open, standing water are classified as lakes and ponds. The lack of emergent woody or "grass-like" vegetation distinguishes them from wetlands. Ponds are typically small and shallow enough to support the growth of rooted aquatic plants. Lakes are larger and deeper, and according to White and Madaney (1978:348), "A lake has an area of deep water sufficiently large enough to produce somewhere on its periphery a barren, wave-swept shore." The land and pond natural communities were found within the Project area in predevelopment times.

Historic lakes and ponds in the Project area are shown in Figure 2-7. The large body of water today called Horseshoe Lake was an example of the "lake" natural community. Several other large bodies of open, standing water were also present in pre-development times. The lakes at present-day Holten State Park were once a single extensive body of water called Pittsburg or Big Lake. To its southwest, just outside the Project area, was another large water body eventually named Goose Lake. Although the extent of Horseshoe Lake has changed little over time, the latter two water bodies have either disappeared or been much reduced in extent due to drainage and development. Despite their size, they most likely were examples of the "pond" natural community. The middle of these ponds may have been deep enough to inhibit the establishment of rooted aquatic vegetation. Smaller examples of ponds include McDonough Lake. Examples of typical plants and animals found in these two communities are provided in Table 2-9.

Table 2-9 Typical Plants and Animals from Two INAI Lake and Pond Natural Communities that Occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
Pond	Characteristic: spatterdock, various pondweeds (*Potamogeton* spp.), great duckweed, small duckweed, various knotweeds (*Polygonum* spp.)	Amphibian: bullfrog Fish: golden shiner, pugnose minnow, black bullhead, bantum sunfish, banded pygmy sunfish, white crappie
Lake	(typically not present)	Fish: white crappie

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.6 Stream The stream class represents permanent, flowing waters. Streams are divided into two subclasses, creek and river. Creeks have watersheds less than 200 square miles, and watersheds of rivers are 200 square miles or more. The communities within each subclass are distinguished mainly by steepness of the streambed. Low gradient streams fall less than one foot per mile, medium gradient streams fall from one to 10 feet per mile, and high gradient streams fall greater than 10 feet per mile.

Six kinds of stream natural communities apparently occurred within the Project area. The "high-gradient creek" natural community has a substrate consisting of sand and gravel, and the water's surface consists of alternating pools and riffles. This community was common in the Project area, and coincided with the steeper portions of creeks in the uplands. The "medium-gradient creek" community was also located in the uplands, either "upstream" or "downstream" of creeks with high gradients. Again, pools and riffles are typical, and the substrate includes sand and gravel as well as silt and organic matter.

Channels of upland tributaries located on the Mississippi River floodplain represented the "low-gradient creek" community. Here the channel bottom is made of silt and organic matter, currents are sluggish, and there are no riffles. Historic maps show that there were about 26 miles of floodplain channels in the American Bottom from upland tributaries that drained into Cahokia Creek. Another 9 miles of floodplain channels originated from Prairie Du Pont Creek and its tributaries.

Historic streams in the Project area are shown in Figure 2-5b and Figure 2-7. Under the INAI classification system, Cahokia Creek was a river, and all other upland tributaries were creeks. The upland portion of Cahokia Creek would be classified as a "medium-gradient river". "Gravel riffles and raceways and sand bars are characteristic of this community" (White and Madaney 1978:350). On the Mississippi River floodplain, the Cahokia Creek channel represented the "low-gradient river" community. Sand bars would have been present in the meandering channel for some distance from the bluff, and would have been largely replaced by silt deposits closer to the Mississippi River. To cross a straight-line distance of about 21 miles, Cahokia Creek meandered across the American Bottom for about 38 miles. After passing Horseshoe Lake, it approached the Mississippi River and turned south, paralleling it for some distance before entering the Mississippi where Prairie Du Pont Ditch now joins the river at the downstream end of today's Arsenal Island, about even with the southern limit of the Project area.

A long linear water body called Long Lake extended across the American Bottom from the vicinity of Alton south to McDonough Lake. The origin of its formation is uncertain, but at one time it apparently carried stream flow from the Wood River upland tributary. Under this condition, the large channel of Long Lake would have been a floodplain stream. Just outside the Project area, the Mississippi River was an example of the "large river" natural community. Species typical of these six communities are listed in Table 2-10.

Table 2-10 Typical Plants (where applicable) and Animals from Six INAI Stream Natural Communities that occurred or may have occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
High-gradient creek	Characteristic: water willow	Amphibian: pickerel frog Fish: banded sculpin, blackstripe topminnow, central stoneroller
Medium-gradient creek	(typically not present)	Fish: longear sunfish, red shiner, suckermouth minnow, black crappie
Low-gradient creek	(typically not present)	Fish: yellow bullhead, creek chub, redfin shiner
Medium-gradient river	(typically not present)	Reptile: smooth softshell Fish: channel catfish, stonecat, smallmouth bass
Low-gradient river	(typically not present)	Reptile: spiny softshell turtle Fish: flathead catfish
Major river	(typically not present)	Fish: paddlefish, shovelnose sturgeon, river shiner, blue catfish, bigmouth buffalo Bird: black tern

*Plant from White and Madany (1978), animals primarily from same source

2.3.4.7 Cultural. The only kinds of cultural features occurring on the predevelopment landscape would have been homesteads, areas of cropland, successional fields where "virgin" forest had been cleared, and dirt roads. By 1800, the French farmers living at their village of Cahokia had been farming portions of the bottomland prairies very close to the Project area for almost a century. With limited exceptions, all farming activities occurred on individually owned agricultural plots within a large, communally fenced area known as the Commons.

In addition to these residents, groups of American immigrants began arriving in the area during the mid-1780s. Many of these extended families were headed by Revolutionary War veterans, eager to build a new life for themselves as yeoman farmers on our fledgling country's western-most frontier - the fertile floodplain of the Mississippi River. By 1800, relatively few American pioneers had migrated into the area. The total number of American farmsteads on the American Bottom numbered less that 25 prior to the Louisiana Purchase in 1804.

The settlement pattern of the independent Americans was totally unlike that of their established French-Canadian neighbors. Almost as soon as they arrived, the Americans began to establish isolated farmsteads on fertile prairie tracts throughout the Project area. The boundaries of these late eighteenth and early nineteenth century tracts can still be seen on modern U. S. Geological Survey topographic maps. Only several hundred people were living within the Project area at that time and of those, only a portion was farming.

The average size of the American farmstead was approximately 160 acres. Assuming each family had a farm, the total area in agriculture would have been no more than 4,000 (160 x 25) acres. Under such a worst-case scenario of development, the area of indigenous native prairie impacted by the Americans would have been no more than about 12 percent of the total floodplain prairie in the Project area (using figures from the GLO land cover analysis). Combined, the agricultural pursuits of the French and American farmers probably disturbed no more than 10 percent of the terrestrial portion of the American Bottom (floodplain) ecosystem. There is presently no evidence to suggest that either of these groups engaged in any type of drainage or levee construction activities. Therefore, it can be assumed that the aquatic portion of the project area was largely unaffected by their respective presence.

2.3.4.8 Flora And Fauna. Because environmental disturbances caused by the early Americans were minimal two hundred years ago, it is fair to assume that all plant and animal species that lived in the vicinity of the Project area just prior to European settlement were still present around 1800. Populations of plants and animals for the most part had not yet been reduced in numbers, although hunting probably affected some animal species. The natural communities these species and populations comprised had yet to experience significant man-made changes. The various forces of nature were still the primary influences on the predevelopment ecosystem, including its constituent species.

A high level of species diversity was characteristic of the Project area and its vicinity. The juxtaposition of two major landforms, floodplain and uplands, and the localized physical variations in each, created the setting for an abundance of life forms to exist. Lists of plants and animals that existed, or may have existed, in the Project area are not included in this report. Such lists would include present-day species (less introduced species) and those that have since disappeared. However, current species of mammals, birds, fishes, reptiles and amphibians, and vascular plants are presented in Appendix B. These tables indicate which natural communities or habitats each species uses (at various levels of detail), and introduced species are highlighted.

2.3.4.8.1 Mammals. More than 45 species of mammals lived in the area, including an opossum, rabbit, and various shrews and moles, bats, rodents, carnivores, and ungulates (those with hoofs). They utilized all habitats, from forests, prairies, and herbaceous wetlands, to creeks and lakes (Appendix B). Other than a few bat species, they lived there year-round. A number of these species no longer occur in the Project area. They include five carnivores and two ungulates - gray wolf (*Canis lupus*), river otter (*Lontra canadensis*), bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), black bear (*Ursus americanus*), wapiti or elk (*Cervus elaphus*), and bison (*Bison bison*). All but the river otter and bobcat are extinct today in Illinois (Hoffmeister 1989; IDNR 1998d). The early settlers hunted a variety of larger species to eat, such as rabbit, squirrels, beaver, raccoon, bear, deer, and elk.

2.3.4.8.2 Birds. About 285 species of birds used to inhabit the Project area and environs (Appendix B). They belonged to many taxonomic groups, included the loons, grebes, pelicans and cormorants, egrets and herons, geese and ducks, hawks and falcons, gallinules, rails, shorebirds, gulls and terns, doves, parakeets, cuckoos, owls, nighthawks, swifts and hummingbirds, woodpeckers, and the diverse songbirds. Like mammals, they made use of all terrestrial, wetland, and aquatic habitats. Many bird species reproduced and stayed throughout the year. Others also raised young but then left before winter to migrate to warmer climates, returning the following year. Still other species passed through the area seasonally, on their way to distant breeding or wintering areas. Three species, the passenger pigeon (*Ectopistes migratorius*), ivory-billed woodpecker (*Campephilus principalis*), and Carolina parakeet (*Conuropsis carolinensis*), are now globally extinct (IDNR 1998b). Ten others have since disappeared from the project area: swallow-tailed kite (*Elanoides forficatus*), greater prairie chicken (*Tympanuchus cupido*), ruffed grouse (*Bonasa umbellus*), barn owl (*Tyto alba*), Chuck-wills-widow (*Caprimulgus vociferous*), Bewick's wren (*Thryomanes bewickii*), Swainson's warbler (*Limnothlypis swainsonii*), Bachman's sparrow (*Aimophila aestivalis*), and white-winged crossbill (*Loxia leucoptera*) (IDNR 1998b; McMullen, pers. comm). Many kinds of birds were part of the diet of early Americans, especially ducks, geese, turkey, ruffed grouse, prairie chicken, woodcock, dove, and bobwhite.

2.3.4.8.3 Fishes. Over 90 species of fish lived in the various creeks, rivers, ponds, and lakes in the Project area (Appendix B), including the Mississippi River. They were very diverse taxonomically, representing 24 families. Some species lived in the Mississippi River only, while others also used the adjacent standing waters on the floodplain. A few species were restricted to the small upland creeks. Many had broad ecological tolerances and inhabited upland creeks, floodplain habitats, and the Mississippi River. Like mammals and birds, these animals also were an important part of the diet of early settlers, especially those in the catfish and sunfish groups.

2.3.4.8.4 Reptiles and Amphibians. At least 65 species of reptiles and amphibians occurred in the Project area. Reptiles consisted of various salamanders, toads, and frogs, and amphibians included a variety of turtles, lizards, and snakes (Table 3-38 in Section 3). For these species as a whole, every habitat in the floodplain and uplands was exploited. Amphibians as a group needed some kind of aquatic habitat, such as a wetland, pond, lake, creek, or river, for breeding, yet the adults of many species also used nonaquatic areas, such as forests and prairies, for their other activities (IDNR 1998f). Most turtles also required some type of aquatic habitat for survival. A number of lizards and snakes did not, and instead existed in terrestrial habitats such as forests and prairies. The alligator snapping turtle (*Macroclemys temminckii*) no longer exists in the Project area (IDNR 1998f). Among reptiles and amphibians, early settlers ate turtles and occasionally frogs and snakes.

2.3.4.8.5 Plants. A variety of species of vascular plants were found in the Project area. These plants included all the trees, shrubs, vines, forbs, grasses, and sedges (Appendix B). (The nonvascular plants, or ferns, mosses, liverworts and others, are not treated in this report.) They formed the preponderance of vegetation that constituted the various natural communities described previously in this section. Plants grew in all habitats, except for those places where either flowing or standing water prevented the establishment of either emergent or rooted floating water-tolerant species. Early settlers ate the fruits of some species, such as nuts from hickory and pecan trees, or fleshy fruits of wild plums and the persimmon.

2.4 PREDEVELOPMENT ECOSYSTEM DISTURBANCE DYNAMICS

A variety of natural disturbances, such as flooding, wildfire, drought and windstorms, occurred periodically during predevelopment times. A disturbance can be defined as "any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability or the physical environment" (White and Pickett 1985:10).

Disturbance dynamics are the processes of change that occur in living resources and their environment in response to disturbance. Disturbances are important to some ecosystems, including those prone to flooding and fire, because they are necessary in order to maintain biological growth and productivity (Cox 1993; Middleton 1999). Middleton (1999:5-6) highlighted the importance of "flood pulsing" in wetlands, or "the idea that the physical and biotic functions of the floodplain wetland are dependent on the dynamics of water discharged from the river channel."

The flooding and wildfire disturbances that were common influences on the ecosystem around 1800 have been largely eliminated from today's environment. They are discussed in this section. Other natural disturbances like drought and windstorms still occur today, and they are not treated because they are unimportant to this report.

2.4.1 Flooding Disturbances. Recurring "flood pulses" caused by riverine overflow was typical of the predevelopment American Bottom. Whenever the Mississippi River or any of the upland tributaries that drained into the bottoms got out of bank, a "pulse" of floodwaters spread out on the floodplain. As water moved laterally, it sought the lowest position on the landscape through gravity, and in so doing often entered wetlands and aquatic areas. As a result, water levels in the affected wetlands and aquatic areas typically rose. Floodwaters remained temporarily stored in these areas until they could drain (if a natural outlet existed), which often coincided with receding levels on the river (or creek) that was the source of flooding. If no natural drainage outlet existed in the wetlands and aquatic areas, water levels would gradually diminish by losses due to evapotranspiration and infiltration into the ground.

Flood pulses are important to wetlands and other floodplain habitats for a variety of reasons. In riverine wetlands they drive processes such as sediment deposition and nutrient transport (see discussion below on wetland functions). Flood pulses also serve as a temporary connection or link between the floodplain and river channel. For example, in the spring some fish species living in the Mississippi River respond to the river's rise and enter the floodplain to gain access to spawning sites (Gutreuter and Theiling 1999), including wetlands. Pulses of floodwater also disperse plant seeds. The decurrent false aster (*Boltonia decurrens*), a Federally listed threatened plant of nonforested wetlands along the lower Illinois River, responded to the great flood of 1993 by expanding its limited distribution to include inundated areas of the leveed floodplain (Middleton 1999).

Flood pulses varied on a continuum from small to very large, in terms of depth and duration. Because the watershed of the Mississippi River at St. Louis was so immense relative to the combined area of all the upland watersheds that drained into the American Bottom, it was the primary source of flood pulses that inundated large portions of the floodplain. Flooding from the Mississippi River varied by season and from year to year. Floods could happen during any month, but they usually occurred in the spring (April-June) and fall (September-October). Springtime events were often higher and greater in duration. Low flow periods typically coincided with summer and winter.

In many years, the Mississippi River rose and gently overflowed its banks, spreading out over the adjacent floodplain to a minor degree. But on an infrequent basis it inundated much of the American Bottom. The following account describes five instances of "big" flood pulses during a 130-year time period.

"At long intervals, the floods of the Mississippi inundate these bottoms. In 1725, a great inundation of the American bottom occurred. In the year 1770 another of less depth visited the bottom, and two years thereafter, in the year 1772, a great rise in the river overflowed the whole bottom. ...The next extraordinary flood occurred in the year 1785, and was next to the highest ever known in the Mississippi. ...The next inundation was the year 1844, and was some higher than that of 1785. The height of the flood of 1844 is marked on a stone monument, erected on Water Street, in the city of St. Louis, and exhibits a terrific flood, rushing over the whole bottom, from bluff to bluff. Since my observation, there have been many small rises in the river, that seemed to portend danger; but no great injury was produced by them. Those deep and sweeping inundations did much injury to the agricultural interest of the country." (Reynolds 1857).

The 1844 event was the greatest recorded flood, prior to the construction of the flood protection system, to cover the American Bottom, in terms of spatial extent and stage or elevation. Under predevelopment conditions of no floodplain development, it appears to have been about a 60-year flood event. No railroad embankments had yet been built to impede its flow (Helm 1905). Peak floodwaters varied in depth across the floodplain, ranging from a maximum of about 20 feet in the vicinity of Indian Lake (near today's Fairmont City, southwest of the intersection of I-55/70 and Route 111), to little or no inundation in the vicinity of Cahokia Creek where it first enters the Mississippi River floodplain. During the flood, "...steamboats were able to sail over it [the American Bottom] from St. Louis to the bluffs six miles from the river channel" (Norton 1912). Because daily records of river levels at St. Louis are not available for years prior to 1861, a description of the 1844 flood's 20-foot plus rise and fall must come from historic accounts.

"The year 1844 was the year of our great flood, and in it the "June rise" was not to be mistaken. The river reached a height of 20 feet not before April 26, and continued above that stage till August 10, 3 ½ months; on May 14 it reached 25 feet, and continued at or above that until August 5, over 2 ½ months; over a month, from June 13 to July 17, it was higher than 30 feet; for 16 days, from June 20 to July 6, it ranged above 35 feet, and for 8 full days, June 24 to July 1, it maintained itself above 40 feet." (Engelmann 1868; readings refer to the St. Louis gage, zero equivalent to 379.94 feet NGVD).

The last major Mississippi River flood event to inundate the American Bottom occurred in 1903. It peaked at an elevation 3.32 feet lower than the 1844 event, which corresponds with a 20-year event under predevelopment conditions. A number of railroad embankments had already been built that impeded the movement of floodwaters across the bottoms. Some of these acted like dams, keeping water out of certain areas.

Bluff tributaries also inundated portions of the American Bottom from time to time, independent of the Mississippi River. Cahokia Creek was chief among these tributaries. Its upland watershed was not only much greater than any other upland tributary, but the floodwaters it carried were augmented by flows from a number of smaller upland tributaries that joined it on the floodplain. Before traversing the American Bottom and discharging into the Mississippi River, Cahokia Creek and its waters linked together a chain of wetland and aquatic complexes that lie adjacent to its 40-mile long meandering channel. If rainfall was intense over its headwaters, Cahokia Creek spilled out of its banks and ran over much of the bottoms. For example, in 1902 and again in 1904, heavy rainstorms in June caused the creek to overtop. This occurred along the reach of channel extending from where it entered the bottoms to the vicinity of East St. Louis, where ground elevations were relatively higher (Helm 1905). At the time, about 40 square miles of the American Bottom were flooded, including a relatively large area of higher ground not inundated since the 1844 flood from the Mississippi.

2.4.2 Wildfire Disturbances. Like flooding, wildfire also was a cyclical phenomenon during predevelopment times. Fires started naturally, as from lightning strikes, but they also were set by people, whether Native Americans or early settlers. When intentional, fire could be used to facilitate the hunting of wild animals, or to clear open areas under invasion from woody encroachment. Fires occurred any time of the year, depending on how dry conditions were, but were most prevalent in the fall and early winter (IDNR 2000).

Wildfire was characteristic of terrestrial areas. In the uplands, prairies and forests burned periodically. Many of the tree species occurring in upland forests have adaptations for surviving fire, such as thick bark. On the floodplain, prairies also were susceptible to fire. The drier floodplain forests also burned, but forested wetlands usually did not, where moisture levels in leaf litter and the ground's surface typically were high. As tree species of forested wetlands generally do not have thick bark, fire often injures mature individuals; seedlings and saplings often die when exposed to fire. Herbaceous wetlands on the floodplain, such as marshes and wet prairies, must have also burned if aboveground plant parts were dry enough.

Fire is important ecologically for maintaining the overall biological integrity of natural habitats adapted to it. In prairies and other herbaceous plant communities, fall or winter burning removed the build-up of dead aboveground plant parts such as leaves and stems, while underground root systems were protected and dormant until the next spring. Without periodic elimination of dead growth, the amount of each year's new growth would be reduced. Other effects of fire on prairie grasses include increased flowering, improved seed germination, and earlier emergence of new growth in the spring (Snyder 1994). Fire also suppressed the encroachment of trees into prairies. In forests, fire maintained plant species composition and diversity, and variably aged populations of trees (IDNR 1998e). In all areas, nutrients bound in plant materials were released by fire to the soil as ash.

To the early settlers, wildfire was a serious threat to human life and personal property. "Two men burned to death in a prairie fire" at Big Prairie in the American Bottom (McClain 1997:37).

2.5 PREDEVELOPMENT ECOSYSTEM FUNCTION

The functions an ecosystem performs are the physical, chemical, and biological processes that are necessary for self-maintenance (Brinson 1993), such as primary production, nutrient cycling, and decomposition. The ecosystem functions of the Project area in predevelopment times reflected the dynamics within the uplands, floodplain, and Mississippi River, and the interactions occurring between these three physical entities. Seven functions are described in this section – store surface water temporarily, maintain characteristic plant community, provide habitat for wildlife, nutrient cycling, remove and sequester elements and compounds, retain particulates, and export organic carbon. These functions are not intended to be comprehensive for the entire ecosystem. Rather, they are meant to serve as a foundation for understanding how wetlands were a vital component of the historic ecosystem. This knowledge can then be applied in developing solutions to today's environmental and flooding problems and opportunities in the Project area.

2.5.1 Temporary Storage of Surface Water. In light of the flooding problems facing the Project area today, perhaps the most important wetland function intrinsic to the historic ecosystem was the ability to temporarily store floodwater. Due to properties such as width, slope, and roughness (Brinson et al. 1995), riverine wetlands in the American Bottom routinely detained riverine overflow from the Mississippi River and adjacent upland watersheds, and released it slowly back to the creeks and river. Aquatic areas (sloughs, lakes, ponds) associated with these riverine wetlands also received overbank floodwaters, and they performed this function. Likewise, nonwetland areas in the American Bottom that became inundated during the larger flood events, such as in 1903 and 1844, also temporarily stored floodwater.

Wetlands detaining overbank flows dissipate energy, and reduce the velocity of moving water. From a flood damage perspective, the capacity for erosion is reduced. Similarly, storage of riverine overflow in wetlands prolongs the passage of a flood event, and thereby reduces the peak discharge downstream (Brinson et al. 1995; Ainslie et al. 1999).

2.5.2 Maintenance of Plant Community Characteristics. Another important wetland function was the maintenance of its own characteristic plant community, like that of forest, prairie, or marsh, which are distinct in terms of species composition and physical characteristics (Brinson et al. 1995). Large areas of these various wetland plant communities existed in the American Bottom. They created much primary production in the form of plant biomass. The type of plant community affected other functions, such as wildlife habitat.

2.5.3 Provision of Wildlife Habitat. The various wetland plant communities served as habitat for many kinds of animals, ranging from macroinvertebrates ("bugs") to vertebrates (animals with backbones) (Brinson et al. 1995). The composition and spatial complexity of the vegetation above ground affected the kinds of animals living there and their abundance. Forested wetlands exhibited vertical stratification (understory, subcanopy, overstory), and this structural complexity offered various opportunities for animals to find sites for shelter, nesting, breeding and foraging. Prairies and marshes had simpler structure, which offered opportunities for other species.

At the landscape scale, the heterogeneity of wetland types in the American Bottom helped maintain higher levels of species diversity. The extensive spatial distribution of wetlands, and the linkages or connections that existed between different wetland types, facilitated the movement and dispersal of animals. Movements between wetlands, between wetlands and uplands, and between uplands (via the relatively small, irregularly shaped wetlands) occurred, in addition to those between wetlands and aquatic areas. Nonwetland areas in the American Bottom also provided wildlife habitat.

2.5.4 Nutrient Cycling. Cycling of nutrients, a fundamental ecosystem function, consists of the "abiotic and biotic processes that convert elements from one form to another; primarily recycling processes" (Brinson et al. 1995). In one process, nutrients are taken up from the soil in inorganic form by plants and transformed into organic forms during photosynthesis and growth. In another process, after the plant dies, these organic nutrients are converted back into inorganic form through microbial decomposition, for renewed uptake by plants. In ecological terms, the function is represented by net primary productivity and detritus turnover. Wetlands in the American Bottom performed this function. Nutrient cycling was also a fundamental process in nonwetland areas.

2.5.5 Removal of Elements and Compounds. Surface water can import natural nutrients (like nitrogen, phosphorus, or potassium), contaminants (such as herbicides and pesticides), and other elements and compounds into wetlands. Once there, wetlands can permanently remove these materials from the water column, or immobilize them (Brinson et al. 1995, Ainslie et al. 1998). The avenues by which they are removed or immobilized include "sorption, sedimentation, denitrification, burial, decomposition to inactive forms, uptake and incorporation into long-standing woody and long-lived perennial herbaceous biomass, and similar process" (Brinson et al. 1995:47). Practical applications of this function are the current use of artificial or natural wetlands to "clean" partially treated wastewater or sewage effluent. As purifiers, wetlands improve the quality of water as it moves downstream. Wetlands in the American Bottom had performed this function, as did aquatic areas.

2.5.6 Particulate Retention. Floodplain wetlands naturally retain organic and inorganic particulates carried in by overbank floodwater. When moving floodwater enters a wetland, its velocity is reduced by the wetland's roughness and increased cross-sectional area. As velocity is reduced, the capacity of the water to carry suspended particulates is reduced, and particulates (>0.45 micrometers or 0.00045 millimeters in diameter) drop out of the water column and settle (Brinson et al. 1995; Ainslie et al. 1998). Sedimentation is a common example of this physical process. Deposition of silt is often observed in wetlands after floodwaters recede. Sedimentation raises ground or substrate surface elevations, creates topographic variability, and augments nutrient levels; the accumulation of organic particulates supports decomposition, nutrient cycling, and detrital food webs (Brinson et al. 1995). Wetlands and aquatic areas in the American Bottom naturally retained organic and inorganic particulates.

2.5.7 Organic Carbon Exportation. Organic carbon in the form of dead and live plant material is exported from wetlands by moving water. Carbon material is either dissolved or particulate. Dissolved forms include organic materials leached out of litter and surface soil during periods of surface inundation. Particulates include living biomass, leaf litter, and fine and coarse woody debris. Organic carbon is typically flushed out of riverine wetlands by overbank floodwater. Downstream aquatic areas usually receive this material. The microbial food web, which forms the base of the detrital food web in aquatic ecosystems, is fueled in large part by the energy in this organic carbon (Bronson et al. 1995). Given their proximity to the Mississippi River and floodplain lakes and ponds, wetlands in the American Bottom would have been significant sources of organic carbon. Adjacent nonwetland areas on the floodplain would also have been sources of organic carbon, but their rates of carbon export are lower than those of wetlands (Brinson et al. 1995).

2.6 SUMMARY AND CONCLUSIONS

Prior to the construction of the levee and drainage system, the Project area ecosystem was vibrant and diverse. Water resources played a significant role in ecosystem maintenance. Rainfall, Mississippi River action, Cahokia Creek overflows, and runoff contributed from bluff tributaries all provided flood pulse disturbance dynamics at varying intervals throughout a given year. These actions, coupled with the occurrence of fire, provided the natural system with the maintenance necessary to ensure its biological integrity.

The historic dynamics that contributed to the healthy functioning of the predevelopment ecosystem provide an insight into ways in which improvements can be made to reintroduce these missing disturbance components and make improvements in habitat quality and ecological function while creating a sustainable ecosystem. This historic information provides a framework for the understanding of existing conditions of the Project area and how today's natural resources are different from an ecosystem and flooding dynamics perspective, and what may be beneficial for their restoration.

SECTION 3 – EXISTING CONDITIONS
(AFFECTED ENVIRONMENT)

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SECTION 3 – EXISTING CONDITIONS (AFFECTED ENVIRONMENT)

3.1 INTRODUCTION

This section of the report provides an overall characterization of existing conditions in the Project area. A significant portion of the information contained in this section is taken from technical documents available from NRCS, USACE, and USGS reports and maps, as well as ordinances, regulations, Master Plans and additional documents from local municipalities, counties, regional and state agencies.

It is important to understand how the historic natural ecosystem of the uplands and bottomlands in the Project area functions today after widespread agricultural development and extensive urbanization. This information also forms the basis for the identification of natural resource problems and opportunities that help guide potential ecosystem restoration objectives, such as restoration of flooding patterns and hydraulic functions that could benefit, rather than detract from, ecosystem structure and function, and at the same time, reduce flood damages in the Project area.

The topics addressed in this section include: Land Cover, Land Use and Socio-Economic Profile, Topography-Drainage-Fluvial Geomorphology, Geology and Soils, Climate and Weather, Air Quality, Noise, Surface Water-Floodplain Management, Stormwater Quality, Aquatic Biological Resources, Terrestrial Biological Resources, Wetlands, Threatened-Endangered and State Listed Species, Cultural Resources, Socio-Economics, Recreation Resources, Aesthetics, Infrastructure, and Hazardous-Toxic-Radiological Wastes. Where appropriate, the explanations of existing conditions will be classified by the affected watershed. In order to facilitate the organization of information, the five sub-basins utilized in the February 1984 study of the Project area, Re-evaluation Report and Environmental Assessment, Cahokia Canal - Harding Ditch Areas, East St. Louis and Vicinity, Illinois Interior Flood Control Project were again used.

3.2 LAND COVER

Land cover of the Project area consists of the various natural and man-made features and structures that are present on the earth's surface. This section describes land cover of the overall Project area, its landforms, and its major watersheds. The land cover characterization reflects the fact that, except for New Orleans, the Project area lies within the largest concentration of industrial, commercial, and residential land use on the Mississippi River floodplain.

3.2.1 Introduction. The Illinois Land Cover Database (ILCD) (IDNR 1996a) has been used to represent existing land cover conditions. Illinois' Critical Trends Assessment Project was initiated in the early 1990s to establish a baseline for the state's ecological and environmental conditions, identify trends in these conditions, and then periodically monitor future changes. As part of this effort, a land cover database was developed for the entire state. It is based primarily on Landsat Thematic Mapper (TM) satellite imagery.

Imagery for the Project area and its vicinity was acquired in 1991 (IDNR 1996a). The spatial resolution of the imagery and database is about 28.5 meters by 28.5 meters (93.5 feet by 93.5 feet), which means the smallest area capable of being discriminated by the satellite is about 0.2 acres. Land cover of the project area is displayed in Figure 3-1.

Figure 3-1 Project Area – Land Cover

The ILCD data for the Project area are broken down into six major land cover categories, and 17 minor categories (Table 3-1). Definitions for these land cover categories can be found in IDNR (1996a, 1996b).

3.2.2 Land Cover for Project Area. As shown in Table 3-1, about 68 percent of the Project area consists of urban/built-up, cropland, and grassland areas. Because these are "man-made" cover types, they are grouped together. The largely "natural" cover types - forested, wetland, and open water areas - make up the remaining 32 percent. Of the minor land cover categories, row crops are the most common, and account for about 25 percent of the Project area. Next in decreasing abundance are deciduous closed-canopy forest, urban grassland, and medium density urban/built-up land.

Table 3-1 Land Cover of the Project Area (from Illinois Land Cover Database).

Major Category	Area (acres)	% Area	Minor Category	Area (acres)	% Area
Urban/Built-Up Land	20,749.2	19.5	High Density Medium Density Low Density	3,734.0 15,984.9 1,030.3	3.5 15.0 1.0
Cropland	29,896.2	28.0	Row Crops Small Grains Orchards/Nurseries	26,155.9 3,706.3 34.0	24.5 3.5 < 0.1
Grassland	22,295.4	20.9	Urban Grassland Rural Grassland	19,016.3 3,279.1	17.8 3.1
Forested/ Wooded Land	21,995.7	20.6	Deciduous Closed Canopy Deciduous Open Canopy	20,018.0 1,977.7	18.8 1.9
Wetland	8,275.2	7.8	Shallow Marsh/Wet Meadow Deep Marsh Forested Wetlands Shallow Water Wetlands	2,188.9 649.7 3,978.0 1,458.6	2.1 0.6 3.7 1.4
Open Water	3,429.6	3.2	Open Water	3,429.6	3.2
TOTAL	**106,641.4**	**100.0**		**106,641.4**	**100.0**

3.2.3 Land Cover by Landform. Within the Project area, the bottoms, or Mississippi River floodplain, and uplands comprise roughly equal proportions in area (54 percent versus 46 percent). The floodplain supports proportionally more urban/built-up, cropland, wetland, and open water areas (Table 3-2). In the uplands, a greater proportion of grassland and forest areas occur. These patterns reflect to a large degree the overall differences between the two landforms in terms of topography (flat floodplain versus rolling to steep uplands), geomorphology (alluvial or river-formed versus glacial till plain), and current land uses.

Table 3-2 Percent Land Cover of Project Area by Landform

Major Category	**Floodplain (54 % of area)**	**Upland (46 % of area)**
Urban/Built-Up	11.6	7.8
Cropland	19.9	8.1
Grassland	9.7	11.2
Forest	2.5	18.2
Wetland	7.0	0.7
Open Water	3.2	< 0.1
Total	**53.9**	**46.1**

Within each landform (Table 3-3), cropland is dominant in the floodplain or bottoms, whereas forest is most abundant in the uplands. Cropland, urban/built-up, and grassland account for about 77 percent of the bottoms, whereas in the uplands, these three major categories cover about 59 percent of the area. Wetlands and open water are much more common in the bottoms.

Table 3-3 Percent Land Cover of Project Area within Landforms

Major Category	**Floodplain (54 % of area)**	**Uplands (46 % of area)**
Urban/Built-Up	21.5	17.0
Cropland	36.9	17.6
Grassland	18.0	24.3
Forest	4.6	39.4
Wetland	13.0	1.6
Open Water	5.9	0.1
Total	**99.9**	**100.0**

3.2.4 Land Cover by Project Watersheds. Land cover assessments for each of the Project area's five major watersheds are presented in the order of their geographic position from north to south. Figure 3-2 displays these areas. This information is presented because assumptions were made about future changes in land cover by watershed without any project, specifically, losses of deciduous forest in the uplands due to future development in each watershed. A detailed table of land cover by landform and watershed is included in Appendix B.

County Ditch. The County Ditch watershed comprises about 11 percent of the Project area (or 11,721 acres), and its floodplain component accounts for 75 percent of the watershed's area (Table 3-4). Of the five major watersheds, it exhibits the smallest proportion of urban/built-up land. In the bottoms, the chief category is cropland, whereas in the uplands it is grassland. Urban/built-up, cropland, and grassland constitute about 87 percent of the bottoms, and 69 percent of the uplands. Forest, wetland, and open water areas account for about 13 percent and 31 percent of these landforms, respectively. Portions of Madison City, Pontoon Beach, Edwardsville, and Glen Carbon lie within this watershed.

Figure 3-2 Project Area Watershed Divisions

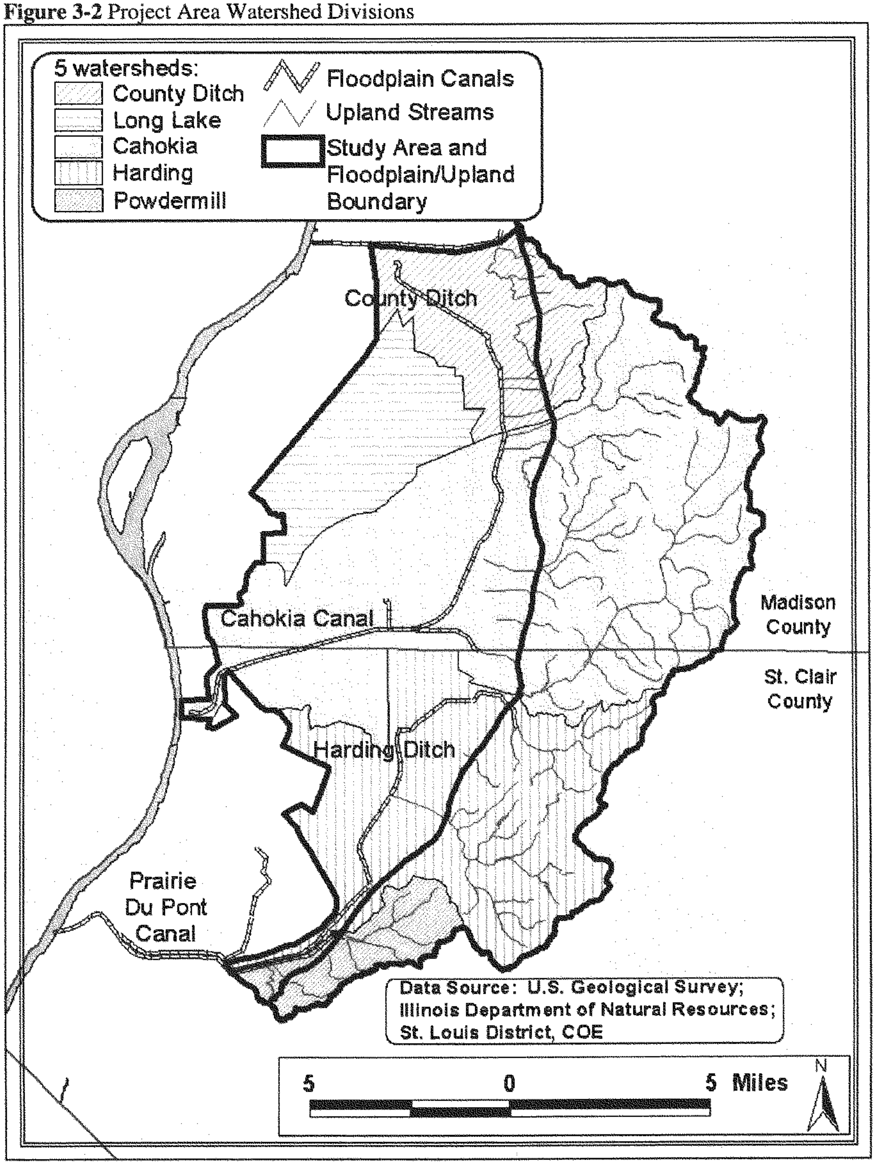


Table 3-4 Percent Land Cover of County Ditch watershed within Landforms

Major Category	Floodplain (75 % of area)	Uplands (25 % of area)
Urban/Built-Up	1.8	11.6
Cropland	70.7	13.5
Grassland	14.5	43.4
Forest	5.2	29.3
Wetland	7.1	2.1
Open Water	0.7	0.2
Total	**100.0**	**100.1**

Long Lake. The Long Lake watershed constitutes about 10 percent of the Project area (or 10,228 acres), and consists of only floodplain because no tributary streams drain into this area. This floodplain area has the greatest relative amount of urban/built-up land of all the watersheds (Table 3-5). This reflects the presence of Granite City and Pontoon Beach within this watershed. Urban/built-up, cropland, and grassland comprise about 91 percent of the area, whereas forest, wetland, and open water account for only 9 percent.

Table 3-5 Percent Land Cover of Long Lake watershed

Major Category	Floodplain only
Urban/Built-Up	39.8
Cropland	33.1
Grassland	18.1
Forest	2.1
Wetland	4.3
Open Water	2.5
Total	**99.9**

Cahokia. The Cahokia watershed is the largest of the five watersheds, and makes up about 49 percent of the Project area (or 52,297 acres). The two landforms, floodplain and uplands, have about equal proportions (Table 3-6). In the floodplain, cropland is the primary land cover category; in the uplands, forest is dominant. Urban built-up, cropland, and grassland account for about 68 percent of the bottoms, and about 64 percent of the uplands. Of the remaining categories, wetland and open water dominate the bottoms, and forest the uplands. Pontoon Beach, National City, Washington Park, Collinsville, Glen Carbon, and Maryville are among the communities within this watershed.

Table 3-6 Percent Land Cover of Cahokia watershed within Landforms

Major Category	Floodplain (46 % of area)	Uplands (54 % of area)
Urban/Built-Up	16.9	17.3
Cropland	35.3	20.8
Grassland	16.2	26.3
Forest	3.6	33.8
Wetland	16.8	1.8
Open Water	11.2	0.1
Total	**100.0**	**100.1**

Harding. The Harding watershed comprises about 26 percent of the Project area (or 27,439 acres). Floodplain and uplands have similar areas (Table 3-7). The urban/built-up category is dominant in the bottoms, and forest is most common in the uplands. About 75 percent of the bottoms consists of urban/built-up, cropland, and grassland, whereas about 48 percent of the uplands is covered by these categories. Forest, wetlands, and open water make up about 25 percent of the bottoms and 52 percent of the uplands. Washington Park, East St. Louis, Centreville, Alorton, Caseyville, Fairview Heights, and Belleville are among the communities within this watershed.

Table 3-7 Percent Land Cover of Harding watershed within Landforms

Major Category	Floodplain (46 % of area)	Uplands (54 % of area)
Urban/Built-Up	31.2	18.7
Cropland	19.3	12.4
Grassland	23.9	16.8
Forest	7.5	50.7
Wetland	15.7	1.4
Open Water	2.5	0.0
Total	**100.1**	**100.0**

Powdermill. The Powdermill watershed represents about 5 percent of the project area (or 4,907 acres). Cropland and forest are the most dominant land cover categories in the bottoms and uplands, respectively (Table 3-8). About 62 percent of the bottoms and 55 percent of the uplands consist of urban/built-up, cropland, and grassland. A substantial portion of the floodplain consists of wetland land cover. Although much of the watershed is unincorporated, a portion of Belleville lies within it.

Table 3-8 Percent Land Cover in Powdermill watershed within Landforms

Major Category	Floodplain (20 % of area)	Uplands (80 % of area)
Urban/Built-Up	1.6	13.0
Cropland	41.9	17.5
Grassland	17.9	24.2
Forest	11.7	44.6
Wetland	26.7	0.6
Open Water	0.1	<0.0
Total	**100.1**	**100.0**

3.2.5 Land Cover Data Deficiencies. The land cover data sets reflect conditions from about 1991, and are out of date by close to 10 years when compared to the point in time - spring of 1999 - that defines this Project's baseline condition. Since 1991, additional development has taken place within the Project area, and the proportions of some categories, such as agriculture, grassland, or forest, are expected to have declined to some degree due to increasing urbanization.

3.3 LAND USE AND SOCIO-ECONOMIC PROFILE

3.3.1 Land Use and Related Activity. Both Madison and St. Clair Counties have prepared master planning documents that include information on existing land use within the Reevaluation area. These documents include a discussion concerning future land use that will be discussed in the next section of this report. The master plans are living documents that are subject to periodic reviews to consider public input, major changes in demographics, government policies, infrastructure, public policy, economic, and employment activities. Below are some of the pertinent information from these master-planning documents, which describes the existing land use and related issues within the Reevaluation area.

3.3.1.1 Existing Land Use Planning Strategy. The existing land use planning strategy in Madison and St. Clair Counties can be summarized as follows: conserve agricultural lands; diversify employment opportunities; give the environment consideration in land use decisions; ensure housing availability; manage growth in a sensible manner; utilize best management conservation practices; provide open space and recreational opportunities; and, provide a safe, efficient, compatible transportation system.

3.3.1.2 Planning Subareas. The master plan reports divide the counties into subareas. Madison County has subdivided itself into the American Bottom, Bluffs, and Rural/Agricultural Corridors, while St. Clair County has subdivided itself into the North American Bottom, South American Bottom, Development, and Southern Tier Corridors. For the purposes of the description here, the Madison County classification system will be applied to that portion of the two counties that fall within the Project area (i.e. the American Bottom Corridor and the Bluffs Corridor).

3.3.1.2.1 American Bottom Corridor. This corridor consists of developed and undeveloped lands in the western third of the counties. On the western edge of this corridor is the Mississippi River. Historically, this area was important for industrial and business uses. The largest municipalities within the Project area portion of the corridor are East St. Louis and Granite City. Corridor land uses include residential, industrial/commercial (including Granite City Steel, Gateway Commerce Center Industrial Commercial Park) and recreational (Lewis and Clark State Park, Horseshoe Lake, Gateway International Raceway, Cahokia Mounds State Park, Frank Holten State Park). Approximately one-fourth of the county's population lives in the American Bottom Corridor.

3.3.1.2.2 Bluffs Corridor. This corridor includes the central region of the two counties. On the west is the American Bottom Corridor, and on the east a broad expanse of farm land. The Bluffs Corridor is a blend of residential development, open space and farmland. The majority of the population of the two counties lives here. The scenery and general amenities of the area make it desirable for residential development. Within the Project area, this corridor includes the growing communities of Edwardsville, Glen Carbon, Maryville, Collinsville, Fairview Heights, and Belleville. The Bluffs Corridor is in the midst of its largest population increase in 20 years. This change includes a shift of population from the older urbanized communities in the American Bottom Corridor to the Bluffs Corridor communities.

3.3.1.3 Land Use Classification By Corridor. Table 3-9 presents the overall land use data for the Project area using the available classifications. As indicated below, both the American Bottom and the Bluff Corridor have considerable amounts of undeveloped lands. The land use data show no physical constraints to future development.

Table 3-9 Current Project Area Land use by Corridor

Parameter	Grand Total	Urban				Open Space	
		Total Urban	**High Density Urban**	**Medium Density Urban**	**Low Density Urban**	**Water/ Wetland**	**Other**
Am. Bottoms							
Acres	58,989	12,709	3,040	9,167	502	11,161	35,119
%	100.0	21.5				18.9	59.6
Bluffs							
Acres	50,373	8,569	789	7,226	554	843	40,961
%	100.0	17.0				1.7	81.3
Total							
Acres	109,362	21,278	3,829	16,393	1,056	12,004	76,080
%	100.0	19.5				11.0	69.5

3.3.1.4 Urban Land Use. The following provides a description of the urban land uses and related activity found within the Reevaluation area. Within the urban setting, commercial, industrial, and residential uses dominate.

3.3.1.4.1 Commercial Uses. Commercial uses include retail, professional, and business services, offices and related showrooms, warehouses, eating and drinking establishments, automobile related commercial activities, and agricultural businesses. The commercial development category includes Regional (or highway) and community (or general) developments. Regional development activities are those that serve the market provided by the transportation corridor. Interstate interchange areas are a typical example of this type of development. Community development includes a variety of activities related to urban arteries, individual businesses, professional office parks, and malls. The number of businesses and their value has grown steadily, with retail sales increasing 18 percent between 1992 and 1995. The retail sector generated $2.0 billion in sales from 2,400 establishments during 1992. By comparison, the services sector generated receipts of $877 million from 6,797 establishments (see Table 3-10).

3.3.1.4.2 Industrial Uses. Manufacturing, wholesale, warehouse, and distribution uses are included in this category. Madison County has a strong industrial development history and has a strong transportation system needed for such development. However, the county has been following the nationwide trend of declining manufacturing due to global competition. Data on manufacturing was reported for four metro-east areas in 1992:

Belleville, East St. Louis, Granite City and the City of Madison. Within these communities there were a total of 118 manufacturing establishments with a total value of shipments of $1.7 billion. Large manufacturers characterize the American Bottom Corridor of Madison County with steel mills and refineries that account for most of the traditional manufacturing jobs. Key features enhancing the utility of this area include Mel Price L&D, Lock 27, Foreign Trade Zone 31, Tri-City Port District, Chain of Rocks Canal and the former U.S. Army Mel Price Support Center. In the Bluffs Corridor, Madison County benefits from the convergence of several interstate highways. Industries in this zone exist interspersed with residential areas. St. Clair County is likewise well suited for industrial development. The completion of I-255 has integrated the regions highway network thereby adding to the system's convenience. The highway represents one of the best opportunities in the Midwest for light industrial, warehouse, and distribution facilities. The renovation of the Martin Luther King Bridge over the Mississippi River also contributes to the areas economic health. The main industries in St. Clair County are the Monsanto Company, Cerro Copper, and Peabody Coal.

Table 3-10 Retail Trade and Services Industries by County (1992)

Location	All Establishments			
	Retail Trade		Service Industries	
	No. of Estab.	Total Sales ($1,000)	No. of Estab.	Total Receipts ($1,000)
MADISON COUNTY				
Collinsville	295	292,000.0	942	99,100.0
Edwardsville	239	148,500.0	1,059	87,800.0
Glen Carbon	35	26,300.0	188	6,300.0
Granite City	319	242,900.0	900	105,500.0
Madison	60	18,600.0	80	7,700.0
Maryville	12	1,400.0	27	5,700.0
Pontoon Beach	9	6,100.0	12	
Venice	5		20	1,300.0
ST. CLAIR COUNTY				
Alorton	3		13	200.0
Belleville	590	493,800.0	2,076	344,600.0
Cahokia	153	114,600.0	304	32,800.0
Caseyville	33	21,300.0	139	10,200.0
Centreville	14	3,100.0	22	5,000.0
Dupo	20	2,600.0	97	3,500.0
East St. Louis	204	94,300.0	354	41,300.0
Fairview Heights	349	492,200.0	397	106,600.0
Swansea	65	69,800.0	187	20,900.0
Washington Park	33	15,100.0	29	2,200.0
COMBINED TOTALS	**2,400**	**2,027,500.0**	**6,797**	**877,200.0**

3.3.1.4.3 Residential Housing and Households. Table 3-11 provides information about housing characteristics of the two counties as compared to the state as a whole. In general, in the area west of the bluffs, both counties provide important advantages to housing developers in the form of low land costs and easily developable land.

Table 3-11 Housing Information by County and State

Category	Madison County			St. Clair County			State of Illinois		
	1980	1990	% Change	1970	1990	% Change	1970	1990	% Change
Total units	93,682	101,098	+7.9	91,354	103,432	+13.2	3,703,367	4,506,275	+21.7
Vacancies	4,586	NA	NA	5,025	8,068	+60.6	199,982	301,920	+51%
Median value ($)	36,200	51,400	+42.0	43,000	61,000	+41.9	70,000	90,000	+28.6

An on-going trend in Madison County is the building of larger houses for fewer people. Single family detached housing is the dominant housing type. Madison County's goal is to provide a diversity of housing types while providing a sense of community rather than promoting conventional urban sprawl. Open space is seen as a primary vehicle for creating areas with a strong sense of community.

In St. Clair County, residential construction is booming particularly with new housing construction occurring in Belleville and Fairview Heights. The number of new housing units increased by 13.2 percent between 1970 and 1990 (Table 3-11). About 95 percent of all units were occupied. In addition, the median property value increased 41.9 percent during the same time period. The number of households increased by 4.8 percent, which is close to the statewide rate (Table 3-12).

Table 3-12 Households – State and Counties' Level (1,000's)

Category	Madison County			St. Clair County			State of Illinois		
	1980	1996	% Change	1980	1996[2]	% Change	1980	1996	% Change
Total Households	89.0	94.9	+6.6	91.0	95.3	+4.8	4,045.4	4,202.2	+3.9

3.3.1.5 Agricultural Use. The agricultural land use category applies to areas of productive farm ground, farmsteads, very low-density residential uses and agricultural-related business and industry. A major concern within the area is preventing premature conversion of farmland to other land uses. The total acreage of land farmed has been on the decline between 1978 and 1992. The acreage drop was 10 percent in Madison County, and 13 percent in St. Clair County (Table 3-13). A decline in the number of farms was evident during the same time period with a 26 percent reduction in Madison County and a 30 percent reduction in St. Clair County. At the same time, farm size has been increasing with a 21.6 percent increase in Madison County and a 24.8 percent increase in St. Clair County. The total cropland acres farmed has declined by roughly 5 percent in both counties over the same time period.

Table 3-13 Agricultural Use.

Category	Madison County			St. Clair County		
	1978[1]	1992[2]	% Change	1978[1]	1992[2]	% Change
No. of farms	1,754	1,299	-25.9	1,371	953	-30.5
Farm Acres	333,000	300,000	-9.9	305,000	264,000	-13.4
% of all land	71.0	NA		70.8	NA	
Ave. size of farm (acres)	190	231	21.6	222	277	24.8
Cropland (acres)	284,000	271,000	-4.6	260,000	245,000	-5.8

In 1992, approximately 516,000 acres within Madison and St. Clair Counties were classified as cropland (Table 3-13). The areas' farm operators produce cash grain and vegetable crops with relatively few involved in livestock production or dairying. Overall, agriculture plays a far less significant role in the economy of the area than does manufacturing. However, it is important to note that within the area, several unique agricultural activities exist. The alluvial fan region at the foot of the bluffs is one of the few areas in the nation suited for the production of horseradishes. In addition, the area known as Poag Terrace is famous for the production of melons

During the period 1978 to 1992, the average market value of land and buildings per farm increased by 36.5 percent in Madison County and by 19.8 percent in St. Clair County. On a per acre basis, the increase was less dramatic, however. The increase was 8.8 percent for Madison County and 3.9 percent for St. Clair County. The market value of agricultural products sold per farm increased very substantially, with an increase of 96.9 percent for Madison County and 68.9 percent for St. Clair County.

In the Project area, agricultural lands currently support row crops, small grains, orchards/nurseries, and rural grassland. Typically, row crops include corn and soybeans, and small grains consist of wheat and sorghum. A specialty crop is horseradish (discussed below). According to the Illinois Land Cover database (1996a), these four kinds of agricultural lands comprised about 28 percent (Table 3-1) of the Project area as of the early 1990s (see Section 3.2). A more recent inventory of agricultural lands in the Project area does not exist.

However, in 1999 the Natural Resources Conservation Service (NRCS) conducted a comprehensive inventory of cropland in the upland portion of the Project area. This inventory was done for this Project to identify potential locations where a variety of best land management practices might be implemented to reduce soil erosion from cropland, and thereby minimize the transfer of upland sediment to the floodplain. Because best professional judgment indicated that most sediment entering the floodplain drainage system had its origin in the uplands, there was no similar inventory of the floodplain portion of the Project area.

The NRCS inventory identified almost 10,500 acres of cropland in the tributary watersheds (Table 3-14). Information concerning this inventory, including maps of identified cropland, is found in Appendix E. Most of this cropland is located in the headwater or eastern portion of the tributary watersheds. (Watersheds in the Project area are depicted in Figure 3-2.) According to this survey, cropland comprises about 21 percent or one-fifth of the uplands within the Project area. In the Cahokia and Powdermill tributary watersheds, about one-quarter of the land is cropland, whereas less than 15 percent occurs in the County Ditch and Harding watersheds (Table 3-14). The proportion of cropland in the minor tributary watersheds varies more widely.

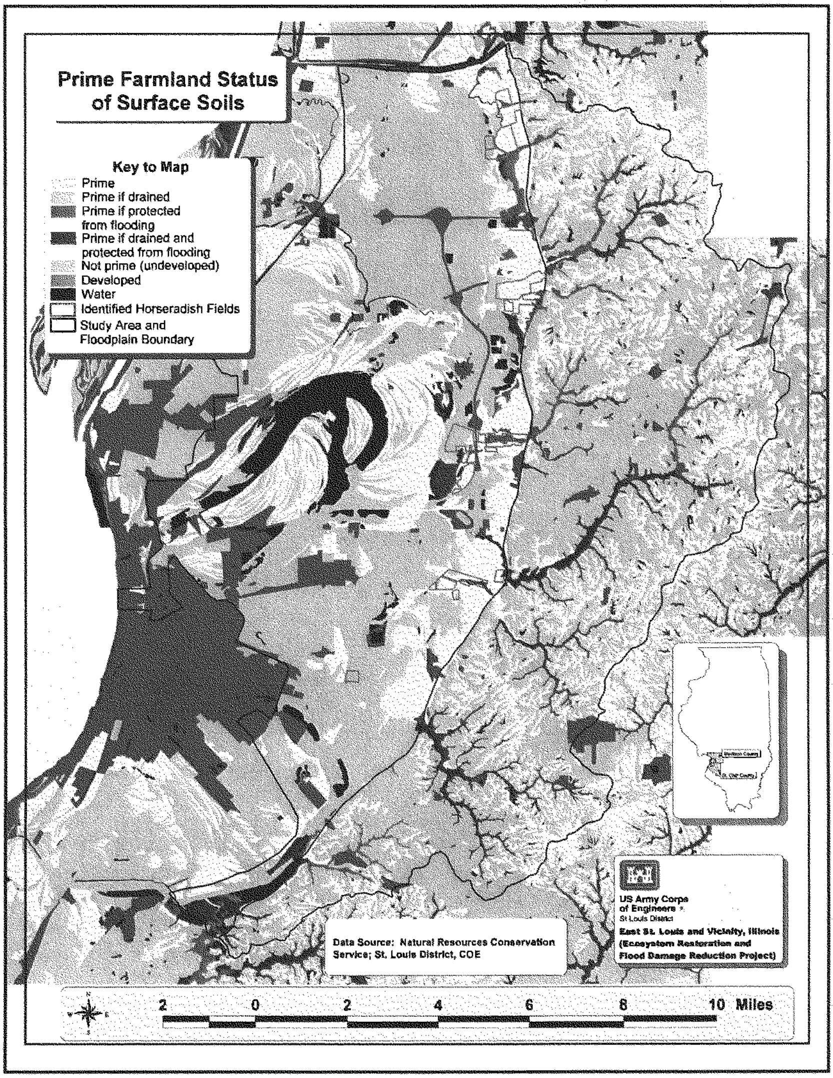
Table 3-14 Cropland identified by NRCS in the Project area's tributary watersheds.

Major Watershed	Minor Watershed	Cropland (acres)	% of Minor Watershed	% of Major Watershed
County Ditch	Bluff 1	372.9	13.0	13.0
Long Lake	(no uplands)	0.0	0.0	0.0
Cahokia	Judy's Branch	1,007.6	18.6	25.1
	Burdick Branch	366.9	20.5	
	Bluff 2	191.1	28.0	
	Schoolhouse Branch	843.0	18.6	
	Bluff 3	0.0	0.0	
	Canteen Creek	4,603.8	31.9	
Harding	Little Canteen Creek	1,133.5	22.5	14.4
	Bluff 4	65.2	6.9	
	Schoenberger Creek	875.1	11.3	
	Bluff 5	39.0	4.0	
Powdermill	Powdermill Creek	463.1	16.0	24.4
	Bluff 6	527.2	45.5	
TOTAL		**10,488.4**		**21.2**

The Project area exhibits variation in the suitability of soils for the production of crops. Based on the digital soil surveys of Madison and St. Clair Counties (NRCS 2000a, 2000b), each of the over 150 different types of soils mapped within the Project area has been classified by the NRCS according to its status as prime farmland. This classification groups soils into five categories: 1) area not prime, 2) all areas are prime, 3) only drained areas are prime, 4) only areas protected from flooding or not frequently flooded during the growing season are prime, and 5) only drained areas that are either protected from flooding or not frequently flooded during the growing season are prime. Appendix B displays all the different mapped soils and their status as prime farmland.

Figure 3-3 displays the relative suitability of the Project area's soils for the production of crops. The category of soils that is not prime has been subdivided into developed soils (which includes all developed and urban land class soils from Appendix B), areas mapped as water, and undeveloped soils that are not prime. The distribution of these various categories across the Project area is generally irregular.

Figure 3-3 Prime Farmland Status of Surface Soils in the Project Area



In Table 3-15, the area and relative proportion of these prime farmland categories is displayed for the Project area as well as its floodplain and upland components. Undeveloped soils that are not prime comprise the greatest proportion of the Project area (about 43 percent), including both floodplain and uplands. A similar pattern occurs for the second most abundant category, prime soils, which makes up about 25 percent of the Project area. Developed soils and water combined constitute over 21 percent of the Project area, with the majority in the floodplain. The remainder of the project area (about 9 percent) consists of the three categories of conditionally prime soils.

Table 3-15 Prime farmland status of surface soils in the Project area, by landform.

Prime Farmland Status of Soils	Floodplain		Upland		Project Area	
	Area (acres)	% Area	Area (acres)	% Area	Area (acres)	% Area
All areas are prime	14,621.0	13.7	12,372.2	11.6	26,993.1	25.3
Only drained areas are prime	1,963.1	1.8	2,264.7	2.1	4,227.8	4.0
Only areas protected from flooding or not frequently flooded during the growing season are prime	612.6	0.6	647.3	0.6	1,259.9	1.2
Only drained areas that are either protected from flooding or not frequently flooded during the growing season are prime	1,993.7	1.9	2,155.4	2.0	4,149.1	3.9
Not Prime - Undeveloped	20,121.9	18.9	26,262.8	24.6	46,384.7	43.5
Not Prime - Developed	13,214.0	12.4	5,064.8	4.7	18,278.8	17.1
Not Prime – Water	4,064.2	3.8	457.1	0.4	4,521.3	4.2
Not mapped	299.1	0.3	527.6	0.5	826.8	0.8
TOTAL	**56,889.5**	**53.5**	**49,751.9**	**46.6**	**106,641.4**	**100.1**

It is important to note that the areas of soils belonging to the prime, conditionally prime, and undeveloped-not prime categories in Figure 3-3 and Table 3-15 do not consist exclusively of farmland currently in use. These areas also include all existing natural habitats, such as wooded areas, marshes, old or abandoned fields, and other similar undeveloped areas.

Horseradish – Specialty Crop: Horseradish has been produced in the American Bottom since the late 1800s, and today about 60 percent of the world's supply comes from this area (Horseradish Information Council 2002). Local producers estimate that about 1,800 acres of farmland are used each year to grow horseradish. In a particular field, horseradish is grown about once every three years, and other crops are planted in the off years. Annual production of horseradish therefore rotates within a total land base estimated by producers to be 2.5 to 3 times what is planted annually (4,500 to 5,400 acres), or roughly 5,000 acres. The St. Louis District consulted with local producers to identify horseradish fields within the Project area. Although this survey was not comprehensive, it yielded 1,537 acres of horseradish fields (Figure 3-3). These identified fields were considered to be a unique agricultural resource within the Project area.

Most horseradish fields are concentrated on alluvial deposits located along the base of the bluff, but some are scattered across the American Bottom. Consequently, the soils occurring within this unique farmland are variable with respect to their prime farmland status as designated by the NRCS. Within the area of horseradish fields shown in Figure 3-3, 68 percent is considered prime, 12 percent is prime if drained, 8 percent is prime if protected from flooding or not frequently flooded during the growing season, 7 percent is prime if drained and protected from flooding or not frequently flooded during the growing season, and 5 percent is not prime. A list, of the 32 different soils found in these identified horseradish fields, is provided in Table B.4 of Appendix B.

3.3.1.6 Open Space. Examples include Horseshoe Lake State Recreation Area, Lewis and Clark Historic Site, Southern Illinois University Campus at Edwardsville. Remaining wetlands in the County are considered an important element of the open space system and are recommended for protection. It is recommended that open space lands be preserved by public agencies and private organizations (e.g. homeowner associations). Areas indicated as open space often have development limitations (e.g. flooding) and can still be preserved if development occurs.

3.3.2 Socio-Economics.

3.3.2.1 Population Size and Location. The seven counties that comprise the Southwestern Illinois region have about five percent of the state's total population. Madison and St. Clair Counties have approximately 40 percent coequal shares of the Southwestern Illinois region's population (Table 3-16). In 1990 about three-fourths of Madison County's population lived in incorporated places. Today, the greatest concentrations of population within the Project area portions of Madison County are found in Collinsville, Edwardsville, Glen Carbon and Granite City. Within St. Clair County the major centers of population are Belleville, Cahokia, East St. Louis, Fairview Heights and Swansea.

Table 3-16 Madison & St. Clair Counties Share of Southwestern Illinois Population.

County	Population 1980	% of S.W. Illinois	Population 1990	% of S.W. Illinois
Madison	247,671	39.1	249,238	39.4
St. Clair	265,469	41.9	262,852	41.5
Monroe	20,117	3.2	22,422	3.5
Bond	16,224	2.6	14,991	2.4
Clinton	32,617	5.2	33,944	5.4
Washington	15,472	2.4	14,965	2.4
Randolph	35,566	5.6	34,583	5.5
S.W. Illinois	633,136		632,995	

3.3.2.2 Population Trends. Historic population figures for Madison and St. Clair Counties are presented in Table 3-17. Between 1970 and 1980 both counties showed a decline in population numbers. Since 1980 that decline has continued for St. Clair County, while for Madison County the data is showing a gradual recovery in population. Table 3-18 shows the change in population at the city and village level between the years 1960 and 2000, and between the years 1990 and 2000.

During the 1960-2000 time frame, towns' showing major drops in population included Brooklyn (-64.8 percent), East St. Louis (-61.4 percent), Venice (-53.0 percent), and Madison (-33.8 percent). Caseyville was the only entity reflecting a major gain during that period.

Table 3-17 Historic Population Data – State and County Level

Region	Population						% Change 1950-2000	% Change 1990-2000
	1950	1960	1970	1980	1990	2000		
Illinois	No Data	No Data	No Data	11,426,518	No Data	12,419,293	N/A	N/A
Madison	182,307	224,689	250,911	247,691	249,238	258,941	+42.0	+3.9 %
St. Clair	205,995	262,509	285,591	267,531	262,852	256,082	+24.3	-2.6 %

Table 3-18 Population – Cities & Villages Level

City/Village	Population				
	1960	1990	2000	% Change	
				1960-2000	1990-2000
MADISON COUNTY					
Collinsville		22,446	24,707		+10.1
Edwardsville		14,579	21,491		+47.4
Glen Carbon		7,731	10,425		+34.8
Granite City	40,073	32,862	31,301	-21.9	-4.8
Madison	6,861	4,629	4,545	-33.8	-1.8
Maryville		2,576	4,651		+80.6
Pontoon Beach		4,013	5,620		+40.0
Venice	5,380	3,571	2,528	-53.0	-29.2
ST. CLAIR COUNTY					
Alorton	3,282	2,960	2,749	-16.2	-7.1
Belleville		42,785	41,410		-3.2
Brooklyn	1,922	1,144	676	-64.8	-40.9
Cahokia	15,829	17,550	16,391	+3.6	-6.6
Caseyville	2,455	4,419	4,310	+75.6	-2.5
Centreville		7,489	5,951		-20.5
Dupo		3,164	3,933		+24.3
East St. Louis	81,712	40,944	31,542	-61.4	-23.0
Fairmont City	2,688	2,140	2,436	-9.4	+13.8
Fairview Heights		14,351	15,034		+4.8
Swansea		8,201	10,579		+29.0
Washington Park	6,601	7,431	5,345	-19.0	-28.1

One can also see that between 1990 and 2000, a number of Madison County localities showed substantial increases in population: Maryville increased by 80.6 percent, Edwardsville by 47.4 percent, Pontoon Beach by 40.0 percent, and Glen Carbon by 34.8 percent. Venice showed a notable population decrease -29.2 percent.

St. Clair County showed a slight decrease in overall population during the 1990-2000 period. The cities that saw the largest decreases were those located west of the bluff and included East St. Louis (-23 percent), Washington Park (-28.1 percent), and Centreville (-21 percent). St. Clair County communities showing population gains included Fairview Heights (+4.8 percent), Swansea (+29.0 percent), Fairmont City (+13.8 percent), and Dupo (+24.3 percent).

3.3.2.3 Age Distribution. The age distribution trends between 1980 and 1996 were similar between the two counties, and were similar to the statewide trends. The under age 5 years group and the over age 65 years group increased slightly, the 17-65 years group held constant, and the 5-17 years old group decreased somewhat. The median age of the population between 1980 and 1996 increased in Madison County (31.0 to 36.9 years) and St. Clair County (28.5 to 34.9 years) consistent with the statewide increase (29.9 to 35.5 years). In 1990, the median age for blacks in Project area communities, for which data are available, was 26.0 years for blacks and 38.8 years for whites. The community showing the greatest difference in median age was East St. Louis, with 58.5 years for whites and 27.3 years for blacks.

3.3.2.4 Education. Another indicator of social well-being is the level of local educational attainment. There is a direct positive relationship between education and other measures of personal welfare such as income. The overall total population numbers have not changed greatly for Madison and St. Clair Counties over the past 16 years. However, during that period, enrollment in schools (grade school and college) have decreased somewhat, while the numbers of those having completed high school or college has increased noticeably. This change may be a result of median age of the population increasing during that same period. The current high school completion rate for both counties is comparable to that of the statewide average, but is about one-third lower in both counties for advanced schooling. The educational attainment rate is somewhat higher for communities east of the bluff line than those west of the bluff line.

3.3.2.5 Labor. Based on 1980 data, the labor force gender split was similar in the two counties and statewide. The breakdown was about 60 percent male and 40 percent female. Comparative data was not available for 1996. With regard to unemployment, the unemployment rate declined over the period 1980 to 1996 for both counties. In Madison it dropped 3.1 percent (from 8.7 to 5.6 percent), and in St. Clair County it dropped from 4.3 percent (from 10.3 to 6.0 percent) during this time period.

Census data parameters have changed enough over the years that a detailed comparison for each employment sector is infeasible. However, a more generalized comparison by reflecting the workforce numbers for those in manufacturing (goods) versus those in other areas (primarily services) is possible (Table 3-19). From this comparison, employment in the manufacturing sector has been on a decline for both Madison (-28.5 percent) and St. Clair (-42.8 percent) since 1960 and that the decline far exceeds the statewide trend (-14 percent). On the other hand, employment in the services sector appears to have picked up the slack employment.

In net overall employment, increases were seen in both Madison (+40 percent) and St. Clair (+22.9 percent) counties. The increase was similar to the statewide increase (+38.9 percent) for Madison County, but was somewhat lower for St. Clair County.

Table 3-19 Civilian Labor Force Information

Item	Civilian Labor Force								
	Madison County			St. Clair County			Illinois		
	1960	1990	% Change	1960	1990	% Change	1960	1990	% Change
Total Employment	80,757	113,082	+40.0	85,859	105,544	+22.9	3,899,472	5,417,967	+38.9
Manufacturing Employment	33,676	24,086	-28.5	25,844	14,776	-42.8	1,240,032	1,056,504	-14.8
Other Employment (Services)	47,081	88,996	+89.0	60,015	90,768	+51.2	2,659,440	4,361,463	+64.0

3.3.2.6 Income. In general, income within the two counties rose approximately 200 percent between 1980 and 1996. During that time period the median household income increased over 80 percent. The percentage of persons living below the poverty level increased by nearly one-third in Madison County, but rose less than 5 percent in St. Clair County. Reference T indicates the region's economy, as in Illinois and the U.S. has changed steadily from a manufacturing base to a more service related economy. In 1992, workers in the manufacturing sector average an annual pay of $35,036, those in the retail trade averaged $10,833 per year, and those in the services sector averaged $21,278 per year. Geographically, manufacturing jobs pay less in the Belleville area than in other regions. Geography does not appear to be much of a factor relative to the retail trade industry. The same can be said for the services industry; however, Belleville and some of the smaller towns (with a small number of workers) west of the bluff line (Centreville, Madison, and Venice) were noticeably higher than the average in this department. As of 1996, East St. Louis had approximately 400 people employed by the riverboat, and many with some form of health insurance.

3.3.2.7 Financing. Table 3-20 presents local government revenue, expenditure and debt information for Madison and St. Clair Counties. Data for Illinois is presented for comparison. Examination of such data can yield valuable information concerning the local governments ability to meet the demand for more government services. For both counties, revenues have increased at a rate about equal to that of expenditures. Consequently, government debt has not changed markedly for the period 1980 to 1994. In 1992, for Madison County, the revenues were slightly less than the expenditure rate, and for St. Clair County the revenues were slightly more than the expenditures. At the state level for 1992, revenues exceeded expenditures, but the percent increase in debt for the 1980 to 1994 period was much higher than it was for the counties.

Table 3-20 Local and State Government Finances ($1,000's)

Year	Madison County		St. Clair County		Illinois	
	Amount ($)	% Change	Amount ($)	% Change	Amount ($)	% Change
Government General Revenue						
1976	166,945.0		191,049.0		8,818,641.0	
1992	392,600.0	+135.2	477,600.0	+150.0	29,778,000.0	+237.7
Government Expenditures						
1976	173,185.0		174,690.0		8,622,886.0	
1992	399,900.0	+130.9	461,500.0	+164.2	21,543,000.0	+149.8
Government Debt						
1976	117,675.0		153,663.0		6,745,321.0	
1992	193,700.0	+64.6	254,300.0	+65.5	22,676,000.0	+236.2

Of the cities/villages for which data was available in 1992, Belleville, East St. Louis and Granite City showed the highest amounts of incoming revenue. Belleville showed the greatest amounted debt, with its debt being two and a half times greater than its 1992 revenue (Table 3-21).

Table 3-21 Local Government Finances ($1,000's)

City/ Village	Local Government Finances, 1992			
	General Revenue	General Expenditures	Debt Outstanding	Debt as % of General Revenue
MADISON COUNTY				
Belleville	20,700.0	22,900.0	51,400.0	248
Cahokia	7,300.0	6,600.0	6,300.0	86
Collinsville	9,400.0	9,900.0	12,100.0	129
Edwardsville	7,000.0	7,000.0	7,900.0	113
Granite City	18,700.0	24,100.0	6,200.0	33
ST. CLAIR COUNTY				
East St. Louis	16,000.0	22,600.0	14,400.0	90
Fairview Heights	6,400.0	4,000.0	300.0	5

3.3.2.8 Transportation. Among the most significant features that have been developed in the Project area are those associated with transportation. The southwestern Illinois railroad network, constructed largely in the last century, focuses upon East St. Louis. Fifteen railroad entities operate approximately fifteen main line routes in the area. In addition, the 35 rail yards located within the Project area represent 50 percent of total rail yards in the St. Louis metropolitan area. Inbound rail traffic is approximately 6400 cars per day while outbound traffic is about 5600 cars per day. Much of the daily traffic (77 percent) does not originate or terminate in the Project area but rather is through traffic destined fore other parts of the nation. Plans for railroad consolidation in the St. Louis metropolitan area call for the construction of several regional rail switching yards within the area. Existing and proposed highways in southwestern Illinois consist of an interstate highway network that includes I-70, I-55, I-255, I-270 and I-64 that links the eastern United States with other mid-western markets.

3.4 EXISTING TOPOGRAPHY DRAINAGE FLUVIAL GEOMORPHOLOGY

3.4.1 Topography. The Project area is primarily located within the Mississippi River floodplain area known locally as the "American Bottom" which includes western portions of Madison and St. Clair Counties. The American Bottom extends beyond the Project area boundaries north to Alton and south into Monroe County near Dupo (see Figure 2-4). The American Bottom covers approximately 175 square miles (112,000 acres). It is approximately 30 miles long and 11 miles wide at its widest point. The existing topography has not changed demonstrably since the Pre-development period with the exception of man made structures, which have been added to the floodplain, altering drainage patterns. In the floodplain it is nearly level bottomland. The floodplain generally slopes to the south and drops in elevation approximately 0.5-foot per mile mirroring the Mississippi River surface profile. The floodplain exhibits river meander scars, abandoned channel oxbow lakes, low-relief ridges, and swales. Ancient Indian mounds rise above the bottoms with the largest being Monks Mound, which rises 85 feet above the adjacent floodplain and is located east of Fairmont City. The average elevation to the north near Alton is 415 feet and to the south near Dupo, 405 feet. In the northern portion, there are terraces located along the foot of the bluff between East Alton and Roxana. The terraces are approximately 25 to 35 feet above the floodplain with elevations between 440 and 450 feet.

The Project area north of Horseshoe Lake is typically higher than the adjacent floodplain with elevations between 420 and 435 feet. The topography near the Illinois bluff on the eastern edge of the floodplain is generally higher than the adjacent floodplain with elevations between 435 and 465 feet. The bluff rises steeply between 150 to 200 feet above the floodplain. The bluff has a rather rugged topography with the creek channels forming valleys with steep slopes. Beyond the bluff line the topography consists of rolling hills and valleys with elevations ranging between 500 and 600 feet. Some shallow surface depressions less than 5 feet deep have been created in the last 100 years by mine subsidence located east of the bluff line.

Man made changes to the area include railroad beds that crisscrossed the area and form mini levee systems across the surface of the floodplain. In the 1800's, East St. Louis was protected from high waters by the railroad embankments of the: Ohio and Mississippi; St. Louis and Southeastern; St. Louis, Alton, and Terre Haute; and, the Cairo Shortline. The exception was an open culvert in the Ohio and Mississippi Railroad embankment between Third and Fourth Streets.

When the water began rising following heavy rains in 1863, East St. Louis had this open culvert closed. The Ohio and Mississippi Railroad, who feared damage to the embankments from the water pressure, promptly reopened it. The city closed it again and placed a guard to protect it. United States troops were sent in to open the embankment and a riot ensued. The citizens were driven away with bayonets and the culvert remained open. The city sustained damage from the flood (Reavis 1876:69). Later, the development of the interstate highway system through the area would further change the topography. Raised roadways, similar to the railroad embankments, changed the natural characteristics of the area forever.

3.4.2 Drainage. By the 1800's, changes to topography through the development of the railroad lines traversing the area had altered the natural drainage patterns of the area. Likewise, manmade levee systems designed to protect cropland from flooding changed the natural drainage. Then, in the 1900's, as a result of increased development in the area, drainage districts were formed for the sole purpose of managing the drainage of the floodplain. By 1904, engineering plans were underway for the construction of a system of canals and drainage ditches designed to carry water as quickly and directly as possible to the River. The construction of this system eliminated the creek system that originally flowed across the Project area. By this time, a levee system had been constructed along the Mississippi River to protect the area from River flooding and in 1910, the tributary drainage area of Cahokia Creek was eliminated from the floodplain and diverted into a large diversion canal on the northern end of the Project area for the purpose of having the creek flow directly into the River. All flow was diverted into the Cahokia Creek Diversion Canal and levees were constructed along the northern boundary of the newly formed East Side Levee and Sanitary District. The Diversion Canal that is approximately 4.5 miles long flows directly west into the Mississippi River at Mile 195. A grade control structure with a low water dam was constructed near the Diversion Canal's mouth to prevent channel head cutting and to stabilize its channel bottom grade. The grade control structure was severely damaged during flash flood events coincident with low Mississippi River levels in 1912, 1913, 1915, 1943, and 1946. The grade control structure was quickly rebuilt near, or at the same location, after each event. The Corps of Engineers rebuilt the structure in 1946 and recently rehabilitated it in 1994. The levee system continued to be improved and today an urban design (500-year) flood control system protects the Project area within the floodplain with large earthen levees and floodwalls. On the northern Project boundary, a levee is located on the left descending bank of the Cahokia Creek Diversion Canal and ties into the bluff west of Edwardsville. On the southern Project boundary, a levee is located on the right descending bank of the Prairie Du Pont Creek and ties into the bluff. While this mainline protection system has continually been improved over time, the original interior drainage canals and ditches remain as originally constructed in the early 1900's.

The natural topography is still a major factor contributing to storm drainage and flooding problems within the Project area. The natural and manmade drainage channels have very little slope and are not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River. Surface water meanders slowly to the Mississippi River or remains in numerous natural depressions.

These problems have increased because of the increased flows from the bluffs and uplands without any corresponding improvements to the drainage system. The flows out of the bluffs enter the American Bottom with high velocities and are able to suspend more sediments than slower moving waters. The slower moving surface waters allow the sediments to aggrade (deposit sediments) in the channels and adjacent lands with overland (out-of banks) flows.

The natural over bank drainage and meandering creeks flowing into the Mississippi River became blocked by the flood protection systems constructed in the early 1900's. The open water areas and wetlands have shrunk more than 40 percent in size with the excavation of 40 miles of drainage ditches and canals constructed between 1907 and 1950 (Bruin and Smith, 1953).

Additionally, the carving up of the natural drainage areas by railroad and road embankments makes drainage of the floodplain areas even more difficult. These manmade features continue to isolate wetlands and open water areas, thus eliminating them from their pre-settlement function of storm water storage. To make the problem worse, groundwater was typically very shallow in most areas within the floodplain as shown on Figure 3-4. The combination of shallow groundwater and poor draining alluvial soils of alternating layers of clays, silts, and sands further promoted the need for the development of the extensive drainage system of levees and varying sizes of drainage ditches, channels, and canals. During the height of the industrial period to until the mid 20th century, the groundwater surface was generally lowered between 2 and 12 feet with localized reductions as a result of extensive ground water pumping in ten areas for industrial and municipal purposes as shown on Figure 3-5. When this pumping stopped, groundwater returned to its historical level and areas like Dobrey Slough that were constructed with dry basements in the 1950's, suffer groundwater flooding today as a result of the cessation of groundwater pumping for industrial purposes. Figure 3-6 shows these post pumping groundwater elevations as of 1990.

Figure 3-4 Groundwater Elevations in Project Area Prior to Pumping

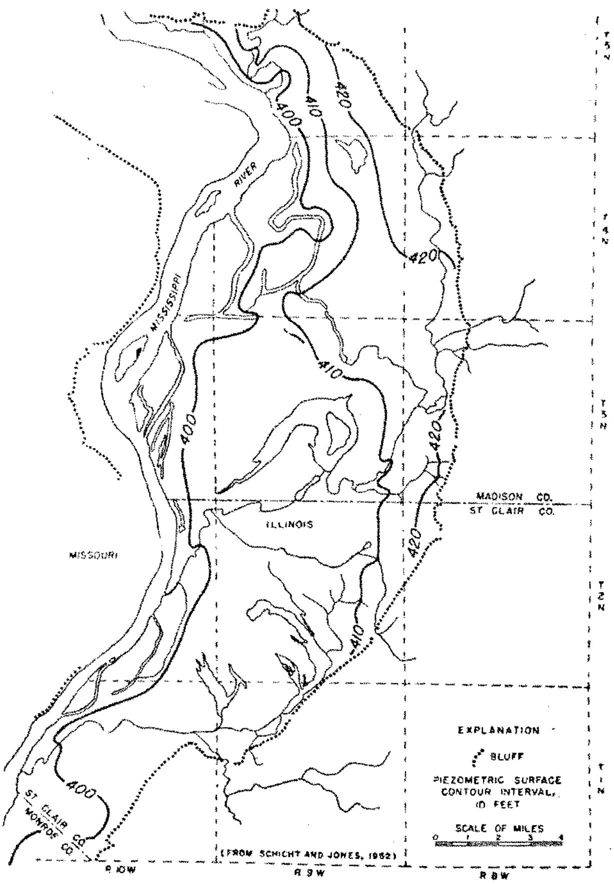


Figure 3-5 Groundwater Elevations in Project Area during Pumping-1956

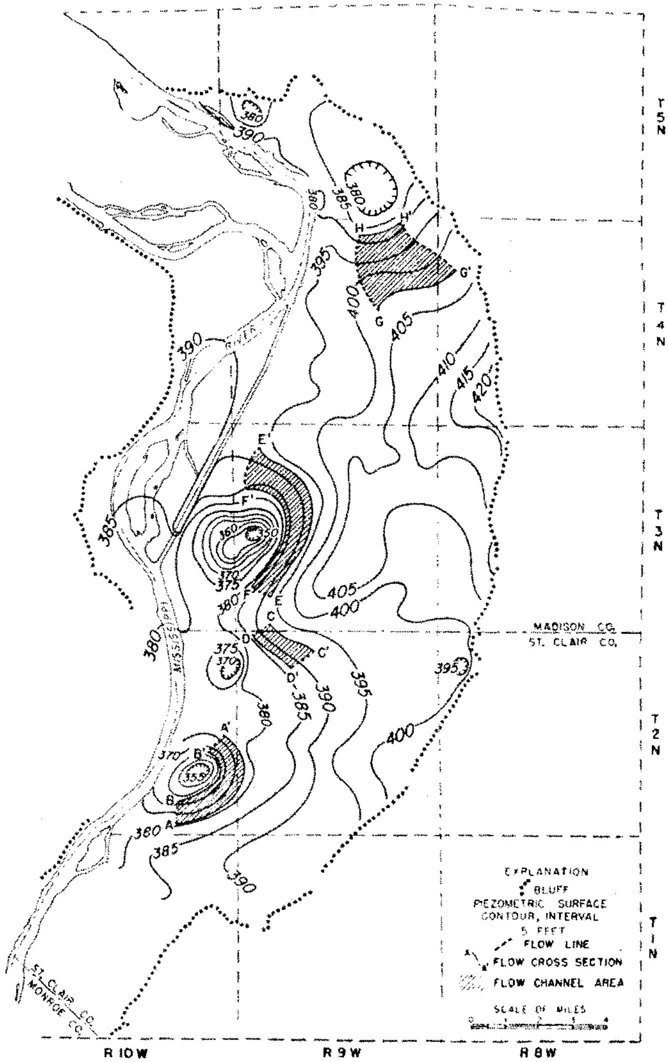


Figure 3-6 Groundwater Elevations in Project Area Post Pumping-1990

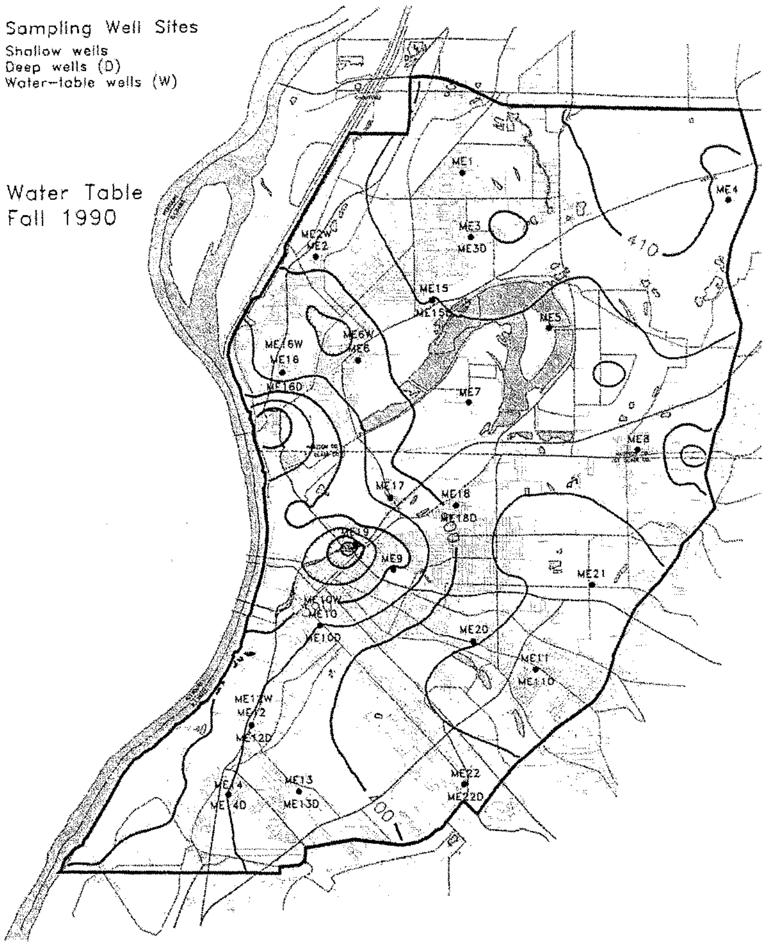
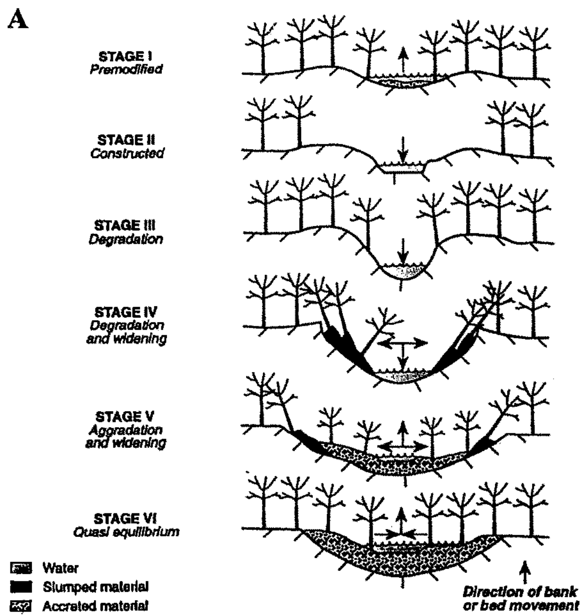


Figure 3. Potentiometric surface map, Fall 1990

3.5 GEOMORPHOLOGY

Since the 1800's, the ongoing geomorphic processes are the stream erosional degradation and sediment aggradation in both the uplands and American Bottom. The tributary streams will proceed through successional changes over time based on the forces placed upon them. This natural progression is depicted by the six stages of channel formation shown in Figure 3-7. The geology, which was formed over millions of years, will maintain its characteristics in spite of the activities of man. In the bluffs, this character includes deep loess cliffs that are highly erodible. This characteristic makes the bluff streams vulnerable to the effects of the changing bluff hydrology, which now produces larger, quicker runoff actions on the streams from the increasing amount of impervious surfaces. These effects are accelerating the successional changes and as a result, are creating instabilities that are adversely impacting infrastructure, stream quality, and floodplain drainage.

Figure 3-7 Six Stages of Channel Formation



A detailed discussion of sediment and erosion within the Project area are contained in Appendix E.

3.6 SURFICIAL SOILS

3.6.1 Alluvial Soils. The surficial alluvial soils that cover the American Bottom are related to their mode of river deposition. The alluvial soils are underlying glacial deposits from the Pleistocene Epoch. The alluvial soils vary in thickness from a few feet to 50+ feet. The soil classifications used for the alluvial soil types are based on the engineering Unified Classification System. The classification system identifies soils based on their grain size and cohesion characteristics. Sands are typically subdivided into well graded, poorly graded, and silty. Silts are subdivided as to whether they have high plasticity or low plasticity. The clays are generally subdivided as to whether they have high plasticity or low plasticity. Five alluvial soil types are identified by their depositional fluvial geomorphic process: abandoned channel, backswamp, point bar, chutes and bar deposits comprise the majority of the unconsolidated deposits and are described below:

Abandoned Channel Deposits. Abandoned channel deposits are predominately fine-grained sediments transported into the abandoned channel during periods of flooding. These deposits normally accumulate slowly and in thin layers. Soil types vary from silty sand (SM) to silt (ML) mixtures in the channel neck area to highly plastic fat clays (CH) common in the bendways. The predominate soil type found in the abandoned channel is fat clay (CH).

Backswamp Deposits. Backswamp sediments occur in thin layers deposited by the floodwaters that periodically deposited on the floodplain. The soil types found in the backswamp deposits vary from silty sand (SM) to fat clay (CH). The predominate soil type found in the backswamp deposits is lean clay (CL).

Point Bar Deposits. Point bar sediments extend as deep as the bottom of the old channel (thalweg). There are two main soil types within the point bar sand and silt in the elongated bar deposits or ridges deposited during rising river stages. Silty clay and fat clay were deposited in the depressions or swales during receding flood stages. Soil types found in point bar deposits vary from silty sand (SM) to fat clay (CH). The predominate soil type in the ridge areas is silty sand (SM). In the swale areas silty clay (CL) and fat clay (CH) are predominate soil types.

Chutes and Bar Deposits. Chutes and bar sediments form more irregular surface topography than point bar deposits. The chutes and bar deposits are graded at the base with sand and gravel and become finer with silty sand (SM) and sand (SP) toward the surface in the ridges and silty clay (CL) and fat clay (CH) in the chutes.

3.6.2 Upland Soils. The bluffs and uplands within the Project area are predominately glacial drift deposits and aeolian (wind deposited) loess deposits.

3.6.3 Soil Mapping Units.

3.6.3.1 General. The Natural Resources Conservation Service (NRCS) has completed their soil surveys for Madison County and St. Clair County that characterize the upper 60 inches of soil. The soil surveys are very detailed and useful in defining soil types to assist in agricultural planning and operations and also in delineating wetlands and creating wetlands. Tables 3-22 and 3-23 summarize the NRCS soil classifications in the floodplain and uplands.

Table 3-22 Floodplain Soil Mapping Units in the Study Area

Floodplain Soil Mapping Units	Area (acres)	% Of Area	% of Accumulative Area
Darwin silty clay, 0 to 2 percent slopes	16,521.7	29.00	29.00
Shaffton clay loam, 0 to 2 percent slopes	6,462.0	11.34	40.34
Landes very fine sandy loam, 2 to 5 percent slopes	4,563.2	8.01	48.35
Water	4,058.5	7.12	55.47
Urban land	2,633.3	4.62	60.10
Dupo silt loam, 0 to 2 percent slopes	2,281.0	4.00	64.10
Orthents, loamy, undulating	2,273.3	3.99	68.09
Nameoki silty clay, 0 to 3 percent slopes	2,100.0	3.69	71.78
Worthen silt loam, 0 to 5 percent slopes	1,887.7	3.31	75.09
Beaucoup silty clay loam, 0 to 2 percent slopes	1,682.8	2.95	78.04
Tice silty clay loam, 0 to 2 percent slopes	1,511.2	2.65	80.69
Fluvaquents, loamy, 0 to 2 percent slopes	1,463.4	2.57	83.26
Fults silty clay, 0 to 2 percent slopes	1,407.4	2.47	85.73
Dozaville, 0 to 2 percent slopes	1,003.2	1.76	87.49
Birds silt loam, 0 to 2 percent slopes	878.2	1.54	89.03
McFain silty clay loam, 0 to 2 percent slopes	819.6	1.44	90.47
Wakeland silt loam, 0 to 2 percent slopes	816.2	1.43	91.90
Littleton silt loam, 0 to 2 percent slopes	565.6	0.99	92.89
Bloomfield loamy fine sand, 1 to 3 percent slopes	551.1	0.97	93.86
Onarga sandy loam, 0 to 3 percent slopes	327.9	0.58	94.44
Ambraw loam, 0 to 2 percent slopes	312.4	0.55	94.98
Dumps	304.7	0.53	95.51
Wilbur silt loam, 0 to 2 percent slopes	344.0	0.60	96.11
Oakville fine sand, 2 to 10 percent slopes	251.9	0.44	96.55
Orion silt loam, 0 to 2 percent slopes	246.6	0.43	96.98
Haymond silt loam, 0 to 2 percent slopes	234.4	0.41	97.40
Rocher loam, 0 to 5 percent slopes	235.3	0.41	97.81
Arenzville silt loam, 0 to 2 percent slopes	213.1	0.37	98.18
Gorham silty clay loam, 0 to 2 percent slopes	207.3	0.36	98.54

Table 3-22 Continued

Floodplain Soil Mapping Units	Area (acres)	% Of Area	% of Accumulative Area
Ridgeville fine sandy loam, 0 to 2 percent slopes	160.7	0.28	98.83
Drury silt loam, 2 to 5 percent slopes	150.1	0.26	99.09
Pits, gravel	69.7	0.12	99.21
Raddle silt loam, 0 to 3 percent slopes	59.4	0.10	99.32
La Hogue loam, 0 to 3 percent slopes	58.7	0.10	99.42
Otter silt loam, 0 to 2 percent slopes	54.4	0.10	99.51
Bartelso silt loam, 0 to 2 percent slopes	46.7	0.08	99.60
Aquents, clayey, 0 to 2 percent slopes	42.5	0.07	99.67
Riley clay loam, 0 to 3 percent slopes	30.1	0.05	99.72
Hurst silt loam, 0 to 10 percent slopes	36.6	0.06	99.78
Colp silty clay loam, 5 to 10 percent slopes	24.8	0.05	99.83
Sylvan-Bold silt loams, 18 to 60 percent slopes	40.9	0.07	99.90
Okaw silt loam, 0 to 2 percent slopes	13.6	0.02	99.93
Ridgway silt loam, 2 to 5 percent slopes	7.9	0.01	99.94
Haynie silt loam, 0 to 2 percent slopes	6.8	0.01	99.95
Bold silt loam, 15 to 30 percent slopes	1.0	0.00	99.96
Menfro silt loam, 5 to 35 percent slopes	1.1	0.00	99.96
Floodplain Total	56,962.0	100.00	

Table 3-23 Upland Soil Mapping Units in the Study Area

Upland Soil Mapping Units	Area (acres)	% of Area	% of Accumulative Area
Menfro silt loam, 2 to 60 percent slopes	18,826.5	37.90	37.90
Sylvan-Bold silt loams, 18 to 60 percent slopes	10,869.9	21.88	59.78
Winfield silty clay loam, 2 to 20 percent slopes	8,409.0	16.93	76.71
Edwardsville silt loam, 0 to 5 percent slopes	1,926.9	3.88	80.59
Wakeland silt loam, 0 to 2 percent slopes	1,906.0	3.84	84.43
Downsouth silt loam, 2 to 5 percent slopes	879.5	1.77	86.20
Bethalto silt loam, 0 to 5 percent slopes	864.2	1.74	87.94
Mascoutah silty clay loam, 0 to 2 percent slopes	840.6	1.69	89.63
Orthents, silty, steep	802.9	1.62	91.25

Table 3-23 Continued

Upland Major Soils Mapping Units Soil Name	Area (acres)	% of Area (%)	% of Accumulative Area (%)
Wilbur silt loam, 0 to 2 percent slopes	736.8	1.48	92.73
Caseyville silt loam, 0 to 5 percent slopes	547.6	1.10	93.83
Water	456.5	0.92	94.75
Sylvan silty clay loam, 10 to 15 percent slopes	433.8	0.87	95.62
Worthen silt loam, 0 to 5 percent slopes	412.0	0.83	96.45
Drury silt loam, 2 to 5 percent slopes	391.2	0.79	97.24
Orion silt loam, 0 to 2 percent slopes	345.3	0.69	97.94
Wakenda silt loam, 2 to 10 percent slopes	249.6	0.50	98.44
Birds silt loam, 0 to 2 percent slopes	238.4	0.48	98.92
Urban land	221.0	0.44	99.36
Littleton silt loam, 0 to 2 percent slopes	72.5	0.15	99.51
Dumps	49.4	0.10	99.61
Bloomfield loamy fine sand, 1 to 3 percent slopes	37.6	0.08	99.68
Bold silt loam, 15 to 30 percent slopes	33.7	0.07	99.75
Arenzville silt loam, 0 to 2 percent slopes	24.2	0.05	99.80
Virden silt loam, 0 to 2 percent slopes	21.7	0.04	99.84
Shaffton-Urban land complex, 0 to 2 percent slopes	18.4	0.04	99.88
Haymond silt loam, 0 to 2 percent slopes	15.2	0.03	99.91
Otter silt loam, 0 to 2 percent slopes	14.2	0.03	99.94
Pierron silt loam, 0 to 2 percent slopes	9.6	0.02	99.96
Dupo silt loam, 0 to 2 percent slopes	6.3	0.01	99.97
Marine silt loam, 0 to 2 percent slopes	5.8	0.01	99.98
Beaucoup silty clay loam, 0 to 2 percent slopes	4.5	0.01	99.99
McFain silty clay loam, 0 to 2 percent slopes	3.9	0.01	100.00
Upland Total	49,674.4	100.00	

3.7 CLIMATE AND WEATHER

The Project area is located directly across the Mississippi River from the city of St. Louis. This is near the confluence of the Missouri and Mississippi Rivers and is also near the geographical center of the United States. Because of its central U.S. location, St. Louis feels the effects of warm moist air moving north from the Gulf of Mexico and the cold air masses moving south from Canada. The conflict along the frontal zones of these invading air masses provides a variety of weather conditions.

Winters are brisk with temperatures dropping to zero or below generally only two or three days per year. The record low temperature at the current weather station site is -18 degrees F, occurring in January 1985, although temperatures as low as -22 degrees F have been measured at other area sites. Snowfall averages about 20 inches per season. Daily temperatures of 32 degrees or less occur less than 25 days per year, while temperatures of 90 degrees F or higher occur about 35-40 days a year. The record high temperature for the area is 115 degrees F, occurring in July 1954. Temperatures exceeding 100 degrees F occur every other year generally, although some years may see 15 or more days with temperatures exceeding 100 degrees F. The prevailing wind direction is from the south for May through November and from the northwest for December through April.

Precipitation averages about 36 inches per year. The winter months are the driest while the months of May through July are the wettest. Rainfall can be severe at times with as much as eight inches of rain recorded in a 24-hour period in 1957. Thunderstorms occur between 40 and 50 days per year, with a few being severe, causing hail and damaging winds. Tornadoes have produced damage and loss of life in the St. Louis area. Climatological data for the area are summarized in Table 3-24. Data were collected at the National Weather Service meteorological station at Lambert-St. Louis International Airport.

An important condition affecting precipitation in the Project area of Madison and St. Clair counties in Illinois is the St. Louis urban effect. Studies by the Illinois State Water Survey have shown substantial increases in rainfall downwind of the City of St. Louis. The increases tend to be the largest in relatively heavy rainstorms and most pronounced in spring and summer when most of the large rainstorms occur. Frequency rainfall values for Madison and St. Clair Counties used in this Project have been adjusted to account for the St. Louis urban effect.

Table 3-24 Climatological Data for St. Louis, Missouri.

Month	**Temperature (°F)**			**Precipitation Average (Inches)**	**Wind Velocity (mph)**	**Wind Direction**
	Average Daily		**Average Monthly**			
	Min	**Max**	**Mean**			
January	19.9	37.6	28.8	1.90	10.6	NW
February	24.5	43.1	33.8	2.14	10.8	NW
March	33.0	53.4	43.2	3.36	11.8	WNW
April	45.1	67.1	56.1	3.63	11.4	WNW
May	54.7	76.4	65.6	3.93	9.5	S
June	64.3	85.2	74.8	3.78	8.8	S
July	68.8	89.0	78.9	3.99	8.0	S
August	66.6	87.4	77.0	2.78	7.6	S
September	58.6	80.7	69.7	2.85	8.1	S
October	46.7	69.1	57.9	2.77	8.9	S
November	35.1	54.0	44.6	3.13	10.1	S
December	25.7	42.6	34.2	2.54	10.4	WNW
Annual	45.3	65.5	55.4	36.66	9.7	S

Source: NOAA 1992, Local Climatological Data of St. Louis, Missouri and NWS 1995, St. Louis WSCMO AP, St. Louis County, Missouri.

3.8 AIR QUALITY

Air Quality information was prepared under a cooperation agreement, by the USEPA Region 5. Appendix F provides the criteria and definitions utilized to assess air quality for a given area. The Project area is located to the east of St. Louis, within the Metropolitan St. Louis Interstate Air Quality Control Region (AQCR). This AQCR covers part of Missouri and Illinois. Areas within the AQCR are further defined according to the attainment status of criteria pollutants. The Metropolitan St. Louis AQCR includes the Illinois counties of Madison, Monroe, and St. Clair, which are referred to as the Metro-East Nonattainment Area (IEPA, 1995). The Metro-East Nonattainment Area is a moderate nonattainment area for ozone. The Project area is in attainment for most of the criteria pollutants, sulfur dioxide, particulate matter, carbon monoxide, nitrogen dioxide, and lead. The area is "nonattainment" for the pollutant ozone and is classified as moderate. A portion of the area is also a "maintenance" area for particulate matter. The townships of Granite City and Nameoki are "maintenance" for PM10. Appendix F provides further information on this classification.

3.9 NOISE

Noise is not considered to be an issue in the preparation of this General Re-evaluation Report. The Project area spans some 266 square miles, which includes industrial, transportation, recreational, residential, retail and agricultural zones. Each of these areas, which are dispersed in pockets of varying sizes and density, make their own contribution to the noise characteristics of the region. The agricultural and open space areas would be expected to have typical noise levels in the range of 34-70 decibels (dB) depending on their proximity to transportation arteries. The use of farm equipment, transport trucks, heavy equipment, tractors, plows, irrigation equipment, and railroad lines, would be expected to provide dominant background noise in the rural areas. Noise associated with transportation arteries such as highways, railroads, airports etc., inherent in areas of higher population would be significant and probably override those sounds associated with natural emissions. Other sources of noise would be expected to include noise from everyday activities, operation of construction and landscaping equipment, and operations of commercial and industrial facilities. In general, urban emissions are not being expected to exceed about 60 dB, but may attain 90 dB or greater in busier urban areas or near frequently used, high volume transportation arties.

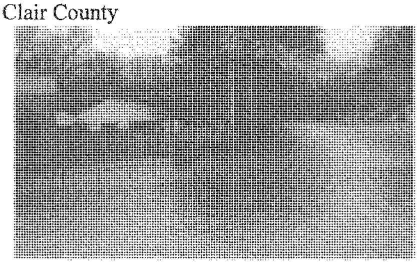
3.10 SURFACE WATER – FLOODPLAIN MANAGEMENT

Surface water-floodplain management has been a challenge for the inhabitants of the bottoms since the early 1900s when the push began in earnest to farm the rich land and develop for industry and commerce the area that sits on the river at the crossroads of the nation. With the diversion of Cahokia Creek and the construction of the Mississippi River levee system, the challenge of taking the remaining surface water from the bluffs to the river, while protecting the intermediate area from flooding, has yet to be met. As early as 1905 the problem of managing interior flooding was sited as being key to the future development of the area. By 1908, construction had begun on a canal system that was designed to manage this surface water as it traveled from the bluff to the river. The system instituted during this period is the same system that is in service today with only minor changes. Past urbanization of the area and climactic changes have increased significantly the peak volume this original system is now expected to contain.

However, no alteration of the system has occurred to increase its capacity. In the bluff area the tributary streams are still in existence, however on the floodplain essentially no natural streams remain. The construction of the interior flood control system eliminated the floodplain streams and in the process severed the once important hydrological connection between the tributary streams and floodplain wetlands.

When storm events exceed the capacity of the interior flood protection system it is overtopped on the floodplain. The result is severe flooding when rainfall events of moderate intensity occur. Figure 3-8 shows the results of these events.

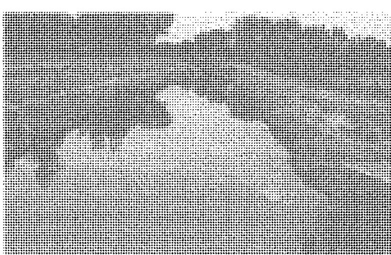
Figure 3-8 Flooding in St. Clair County



3.10.1 Surface Water.

3.10.1.1 Drainage System. As detailed in the earlier discussion on drainage, natural surface water courses have been altered since pre-settlement times to attempt to carry water as quickly and directly as possible from the base of the bluffs to the river. To this end, eighteen principal ditches, canals and streams traverse the area under study. This combination of streams in the bluffs, and ditches and canals in the bottoms, forms today's storm water drainage/management system to carry water from the bluffs to the Mississippi River. Figure 3-9 shows a typical drainage canal seen across the Project area.

Figure 3-9 Canal System

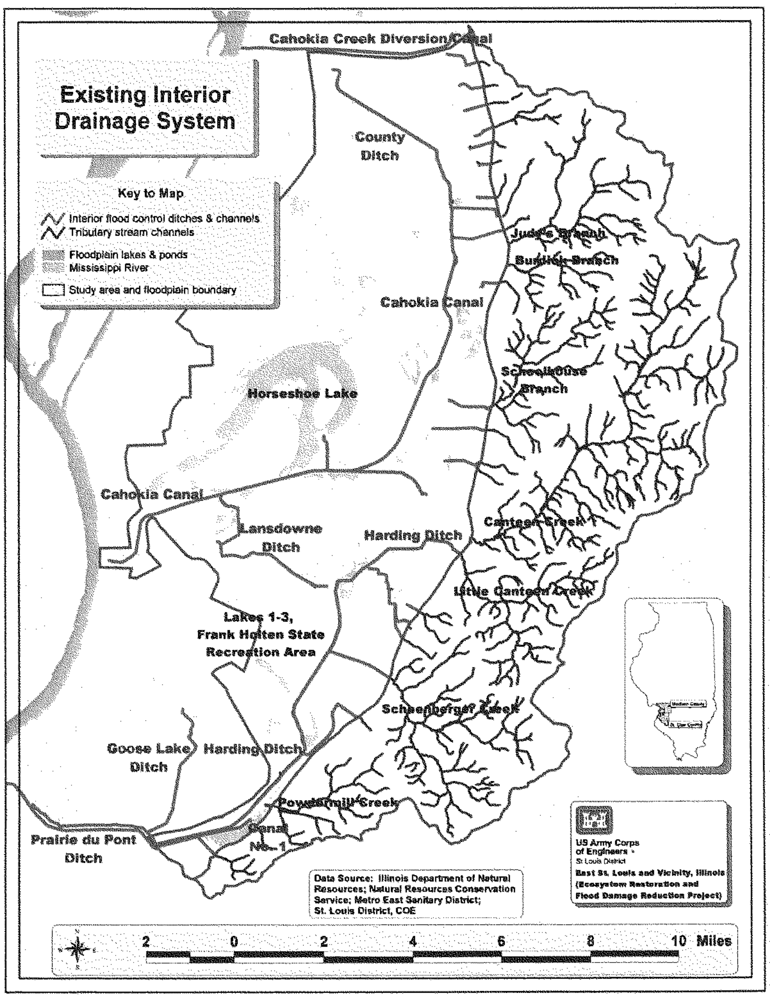


In addition to those listed below, there are many lateral ditches and farm ditches. The locations of the principal watercourses are indicated on Figure 3-10. The principal watercourses are described as follows:

3.10.1.1.1 County Ditch. County Ditch originates in the bottomland area in the vicinity of the intersection of the Gulf, Mobile & Ohio Railroad and the Cahokia Creek Diversion Channel in the extreme northern end of the Project area and flows generally in a southeasterly direction to converge with Cahokia Canal at Illinois State Highway 162. The ditch is approximately 5.6 miles long with an average channel slope of 1.8 feet/mile. County Ditch is completely man-made and as such, was not a modified natural stream.

3.10.1.1.2 Cahokia Canal. Cahokia Canal originates in the bottomland area at the point of confluence of County Ditch and Judy's Branch. It flows generally in a southwesterly direction for an approximate distance of 12.4 miles, and terminates at the North Pumping Station. The channel has an average channel slope of 1.8 feet per mile. The cross-sectional area of the canal varies from 1,000 square feet minimum at the origin to 2,120 square feet maximum at its terminus. Of the total of 75,333 acres that drain into Cahokia Canal, 43,841 acres are bottomland and 31,492 acres are upland. Currently, within the Metro East Sanitary District, the channel is in fair condition. The original Cahokia Creek, located downstream of the diversion cutoff, was straightened and realigned to flow past the southern end of Horseshoe Lake and under the stockyards through three very long, large, box culverts to its relocated confluence with the Mississippi River at Mile 180.6. After Cahokia Creek was modified to a constructed channel, it became known as Cahokia Canal.

Figure 3-10 Project Area - Drainage System



3.10.1.1.3 Judy's Branch. Judy's Branch originates in the uplands and enters the bottomland area at Highway 157 in the northeastern part of the Project area. It flows in a southwesterly direction, parallel to the Norfolk and Western and Illinois Central Railroads, and discharges into the upper end of Cahokia Canal. Judy's Branch has a drainage area of 8.6 square miles and an average slope of 30 feet per mile. The natural stream changes to a channelized ditch approximately 3500 feet downstream of Highway 157.

3.10.1.1.4 Burdick Branch. Burdick Branch originates in the uplands area and discharges into Cahokia Canal just south of Judy's Branch. The stream enters the bottomland at Highway 157 and changes from a natural channel to a channelized ditch approximately 3000 feet downstream of Highway 157. Burdick Branch has a drainage area of 2.8 square miles and an average slope of 43 feet per mile.

3.10.1.1.5 Schoolhouse Branch. Schoolhouse Branch originates in the uplands and enters the bottomland area at Highway 157 in the eastern part of the Project area. The bottomland reach is a channelized ditch which flows westerly and parallels the Illinois Terminal Railroad until it discharges into Cahokia Canal south of McDonough Lake. Schoolhouse Branch has a drainage area of 7.2 square miles and an average slope of 30 feet per mile.

3.10.1.1.6 Canteen Creek. Canteen Creek originates in the uplands and enters the bottomland area at Highway 157 through the northern section of Caseyville, Illinois. The bottomland reach is a channelized ditch flows in a northwesterly direction and discharges into Cahokia Canal just east of the Horseshoe Lake control works. Canteen Creek has a drainage area of 22.6 square miles with an average slope of 17.4 feet per mile.

3.10.1.1.7 Horseshoe Lake Canal. Horseshoe Lake Canal is a zero grade floodway interconnecting Cahokia Canal and Horseshoe Lake. The channel provides access to divert water to or from Horseshoe Lake which functions as a storage area for flows into Cahokia Canal. Historically, Cahokia Creek flowed into and out of the southern end of Horseshoe Lake. After Cahokia Creek was straightened and re-aligned (then Cahokia Canal), the man-made Horseshoe Lake Diversion Canal was constructed to reconnect the lake and the canal. In addition to the connecting canal, a gated control structure on Cahokia Canal immediately downstream of the connecting canal was also built to enhance the flood retention ability of Horseshoe Lake.

3.10.1.1.8 Lansdowne Ditch. Originally, Lansdowne Ditch was a portion of Schoenberger Creek in the bottoms. It begins just east of the Alton and Southern Railroad in the vicinity of Spring Lake and flows northwesterly and discharges into Cahokia Canal downstream from the Horseshoe Lake control works. When the upper Harding Ditch levees are overtopped, flow from Harding enters Lansdowne Ditch through the culvert openings under the Alton and Southern Railroad track.

3.10.1.1.9 Nameoki Ditch. Nameoki Ditch originates in the bottomland areas in the vicinity of Granite City, Illinois, and flows in a southerly direction through the eastern section of Granite City and discharges into Horseshoe Lake. Nameoki Ditch is a man-made channel built to provide storm drainage for the eastern portion of the city of Granite City.

3.10.1.1.10 Long Lake Ditch. Long Lake Ditch originates in the bottomland area downstream of the Norfolk and Western Railroad crossing of Long Lake. Generally, this ditch flows southerly and discharges into Horseshoe Lake via Elm Slough. The Long Lake ditch is a man-made channel built by the Metro-East Sanitary District to shorten the flow path to Horseshoe Lake.

3.10.1.1.11 Mitchell Ditch. Mitchell Ditch originates in the bottomland area in the northern section of the Project area adjacent to the Norfolk and Western Railroad and flows in a southeasterly direction into lower Long Lake. Mitchell Ditch is a man-made channel that drains the community of Mitchell and a large area of agricultural land.

3.10.1.1.12 Harding Ditch. The Harding Ditch drainage area lies in the eastern part of the American Bottom. It originates in the vicinity of Caseyville, Illinois where Little Canteen Creek enters the bottoms. Harding Ditch flows in a generally southerly direction through a section of East St. Louis and then passes through Frank Holten State Park for a distance of 6.8 miles. The outflow from the State Park then enters lower Harding Ditch and flows 4.1 Miles to the South Pumping Station. The average channel slope on Harding Ditch is approximately 2 feet/mile. Schoenberger Creek enters the American Bottom at the community of French Village, flows westerly and enters Harding Ditch 0.9 Miles upstream of Frank Holten State Park. The drainage area includes 10,900 acres of bottomland and 16,050 acres of upland. Thirteen roads and four railroads cross Harding Ditch. The road crossings include Black Lane, Forest Blvd., Bunkum Road, 1-64, Rock Road, St. Clair Avenue (U.S. Highway 50), Marybell Avenue, State Street, Lake Drive, Illinois Highway 15, Illinois Highway 13, Corners Avenue, and Illinois Highway 163. The four railroad crossings are the CSX Railroad, the Metro-Link Light Rail, Southern Railroad and the Illinois Central Railroad. All of the crossings are bridges. The Harding Ditch is an entirely man-made channel built to intercept all hillside drainage from Little Canteen Creek south to Prairie Du Pont Creek.

3.10.1.1.13 Canal No. 1. Canal No. 1 is a large drainage channel in the southern part of the Project area. It is fed by the hillside runoff from Powdermill Creek that enters the American Bottom downstream of Frank Holten State Park. Canal No. 1 flows parallel, and adjacent to, Harding Ditch for 2.8 miles and exits the Project area at the Canal No. 1 Pumping Station located at the Prairie Du Pont Diversion Channel. Canal No. 1 drains 3,200 acres of uplands and 850 acres of bottomland. The canal has an average channel slope of 2.6 feet/mile. One road crosses Canal No. 1 at Illinois Highway 163. Siltation is a problem at Canal No. 1. Lack of sufficient maintenance has allowed excessive growth to occur in the Canal thereby reducing its effective flow area. Canal No. 1 is an entirely man-made channel which was originally intended to intercept Schoenberger Creek near the bluff line with the intention of relieving Harding Ditch of becoming overloaded from the Shoenberger Creek flows.

3.10.1.1.14 Little Canteen Creek. Little Canteen Creek originates in the uplands in the upper portion of the Project area and enters the bottomland through the city of Caseyville, Illinois. The stream converges into Harding Ditch at the Baltimore and Ohio Railroad crossing. The reach of Little Canteen Creek between Long Street and its convergence with Harding Ditch has been channelized. Little Canteen Creek drains 5,095 acres and has an average channel slope of 32 feet per mile.

3.10.1.1.15 Schoenberger Creek. Schoenberger Creek originates in the uplands just below the Little Canteen Creek watershed and enters the bottomland at the community of French Village. The bottomland reach at Highway 157 is a channelized ditch that flows northwest parallel to U.S. Highway 50 and discharges into Harding Ditch 0.9 miles upstream of Frank Holten State Park. Schoenberger Creek drains 7,700 acres and has an average channel slope of 31 feet per mile.

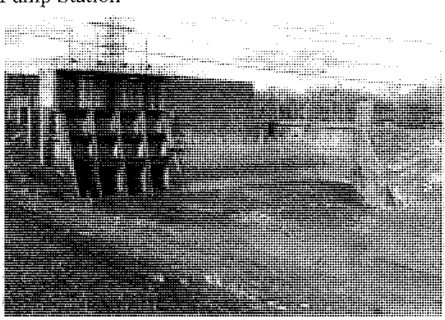
3.10.1.1.16 Powdermill Creek. Powdermill Creek originates in the uplands in the southern part of the Project area where it enters the bottomland area and flows directly into Canal No. 1 in the vicinity of the Illinois Central Railroad. Powdermill Creek has a hillside drainage area of 2,765 acres and has an average channel slope of 54 feet/mile.

3.10.1.1.17 Prairie Du Pont Creek. Prairie Du Pont Creek flows out of the hillside in the southern-most part of the Project area. It has a drainage area of 38.5 square miles and an average channel slope of 17.6 feet per mile. When the flow reaches the bottoms, it is channeled to the Mississippi River between 5.1 miles of flank levees. This channelized portion is known as the Prairie Du Pont Diversion Channel. Discharge from Harding Ditch, Canal No. 1, and Blue Waters Ditch enter the Diversion Channel through either gravity drains or by pumping.

3.10.1.1.18 Additional Ditches. In addition to the principal channels described above, there are numerous small farm ditches and urban ditches which are in place to remove local runoff as well as to channelize bluff runoff through the bottomland.

3.10.1.2 Pumping Facilities. The 19 existing pump stations that form the floodplain storm water management system in the Project area are of two types. There are 14 perimeter levee pump stations and five internal pump stations within the limits of the Metro East Sanitary District (MESD). The figure shows the perimeter North Pump Station that receives its flow from the Cahokia Canal. In addition, there is one pump station along the Chain of Rocks Canal levee in the Chouteau, Nameoki and Venice Drainage and Levee District. It has three pumps with a combined capacity of 78 c.f.s. at a static head of 18 feet. Figure 3-11 shows one of the perimeter levee pump station situated on Cahokia Canal.

Figure 3-11 North Pump Station



The types, locations, capacities, number of pumps and operating jurisdiction are as follows:

3.10.1.2.1 Cahokia Pumping Station. This perimeter levee pump station is located at levee station 1315+16. There are two storm pumps in the station. One has a capacity of 31.4 c.f.s. at 20.0 t.d.h. (total dynamic head), and the other has a capacity of 60.1 c.f.s. at 15.4 t.d.h. The station is operated by the MESD.

3.10.1.2.2 Illinois Department of Transportation Station. This internal pump station is located at Harding Ditch just south of Forest Blvd. The station has two pumps with an estimated capacity of 44 c.f.s. at 16 t.d.h.

3.10.1.2.3 East St. Louis Pumping Station. This perimeter levee pump station is located at levee station 1110+50. There are three storm pumps in the station with a combined capacity of 1285.0 c.f.s. at 23.1 t.d.h. A municipality operates the station.

3.10.1.2.4 Fairmount Jockey Club Station. This internal pump station is located near the Fairmount Race Track and removes excess rainfall from the immediate area by discharging it into Canteen Creek. The station has two storm pumps with an estimated capacity of 12.5 c.f.s. at 5.0 t.d.h. Private interests operate the station.

3.10.1.2.5 Granite City Engineer Deport Lift Pumping Station. This perimeter levee pump station is located at levee station 798+16. There is a total of four storm water pumps with a combined capacity of 66.7 c.f.s. at 43.0 t.d.h. The Federal Government operates the station.

3.10.1.2.6 Granite City Seepage Pumping Station No. 1. This perimeter levee pump station is located at levee station 782+39. There are two storm water pumps in the station with a combined capacity of 11.1 c.f.s. at 33.0 t.d.h. The station is operated by the MESD.

3.10.1.2.7 Granite City Seepage Pumping Station No. 2. This perimeter levee pump station is located at levee station 814+65. There are two storm water pumps in the station with a combined capacity of 16.0 c.f.s. at 35.0 t.d.h. The station is operated by the MESD.

3.10.1.2.8 Granite City Seepage Pumping Station No. 3. This perimeter levee pump station is located at levee station 846+18. There are two storm water pumps in the station with a combined capacity of 11.1 c.f.s. at 33.0 t.d.h. The station is operated by the MESD.

3.10.1.2.9 Granite City Pumping Station. This perimeter levee pump station is located at Chain of Rocks Canal Station 46+70. There are four storm water pumps with a combined capacity of 406.0 c.f.s. at 43.0 t.d.h. The Federal Government operates the station.

3.10.1.2.10 Madison Pumping Station. This perimeter levee pump station is located at levee station 862+66. There are three storm water pumps in the station with a combined capacity estimated as 360.0 c.f.s. at 16.4 t.d.h. The station is operated by the MESD.

3.10.1.2.11 Monsanto Pumping Station. This perimeter levee pump station is located at levee station 115+90. There are six combined sewer pumps with a combined capacity of 154 c.f.s. at 38.5 t.d.h. The station is operated by the MESD.

3.10.1.2.12 North Pumping Station. This perimeter levee pump station is located at levee station 1009+00. There are five storm water pumps in the station with a combined capacity of 1396 c.f.s. at 14.8 t.d.h. The station is operated by the MESD.

3.10.1.2.13 Park Side Pumping Station. This internal pump station is located south of State Street and east of Harding Ditch and serves the adjacent area with discharge into Harding Ditch. There are two storm water pumps in the station with a combined capacity of 17.8 c.f.s. at 30.0 t.d.h. The station is operated by the City of East St. Louis.

3.10.1.2.14 Phillips Oil Co. Seepage Pumping Station. This perimeter pump station is located at levee station 1225+64. There are two storm water pumps in the station with a combined capacity of 22.0 c.f.s. at 33.7 t.d.h. The station is operated by the MESD.

3.10.1.2.15 South Pumping Station. This perimeter pump station is located at levee station 1505+50. There are four storm water pumps with a combined capacity of 528.0 c.f.s. at 15.2 foot static head. The station is operated by the MESD.

3.10.1.2.16 Canal No. 1 Pumping Station. This perimeter pump station is located at levee station 1511+30. There are three storm water pumps with a combined capacity of 130.0 c.f.s. at 12.0 foot static head. The station is operated by the MESD.

3.10.1.2.17 Venice Pumping Station. This perimeter pump station is located at levee station 891+22. There are three storm water pumps with a combined capacity of 90.0 c.f.s. at 40.0 t.d.h. The station is operated by the MESD.

3.10.1.2.18 Caseyville Station. This internal pump station is located near the Harding Ditch levee and serves an area in Caseyville by discharging into Harding Ditch. There is one storm water pump with a capacity of 1.7 c-f-s. A municipality operates the station.

3.10.1.2.19 Chouteau, Nameoki, and Venice. This perimeter pump station is located on the Chain of Rocks Canal. There are three storm water pumps with a total capacity of 78 c.f.s. at 18.0 t.d.h. The Chouteau, Nameoki, and Venice District's operate the station.

3.10.1.2.20 Existing Natural Detention Areas. Many lakes and sloughs in the Project area function as detention areas. Those areas that are part of the existing design systems are Horseshoe Lake and Frank Holten Lakes. The remaining detention areas are not currently dedicated for that purpose in the existing system but do provide detention storage. They are: Spring Lake; Crooked Lake; Upper and Lower McDonough Lakes; Elm Slough; Edelhardt Lake; Long Lake; and, Dobrey Slough.

3.10.2 Floodplain Management. Floodplain management is divided among the four drainage districts on the floodplain that have responsibility for the operation and maintenance of the canal and ditch system as well as the pumping facilities associated with them. Additionally, the county for unincorporated areas and each municipality have responsibility for floodplain management within their area of responsibility. This management responsibility takes the form of ordinance enforcement and the issuance of permits for any disruptive activity (i.e.: construction) that occurs within the drainage system, all within the context of the regulation of the federal flood insurance program.

The Federal and State Emergency Management Agencies also form a review and approval tier in the floodplain management process, as does the Corps of Engineers with its oversight responsibility for the Section 404 permit program. As in any urban setting where watersheds cross county and municipal boundaries, the effective management of the floodplain is a constant challenge.

The formation of the Metro East Regional Stormwater Committee has been an attempt on the part of the floodplain communities to address these challenges. The Metro East Regional Storm Water Committee charter envisions a region in which properly managed storm water leads to a higher quality of life for the residents and better protection for the overall environment.

In order to make this vision possible, the Committee has undertaken an effort to provide a general framework for the development and implementation of comprehensive storm water management in the area. It is this Committee that has participated throughout the Project process to provide a public and political forum for the Project formulation, assessment, and evaluation process. During this Project process, the Committee has worked for the adoption of comprehensive standardized Stormwater Management Ordnance. On February 3, 2000 Madison County adopted a comprehensive storm water management ordinance designed to achieve these goals. In St. Clair County, a similar ordinance has been formulated and its adoption is pending. The roll of this Regional Committee has been one of education, influence and maintaining focus. While its successes have been many, it is still working on behalf of the goal of regionalized comprehensive stormwater management.

3.11 WATER QUALITY

The Project area is within the watershed system referred to as the American Bottom Basin and/or the Mississippi South Central River Watershed by the Illinois Environmental Protection Agency. The Mississippi South Central Watershed encompasses parts of Jersey, Macoupin, Madison, St. Clair, Monroe and Randolph Counties in Illinois. The Corps' project area encompasses a subset area of the Mississippi south Central Watershed consisting of parts of Madison and St. Clair Counties. Streams within the project area which were assessed from historical water quality data were 1) Cahokia Chute, 2) Canal #1, 3) Prairie Du Pont, 4) Harding Ditch, 5) Cahokia Canal, 6) Canteen Creek, 7) Judy's Branch, 8) Cahokia Creek, 9) Indian Creek, and 10) Little Mooney Creek. Surface lakes assessed within the project area were the Horseshoe Lake, the three Frank Holten State Park Lakes, Dunlap Lake, Mt. Olive (Old) Lake, Weslake, Holiday Shores, and Edward and Thompson Farm Pond. A segment of the Mississippi River, which accepts the discharges from the project area, was also assessed by review of historical water quality data. A more in depth coverage of this information is contained in Appendix F.

The streams, lakes and river in the Project area have been assessed on a wide variety of water quality parameters over time. None of the streams, lakes or river segments is pristine and, therefore, a common practice is to identify the causes of water quality impairment and the possible sources of impairment. The water quality conditions of each water body within Illinois are compared to the governing Illinois Water Quality Standards as set up by the Illinois Environmental Projection Agency. The water quality standards vary by designated use of the water body.

The issue of classification of an area's water quality is complex in light of the fact that water systems will have varying use designations, impairments and impairment sources. The focus of this water quality assessment in light of the complexity of water quality classification has been to address the identified impairments and impairment sources based on historical water quality data within the project area. The lakes, ponds, streams and canal system within the project area are currently receiving waters, which have been impaired by multiple sources.

These areas are individually addressed in Appendix F. Overall general causes of impairment in the Project area include the following:

1. Priority Organic Contaminants
2. Metals Contaminants
3. Nutrient Enrichment (i.e., phosphorus, nitrogen, nitrates)
4. Siltation
5. Organic Enrichment/Low Dissolved Oxygen
6. Habitat Alteration
7. Suspended Solids
8. Excessive Algae
9. Noxious Aquatic Plants

The sources of impairment to water quality within the Project area vary widely from urban to industrial to agricultural. The following list of impairment sources is commonly found to be associated with most of the watersheds in the Project area.

1. Agricultural Operations
2. Construction/Land Development/Commercialization/Urbanization
3. Urban/Stormwater Runoff
4. Hydrologic/Habitat Modification via Channelization
5. Land disposal/Septic Tanks
6. Streambank Erosion

3.11.1 Groundwater Conditions in the American Bottom. As described earlier in this section, the bottoms portion of the Project area is part of the larger area known as the American Bottom. The valley fill, situated over bedrock, is composed of glacial (sands and gravels) and alluvium (sands, gravels, silts, and clay) materials. The average depth of the valley fill is 120 feet. This alluvial and glacial valley fill contains the large American Bottom aquifer. The groundwater in the aquifer is a dynamic system constantly changing in response to variations in the level of the Mississippi River, rainfall-infiltration, and man-induced ditching and pumping.

In contrast to surface water flow, groundwater flow in the aquifer is a relatively slow process since the groundwater flow must move through the valley fill. Thus, groundwater levels vary primarily with seasonal and long-term variations in river levels, rainfall, and pumpage. Most of the rainfall-infiltration naturally flowing into the aquifer comes from rainfall directly on the bottoms. About one-fifth of the water comes from groundwater and surface runoff from the bluffs. The groundwater in the bottoms then flows slowly westward and exits into the Mississippi River under normal circumstances. Under high Mississippi River levels, groundwater movement can be away from the River toward the interior. Combining above-average rainfall and long-duration high river levels produces the highest groundwater levels.

3.11.1.1 Groundwater Trends Since the Turn of the Century. Prior to major development in the East St. Louis area, groundwater as high as a few feet below the surface was common. Development first led to levees and drainage ditches, which lowered groundwater levels from 2 to 12 feet. During the period 1900 to the early 1950's, groundwater pumpage, mostly industrial, increased drastically.

As a result of this pumping, water levels in the industrial and urban areas were lowered 40 to 60 feet. A prolonged drought between 1952 and 1956 contributed to even lower groundwater levels with the lowest level on record occurring in 1956. Because groundwater levels were so low, many industries abandoned their wells, especially in the Granite City area. Instead, they opted to withdraw water from the Mississippi River. This reduction in pumping plus the end of the severe drought conditions caused groundwater levels in Granite City to raise approximately 50 feet. In general though, average levels rose from 0 to 10 feet throughout the bottoms during this same period. For most of the 1960's, pumpage increased slightly with a maximum pumpage of 110 MGD in 1964. Average groundwater levels declined from 0 to 5 feet. Starting in the late 1960's, pumpage steadily declined, especially in the major pumping centers in the East St. Louis area until withdrawals were only about 45 MGD in 1981. Existing groundwater levels are generally a few feet to 12 feet below the surface.

3.11.1.2 Groundwater Flooding Problems. As mentioned above, high groundwater was common in the early 1900's. No significant problems related to groundwater were noted since the area was primarily agricultural and undeveloped. Development and pumping increased through the first half of the century, including a post-World War II surge in residential development, which happened to coincide with the 1950's drought conditions. As early as 1961, rising groundwater levels began causing some failure to sewers that were built "in the dry". Since 1969, reductions in pumpage and periods of high Mississippi River levels and/or higher than normal rainfall, has caused constant problems. Flooding of basements, structural damage to homes, sewer failures, and high rates of sewer infiltration has occurred. Major groundwater flooding problems occurred in 1969, 1973, 1974, 1979, 1982, 1986, and 1993 through 1995.

3.11.1.3 Groundwater Quality. Iron, manganese, and dissolved solids concentrations exceed Illinois public water supply, effluent, and general water-quality standards. Also some samples have indicated high concentrations of nitrate + nitrate nitrogen, fluoride, mercury, zinc, lead, and sulfate. In general, any groundwater in the American Bottom would need to be treated before being discharged into the interior surface water system. Industrial contamination of the groundwater aquifer has also occurred at specific locations in the area. The contamination consists of organics and heavy metals.

3.12 ECOLOGICAL AND NATURAL RESOURCES

This section describes existing ecological resources and conditions in the Project area. Because development has extensively modified the natural environment over the past 200 years, losses occurring in the Project area to historic natural communities are described first. Then the remaining natural communities – forests, prairies, wetlands, lakes and ponds, and streams – are described, class-by-class. For each class, ecological problems are presented, along with brief assessments of the resource's natural quality and quality as wildlife habitat. Following this, plant and animal species occurring in the Project area are described. Finally, areas with special ecological status as well as endangered and threatened species are identified.

3.12.1 Significance of Resources. Aquatic resources of national and regional significance are found in the Project area. They include aquatic features, such as 2,000-acre Horseshoe Lake, and over 6,000 acres of various wetlands on the Mississippi River's floodplain, as well as over 200 miles of streams in small tributary watersheds. The national and regional level of significance attributed to these resources comes from institutional and technical sources. Sources of significance for the Project area's aquatic resources are described below. Details concerning significant resources in the Project area and their sources of significance are included in Annex B.25 in Appendix B.

North American Waterfowl Management Plan. Aquatic resources on the Mississippi River's floodplain in the Project area, such as Horseshoe Lake and surrounding wetlands, serve as resting and feeding habitat for about 30 species of waterfowl during fall and spring migration along the Mississippi Flyway. A few of these waterfowl species also use these aquatic resources as breeding habitat. These resources occur in a waterfowl habitat area of major concern designated under the North American Waterfowl Management Plan. Approved in 1993 under the NAWMP, the Upper Mississippi River/Great Lakes Region Joint Venture encompasses this area of concern and addresses its waterfowl status and habitat needs.

Additionally, the Project area's aquatic resources exist within a priority or focus area bordering the Mississippi River in Illinois that was designated in the Joint Venture's Implementation Plan. Additional wetlands are to be restored in this focus area to protect migratory waterfowl. The NAWMP and the UMR/GLR Joint Venture institutionally recognize the significance of these resources from an international and national perspective. The Joint Venture's Implementation Plan institutionally recognizes their significance from a regional perspective.

Upper Mississippi River System Environmental Management Program. The Project area's aquatic resources that are located on the Mississippi River's floodplain are part of the Upper Mississippi River System. This river system is the only inland waterway in the U.S. formally recognized by Congress as a nationally significant ecosystem and commercial navigation system. The Upper Mississippi River System Environmental Management Program was established in 1986 to monitor, research, and restore UMRS habitats. A Habitat Needs Assessment prepared for the UMRS-EMP in 2000 concluded that floodplain prairies, hardwood forests, marshes, and deep backwaters are the most threatened habitats of the UMRS due to past habitat loss and continuing degradation.

The Assessment called for the restoration of these habitats along the Mississippi River, especially in the reach where the Project area lies (St. Louis to Cairo). Based on the HNA, most floodplain habitats in the Project area (prairies, bottomland forests, marshes, and deep backwaters) can be recognized as technically significant from a regional perspective because of their status and trends. These resources can be recognized as institutionally significant from a regional perspective because they are in an area of the UMRS targeted for habitat restoration under the UMR-EMP.

Clean Water Action Plan. Five small watersheds within the Project area have been designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan. The Plan was initiated in 1998 to revitalize the nation's commitment to water resources. In support of the Plan, the Illinois Environmental Protection Agency and Natural Resources Conservation Service assigned restoration priorities for small Illinois watersheds. Watershed restoration measures can improve water quality and also restore aquatic systems. Under the Clean Water Action Plan, streams of the Project area's watersheds, including those of tributary watersheds that drain into the Mississippi River's floodlpain, are recognized as institutionally significant from a national perspective.

Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is a partnership of Federal and state agencies and tribes committed to the development of a national strategy to reduce the frequency, duration, size and degree of oxygen depletion of the hypoxic zone of the northern Gulf of Mexico. Since the Project area is located on the floodplain of the Mississippi River north of the Ohio River, it occurs in an area highlighted by the Task Force's Action Plan as potentially important to contributing to the Action Plan's goal of reducing nitrogen loads to the Gulf of Mexico and improving waters within the Mississippi River's basin. To help reduce nitrogen levels, the Plan recommends that Federal agencies identify opportunities to restore floodplain wetlands along and adjacent to the Mississippi River. Under the Action Plan, the Project area and its aquatic resources can be recognized as institutionally significant from a regional perspective.

Species of Concern. Aquatic resources within the Project area serve as migratory, wintering, or breeding habitat for 34 migratory bird species of concern, and support two Federally threatened species, the Bald eagle and false decurrent aster. The cause of concern for these species is declining or low population levels. These bird species of concern comprise four major groups - waterfowl, waterbirds, shorebirds, and land birds. They have been the focus of a number of ongoing bird conservation initiatives and partnerships in North America that aim to protect declining species before they become endangered or threatened. Initiatives for these four bird groups include the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, and Neotropical Migratory Bird Conservation Program. Habitat restoration efforts at the national and regional levels are being developed under these plans to protect these species. The listing of these birds as species of concern by the U.S. Fish and Wildlife Service illustrates that the Federal government recognizes them as highly significant. Their institutional significance is further supported by various international agreements the Federal government has entered into with Canada, Mexico, and other countries to foster continental and regional bird conservation strategies.

Aquatic habitats in the Project area are technically significant because they provide connectivity for the seasonal movements of these 34 migratory bird species of concern. They are also technically significant because of their potential for recovery of two federally threatened species.

3.12.2 Loss of Historic Natural Communities. Natural resources in the Project area have undergone dramatic changes since 1800. These changes include significant reductions in the spatial extent of historic forests, prairies, wetlands, lakes and ponds, and streams. In this section, estimates of Project area losses of these classes of natural resources are presented, and compared to statewide and county-level losses when possible. Changes also include losses of some kinds of natural communities, such that the diversity of today's natural communities is less than what it was historically. Further details concerning losses of natural communities are included in Appendix B.

3.12.2.1 Forest. Estimates of forest losses in the Project area range from about 60 to 70 percent (Table 3-26). This level of loss has occurred in both floodplain and upland areas. Similar losses of forest have occurred in Illinois at the state and county level. Loss of historic forest for the state is estimated to be about 63 percent, and about 58 percent and 67 percent for Madison and St. Clair Counties (IDNR 1994, 1996). One of the nine types of natural forest communities that were present in the Project area in predevelopment times has disappeared (Table 3-25). All wet-mesic upland forest that occurred on the flat drainage divide in the headwater reaches of the Project area's tributary watersheds appears to be gone. No map has been prepared to illustrate forest losses because the map representing historic forests is too generalized to allow for an accurate spatial comparison with current forest conditions.

Table 3-25 Estimates of spatial loss for historic natural community classes in the Project area and its landforms. (1)

Community Class	% Loss			Data Sources (2) (current, historic)
	Project Area	Floodplain	Uplands	
Forest	59	68	54	(ILCD, INHS)
	70	63	72	(NLCD, INHS)
Prairie	~100	99.9	100	(IDNR, INHS)
Savanna	(100 if present historically)		(all in uplands)	(IDNR)
"Wetland" (3)	66	68	30	(ILCD, NRCS)
	69	71	33	(IWI, NRCS)
	85	86	72	(NLCD, NRCS)
Lake and Pond	36	all in floodplain		(NLCD, 1909)
	45			(ILCD, 1909)
	50			(NRCS, 1909)
	52			(IWI, 1909)
Stream	(not assessed)	66	(not assessed)	(1998, 1909)

(1) Estimates based on area for all classes except streams (based on length)

(2) Data sources representing current conditions for each class include: ILCD - Illinois Land Cover Database (IDNR 1996a); NLCD - National Land Cover Database (USEPA 2000a); IDNR - Sinkhole Plain Area Assessment (IDNR 1998); IWI - Illinois Wetland Inventory (Suloway and Hubbell 1994); NRCS - digital soil surveys of Madison and St. Clair Counties (NRCS 2000a,b); digital orthophoto quarter quads (INRGDC undated).For historic conditions, INHS - digital presettlement land cover, INHS (1998) and this study; NRCS - digital soils surveys of Madison and St. Clair Counties (NRCS 200a,b);

1909 - digital topographic maps of American Bottom from 1909, this study.

(3) Includes marsh, shrub swamp, wet-mesic upland forest, wet-mesic floodplain forest, wet floodplain forest, wet-mesic prairie, wet prairie, and pond.

3.12.2.2 Prairie. The most striking loss in the Project area is the virtual disappearance of prairie. Roughly 35,000 acres of historic prairie have been reduced to about 33 acres, which are confined to the floodplain. This equates to an overall loss of about 99.9 percent. Losses across Illinois, the "Prairie State", are 99.99 percent (IDNR 1994). At least half of Madison and St. Clair Counties was once prairie (IDNR 1998c), and countywide losses are also at the same level. Of the eight types of prairie natural communities that were present historically, six have disappeared – two from the floodplain and four from the uplands (Table 3-26). Because prairie losses have been so extensive, no separate map has been prepared to illustrate them.

Table 3-26 Status of INAI community classes and natural communities in the existing Project area, according to landform. (1)

Community Class	Natural Community (2)	Mississippi River floodplain (3)	Adjacent uplands (4)
Forest	Dry upland forest		?
	Dry-mesic upland forest		√
	Mesic upland forest		√
	*Wet-mesic upland forest		lost
	Mesic floodplain forest	√	√
	*Wet-mesic floodplain forest	√	√
	*Wet floodplain forest	√	?
	Mesic sand forest	√	
Prairie	Dry prairie		lost if occurred
	Dry-mesic prairie		lost
	Mesic prairie	lost	lost
	*Wet-mesic prairie	√	lost
	*Wet prairie	lost	lost if occurred
	Mesic sand prairie	√	
	Loess hill prairie		lost
Savanna	Dry-mesic savanna		lost if occurred
	Mesic savanna		lost if occurred
Wetland	*Marsh	√	
	*Shrub swamp	√	
Lake and Pond	*Pond	√	
	Lake	√	
Stream	High-gradient creek		√
	Medium-gradient creek		√
	Low-gradient creek	√	√
	Low-gradient river	lost	
	Major river	√	
Cultural	Pastureland	√	√
	Successional field	√	√
	Developed land	√	√
	Tree plantation	√	√
	Artificial pond	√	√
	Prairie restoration	√	?
	Cropland	√	√

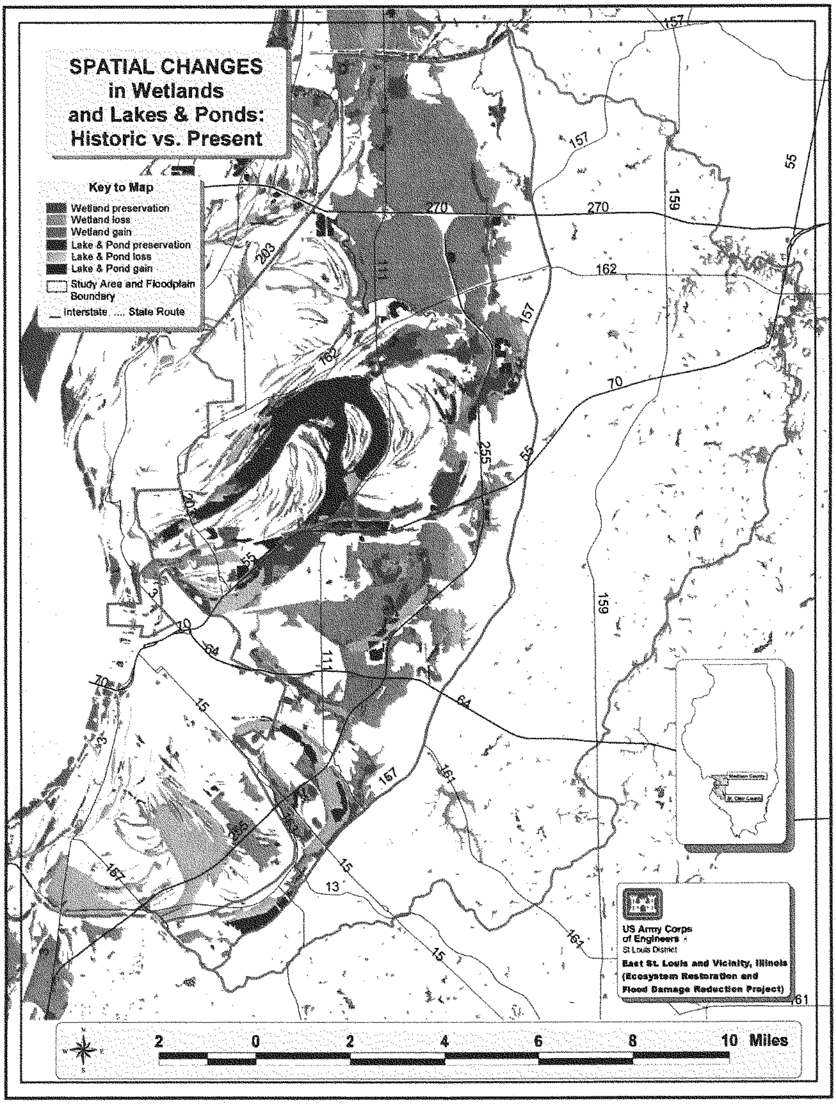
(1) Illinois Natural Areas Inventory (White and Madany 1978); floodplain and upland examples of the same natural community are distinct because they occur in different natural divisions; occurrence indicated by "√", unknown status indicated by "?"
(2) Natural communities that are wetlands are preceded by ""*
(3) Lower Mississippi River Bottomlands Natural Division, Northern Section
(4) Southern Till Plain Natural Division, Effingham Section

3.12.2.3 Savanna. Savanna is not currently known from the Project area (IDNR 1998e). It is included in this section only because it may have been present in predevelopment times in the uplands. If any remnants survived, they would have since changed into forest. Because periodic wildfires enabled this type of vegetation to persist in historical times, the suppression of wildfire that came with settlement caused vegetational changes in savanna. Tree density became greater and open savanna converted to closed forest. Other factors have led to the loss of savanna in addition to fire absence and destruction. These include fragmentation, degradation of the ground cover from intense grazing, and invasion by exotic plant species (IDNR 1998e).

3.12.2.4 Wetland. Estimates of wetland losses in the Project area range from about 65 to 85 percent. Losses of wetlands in the uplands may be less extensive than those in the floodplain. At least 90 percent of Illinois' historic wetlands are gone (IDNR 1994a). For Madison and St. Clair Counties, estimates of wetland losses are 61 and 63 percent, respectively (IDNR 1998c). Wetland diversity has declined because of the loss of three of ten historic wetland natural communities: wet-mesic upland forest and wet-mesic prairie in the uplands, and wet prairie in the floodplain.

Figure 3-12 displays the extent and location of wetland change in the Project area by contrasting the distribution of historic and current wetlands. Areas of preservation, historic loss, and recent gain are distinguishable from each other. In this figure, all soil mapping units in each county's soil survey that exhibit wetland or hydric characteristics represent historic wetlands. (Appendix B includes a table of all Project area soils and their wetlands status.) Wetlands included in the Illinois Wetland Inventory serve as the current condition. The amount of wetland loss is about 70 percent. Natural communities represented as wetlands in this figure include all those marked with an asterisk in Table 3-26, except for one. The exception is historic ponds. They are combined with historic lakes because they could not be easily distinguished using existing digital databases.

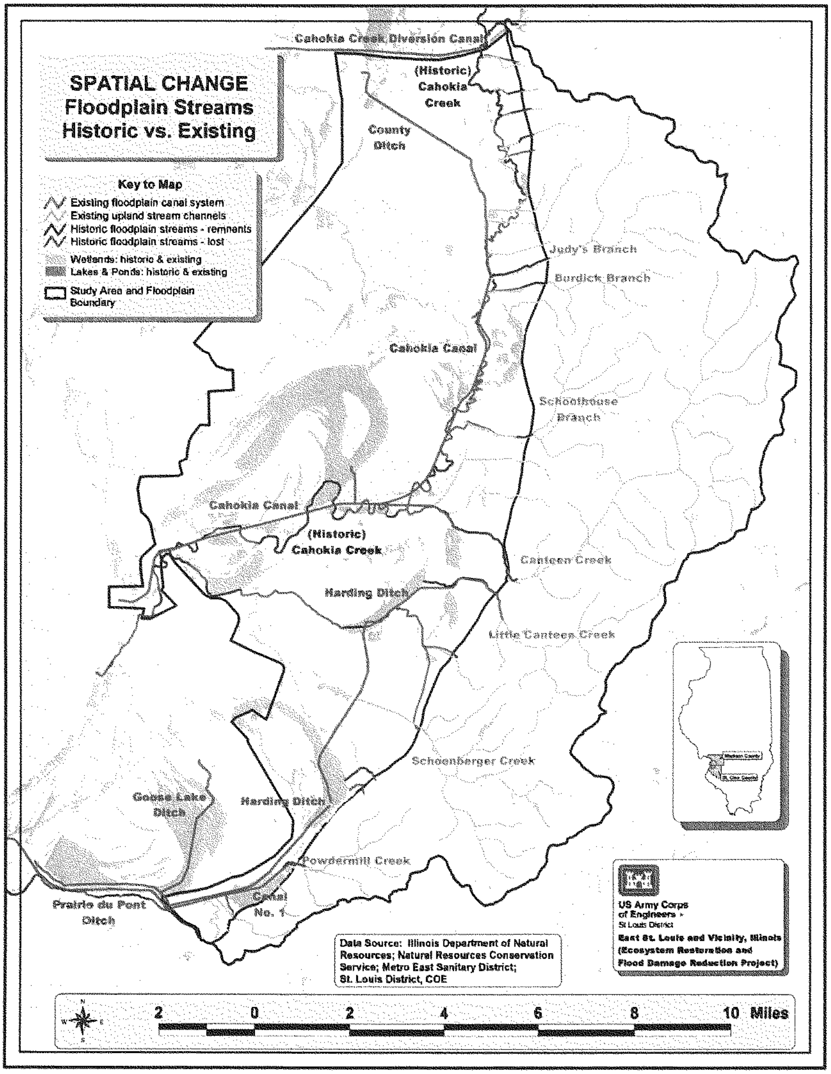
Figure 3-12 Project Area - Spatial Changes in Wetlands and Lakes & Ponds



3.12.2.5 Lake and Pond. Estimates of lake and pond loss range from about 35 to 50 percent in the Project area. No comparable data are available for Illinois or its counties. Because lakes and ponds still occur in the Project area today, diversity of natural communities within this class has not been reduced. Figure 3-12 displays the extent and location of changes in lakes and ponds in the Project area. Areas of preservation, historic loss, and recent gain are distinguishable from each other. Lakes and ponds depicted on the 1909, 2-foot contour maps developed by the East Side Levee and Sanitary District represent historic conditions. Existing conditions are represented by areas mapped as water in the digital soil surveys of Madison and St. Clair Counties. The amount of lake and pond loss shown in Figure 3-12 is about 50 percent.

3.12.2.6 Stream. The overall loss of all floodplain streams by length in the Project area is estimated to be about 66 percent. About 62 percent of the historic channel of Cahokia Creek in the Project area has been filled in for development or modified into ditches. The isolated remnants no longer convey flowing waters. Of the floodplain channels tributary to Cahokia Creek, about 72 percent have also been lost. Channels in the Project area within the Prairie Du Pont drainage area experienced a loss of about 57 percent. Like lakes and ponds, there are no statewide or county-level estimates of historic loss of streams. Figure 3-13 shows the location of historic floodplain channels and existing remnants. In this figure, stream channels depicted on the 1909 maps developed by the East Side Levee and Sanitary District represent historic conditions. Current conditions were obtained from 1998 digital aerial photographs.

Figure 3-13 Project Area - Spatial Change in Floodplain Streams



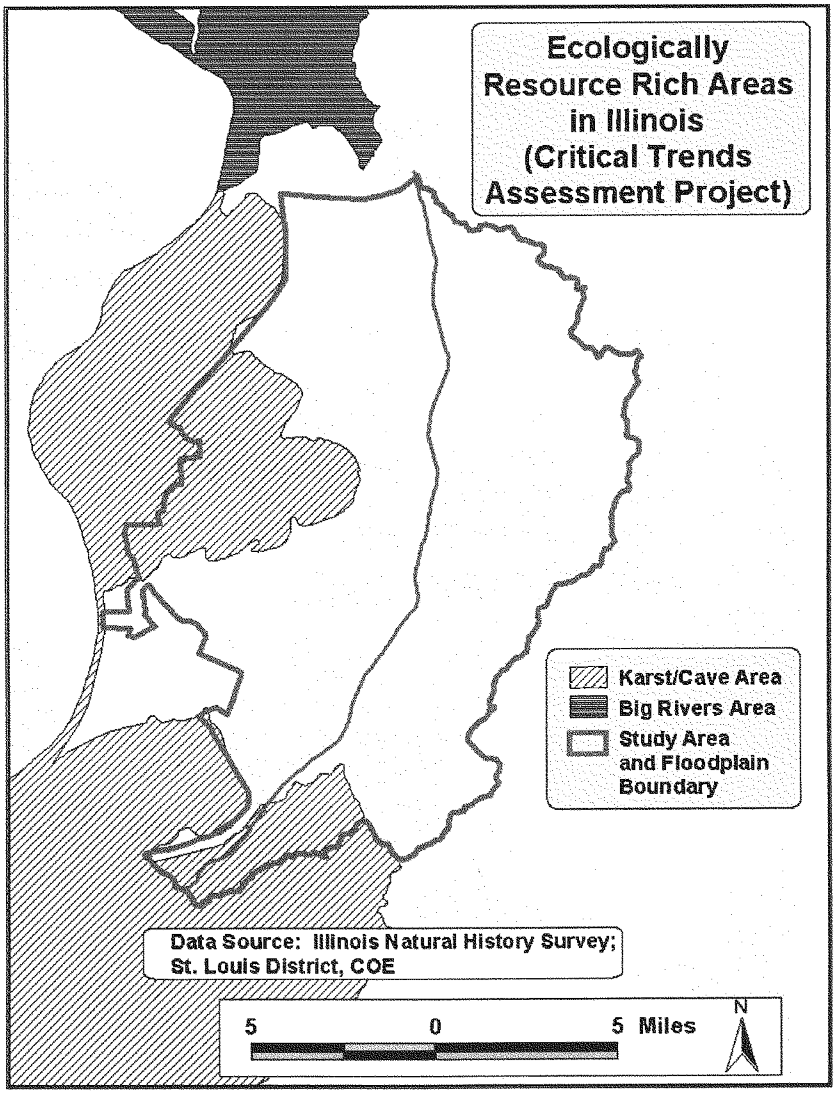
No estimate has been developed of the losses of historic tributary stream channels due to development. Portions of some tributary streams were straightened many years ago to facilitate the construction of railroad and road embankments that followed the stream bottoms. Examples of this are found in the Judy's Branch, Big Canteen Creek, and Powdermill Creek watersheds. By and large, historic tributary stream losses are much less than those in the bottoms. The tributary watersheds within the Study area are designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan.

3.12.3 Existing Living Resources. This section describes living resources that currently occur in the Project area. Like the preceding section on historic losses of natural resources, the framework for this section is based on the classes of natural communities used by the Illinois Natural Areas Inventory: forest; prairie; wetland; lake and pond; stream; and, cultural.

3.12.3.1 Resource Rich Areas. Despite extensive local losses of various historic natural resources, and degradation of remaining resources, the Project area lies in a belt of existing "resource rich areas" strung along the Mississippi River in southwestern Illinois. "Resource rich areas" are relatively large areas in Illinois where current biologically significant resources are concentrated. Thirty such areas have been identified statewide (Suloway et al. 1996). They were delineated and evaluated by the Illinois Natural History Survey as part of the Critical Trends Assessment Project and Ecosystems Program of the Illinois Department of Natural Resources (Suloway et al. 1996). They often occur along the state's major streams and rivers, and in addition to natural resources, include "developed" areas such as cropland and urban/built-up land.

Two resource rich areas are found in the vicinity of the Project area (Figure 3-14). "Big Rivers" lies just north, and "Karst/Cave Area" overlaps partially with the Project area. Many of Karst/Cave Area's significant natural features, such as caves, hill prairies, springs, marshes, and herpetological sites, are outside the Project area to the south in St. Clair, Monroe, and Randolph Counties. A number of these are found within the Project area and are discussed in detail in Section 3.12.3.

Figure 3-14 Project Area - Ecologically Resource Rich Areas



3.12.3.2 Forest. According to Illinois Land Cover data obtained in the early 1990s, about 26,000 acres of forest are found in the Project area (Appendix B). About 75 percent of this forest occurs in the uplands.

3.12.3.2.1 Forest in Tributary Watersheds. About 20,000 acres of forest exist in the tributary watersheds. Forest that once occupied the flatter upland topography has largely been eliminated for farming and development. The remaining forest is largely confined to steeper slopes. As a consequence, most of the remaining forest occurs in irregularly shaped areas that border tributary stream channels.

Mainly suburban areas and cropland surround these areas of forest. Forest located on slopes probably represents the dry-mesic upland forest and mesic upland forest communities. Most forest in the bottoms of tributary streams represents the mesic floodplain forest community. No estimates are available concerning the relative amount of each of these natural communities. Wetland forest occurs in the tributary watersheds in small quantities. About 300 acres of wetland forest are included in the Illinois Land Cover database and about 85 acres are included in the Illinois Wetlands Inventory (IWI) data collected in the mid-1980s. Wet-mesic floodplain forest represents nearly all the IWI wetland forest in the uplands. Over 750 acres of evergreen forest occurs in the uplands, according to the National Land Cover database but the coniferous woods category is not represented in the Project area in the Illinois Land Cover database in Appendix B. Assuming a relatively small amount of evergreen forest exists, it likely consists of species like pine that have been planted in groves as landscaping or tree farms. Although no figures are available, little upland forest is in public ownership.

3.12.3.2.2 Natural Quality of Upland Forests. Of the 20,000 or so acres of forest in the upland portion of the Project area, the Illinois Natural Areas Inventory of the mid-1970s recognized less than 15 acres as of high natural quality. The vast majority of the forest has been subjected to various disturbances since settlement, to the degree that it no longer resembles its historic condition.

3.12.3.2.3 Ecological Problems of Upland Forests. Upland forests in the Project area exhibit a loss of ecological integrity due to fragmentation, habitat degradation, introduction of exotic species, and, in the drier communities, absence of fire (IDNR 1998e). Forests have become fragmented due to surrounding development. Fragments have relatively high edge to interior ratios, meaning that most forest within a fragment is located relatively close to its border, and little of it consists of a "core" area in the interior at a distance from any edge. Fragments of upland forest occur in all minor and major tributary watersheds delineated for this Project. Most forest is concentrated in the Canteen Creek, Little Canteen Creek, and Schoenberger Creek watersheds, where fragments are generally larger than those in the other watersheds of the Project area. Use of forests as grazing areas for livestock is a typical cause of habitat degradation. Grazing at some time during the last 200 years probably has affected most remaining forest in the Project area. Sustained grazing leads to the disappearance of grazing-sensitive plant species, an increase in abundance of native thorn-bearing plants, and the introduction of exotic species (IDNR 1998e).

Logging can degrade forests when commercially desirable tree species are removed, especially when consideration for natural regeneration is not given. Absence of fire leads to changes in tree species composition and forest structure, which often results in denser stands of woody species, and higher levels of shade. In turn, the number of herbaceous plant species growing at ground level often declines, and the amount of ground surface they cover is reduced (IDNR 1998e). Because of the lack of fire, an increase in density of sugar maple (*Acer saccharum*) and a decline in oaks has been observed in old-growth oak-hickory upland forests in the Midwest (Shotola et al. 1992).

3.12.3.2.4 Vegetation of Upland Forests. Common canopy tree species of historic upland forest natural communities are provided in Table 2-3 of Section 2. Various oaks and hickories comprise many of the historic species in mesic upland and mesic floodplain forests. However, existing tree canopy cover consisting of hard mast species such as oaks and hickories was found to be relatively low, during this Project's assessment of quality of upland forests in ravines and along creek bottoms as wildlife habitat.

Based on assessment of 66 sites in the major tributary watersheds in the spring of 1999, means for tree canopy coverage consisting of hard mast species are 18 percent (County Ditch), 9 percent (Cahokia), 27 percent (Harding), and 11 percent (Powdermill). These data suggest that composition of tree canopy species has shifted in dominance from historic oaks and hickories to other species, such as sugar and silver maple, white and green ash, American elm, and sweet gum. A comprehensive description of canopy, subcanopy, shrub, woody vine, and ground-cover plant species of upland forest communities is provided by IDNR (1998e). A nearly complete list of such species is presented in Appendix B. Exotic species occurring in mesic upland and mesic floodplain forests include the tree, white mulberry; the shrubs, amur honeysuckle and multiflora rose; and the vine, Japanese honeysuckle (IDNR 1998e).

3.12.3.2.5 Wildlife Habitat of Upland Forests. Many species of birds use forests in the uplands, but remaining patches are "unlikely to have successful breeding populations of most species" because they are too small and narrow (IDNR 1998b:67). Most mammals using upland forests are likely to consist of species that can tolerate fairly close association with people, and common visible species would include the eastern chipmunk, eastern mole, woodchuck, and gray and fox squirrels (IDNR 1998d). Typical reptiles and amphibians using upland forests would include the black rat snake, five-lined skink, gray treefrog, and slimy salamander (IDNR 1998f). Lists of vertebrate species using forests are presented in Section 3.12.4.

For this Project, existing quality of forest as wildlife habitat was assessed in the spring of 1999 for three vertebrate species at 66 sites scattered across the upland portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the fox squirrel, mink, and wood duck were employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of forest in tributary watersheds is moderate for the fox squirrel and mink, and of very low suitability for the wood duck (Table 3-27). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-27 Existing habitat quality of forest in tributary watersheds of the Project area, expressed as habitat suitability indices (average and range) for three evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	**Existing HSI (TY0)***	
	Average	**Range**
Fox squirrel	**0.54**	0 - 0.62
Mink	0.40	0 - 1
Wood duck	0.04	0 - 0.17

* TY0 denotes target year 0

3.12.3.2.6 Forest in the Bottoms. According to the Illinois Land Cover database, about 6,400 acres of forest occurred in the floodplain portion of the Project area in the early 1990s. From these data, about 3,500 acres consists of forested wetland. On the other hand, about 7,100 acres of forest are reflected in the National Land Cover Database from the same timeframe and about 2,700 acres consist of forested wetland. The Illinois Wetland Inventory (IWI) data collected in the mid-1980s provide the best estimate for the area of forested wetlands in the bottoms. According to this source, about 2,935 acres of bottomland forest (forested wetlands) occur in the five major floodplain watersheds. Wet-mesic floodplain forest and wet floodplain forest communities comprise this forested wetland. There are about 1,835 acres of the former, and 1,100 acres of the latter. About 60 percent of all this forested wetland is located in the Cahokia watershed. In this watershed, four relatively large tracts of forested wetland are found. All are within three miles of Horseshoe Lake. These tracts, with their area according to the IWI in parentheses, occur northeast of the lake at the west end (225 acres) and east end (135 acres) of Elm Slough, east of the lake in the vicinity of McDonough Lake (185 acres), and southeast of the lake at Brushy (Levy) Lake (205 acres).

Estimates of forest in the floodplain that is not wetland vary from about 2,700 to 4,375 acres, depending on the land use dataset. This type of forest is mesic floodplain forest. It occurs in all five major watersheds, and is extremely fragmented compared to forest in the uplands as well as forested wetland in the floodplain. Relatively large areas of publicly owned forest in the bottoms, both wetland and nonwetland, occur at Brushy (Levy) Lake, Cahokia Mounds State Historic Site, Frank Holten State Park, and Horseshoe Lake State Park.

3.12.3.2.7 Natural Quality of Forest in the Bottoms. Of the roughly 7,000 acres of forest in the bottoms portion of the Project area, the Illinois Natural Areas Inventory of the mid-1970s did not recognize any as possessing high natural quality. All forest was recognized as either moderately to heavily disturbed, or early to mid-successional.

3.12.3.2.8 Ecological Problems of Forest in the Bottoms. Like upland forest, forest in the Mississippi River floodplain also has declined in ecological integrity since settlement. Causes include fragmentation, changes in flooding frequency and duration, logging, habitat degradation due to grazing, and the introduction of exotic species (IDNR 1998e).

Excessive siltation from floodwaters is an additional cause of habitat degradation. The absence of fire does not represent an ecological problem because fire is not considered to have been an important factor in maintaining these communities (IDNR 1998e). Like upland forests, much floodplain forest was cleared for agriculture and development. Fragments of forested wetlands and forested nonwetlands occur in each of the major watersheds. Construction of the levee system along the Mississippi River and the interior flood control system within the Project area has dramatically reduced the depth and duration of flooding in remaining floodplain forests. Logging of commercially valuable tree species has led to the loss of many kinds of oaks and hickories; most forest remnants contain an abundance of soft-wooded species like silver maple, green ash, cottonwood, and elm. Many remaining forests would have been grazed at some time in the past, but the wettest ones most likely experienced the least grazing pressures.

3.12.3.2.9 Vegetation of Forest in the Bottoms. For this Project, vegetation at 33 sites in forested wetlands was assessed. Common tree species consisted of silver maple (*Acer sacharinum*), box elder (*Acer negundo*), black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulmus americana*). Sometimes pin oak (*Quercus palustris*) was observed. Typical shrubs and saplings included silver maple, American elm, green ash, hackberry (*Celtis occidentalis*), box elder, poison ivy (*Toxicodendron radicans*), and trumpet creeper (*Campsis radicans*). Dominant ground cover species at less wet sites (wet-mesic floodplain forest) included a sedge (*Carex hyalinolepis*), panicled aster (*Aster simplex*), lizard's tail (*Saururus cernus*), stoutwood reed (*Cinna arundinacea*), Lyme grass (*Elymus virginicus*), Canada wood nettle (*Laportea canadensis*), annual bedstraw (*Galium aparine*), swamp buttercup (*Ranunculus septentrionalis*), and jewelweed (*Impatiens capensis*). Many of the species of oaks and hickories present in historic forested wetlands are lacking.

A nearly complete list of plant species of forested wetlands is presented in APPENDIX B. A comprehensive description of vegetation of wet-mesic and wet floodplain forest communities is provided by IDNR (1998a,e). Some exotic species that have invaded floodplain forests include the vine, Japanese hops (*Humulus japonicus*); some grasses, including reed canary grass (*Phalaris arundinacea*) and common reed (*Phragmites australis*); and Japanese honeysuckle (*Lonicera japonica*) (IDNR 1998e).

3.12.3.2.10 Wildlife Habitat of Forest in the Bottoms. Numerous bird species use floodplain forests, but most species are unlikely to successfully breed in remaining patches of such forest because they are too small and narrow (IDNR 1998b). Most mammals using forest in the bottoms are likely to tolerate human disturbances, and common species would include the opossum, raccoon, white-tailed deer, mink, beaver, eastern cottontail rabbit, and white-footed mouse. Typical reptiles and amphibians using floodplain forests would include various salamanders, frogs, and snakes. Lists of vertebrate species using forests are presented in Section 3.12.4.

For this Project, existing quality of bottomland forest as wildlife habitat was assessed in the spring of 1999 for five vertebrate species at 35 sites scattered across the floodplain portion of the Project area. Nonwetland bottomland forest was treated separately from wetland bottomland forest. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the fox squirrel, mink, great blue heron, wood duck, and slider turtle were employed after modification for this Project.

HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of bottomland forest is moderate for the great blue heron, and relatively low for the fox squirrel, mink (wetland forests only), and slider turtle (Table 3-28). For the wood duck, these forests are unsuitable. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-28 Existing habitat quality of bottomland forest in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	Range
Nonwetland bottomland forest		
Great blue heron	**0.52**	0 - 0.52
Fox squirrel	0.33	0 - 0.33
Mink	0.00	0 - 0
Wood duck	0.01	0 - 0.01
Wetland bottomland forest		
Great blue heron	0.45	0 - 0.62
Mink	0.29	0 - 1
Slider turtle	0.23	0 - 0.46
Wood duck	0.02	0 - 0.04

* TY0 denotes target year 0

3.12.3.3 Prairie. One remnant prairie occurs in the Project area on the Mississippi River floodplain, but apparently no historic upland prairie remains. The only other prairie vegetation in the Project area consists of man-made restorations. Restorations occur on a small scale in the bottoms. Over the last twenty years, roughly 100-200 acres have been planted at Cahokia Mounds State Historic Site. More recently, prairie vegetation has been established to a limited extent in the right of way along local interstate highways, such as I-255 and I-270, especially at interchanges. These restoration sites are publicly owned.

3.12.3.3.1 Natural Quality of Prairie. According to the Illinois Natural Areas Inventory of the 1970s, none of the remnant prairie in the Project area was of high quality. However, the Poag Railroad Prairie Natural Area, a 33-acre remnant, was identified as a significant example of two prairie communities because of the rarity of remnant prairie in Illinois.

3.12.3.3.2 Ecological Problems of Prairie. Ecological problems facing prairies include fragmentation, absence of fire, invasion by exotic species, habitat degradation, and for floodplain prairies, modification of flooding regimes (IDNR 1998e). Due to fragmentation, most remnants are small and isolated, and many plant species consist of relatively few individuals. Consequently, local extinctions of prairie plants are likely. The absence of fire allows woody vegetation to encroach, which leads to the elimination of shade-intolerant species. Exotic plant species can easily invade narrow, linear fragments. Grazing by livestock eliminates native species, and allows for the establishment of some weedy species.

Additional degradation occurs when prairie soils are disturbed, such as when soils along railroads are scraped, thereby allowing weeds to take hold. Improved drainage conditions for agriculture often create drier conditions in historical wet-mesic and wet prairie. Construction of the levee system along the Mississippi River and the interior flood control system within the Project area has significantly reduced the flooding regime in the Poag Road remnant prairie.

3.12.3.3.3 Vegetation of Prairie. Typical plants that occurred in various historic prairie communities are presented in Table 2-4 of Section 2. A nearly complete list of plants found in the wet-mesic prairie community is presented in Appendix B. No vegetational surveys of remnant or restored prairies were conducted for this Project. IDNR (1998a,e) provides a comprehensive description of plant species occurring in various prairie natural communities.

3.12.3.3.4 Wildlife Habitat of Prairie. For this Project, existing quality of prairie as habitat for the eastern meadowlark (bird) was assessed in the spring of 1999 at one prairie restoration site in the Project area. The habitat suitability index (HSI) model developed by the U.S. Fish and Wildlife Service for the eastern meadowlark was employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of the prairie restoration site is high for the meadowlark (Table 3-29). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-29 Existing habitat quality of a restored prairie in the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	Range
Eastern meadowlark	0.94	0 - 0.94

* TY0 denotes target year 0

3.12.3.4 Wetland. According to the Illinois Wetland Inventory data, there were 7,414 acres of wetlands in the Project area as of the mid-1980s (Table 3-30). Eight kinds of wetlands are represented. About 70 percent of all wetlands are classified as bottomland forest or shallow marsh/wet meadow. Open water wetlands make up another 15 percent, and the remaining 15 percent consists of various amounts of deep marsh, shallow lake, scrub-shrub, lake shore, and swamp.

The very small example of swamp does not represent true swamp, which is common to extreme southern Illinois, but bottomland forest that has semipermanent to permanent standing water (Suloway and Hubbell 1994).

A brief description of the IWI classification system and wetland types is provided in Appendix B. Although the wetlands identified in the Illinois Wetland Inventory serve satisfactorily in representing existing wetlands for purposes of this Project, they do not represent existing wetlands subject to Section 404 jurisdiction under the Clean Water Act, for two reasons.

First, the IWI database is about 15 years old, and is not representative of today's conditions. Second, delineation of Section 404 wetlands requires an on-site investigation, and information used to delineate IWI wetlands was obtained remotely by aerial photography.

With regard to the Project area's two major landforms, about 90 percent of all wetlands in the Project area are located on the Mississippi River floodplain (Table 3-30). All eight kinds occur in the bottoms, and five are found in the tributary watersheds. In the bottoms, bottomland forest and shallow marsh/wet meadow wetlands are most common, and collectively comprise about 65 percent of the total. In the uplands, most wetlands are nonwoody. The most common are open water and shallow marsh/wet meadow wetlands. About 82 percent of all wetlands in the Project area are natural. The remaining 18 percent are modified, and have been created or affected by either excavation or impoundment. Most of the eight kinds of wetlands consist of both natural and modified forms. Only shallow lakes and swamps are entirely natural. Unlike the bottoms, most wetland acreage in the uplands is man-made. Nearly all open water wetlands in the uplands were artificially created by either excavation or impoundment. The same is true for most open water wetlands in the bottoms.

Table 3-30 Wetlands and deepwater habitats in the Project area, as classified by the Illinois Wetland Inventory, using National Wetlands Inventory data.

	Project Area		**Floodplain**				**Upland**			
	Area (acres)	**% of Total Area**	**Area (acres)**			**% of Total Area**	**Area (acres)**			**% of Total Area**
			natural	**modified**	**all**		**natural**	**modified**	**all**	
WETLAND HABITAT										
Bottomland forest	3,022.8	40.8	2,907.8	28.8	2,936.6	39.6	84.0	2.2	86.2	1.2
Shallow marsh/ wet meadow	2,166.5	29.2	1,860.1	106.2	1,966.3	26.5	199.3	0.9	200.2	2.7
Open water	1,119.4	15.1	83.0	561.2	644.2	8.7	2.3	472.9	475.2	6.4
Deep marsh	630.1	8.5	529.6	98.0	627.6	8.5		2.5	2.5	0.0
Shallow lake	247.1	3.3	247.1		247.1	3.3				0.0
Scrub-shrub	201.1	2.7	179.6	15.3	194.9	2.6	4.6	1.7	6.3	0.1
Lake shore	26.6	0.4		26.6	26.6	0.4				0.0
Swamp	0.4	0.0	0.4		0.4	0.0				0.0
Total Wetland Habitat	*7,414.0*	*100.0*	*5,807.6*	*836.0*	*6,643.6*	*89.6*	*290.3*	*480.1*	*770.4*	*10.4*
DEEPWATER HABITAT										
Lake (Limnetic lake)	2,630.0	99.9	1,861.2	768.7	2,630.0					
River (Perennial river)	3.5	0.1	3.3	0.2	3.5					
Total Deepwater Habitat	*2,633.5*	*100.0*	*1,864.5*	*768.9*	*2,633.5*					
Total Wetland & Deepwater Habitat	**10,047.4**		**7,672.2**	**1,604.9**	**9,277.0**	**92.3**	**290.3**	**480.1**	**770.4**	**7.7**

Significant concentrations of wetlands are located at about a half-dozen floodplain sites in the Project area (Figure 3-15). They are briefly described according to the wetland categories and extent (acres) presented in the IWI. They are listed below in the order they occur from north to south in the Project area.

Elm Slough - (northeast of Horseshoe Lake, east of IL Route 111 and south of IL Route 162) supports four types of wetlands within a 280-acre tract. Wetland types include bottomland forest, deep marsh, shallow marsh/wet meadow, and scrub-shrub.

McDonough Lake - (east of Elm Slough on the west side of IL Route 159 between Il Route 162 and I-55/70) has a 310-acre area with five wetland types, as well as a deepwater lake. Wetlands include bottomland forest, deep marsh, shallow marsh/wet meadow, open water, and scrub shrub.

Brushy (Levy) Lake - (east of Cahokia Canal, south of Horseshoe Lake Road, west of I-255, and north of I-55/70) has five kinds of wetlands in a 275-acre area. They include bottomland forest, deep marsh, and shallow marsh/wet meadow, open water, and scrub-shrub.

Indian Lake - (south of I-55/70, east of IL Route 203, west of IL Route 111, north of Collinsville Road) supports 565 acres of bottomland forest, shallow marsh/wet meadow, deep marsh, and open water wetlands.

A portion of Cahokia Mounds State Historic Site - (south of Collinsville Road, west of I-255, north of Forest Boulevard) supports about 520 acres of various wetlands. They are somewhat scattered, and include five kinds: bottomland forest, shallow marsh/wet meadow, deep marsh, open water, and scrub shrub wetlands. A small area of deepwater lake is also present. Outside the Historic Site, to the south of Forest Boulevard, are about 110 acres of additional bottomland forest and shallow marsh/wet meadow wetlands, along with a deepwater lake.

A portion of Frank Holten State Recreation Area - (east of I-255, south of Lake Drive, west of IL Route 157) supports about 370 acres of wetland and deepwater lake habitats. Wetlands include bottomland forest, shallow marsh/wet meadow, and deep marsh.

Publicly owned lands at these sites are found only at Cahokia Mounds State Historic Site and Frank Holten State Recreation Area.

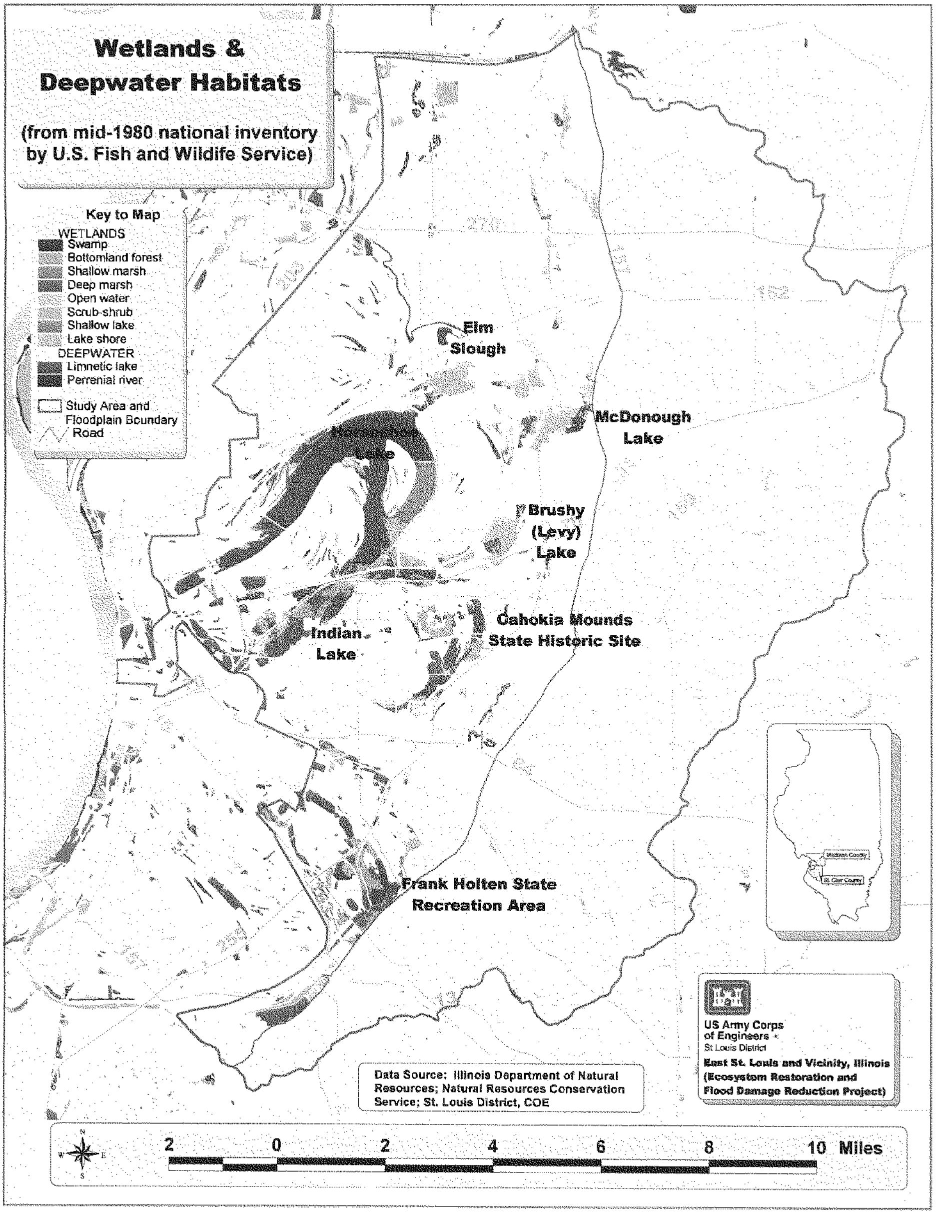


Figure 3-15 Wetlands and Deepwater Habitats of the Project Area (IWI data)

3.12.3.4.1 Natural Quality of Wetland. The Illinois Natural Areas Inventory of the mid 1970s recognized only one example of a relatively undisturbed wetland in the Project area. This site, Levee Lake Natural Area, had 103 acres of high quality shrub swamp and associated pond communities that were recognized as the best remaining examples in the American Bottom. Since the inventory, this natural area has been adversely affected by agricultural drainage.

3.12.3.4.2 Ecological Problems of Wetland. Ecological problems associated with forested wetlands and wetland versions of prairies are discussed above in the respective sections for these community classes. Problems related to marshes and shrub swamps are presented here. Those associated with ponds, another form of wetland, are given below. Problems in marshes and shrub swamps include alteration of the flooding regime (drier or wetter), introduction of sediments and agricultural chemicals or urban runoff, encroachment by exotic plant species, and "an overabundance of aggressive, disturbance-tolerant native species" (IDNR 1998e:53).

Construction of the levee system along the Mississippi River and the interior flood control system within the Project area has dramatically reduced the depth and duration of flooding in remaining marshes and shrub swamps.

3.12.3.4.3 Vegetation of Wetland. Common herbaceous plants noted in marshes during this Project include fox sedge (*Carex vulpinoidea*), broom sedge (*Carex scoparia*), a sedge (*Carex hyalinolepis*), water knotweed (*Polygynum amphibium*), curttop lady's thumb (*Polygonum lapathifolium*), common cattail (*Typha latifolia*), common reed (*Phragmites australis*), false nettle (*Boehmeria cylindrica*), swamp dock (*Rumex verticillatus*), and tall nettle (*Urtica gracilis*). Scattered shrubs and saplings were also encountered, and common species consist of poison ivy (*Toxicodendron radicans*), green ash (*Fraxinus penssylvanica*), and persimmon (*Diospyros virginiana*). Common cattail, river bulrush (*Scirpus fluviatilis*), and common reed are typical native plants that become overabundant when sediments, fertilizer-containing runoff, and a wetter hydrologic regime occur in marshes (IDNR 1998e). Shrub swamps consist of many grass, sedge, and forb species found in marshes, plus various shrubs, such as buttonbush (*Cephalanthus occidentalis*), false indigo bush (*Amorpha fruticosa*), swamp privet (*Forestiera acuminata*), and black willow (*Salix nigra*) (IDNR 1998e).

A comprehensive description of marsh and shrub swamp plant communities is provided by IDNR (1998a,e). A nearly complete list of plants for these two communities is presented in Appendix B.

3.12.3.4.4 Wildlife Habitat of Wetland. Vertebrates using forested wetlands as habitat are briefly discussed in the previous section on forest natural communities. There are numerous birds, mammals, and reptiles and amphibians that use other types of wetlands, especially marshes, as well. Lists of vertebrate species using marshes or herbaceous wetlands are presented in Section 3.12.4.

For this Project, existing quality of marshes and scrub-shrub wetlands as wildlife habitat was assessed in the spring of 1999 for five vertebrate species at 31 sites scattered across the floodplain portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the great blue heron, marsh wren, slider turtle, mink, and wood duck were employed after modification for this Project.

HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of marsh and scrub-shrub wetlands is above 0.5 for three of the five species (Table 3-31). These wetlands offer optimal habitat for the mink, and unsuitable habitat for the wood duck. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-31 Existing habitat quality of marsh and scrub-shrub wetlands in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	Range
Great blue heron	**0.66**	0 - 1
Marsh wren	**0.62**	0 - 0.7
Mink	**1.00**	0 - 1
Slider turtle	0.29	0 - 0.55
Wood duck	0.00	0 - 0.02

*TY0 denotes target year 0

3.12.3.4.5 Functional Capacity of Wetlands. Because of development, existing wetland hydrology is very different from historic conditions. Variable overflows from the Mississippi River, sometimes consisting of catastrophic events for human development, are absent from today's environment because of the main levee. Similar over bank flooding from tributaries, Cahokia Creek being the principle historic influence, has been greatly diminished across the Project area ever since construction of the interior flood control system about 100 years ago. The system's canals and levees have cut off many floodplain wetlands from their hillside sources of water. Principle sources of wetland hydrology for wetlands historically influenced by overflow from creeks and rivers now consist of local runoff and direct rainfall. Maximum depth of flooding is much reduced at all wetlands in the Project area. Whereas most wetlands in the American Bottom once experienced occasional flood depths greater than 10 to 20 feet, today's depths rarely exceed 1-2 feet. Duration of flooding during "big" events has also been reduced, from months to weeks or days.

Changes in wetland hydrology in terms of depth, duration, and water circulation patterns within the landscape are expected to have also altered the ability of existing wetlands to function as they once did. Functions performed by presettlement wetlands were discussed in Section 2.5. Of the five hydrogeomorphic (HGM) classes of wetlands historically present in the Project area, overbank flooding apparently played the dominant role in historic wetland hydrology for two – the riverine overflow and connected depression classes.

For the other three classes – flats, isolated depression, and fringe – sources other than overbank flooding served as the principle historic source of hydrology for those wetlands. Draft models for assessing functions of wetlands belonging to these three classes were intended to be developed and used in this Project to quantitatively track changes in functional capacity of all wetlands potentially impacted by all proposed plans. However, HGM models for these three wetland classes were not developed because of time and budget constraints.

For this Project, existing capacity of some wetlands to perform various functions was assessed in the spring of 1999 at 3 sites in the floodplain portion of the Project area. Functions assessed include floodwater detention, storage of surface water, nutrient cycling, export of organic carbon, removal and sequestration of elements as compounds, maintenance of characteristic plant community, and maintenance of wildlife habitat. Two of five hydrogeomorphic classes of wetlands occurring in the Project area were evaluated. Functional capacity was evaluated using the Expert HydroGeoMorphic Approach and draft functional capacity index (FCI) models developed by the Corps' Engineer Research and Development Center (Vicksburg, Mississippi) for this Project. FCI values potentially range from 0 to 1, the former representing no functional capacity, the latter optimal functional capacity.

According to the baseline assessment, average functional capacity is above 0.5 at each site for all applicable functions, or nearly so (Table 3-32). The only function to score below 0.5 was maintenance of habitat quality at Dobrey Slough. Evaluation procedures for wetland functional assessment are discussed in depth in Appendix A.

Table 3-32 Existing functional capacity of wetlands within three sites in the Project area, expressed as functional capacity indices for seven wetland functions. Indices potentially range from 0 (no capacity) to 1 (optimum capacity); indices $\geq$ 0.5 shown in bold. NA indicates not applicable.

Wetland Functions	Existing FCIs (TY0), by HGM subclass and Site*		
	Isolated depressional wetland	Connected depressional wetland	
	Dobrey Slough (entire site is isolated depressional: disturbed marsh, forested and scrub-shrub wetland)	Elm Slough (portion of site is connected depressional: deep marsh and scrub-shrub wetland)	Brushy Lake (portion of site is connected depressional: shallow marsh within Levee Lake INAI site)
Detain floodwater	NA	**0.58**	**0.53**
Store surface water	**0.86**	NA	NA
Cycle nutrients	**0.58**	**0.73**	**0.68**
Export organic carbon	NA	0.48	**0.58**
Remove & sequester elements as compounds	NA	**0.73**	**0.56**
Maintain characteristic plant community	**0.55**	**0.66**	**0.66**
Maintain wildlife habitat	0.27	**0.62**	**0.75**

* TY0 denotes target year 0.

3.12.3.5 Lake and Pond. A number of natural lakes and ponds occur in the Project area. Man-made water bodies are also present. The Illinois Wetlands Inventory (Suloway and Hubbell 1994) has been used to quantify these resources. According to this database, lakes are deepwater habitats, and ponds are shallow lake and open water wetlands. As of the mid-1980s, when the IWI data were collected, there were 2,630 acres of lakes in the Project area, all on the Mississippi River floodplain. About 1,365 acres of open water and shallow lake wetlands were also present, and 65 percent of these resources are also located on the floodplain. Figure 3-15 displays existing lakes and ponds in the Project area as deepwater habitats.

Among natural lakes, Horseshoe Lake is a very prominent landmark. It is found near the middle of the Project area. The lake is one of only a few large floodplain lakes in Illinois. Its surface area is 2,017 acres, and average water depth is about 2 feet (IEPA undated *a*). The bottom consists of soft mud and much of the lake supports little to no emergent or submergent vegetation. The shore is often margined by a thin band of herbaceous plants and trees, such as willow and cottonwood. An area dredged for sand and gravel in the lake has a maximum depth of 69 feet (IEPA undated *a*). About half of the lake (1,013 acres) lies in Horseshoe Lake State Park, and is publicly owned. It is used for fishing, hunting, and recreation. Except for a relatively small area owned by the Corps of Engineers, the rest of the lake is privately owned.

Long Lake, also a natural lake, lies north of Horseshoe Lake. It meanders across the northwest part of the Project area for about 3.5 miles. It has a 76-acre surface area, an average width of about 175 feet, and is apparently shallow (2-3 feet deep). Soft mud comprises the bottom, little aquatic vegetation is present, and logs and branches are often found on the bottom where the shore is tree-lined (Kulfinski and Thomerson 1981). Numerous residences abut the lake, and boat docks and riprap frequently cover the shoreline in addition to trees. The lake is privately owned, and it is used for fishing and recreation.

Toward the south end of the Project area, three lakes at Frank Holten State Recreation Area have a combined surface area of 173 acres. They are used for fishing, picnicking, and recreation. Average water depth ranges from 5 to 7 feet from one lake to another (IEPA undated *b,c,d*). Mowed grassy vegetation surrounds much of two lakes (Lakes 1 and 2, both known as Whispering Willow Lake), and trees and other natural vegetation envelop the third lake (Lake 3 or Grand Marais Lake). In the 1980s, improvements to these lakes were made by the State of Illinois. Diverting Harding Ditch around them reduced sediment loads into these lakes, dredging increased water depths, and rough fish were removed and replaced by game fish (Raman and Bogner 1994). These three lakes are the remnants of historic Pittsburg Lake.

Mullens Slough (or Mullins Creek Slough, 209 acres) is found at the extreme south end of the Project area along Canal No. 1. Water depths apparently reach about 6 feet, and average about 3 to 4 feet. Hard mud evidently makes up the bottom. Little to no emergent or submergent vegetation exists in the lake. Until the early 1990s, the lake was formerly cropland, until natural gravity drainage into Canal No. 1 became impaired. Its footprint occupies a portion of historic Pittsburg Lake. The Natural Resources Conservation Service obtained during the mid-1990s permanent conservation easements under the Emergency Wetlands Reserve Program from landowners of the slough, as well as some adjacent flood-prone cropland.

Smaller natural lakes occur at several locations, including McDonough Lake (about 50 acres), mentioned above for its surrounding wetlands. Man-made borrow pit lakes are scattered across the Project area. Two such water bodies (35 and 60 acres) are located along Cahokia Canal and I-55/70 near the southeast end of Horseshoe Lake.

3.12.3.5.1 Natural Quality of Lake and Pond. No high quality lakes occur in the Project area. The Illinois Natural Areas Inventory of the mid 1970s recognized only one example of a high quality pond, at Levee Lake Natural Area.

3.12.3.5.2 Ecological Problems of Lake and Pond. Other than drainage, ecological problems affecting lake and pond communities include siltation and habitat degradation (IDNR 1998e). Siltation is a natural process, but at a number of water bodies it is occurring at excessive rates because sediment-laden storm water regularly enters them. Horseshoe Lake is a prime example of this problem. Sediment carried into the lake via storm water from Cahokia Canal has reduced the average water depth, and has also formed a delta in the lake. Storm water can also carry various pollutants coming from agricultural and developed areas. Because of high levels of phosphorus (needed for plant growth) carried by inflows, Horseshoe Lake has experienced algal blooms in the summer that deplete dissolved oxygen levels, which can kill fish (IEPA undated *a-d*, Raman 1992, QST 1997). During the summer thermal stratification period, the lakes at Frank Holten State Recreation Area have experienced very low dissolved oxygen levels near their bottom, which limits the use of this zone as habitat by fish (Raman and Bogner 1994). The shallow depth of natural lakes and ponds can also lead to fish kills if a severe winter causes extensive freezing, or hot summers or drought cause these water bodies to dry up. Floodplain lakes and ponds can no longer be "recharged" with fishes carried by floodwaters from the Mississippi River, but instead need to be managed and stocked artificially. Nonnative fish species such as carp uproot aquatic plants growing in lakes and ponds, and in so doing reduce vegetative cover used by many aquatic invertebrates and fishes. Uprooting of plants by carp also raises turbidity levels in the water, which can interfere with sight-dependent feeding behavior of other fish species. Livestock can degrade lakes and ponds located in grazing lands by destroying shoreline vegetation and introducing animal wastes.

3.12.3.5.3 Vegetation of Lake and Pond. A comprehensive description of vegetation associated with lakes and ponds is provided in IDNR (1998a,e). These plants can be grouped into three categories: shore and mudflat species, emergent species (growing out of shallow water), and aquatics (often submerged) (IDNR 1998e). Examples of shore and mudflat species include giant ragweed (*Ambrosia trifida*), Spanish needles (*Bidens bipinnata*), and barnyard grass (*Echinochloa crus-galli*); of emergent species, yellow pond lily (*Nuphar luteum*), American lotus (*Nelumbo lutea*), and halberd-leaved rose mallow (*Hibiscus laevis*); of aquatic species, common duckweed (*Lemna minor*), coontail (*Ceratophyllum demersum*), and pondweed (*Potomogeton* spp.) (IDNR 1998e). A nearly complete list of plant species occurring in association with lakes and ponds is presented in Appendix B.

3.12.3.5.4 Wildlife Habitat of Lake and Pond. In the Project area, fish are an important group of animals in lakes and ponds. Twenty-one species of fish have been reported since 1984 from Horseshoe Lake and the three lakes at Frank Holten State Recreation Area. Yellow bass, common carp, bluegill, and orange spotted sunfish are commonly encountered at Horseshoe Lake during fish surveys using electrofishing techniques (QST 1997). About 10 additional fish species that have not been collected at these lakes are characteristic of natural standing water habitats (Appendix B).

Fishes support limited recreational and commercial opportunities in the Project area. Sport-fishing at Horseshoe and Holten lakes has been described as "poor" or "marginal" (Raman 1992, Raman and Bogner 1994). The more common species obtained by sport anglers at these lakes, in addition to the four mentioned above, include white crappie, black crappie, channel catfish, and freshwater drum (Raman and Bogner 1994, QST 1997). Commercial fishing at Horseshoe Lake is limited to fish salvage operations at an area of the lake drawn down annually in the late spring to promote the growth of herbaceous wetland plants for waterfowl management.

Other animal species use lakes and ponds as habitat. Among birds, waterfowl are common during migration in the spring and fall. Lists of vertebrate species using lakes and ponds are presented in Section 3.12.4.

For this Project, existing quality of lakes and ponds (lacustrine areas) as wildlife habitat was assessed in the spring of 1999 for four vertebrate species at 10 sites scattered across the floodplain portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the great blue heron, slider turtle, mink, and white crappie were employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of lakes and ponds is above 0.5 for the great blue heron and mink (Table 3-33). Sampled lakes and ponds were considered to be unsuitable to the white crappie because of the lack of deepwater habitat. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-33 Existing habitat quality of lakes and ponds in the Project area, expressed as habitat suitability indices (average and range) for four evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing HIS (TY0)*	
	Average	**Range**
Great blue heron	**0.61**	0 - 0.71
Mink	**0.74**	0 - 1
Slider turtle	0.44	0 - 0.78
White crappie	0.00	0 - 0

* TY0 denotes target year 0

3.12.3.6 Streams. Natural free-flowing streams in the Project area occur mainly in the uplands. In the American Bottom, they are restricted to relatively short portions of these tributary streams that extend onto sediment fans located on the Mississippi River's floodplain at the base of the bluff. From there to the Mississippi River, natural channels have been replaced by a series of ditches and canals.

The main tributary streams occur in the Judy's Branch, Burdick Branch, Schoolhouse Branch, Canteen Creek, Little Canteen Creek, Schoenberger, and Powdermill Creek watersheds. In their natural state, these streams possess substrates consisting of silts, sands, gravel, and some cobbles. Shale-like materials form the creek bed in some reaches. Because these streams have moderate gradients, pool and riffle complexes are also characteristic of relatively undisturbed streams.

In the bottoms, Cahokia Canal, Harding Ditch, County Ditch, Mitchell Ditch, Landsdowne Ditch, and Canal No. 1 have replaced most of the floodplain streams. These waterways are homogeneous in their structure. Channels are straight and lack meanders like natural streams. Channel bottoms consist mainly of silts and sands. Woody debris characteristic of natural streams is minimal. Riparian (woody) vegetation is largely absent along either side of the channel. Herbaceous vegetation growing in the channel and along its margin is often sparse. Because of the flatness of the channel gradient, riffles are uncommon. Occasionally beavers build dams across the channel bottom.

3.12.3.6.1 Natural Quality of Streams. No streams in the Project area were identified to possess high natural quality in the mid 1970's Illinois Natural Areas Inventory. Likewise, none were considered to be "biologically significant Illinois streams" by Page et al. (1992). Point locations on four floodplain streams in the Project area were assessed in the summer of 1998 using the Illinois Environmental Protection Agency's stream habitat assessment procedure ("SHAP"). This procedure assesses a total of 15 habitat parameters that fall under three general categories: substrate and instream cover; channel morphology and hydrology; and, riparian and bank features. SHAP ratings ranged across sites from "poor" at Cahokia Canal and Canal No. 1 to "fair" at Harding Ditch and "good" at Canteen Creek (IEPA 2000). The watersheds within the Study area are designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan.

3.12.3.6.2 Ecological Problems of Streams. Ecological problems of streams in the Project area include fragmentation (often by channelization), loss of riparian vegetation, instability of channel banks and bottoms (mainly in the tributary watersheds), excessive transport of sediment, inflows of agricultural and urban runoff, desiccation, and encroachment by exotic species. Fragmentation includes replacement of natural channels with man-made ones, such that historic remnants are bypassed and no longer functional. This has happened to most floodplain streams in the Project area. In the tributary watersheds, some portions of streams were straightened many years ago to facilitate the construction of railroad and road embankments that followed the stream bottoms. Examples of this are found on Judy's Branch, Big Canteen Creek, and Powdermill Creek. In the headwaters, little riparian land cover exists along stream channels, which are often bordered by cropland. Recent development adjacent to tributary streams often extends to the edge of the ravine overlooking the stream. The lack of streamside riparian buffer strips often leads to unstable banks, and transport of sediment and agricultural nutrients from cropland into streams (IDENR 1994a). Desiccation of streams often occurs when adjacent lands are drained with underground tiles, such that during dry periods little "ground" water flows into streams to sustain base flow. On the other hand, base flow in some streams has been increased by treated effluent coming from individual homes in subdivisions not connected to a municipal sewer system. The increased base flow causes erosion or head cutting within the channel. In the bottoms, because floodplain ditches are maintained for the conveyance of storm water, woody vegetation is removed periodically during maintenance activities from both sides of the channel. Consequently, little to no shading is available to reduce summertime water temperatures.

3.12.3.6.3 Vegetation of Streams. Because flowing waters of streams can at times become erosive, vegetation associated with streams is often limited to stream banks, in-channel deposits of sediments, and areas of quiet or slowly moving water. A comprehensive description of vegetation associated with streams is provided in IDNR (1998a,e). Most species are herbaceous, and examples include common beggar ticks (*Bidens frondosa*), panicled aster (*Aster simplex*), and water willow (*Justicia americana*). Other species consist of trees typical of wet floodplain forest, such as silver maple (*Acer saccharinum*) (IDNR 1998e).

3.12.3.6.4 Wildlife Habitat of Streams. Thirty-three fish species have been captured from floodplain streams in the Project area since 1984 by the Illinois Environmental Protection Agency as part of its statewide surface water quality monitoring and assessment program. Sand shiner, red shiner, bigmouth shiner, gizzard shad, common carp, and green sunfish are common species encountered using electrofishing techniques (IEPA 2000). The same four floodplain sites that were assessed for quality of stream habitat ("SHAP") were also sampled under the program for their fish communities. Based on attributes of sampled fish communities, Alternate Index of Biotic Integrity (AIBI) values calculated for these sites ranged from 31.6 to 38.2 in the summer of1998. These AIBI values fall into the "moderate" category of five stream classes created for biological stream characterization (from best to poorest, the five categories are unique aquatic resource, 51-60; highly valued, 41-50; moderate, 31-40; limited, 21-30; restricted, less than 20).

Similar fish sampling within tributary watersheds in the Project area has not been conducted by IEPA. However, Thomerson (1981) reported that these tributary streams support five to seven species of fish, or fewer than larger hillside watersheds north and south of the Project area. Potential fish species expected to be found in the streams of Judy's Branch, Burdick Branch, Schoolhouse Branch, Canteen Creek, Little Canteen Creek, Schoenberger Creek, and Powdermill Creek watersheds include red shiner, sand shiner, bigmouth shiner, fathead minnow, creek chub, and green sunfish (Thomerson 1973, 1981). Creek chubs are a dominant element in these small creeks, and are able to survive in pools when streams dry up.

For this Project, existing quality of floodplain streams as wildlife habitat was assessed in the spring of 1999 for five vertebrate species at one site located in the floodplain portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the great blue heron, slider turtle, mink, black crappie, and wood duck were employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat.

According to the baseline habitat assessment, average habitat quality of floodplain streams is above 0.5 for the great blue heron, black crappie, and mink (Table 3-34). This habitat was unsuitable for the wood duck, and of low value for the slider turtle. Evaluation procedures for these species are discussed in depth in Appendix A.

Existing quality of tributary streams as habitat for aquatic invertebrates and fish was assessed in the summer of 2003 at 17 sites located in six tributary watersheds of the Project area. The Qualitative Habitat Evaluation Index method developed by the state of Ohio to assess the condition of its warm water streams was employed (see Appendix A). The average habitat quality of sampled tributary streams was 0.64.

Table 3-34 Existing habitat quality of floodplain streams in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	**Existing HSI (TY0)***	
	Average	**Range**
Black crappie	**0.55**	0 – 0.79
Great blue heron	**0.54**	0 – 0.79
Mink	**0.72**	0 – 0.87
Slider turtle	0.27	0 – 0.45
Wood duck	0.01	0 – 0.16

*TY0 denotes target year 0.

3.12.3.7 Cultural. Following the classification system for natural communities used by the Illinois Natural Areas Inventory, a number of cultural communities occur in the Project area. These include cropland, pastureland, successional field (including abandoned fields and pastures, roadsides, and vacant lots), developed land, tree plantation (including orchards), artificial pond, and prairie restoration. These cultural communities are not discussed in detail here, but some are addressed briefly in other sections. Tree plantations are included in the section on existing forest, artificial ponds as modified open water wetlands, and prairie restorations are included in the section on prairie. About 70 percent of the Project area consists of cropland, grassland, and developed land, or as classified in Table 3-1, cropland, grassland, and urban/built-up land cover classes.

3.12.3.7.1 Vegetation of Cultural Areas. Plant species occurring in cultural areas are described in IDNR (1998a,e). A nearly complete list is provided in Appendix B. These species include those planted for agricultural practices, landscaping, and other purposes, as well as native species that colonize cropland, pastureland, successional fields, developed land, tree plantations, and other highly modified areas.

3.12.3.7.2 Wildlife Habitat of Cultural Areas. Some vertebrate animal species use various cultural areas as habitat. Lists of such species are presented in Section 3.12.4.

For this Project, existing quality of cultural habitats (specifically grassy or abandoned fields and abandoned subdivisions) as wildlife habitat was assessed in the spring of 1999 for one vertebrate species at six sites in the floodplain portion of the Project area. The habitat suitability index (HSI) model developed by the U.S. Fish and Wildlife Service for the eastern meadowlark was employed after modification for this Project.

HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of field-like habitats is below 0.5 for the meadowlark (Table 3-35). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-35 Existing habitat quality of cultural areas (fields) in the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	Range
Eastern meadowlark	0.34	0 - 0.34

* TY0 denotes target year 0.

3.12.4 Natural Areas, Nature Preserves, and Endangered Species Sites. The Project area includes ten examples of natural areas, nature preserves, or endangered species sites (Table 3-36). There are three natural areas identified in the mid 1970s during the Illinois Natural Areas Inventory (INAI). These three sites supported significant and exceptional examples of natural communities. One of these received designation as a nature preserve. Among these three sites, forest, prairie, wetland, and pond communities are represented. In addition to these areas, habitats where endangered species have been found have been assigned special status, and are listed in a biological conservation database maintained by the Illinois Department of Natural Resources. Five such sites occur within the Project area.

Table 3-36 Natural areas, nature preserves, and endangered species sites in the Project area.

County	Name	Area of Overlap (acres) (1)	Recognizing Feature(s)
		Natural Areas	
Madison	Bohm Woods	5	dry-mesic and mesic upland forest; 94 acres outside Project area
Madison	Poag Railroad Prairie	33	mesic sand and wet-mesic prairie;
/Madison	Levee Lake	230	pond, shrub swamp, marsh
		Nature Preserves	
Madison	William & Emma Bohm Memorial	7	dry-mesic and mesic upland forest; 8 acres outside Project area
		Endangered Species Sites	
Madison	Chouteau Catchfly Site	2	royal catchfly
Madison	Poag Railroad Prairie		Spring ladies' tresses
Madison	Precision habitat	475	Illinois chorus frog
Madison	Eagle Park Marsh	105	common moorhen, pied-billed grebe, yellow-headed blackbird
St. Clair	Fairmont City Site	38	decurrent false aster
St. Clair	East St. Louis (Alorton) Heron Colony	2	snowy egret, little blue heron, black crowned night-heron
Total Area in Project Area		893	

(1) Within Project area; acres for all sites taken from IDNR (1998c), except for precision habitat

3.12.4.1 Natural Areas and Nature Preserves. Bohm Woods Natural Area, a 99-acre privately owned tract supporting dry-mesic and mesic upland forest was identified by the INAI as relatively undisturbed and in high-quality condition (IDNR 1998c). This natural area straddles the Project area boundary in Madison County at the extreme north, near the point where Cahokia Creek turns into Cahokia Creek Diversion Channel. Most of it occupies bluff slopes. About 10 acres of this forest is formally dedicated as the William and Emma Bohm Memorial
Nature Preserve. "Bohm Woods is a fine example of dry-mesic and mesic upland forest and is known for its species-rich herbaceous understory" (IDNR 1998e:37). About five acres of this natural area and nature preserve fall within the Project area, within the watershed referred to in this Project as "Bluff 1".

Poag Railroad Prairie Natural Area, a 33-acre prairie remnant, was identified by the INAI as a significant example of two prairie communities (IDNR 1998c). The natural area is located in Madison County in the northern portion of the Project area. It is privately owned. It lies east of Illinois Route 111 along the embankment of a southwest-northeast extending railroad for a distance of about 1.8 miles. The entire natural area lies within the boundaries of historic Rattan's Prairie, a predominantly wet-mesic prairie of over 15,000 acres. At its eastern limit, the natural area extends for about one-quarter mile onto the sandy terrace along the bluff where historic Cahokia Creek entered the Mississippi River floodplain. Poag Railroad Prairie consists of both wet-mesic and sand prairie communities, but their current quality and extent have not been reported (IDNR 1998e). Biologists from the St. Louis District and Illinois Natural History Survey briefly visited the site in the spring of 1999 for this Project, and little if any of the purportedly wet-mesic portion appeared to possess wetland hydrology.

Levee Lake Natural Area is in Madison County in a meander scar of the Mississippi River, about 1.5 miles east of Horseshoe Lake. The INAI site envelops 230 acres (IDNR 1998c), and is under private and public ownership (Metro East Sanitary District). In terms of natural communities, about half of the area consisted in the mid-1970s of pond, shrub swamp, and marsh, and the remainder of wet floodplain forest and wet-mesic floodplain forest. The examples of pond, shrub swamp, and marsh were judged to be of high quality at that time. "Levee Lake is a high quality wetland. This ... area is the largest and least disturbed complex of marsh, pond, and swamp communities in the American Bottoms" (IDNR undated). However, the hydrological characteristics of this area were later altered, evidently in the 1980s. Normal wet-season surface water levels in the pond, shrub swamp, and marsh areas were lowered when a series of surface ditches was dug on adjacent private cropland to carry drainage to Cahokia Canal. The pond and shrub-swamp communities have since been replaced by marsh and encroaching woody growth consisting of willows.

Brushy Lake is the name used in this Project to refer to the Levee Lake Natural Area and adjacent lands to the north and south. A detailed biological analysis of a 389-acre tract enveloping the natural area was conducted for this Project (ZE 1998).

3.12.4.2 Endangered Species Sites. Chouteau Catchfly Site is a locality in Madison County at which the royal catchfly (*Silene regia*), a state endangered plant, has been found. The INAI site is along the western border of the northern portion of the Project area. It envelops less than two acres along a railroad embankment on private property.

The royal catchfly was historically found in prairies and savannas. This site lies in the western portion of historic Rattan's Prairie, and southwest of historic Grassy Lake.

The Poag Railroad Prairie Natural Area (described above) is an INAI site at which a state-endangered plant, spring ladies' tresses (*Spiranthes vernalis*), has been found recently. This plant is an orchid.

Precision habitat for the Illinois chorus frog (*Pseudacris streckeri illinoensis*), a state-threatened species, is located in Madison County on the Mississippi River floodplain in the vicinity of the historic channel of Cahokia Creek. Four separate areas have been established to help meet this species' life history requirements.

Eagle Park Marsh is an INAI site located in Madison County. It once supported a population of breeding yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), a state-endangered species. This marsh and open water area is found at the tip of the western arm of Horseshoe Lake, south of National City. The site encompasses about 105 acres on private property.

Fairmont City is an INAI site in St. Clair County that supports the decurrent false aster (*Boltonia decurrens*), a state and federally endangered plant. This site occurs in a meander scar of the Mississippi River near Fairmont City, and is located on private property within the area south of I-55/70, west of Route 111, north of Collinsville Road, and east of Route 203. It coincides with an open, marshy area. Indian Lake is the name used in this Project to refer to the larger area enveloping this site, which is delineated by the four roads described above.

East St. Louis (Alorton) Heron Colony is a site in St. Clair County that supports a rookery used by various state-listed species of herons and egrets. These species include the snowy egret (*Egretta thula)*, little blue heron (*Egretta caerulea)*, and black-crowned night-heron (*Nycticorax nycticorax)*, all state-endangered species. The cattle egret (*Bubulcus ibis*) and great egret (*Ardea alba*) also use this rookery. It is located on private property in Alorton, to the southeast of East St. Louis.

3.12.5 Existing Species.

3.12.5.1 Plants. Roughly 1,000 plant species consisting of various trees, shrubs, vines, grasses, sedges, forbs, and ferns occur, or are likely to occur, in the Project area. Appendix B presents 949 plant species by common and scientific name, as well as the natural communities in which each one occurs. Plant species are ordered by physiognomic class (tree, shrub, etc.). Also, within each physiognomic class, all species are ranked from "driest" to "wettest" according to their likelihood of occurring in wetlands. This likelihood is represented by the coefficient of wetness as assigned by the National Wetland Inventory to each plant species in the upper Midwest (Reed 1988).

About 18 percent of the Project area's flora, consisting of 173 species, is not native to Illinois. Table B.9 in Appendix B displays the prevalence of exotic species in the Project area's natural communities. Exotic species occur in all kinds of natural communities, but, excluding cultural areas, are most prevalent in remnant prairies and savannas. Recommended methods of eradication for many of these species are provided by IDNR (1998e).

For Appendix B, it should be noted that plant species indicated for each kind of community are representative of the Project area as a whole, and not a particular site. All plant species living at an individual site would represent some fraction of the total. The occurrence of fewer species at individual sites reflects the loss of some species due to habitat destruction and degradation, as well as natural variation from site to site.

Recommendations for the long-term maintenance of local natural vegetation communities have been described by IDNR (1998e) in its "Sinkhole Plain Area Assessment," which addresses the Project area as well as a larger contiguous area to the south. First, an update of the Illinois Natural Areas Inventory, conducted in the mid 1970s, should be carried out to identify and map any natural community remnants, including moderately degraded ones, missed the first time around. Second, ecological problems occurring at specific remnants should be identified and prioritized, so that effective rehabilitation measures can be developed. Third, remnants of native vegetation with the greatest ecological integrity should receive priority for rehabilitation and management. Fourth, existing natural areas with higher levels of ecological integrity should have sizable buffer zones established around them, or additions made to narrow existing zones. Corridors or connections between isolated areas should be established. These actions would help to keep invasive plant species from entering such areas. Fifth, long-term programs for the application of periodic prescribed fire in remnants of natural vegetation should be developed, where fire was historically an important ecological component. And, lastly, the long-term survival of local populations of threatened and endangered plant species should be ensured.

3.12.5.2 Invertebrates. Macroinvertebrates. Roughly 350 relatively common macro invertebrate species consisting primarily of beetles, worms, water bugs, midges, caddis flies, mayflies, damselflies, dragonflies, damselflies, leeches, mosquitoes, clams, crayfish, mussels, and snails occur, or are likely to occur, in the Project area. Table B.10 in Appendix B presents invertebrate species by common and scientific name. In this table, macro invertebrate species are ordered alphabetically by common name (leech, clam, etc.). Also, within each group, all species are arranged alphabetically. Additionally, Table B.11 in Appendix B presents 51 species of mosquitoes that may occur in the Project area, as well as their human pest potential, primary activity period, status as a disease vector, flight range, preferred larval habitat (oviposition site), and preferred adult habitat. The mosquito species presented in this table are arranged alphabetically.

Aquatic Biota. The use of aquatic organisms to evaluate water quality is well established. The underlying principle is that good water quality supports a diverse biological community with pollution-intolerant forms (Wilhm 1975, IEPA 1989). An evaluation of aquatic macro invertebrate community composition in the American Bottom basin was performed in 1984 as part of IEPA's *Intensive Survey of the American Bottoms Basin* (IEPA 1989). Slight to moderate stream degradation was observed. In general, the macro invertebrate populations sampled appeared to be influenced by a variety of sources originating from agricultural, industrial, urban, and municipal activities. Channelization was also a negative factor at several sites. Stream impacts were generally greater in the highly developed East St. Louis area compared to outlying areas, as indicated by the Macro invertebrate Biotic Index (MBI).

The MBI is a pollution tolerance rating system which ranges from 0 to 11; a rating of zero is assigned to taxa found only in unaltered streams of high water quality, and a rating of 11 is assigned to taxa known to occur in severely polluted or disturbed streams. Mean MBI values of 6.2 (upper America Bottom), 6.8 (middle America Bottom, including the East St. Louis area), and 6.0 (lower America Bottom) illustrated this pattern (IEPA 1989).

Within the middle American Bottom, the sample site at Canal No. 1 was described as a channelized reach that received urban runoff and storm sewer discharges. A MBI value of 6.7 and representation by only 21 taxa revealed the effects of these negative influences (IEPA 1989). The sample site at the Cahokia Canal revealed 23 taxa and a MBI of 6.7. Factors influencing the community composition include channelization, nearby land development, and agricultural and urban runoff (IEPA 1989). Two sites were sampled within Canteen Creek. Each site contained 17 taxa, and MBI values were calculated at 7.9 for Site One and 6.5 for Site Two. Sites One and Two both received urban, agricultural, and mine debris runoff; in addition, Site Two was channelized and substantially degraded by Collinsville municipal wastewater treatment plant effluent (IEPA 1989).

Although the area supports a moderate diversity of aquatic macro invertebrates, aquatic species have disappeared from the area in recent decades (IDNR 1998g). However, with improvements in water quality, species that have been extirpated could return, and natural communities could become reestablished where they have been eliminated or altered (IDNR 1998g).

Mosquitoes. Mosquitoes are by far the most important arthropods subject to control for general health reasons in the United States, according to the Public Health Study Team of the Environmental Studies Board (National Research Council 1976). Mosquitoes are a perennial problem in the American Bottom because of spring flooding and the region's long, wet summers. Drainage and mosquito control efforts in the area serve to reduce the problem.

Approximately fifty-seven species of mosquitoes have been collected in Illinois (Ross and Horsfall 1965). Of these, 12 species are considered a major pest to humans in the state (Kulfinski and Myer 1981, ESHD 2001). These include *Aedes albopictus*, *Aedes sollicitans*, *Aedes sticticus*, *Aedes triseriatus*, *Aedes vexans*, *Anopheles punctipennis*, *Anopheles quadrimaculatus*, *Coquillettidia perturbans*, *Culex erraticus*, *Culex pipiens*, *Culex salinarius*, and *Psorophora ciliata.*

- *Aedes albopictus* was first identified in Illinois in 1986 (ESHD 2001). It breeds primarily in artificial containers and water-filled tree cavities. It is a possible vector for LaCrosse encephalitis and dog heartworm in Illinois, and Dengue fever and Yellow fever in other states.

- *Aedes sollicitans* is associated with frequently flooded marshes and sulfuretted water from coal mining or salt water from oil wells. It is a vector for Eastern equine encephalitis, Western equine encephalitis, dog heartworm, and Venezuelan equine encephalitis, although the species is not known to transmit the disease in Illinois (ESHD 2001).

- *Aedes sticticus* breeds in temporary pools. It is not a known disease vector.

- *Aedes triseriatus* breeds in water-filled tree cavities and artificial containers. It is the primary vector for LaCrosse encephalitis in Illinois, and a vector for Eastern equine encephalitis and Western equine encephalitis in other states.

- *Aedes vexans*, which breeds in temporary pools and floodplains, is the major nuisance mosquito in the project area. These mosquitoes are vicious biters and account for most of the East Side Health District's (ESHD, IL) mosquito related complaints (ESHD 2001). *A. vexans* is a possible vector for Eastern equine encephalitis, Western equine encephalitis, LaCrosse encephalitis, and Dengue fever, although the species is not known to transmit diseases in Illinois (ESHD 2001).

- *Anopheles punctipennis* breeds in artificial containers, bogs, ponds and lakes with emergent vegetation, and marginal vegetation of sluggish streams. It is a disease vector for LaCrosse encephalitis, malaria, and dog heartworm.

- *Anopheles quadrimaculatus* breeds in artificial containers, sluggish streams, ponds and lakes with emergent vegetation, marshes, and semi-permanent wetlands. It is a disease vector for Eastern equine encephalitis and Western equine encephalitis in other states and was a vector for malaria in Illinois in the past.

- *Coquillettidia perturbans* breeds in ponds and lakes with emergent vegetation. It is a disease vector for Eastern equine encephalitis, LaCrosse encephalitis, and Flanders virus in other states.

- *Culex erraticus* breeds in ponds and lakes with emergent vegetation and in swamps. It is not a known disease vector.

- *Culex pipiens* breeds in artificial containers, temporary pools, catch basins, ditches, marshes, and polluted waters. In Illinois it is a disease vector for St. Louis encephalitis, and dog heartworm. In other states it is a vector for Western equine encephalitis, LaCrosse encephalitis, Flanders virus, Filariasis, and West Nile virus.

- *Culex salinarius* breeds in artificial containers, water-filled tree holes, grassy unshaded temporary pools, and marshes. It is a disease vector for St. Louis encephalitis, Flanders virus, and dog heartworm.

- *Psorophora ciliata* is associated with frequently flooded marshes, and temporary pools. It is a vector for Eastern equine encephalitis, but is not known to transmit the disease in Illinois (ESHD 2001).

According to the East Side Health District (IL) and the Illinois Department of Public Health, the only mosquito-borne encephalitis documented in humans in Illinois in the past ten years include St. Louis encephalitis, and LaCrosse encephalitis. The last major outbreak of St. Louis encephalitis in Illinois occurred in 1975 (ESHD 2001).

There is evidence from Illinois and other Midwestern states that the St. Louis encephalitis virus continues to be transmitted in the avian reservoir at a low level, thus the potential for an outbreak of St. Louis encephalitis exists. LaCrosse encephalitis is the most consistently occurring mosquito borne illness in Illinois, existing as an endemic rather than an epidemic disease (ESHD 2001). No confirmed human cases of Eastern equine encephalitis have been reported from Illinois, and there has been little Western equine encephalitis activity in the U.S. in recent years (ESHD 2001). According to the Illinois Department of Public Health (IDPH 2002), the West Nile virus was first documented in Illinois in September 2001 when laboratory tests confirmed its presence in two dead crows found in the Chicago metropolitan area. By September 2002, birds, mosquitoes, and horses have tested positive for the virus in nearly all the state's counties. Also, about 270 confirmed human cases of West Nile viral encephalitis have been reported in Illinois from 23 counties, including 10 deaths. The City of Chicago and adjacent Cook County are the source of over 200 cases and seven deaths. In Madison and St. Clair Counties, there have been 5 and 6 confirmed human cases, respectively, and no deaths (IDPH 2002).

Some observations in the field indicate that mosquitoes are not a problem in constructed wetlands. Generally, functioning stormwater wetlands are less likely to produce mosquitoes than are nutrient laden secondary sewage and agricultural wastewater ponds, or ponds that do not have frequent turnover (Adams 1983, Bennett 1971). Furthermore, healthy ecosystems provide habitat for insectivorous birds, fish, copepods, and other animals that feed on larval and adult mosquitoes. The best fish for mosquito control are those species that reproduce quickly and have a wide tolerance of environmental conditions. Commonly stocked species include guppies (*Poecilia reticulata*), mosquitofish (*Gambusia affinis*), and pupfish (*Cyprinodon* spp.) (McClean 1995).

Other Pestiferous Invertebrates. Other pestiferous insects in the area include several biting flies e.g. some black flies (Simuliidae), sand flies (Phlebotominae), biting midges (Ceratopogonidae), horse flies and deer flies (Tabanidae), and the sable fly *Stomoxys calcitrans* (Muscidae). Many non-biting flies, particularly the housefly and numerous species of non-biting midges (Chironomidae) frequently constitute a major nuisance because of their numbers. In addition to flies (Diptera) several ants, bees, wasps, and hornets (Hymenoptera) are a major cause of discomfort or possibly death. Several species of chiggers (*Eutrombicula*) are also present in the area, and cause dermatitis after feeding on the skin (Kulfinski and Myer 1981).

Two spiders that occur in the project area are particularly dangerous. The black widow spider (*Latrodectus mactans*) and the brown recluse spider (*Loxosceles reclusa*) both occur with frequency in the area. Two tick-vectored diseases are a potential problem in the project area. These are Rocky Mountain spotted fever and tularemia. *Dermacentor variabilis* has the greatest potential for spreading these diseases because it is the only local species that bites humans with any notable frequency. It is associated with wooded and brushy areas and along the banks of streams. *Amblyomma americanum* also bite humans, but does so with considerably less frequency than does *Dermacentor variabilis*. *Haemaphysalis leporio* rarely bites humans, but is important in disseminating the parasites among wild animal reservoirs.

3.12.5.3 Fishes. The existing fish fauna is much reduced from what it was historically, and today has little relationship to the original fauna (Parker 1973). Native species are wide-ranging, and are characteristic of habitats that have been heavily modified and subjected to considerable environmental fluctuations, such as in water temperature, flow, turbidity, and dissolved oxygen. As shown in Table 3-37, thirty-six species of fish have been collected since 1984 during fish surveys of channels and lakes within the Project area. Thirty-three species inhabit floodplain channels, and twenty-one species occur in lakes. None of the 36 species are federally or state protected. Three species, the gold fish, common carp, and grass carp, are exotic or non-native.

Collection sites for these 36 species are restricted to the bottoms or floodplain of the Mississippi River. None are in the uplands, but some in channels are located along the base of the bluff where tributary streams enter the floodplain. No collection sites are in the Mississippi River. Lake species are represented by collections in Horseshoe Lake and the three lakes at Frank Holten State Recreation Area.

A longer list of 98 species that includes additional fishes that may occur in the Project area as well as the adjacent Mississippi River appears in Appendix B. Habitat preferences are indicated, as well as relative abundance. Habitat types include streams, small rivers, medium and large rivers, and standing water. Stream habitat could be considered to represent the upland tributaries in the Project area, small rivers the floodplain channels, medium and large rivers the Mississippi River, and standing water the floodplain's lakes and ponds. Three listed species are included in the long list, and they are discussed in Appendix B in Annex B.14.

A number of fish species apparently have disappeared since settlement (Parker 1973). Their loss is most likely due to habitat modifications caused by development. These species would include the alligator gar (*Lepisosteus spatula*), central mudminnow (*Umbra limi*), northern pike (*Esox lucius*), muskellunge (*Esox masquinongy*), blacktail shiner (*Cyprinella venusta*), ironcolor shiner (*Notropis chalybaeus*), taillight shiner (*Notropis maculatus*), pugnose minnow (*Opsopoeodus emiliae*), lake chubsucker (*Erimyzon sucetta*), spotted sucker (*Minytrema melanops*), freckled madtom (*Noturus nocturnus*), starhead topminnow (*Fundulus notti*), bantam sunfish (*Lepomis symmetricus*), crystal darter (*Ammocrypta asprella*), western sand darter (*Ammocrypta clara*), stargazing darter (*Percina uranidea*), and banded pygmy sunfish (*Elassoma zonatum*). The muskellunge and alligator gar have been extirpated from Illinois (IDENR 1994), and the others would be regionally or locally extinct.

Management recommendations for fish have been described by IDNR (1998b) in its "Sinkhole Plain Area Assessment," which addresses the Project area as well as a larger contiguous area to the south. The major recommendation is establishment of natural riparian vegetation along streams. Riparian zones of native plant species would reduce levels of pollutants entering streams, such as silt and chemicals, by acting as filters of runoff. Vegetation would also stabilize unstable banks, and would provide shade to lower higher than normal water temperatures. Other recommendations, besides the cessation of removal of riparian vegetation, include a halt to further stream channelization, drainage of floodplain lakes, and introduction of non-native fish species. Avoidance of mainstream impoundments and rectification of existing pollution problems was also suggested. A watershed approach to developing management strategies was stressed.

Table 3-37 Fish species collected in the Project area since 1984, according to habitat type (1).

Common name	Family/*Species* Name	Channels	Lakes
Bowfins	**Amiidae**		
Bowfin	*Amia calva*	X	X
Herrings, Shads, Sardines	**Clupeidae**		
Gizzard shad	*Dorosoma cepedianum*	X	X
Minnows & Carps	**Cyprinidae**		
Central stoneroller	*Campostoma anomalum*	X	
Goldfish (I)	*Carassius auratus*	X	X
Grass carp (I)	*Ctenopharyngodon idella*	X	
Red shiner	*Cyprinella lutrensis*	X	
Common carp (I)	*Cyprinus carpio*	X	X
Golden shiner	*Notemigonus crysoleucas*	X	X
Emerald shiner	*Notropis atherinoides*	X	
Bigmouth shiner	*Notropis dorsalis*	X	
Sand shiner	*Notropis ludibundus*	X	
Fathead minnow	*Pimephales promelas*	X	
Bullhead minnow	*Pimephales vigilax*	X	
Creek chub	*Semotilus atromaculatus*	X	
Suckers	**Catostomidae**		
River carpsucker	*Carpiodes carpio*	X	
White sucker	*Catostomus commersoni*	X	
Smallmouth buffalo	*Ictiobus bubalus*	X	X
Bigmouth buffalo	*Ictiobus cyprinellus*	X	X
Shorthead redhorse	*Moxostoma macrolepidotum*	X	
Freshwater Catfishes (N. America)	**Ictaluridae**		
Black bullhead	*Ameiurus melas*	X	X
Yellow bullhead	*Ameiurus natalis*	X	X
Channel catfish	*Ictalurus punctatus*	X	X
Pikes	**Esocidae**		
Grass pickerel	*Esox americanus*	X	
Salmonides	**Salmonidae**		
Rainbow trout	*Oncorhynchus mykiss*		X
Livebearers	**Poeciliidae**		
Mosquitofish	*Gambusia affinis*	X	
Temperate Basses	**Moronidae**		
White bass	*Morone chrysops*	X	X
Yellow bass	*Morone mississippiensis*		X

Table 3-37 Continued

Common name	Family/*Species* Name	Channels	Lakes
Sunfishes and Freshwater Basses	**Centrarchidae**		
Warmouth	*Chaenobryttus gulosus*	X	
Green sunfish	*Lepomis cyanellus*	X	X
Orangespotted sunfish	*Lepomis humilis*	X	X
Bluegill	*Lepomis macrochirus*	X	X
Redear sunfish	*Lepomis microlophus*		X
Largemouth bass	*Micropterus salmoides*	X	X
White crappie	*Pomoxis annularis*	X	X
Black crappie	*Pomoxis nigromaculatus*	X	X
Drums and Croakers	**Sciaenidae**		
Freshwater drum	*Aplodinotus grunniens*	X	X
Number of Species Per Habitat Type		33	21

(1) list does not reflect the Mississippi River; (I) = introduced species
Source: IEPA (1989, 2000), Raman (1992), and Raman and Bogner (1994).

3.12.5.4 Reptiles and Amphibians. As shown in Table 3-38, a total of 65 species of reptiles and amphibians occur or may occur in the Project area. Various kinds of salamanders and toads and frogs comprise the 22 amphibian species, of which 12 have documented occurrences. Forty-three species of reptiles include a number of turtles, lizards, and snakes; twenty-four of these species have been documented from the area. All species are native. None have been introduced. Reptiles and amphibians are found in all communities of the Project area. In cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, they are less diverse than in forest, prairie, wetland, creek and river, and lake and pond habitats.

The alligator snapping turtle (*Chelydra serpentina*) has become locally extinct. One species of frog and three species of snakes are either state or federally protected species. They are discussed in Appendix B in Annex B.14.

Overall habitat quality in the Project area for reptiles and amphibians has been described as "fair" due to the extensive loss of forests and wetlands and fragmentation of remaining habitats (IDNR 1998f). In its "Sinkhole Plain Area Assessment", which also addresses a larger contiguous area to the south, IDNR (1998f) has provided various management recommendations for reptiles and amphibians. The most important actions that would benefit these species are as follows. First, restoration of a continuous riparian zone consisting of floodplain forests, backwater sloughs, and wetlands along the Mississippi River would provide a corridor for dispersal, and connect populations isolated by various types of development. Second, reduction of road kills caused by vehicular traffic on roads along the base of the bluff would lessen an important source of mortality. Movements between the bottoms and upland areas correspond to seasonal migrations between breeding or hibernation areas.

Third, within the uplands, corridors of natural vegetation need to be created to connect existing (often small) wetlands, such as isolated sinkholes or man-made ponds. Forest or grassland connections need to be established to link ponds, lakes and impoundments. Fourth, small temporary fishless ponds need to be maintained in forests, especially forests in the tributary watersheds, as breeding areas; at least some of the shore along these ponds needs to remain unmowed. And, lastly, sand prairie remnants need to be restored and managed to benefit the Illinois chorus frog and massasauga rattlesnake. Wetland and ponds in or adjacent to sand prairies need to be restored to benefit the Illinois chorus frog.

Table 3-38 Amphibian and reptile species that occur or are likely to occur in the Project area (1).

Name (2,3)			Habitat (4)						Relative Abundance (5)
Common Name	**Order/*Species* Name**		**For**	**Pra, Sav**	**Wet**	**Cre**	**Lake**	**Cult**	
Amphibians	**Amphibia**								
Salamanders	**Caudata**								
Spotted salamander	*Ambystoma maculatum*		X		X				U
Smallmouth salamander	*Ambystoma texanum*	*	X	X	X				C
Tiger salamander	*Ambystoma tigrinum*		X	X	X		X		C
Longtail salamander	*Eurycea longicauda*		X			X			U
Cave salamander	*Eurycea lucifuga*		X						U
Mudpuppy	*Necturus maculosus*					X			R
Eastern newt	*Notophthalmus viridescens*		X		X		X		U
Western lesser siren	*Siren intermedia*				X	X	X		U
Toads and Frogs	**Anura**								
Cricket frog	*Acris crepitans*	*			X	X	X		C
American toad	*Bufo americanus*	*	X	X	X	X	X	X	C
Fowler's toad	*Bufo fowleri*	*	X	X	X	X	X		C
Cope's grey treefrog	*Hyla chrysoscelis*		X		X				C
Eastern grey treefrog	*Hyla versicolor*	*	X		X				C
Spring peeper	*Pseudacris crucifer*	*	X		X		X		C
Illinois chorus frog (ST)	***Pseudacris streckeri illinoensis (ST)***	*			**X**				R
Western chorus frog	*Pseudacris triseriata*	*	X		X		X	X	C
Plains leopard frog	*Rana blairi*		X	X	X	X			U
Bullfrog	*Rana catesbeiana*	*	X	X	X	X	X	X	C
Green frog	*Rana clamitans*	*	X		X	X			C
Pickerel frog	*Rana palustris*	*	X		X				U
Southern leopard frog	*Rana sphenocephala*	*	X		X		X		C
Northern leopard frog	*Rana pipiens*			X	X	X	X		U
Reptiles	**Reptilia**								
Turtles	**Testudines**								
Smooth softshell	*Apalone mutica*					X			U
Spiny shoftshell turtle	*Apalone spinifera*	*			X	X	X		C
Snapping turtle	*Chelydra serpentina*	*			X	X	X		C
Painted turtle	*Chrysemys picta*	*			X	X	X		C

Table 3-38 Continued

Name (2,3)			Habitat (4)						Relative Abundance (5)
Common Name	**Order/*Species* Name**		**For**	**Pra, Sav**	**Wet**	**Cre**	**Lake**	**Cult**	
Map turtle	*Graptemys geographica*					X			C
False map turtle	*Graptemys pseudogeographica*					X			C
Common musk turtle	*Sternotherus odoratus*				X	X	X		C
Eastern box turtle	*Terrapene carolina*	*	X	X		X			C
Ornate box turtle	*Terrapene ornata*			X					U
Red-eared slider	*Trachemys scripta*	*			X	X	X		C
Lizards	**Squamata (Sauria)**								
Six-lined racerunner	*Cnemidophorus sexlineatus*	*		X					U
Five-lined skink	*Eumeces fasciatus*	*	X	X					C
Broadhead skink	*Eumeces laticeps*	*	X	X					C
Slender glass lizard	*Ophisaurus attenuatus*			X					R
Eastern fence lizard	*Sceloporus undulatus*	*	X	X					C
Ground skink	*Scincella lateralis*	*	X						U
Snakes	**Squamata (Serpentes)**								
Copperhead	*Agkistrodon contortrix*		X	X					C
Worm snake	*Carphophis amoenus*	*	X	X					U
Racer	*Coluber constrictor*	*	X	X	X	X	X		C
Timber rattlesnake (ST)	***Crotalus horridus (ST)***		**X**	**X**					R
Ringneck snake	*Diadophis punctatus*	*	X	X					U
Great Plains rat snake (ST)	***Elaphe guttata emoryi (ST)***		**X**	**X**					R
Black rat snake	*Elaphe obsoleta*	*	X	X	X				C
Fox snake	*Elaphe vulpina*			X	X				R
Eastern hognose snake	*Heterodon platirhinos*	*	X	X	X				U
Prairie kingsnake	*Lampropeltis calligaster*	*		X				X	C
Speckled kingsnake	*Lampropeltis getula*	*	X	X					U
Milk snake	*Lampropeltis triangulum*	*	X	X					U
Plainbelly water snake	*Nerodia erythrogaster*	*			X	X	X		C
Diamondback water snake	*Nerodia rhombifer*	*			X	X	X		C
Northern water snake	*Nerodia sipedon*	*			X	X	X	X	C
Rough green snake	*Opheodrys aestivus*	*	X						U
Bullsnake	*Pituophis melanoleucus*			X					U
Graham's crayfish snake	*Regina grahamii*				X		X		U
Massasauga (SE, FC)	***Sistrurus catenatus (SE, FC)***	*		**X**	**X**				R
Brown snake	*Storeria dekayi*		X	X	X	X	X	X	C
Redbelly snake	*Storeria occipitomaculata*		X	X					U

Table 3-38 Continued

Name (2,3)			Habitat (4)						Relative Abundance (5)
Common Name	Order/*Species* Name		For	Pra, Sav	Wet	Cre	Lake	Cult	
Flathead snake (ST)	***Tantilla gracilis (ST)***		X	X					R
Western ribbon snake	*Thamnophis proximus*		X	X	X	X			U
Plains garter snake	*Thamnophis radix*			X				X	U
Common garter snake	*Thamnophis sirtalis*		X	X	X	X	X	X	C
Lined snake	*Tropidoclonion lineatum*	*	X	X					R
Earth snake	*Virginia valeriae*		X						U

(1) Known species are indicated by "" in middle column, and come from Parker (1973, 1974, 1981); likely to occur species come from IDNR (1998f) and Phillips et al. (1999).*
(2) Bold type indicates Illinois threatened (ST), Illinois endangered (SE), or Federal species of concern (FC).
(3) I = Introduced species
(4) The following habitat codes taken from Hofmann and Heske (1998) and Hoffmeister (1989) are used.
For = Forest (wetland and nonwetland)
Pra, Sav = Prairie and savanna
Wet = Wetland (not forested)
Cre = Creeks and rivers
Lake = Lakes, ponds, and impoundments
Cult = Cultural
(5) Relative abundance taken from IDNR (1998f). The following relative abundance codes are used:
C = Common
U = Uncommon
R = Rare

3.12.5.5 Birds. Numerous species of birds, as shown in Table 3-39, occur regularly or occasionally in the Project area. Table B-39 lists 126 species that occur regularly, and displays for each species the types of habitat used and breeding status within each habitat type. Birds are the most diverse group of vertebrates living in the Project area, and consist of species from over 40 families. Herons, waterfowl, sandpipers, woodpeckers, flycatchers, swallows, warblers, sparrows, and blackbirds are bird families that are represented by numerous species. When bird species that occasionally use the Project area are added to those that are regular inhabitants, the total number of species increases to 288. Appendix B includes a table of all of the bird species known to occur, or likely to occur, in the Project area. Of the 288 species, one dove, one starling, one finch, and two sparrows are exotic or non-native.

Habitat loss and degradation are associated with the loss of a number of bird species, or a change in status from breeding to migratory. According to IDNR (1998b), birds that historically occurred in the Project area but are now globally extinct include the passenger pigeon (*Ectopistes migratorius*), ivory-billed woodpecker (*Cempephilus principalis*), and Carolina parakeet (*Conuropsis carolinensis*). Locally extinct species include the swallow-tailed kite (*Elinoides forficatus*), greater prairie chicken (*Tympanuchus cupido*), ruffed grouse (*Bonasa umbellus*), Bewick's wren (*Thryromanes bewickii*), and Bachman's sparrow (*Aimophila aestivalis*) (IDNR 1998b).

Others include the barn owl (*Tyto alba*), chuck-will's-widow (*Caprimulgus carolinensis*), Swainson's warbler (*Limnothlypis swainsonii*), and white-winged crossbill (*Loxia leocoptera*) (McMullen 2001). Of the 288 species that may occur in the Project area, 147 of them probably breed in existing habitats, and the rest are migrants that pass through the area. At least six species formerly bred in the Project area and its environs, but do not do so today because of habitat alterations. These species include the trumpeter swan, osprey, least tern, black tern, yellow-bellied sapsucker, and yellow-headed blackbird (IDNR 1998b). Several species that were once gone are now back, and they include the double-crested cormorant, bald eagle, and wild turkey (IDNR 1998b).

Of the 288 species that may use the Project area, 27 of them are federally or state protected. These listed species are discussed in Appendix B in Annex B.14. The diversity and number of threatened and endangered birds is an indication that remaining natural habitats in the Project area that are or could be used by these species are important natural resources.

Birds use all natural communities in the Project area. While a number of species are able to use multiple kinds of habitats, many others are limited to one or only a few. Two major groups of migratory bird species pass through the Project area seasonally: water birds and landbirds. A major flyway for migratory waterfowl is centered on the Mississippi River and its adjacent floodplain. As these species typically use water bodies and herbaceous wetlands as resting areas, Horseshoe Lake and surrounding wetlands serve as stopover points in the fall and spring. Other migrant birds, such as shorebirds from the plover, stilt and avocet, and sandpiper families, and species from the gull and tern family, also use Horseshoe Lake and other local waterbodies. The Mississippi River corridor and its adjacent uplands also serve the needs of many migrant landbirds. Many of these species are from the hawk, flycatcher, warbler, and sparrow families, as well as many other less diverse groups.

For those that do not use a variety of habitats, habitat destruction and fragmentation have adversely affected the status of a number of species. Many grassland birds adapted to Midwestern native tallgrass prairies have experienced significant population declines after the disappearance of their native habitat (Herkert et al. 1993). Loss of forest has also adversely affected many forest species. Research in Illinois has shown that birds breeding in forest sites smaller than 500 acres generally suffer high rates of nest predation (70-90 percent) and a high incidence of brood parasitism by brown-headed cowbirds (70-80 percent) (IDNR1998b, Robinson et al. 2000). As a result, forest fragments smaller than 500 acres act as population "sinks" because they attract breeding birds, but most offspring die before reaching maturity. Except for some fragments in the uplands, most forest fragments in the Project would be expected to act as "sinks."

A number of management recommendations for birds were described by IDNR (1998b) in its "Sinkhole Plain Area Assessment," which addresses the Project area as well as a larger contiguous area to the south. First, the highest priority action for birds is preservation of existing wetlands and forests, including restoration of savanna. This action is needed because many wetlands and forests in the assessment area currently support significant populations of state-listed bird species. Savanna restoration is recommended because savannas seem to support a number of migrating species.

Second, prairie restorations are important because they will benefit grassland birds that as a group have exhibited a significant population decline in the Midwest (citation). Prairie restorations to benefit birds should not consist of dense stands of tall prairie grasses, but a mixture of grasses and forbs. To benefit breeding grassland birds that are area-sensitive, restoration areas should exceed 150 to 250 acres (Herkert citation). Third, forests should be restored in blocks of 500 acres or larger. Sites meeting this size requirement are considered to be favorable for sustaining regional bird populations. Research in Illinois has shown that birds breeding in sites smaller than 500 acres generally suffer high rates of nest predation (70-90 percent) and a high incidence of brood parasitism by brown-headed cowbirds (70-80 percent) (IDNR1998b, Robinson et al. 2000). As a result, forest fragments smaller than 500 acres act as population "sinks" since they attract breeding birds, but most offspring die before reaching maturity. Fourth, native plant communities should be restored in small forest fragments. Within developed areas, the planting of oaks and maintenance of shrubby areas is recommended to benefit some migrating species. Fifth, wetlands should have vegetated buffers established around their perimeter. Buffers can consist of prairie restorations or woody vegetation. Such areas would help shield wetlands from encroaching development, and would serve as nesting areas also. Sixth, in cropland areas, ground cover consisting of plant residue from crops should be maximized as much as possible; shrubs should be maintained along ditches, and roadsides should be mowed infrequently.

And, finally, the amount of emergent vegetation should be increased along edges of ponds, lakes, and impoundments, and woody riparian corridors along creeks and rivers should be enhanced. Nesting platforms at the edges of lakes could serve the osprey and double-crested cormorant.

Table 3-39 Bird species that regularly occur in the Project area (1).

Name (2,3)		**Habitat (4,5)**								
		UpFor	**ForWet**	**Shrub**	**Grass**	**Sav**	**HeWet**	**Water**	**Crop**	**Cult**
Grebes	**Podicipedidae**									
Pied-billed Grebe (ST)	***Podilymbus podiceps (ST)***						**B M**	**B M**		
Pelicans	**Pelecanidae**									
American White Pelican	*Pelecanus erythrorhynchos*							M		
Cormorants	**Phalacrocoracidae**									
Double-crested Cormorant	*Phalacrocorax auritus*						B	M		
Herons	**Ardeidae**									
Great Blue Heron	*Ardea herodias*	B	B				B W M	B W M		
Great Egret	*Ardea alba*						B M	M		
Snowy Egret (SE)	***Egretta thula (SE)***						**B M**			
Little Blue Heron (SE)	***Egretta caerulea (SE)***						**B M**	**M**		
Cattle Egret	*Bubulcus ibis*		B		M		B M		M	
Green Heron	*Butorides virescens*		B M				B M	B M		
Black-crowned Night-heron (SE)	***Nycticorax nycticorax (SE)***		**B M**				**B M**	**B**		

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Swans, Geese, & Ducks	**Anatidae**									
Canada Goose	*Branta canadensis*						B W M	B W M	B W M	M
Wood Duck	*Aix sponsa*		B M				B M	M		
Gadwall	*Anas strepera*						W M	W M		
American Wigeon	*Anas Americana*						M	M		
Mallard	*Anas platyrhynchos*		B W M		B		B W M	B W M	B W M	
Blue-winged Teal	*Anas discors*				B		B M	M		
Canvasback	*Aythya valisineria*						W M	W M		
Greater Scaup	*Aythya marila*						W M	W M		
Lesser Scaup	*Aythya affinis*						W M	W M		
Common Goldeneye	*Bucephala clangula*							W M		
Bufflehead	*Bucephala albeola*						M	W M		
Hooded Merganser	*Lophodytes cucullatus*		B M				M	M		
Rudy Duck	*Oxyura jamaicensis*						B M	M		
Eagles, Kites, & Hawks	**Accipitridae**									
Northern Harrier (SE)	***Circus cyaneus (SE)***				B W M		B W M		W M	
Cooper's Hawk	*Accipiter cooperii*	B W M		B W M		B W M				W M
Red-tailed Hawk	*Buteo jamaicensis*	B W M		B W M	B W M				B W M	B W M
Falcons	**Falconidae**									
American Kestrel	*Falco sparverius*				B W M	B W M			B W M	B W M
Grouse	**Phasianidae**									
Wild Turkey	*Meleagris gallopavo*	B W M	B W M	B W M		B W M			W M	
Quail	**Odontophoridae**									
Northern Bobwhite	*Colinus virginianus*			B W M	B W M	B W M			B W M	
Rails	**Rallidae**									
American Coot	*Fulica americana*						B M	W M		
Plovers	**Charadriidae**									
Killdeer	*Charadrius vociferous*				B M		B M		B M	B M
Sandpipers	**Scolopacidae**									
Lesser Yellowlegs	*Tringa flavipes*						M			
Solitary Sandpiper	*Tringa solitaria*						M			
Spotted Sandpiper	*Actitis macularia*						M	B		
Semipalmated Sandpiper	*Calidris pusilla*						M			
Least Sandpiper	*Calidris minutilla*						M			
Common Snipe	*Gallinago gallinago*				M		M			
American Woodcock	*Scolopax minor*	B M	B M	B M						
Jaegers, Gulls, & Terns	**Laridae**									
Ring-billed Gull	*Larus delawarensis*						W M	W M	W M	
Herring Gull	*Larus argentatus*						M	W M	M	

Table 3-39 Continued.

Name (2,3)		**Habitat (4,5)**								
		UpFor	**ForWet**	**Shrub**	**Grass**	**Sav**	**HeWet**	**Water**	**Crop**	**Cult**
Doves	**Columbidae**									
Rock Dove (I)	*Columba livia*								B W M	B W M
Mourning Dove	*Zenaida macroura*			B W M					B W M	B W M
Cuckoos, Roadrunner & Anis	**Cuculidae**									
Yellow-billed Cuckoo	*Coccyzus americanus*	B M	B M	B M		B M				
Owls	**Strigidae**									
Eastern Screech-owl	*Otus asio*			B W M		B W M				B W M
Great Horned Owl	*Bubo virginianus*	B W M	B W M			B W M			B W M	B W M
Barred Owl	*Strix varia*		B W M			B W M				
Goatsuckers	**Caprimulgidae**									
Common Nighthawk	*Chordeiles minor*				M	B			M	B M
Whip-poor-will	*Caprimulgus vociferus*	B M				B M				
Swifts	**Apodidae**									
Chimney Swift	*Chaetura pelagica*	B M	B M	B M	M	B M	M	M	M	B M
Hummingbirds	**Trochilidae**									
Ruby-throated Hummingbird	*Archilochus colubris*	B M	B M	B M		B M				B M
Kingfishers	**Alcedinidae**									
Belted Kingfisher	*Ceryle alcyon*						B W M	B W M		
Woodpeckers	**Picidae**									
Red-headed Woodpecker	*Melanerpes erythrocephalus*	W M	B W M			W M			B M	B M
Red-bellied Woodpecker	*Melanerpes carolinus*	B W M	B W M	B W M		B W M				B W M
Downy Woodpecker	*Picoides pubescens*	B W M	B W M	B W M		B W M				B W M
Hairy Woodpecker	*Picoides villosus*	B W M	B W M	W M		B W M				B W M
Northern Flicker	*Colaptes auratus*	B W M	B W M	B W M		B W M				B W M
Flycatchers	**Tyrannidae**									
Eastern Wood-pewee	*Contopus virens*	B M	B M			B M				B M
Acadian Flycatcher	*Empidonax virescens*	B M	B M							
Willow Flycatcher	*Empidonax traillii*			B M		M	B M			
Eastern Phoebe	*Sayornis phoebe*		B M							B M
Great Crested Flycatcher	*Myiarchus crinitus*	B M	B M	M		B M				M
Eastern Kingbird	*Tyrannus tyrannus*	M		B M	B M	B M			B M	
Larks	**Alaudidae**									
Horned Lark	*Eremophila alpestris*				B W M				B W M	
Swallows	**Hirundinidae**									
Purple Martin	*Progne subis*				B M		B M	B M		B
Tree Swallow	*Tachycineta bicolor*		B M		B M		B M	B M		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*		B		B M		B M	B M		
Bank Swallow	*Riparia riparia*				B M		B M	B M		
Cliff Swallow	*Petrochelidon pyrrhonota*				B M		B M	B M		
Barn Swallow	*Hirundo rustica*			B M	B M		B M	B M	B M	B M

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Jays & Crows	**Corvidae**									
Blue Jay	*Cyanocita cristata*	B W M	B W M	B W M		B W M			B W M	B W M
American Crow	*Corvus brachyrhynchos*	B W M	B W M	B W M	B W M	B W M	B W M	B W M	B W M	B W M
Fish Crow	*Corvus ossifragus*	B M	B M					B M		
Chickadees & Titmice	**Paridae**									
Carolina Chickadee	*Poecile carolinensis*	B W M	B W M	B W M		B W M				B W M
Black-capped Chickadee	*Poecile atricapillus*	B W M	B W M	B W M		B W M				B W M
Tufted Titmouse	*Baeolophus bicolor*	B W M	B W M			B W M				B W M
Nuthatches	**Sittidae**									
White-breasted Nuthatch	*Sitta carolinensis*	B W M	B W M			B W M				B W M
Wrens	**Troglodytidae**									
Carolina Wren	*Thryothorus ludovicianus*	B W M	B W M	B W M		B W M				B W M
House Wren	*Troglodytes aedon*	B W M		B W M		B W M				B W M
Sedge Wren	*Cistothorus platensis*				B M		B M			
Kinglets	**Regulidae**									
Golden-crowned Kinglet	*Regulus satrapa*	W M	W M			W M				W M
Gnatcatchers	**Sylviidae**									
Blue-gray Gnatcatcher	*Polioptila caerulea*	B M	B M	B M		B M				
Thrushes	**Turdidae**									
Eastern Bluebird	*Sialia sialis*	B W M		B W M	B M	B W M			B W M	B W M
Wood Thrush	*Hylocichla mustelina*	B M	B M			M				M
American Robin	*Turdus migratorius*	B W M	B W M	B W M	M	B W M			M	B W M
Mockingbirds & Thrashers	**Mimidae**									
Gray Catbird	*Dumetella carolinensis*		B M	B M		B M				B M
Northern Mockingbird	*Mimus polyglottos*			B W M						B W M
Brown Thrasher	*Toxostoma rufum*			B M	B	B M			B M	B M
Waxwings	**Bombycillidae**									
Cedar Waxwing	*Bombycilla cedrorum*	B W M	B W M	B W M		B W M				B W M
Starling	**Sturnidae**									
European Starling (I)	*Sturnus vulgaris*	B W M	B W M			B W M			B W M	B W M
Vireos	**Vireonidae**									
Bell's Vireo	*Vireo bellii*			B M	B M					
Yellow-throated Vireo	*Vireo flavifrons*	B M	B M							M
Warbling Vireo	*Vireo gilvus*	M	B M	B M		B M				B M
Red-eyed Vireo	*Vireo olvaaceus*	B M	B M	M		B M				M

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Warblers	**Parulidae**									
Northern Parula	*Parula americana*	B M	B M			M				M
Yellow Warbler	*Dendroica petechia*		M	B M		M	B M			M
Yellow-throated Warbler	*Dendroica dominica*	M	B M							
Cerulean Warbler	*Dendroica cerulea*	B M	B M			M				M
American Redstart	*Setophaga ruticilla*	M	B M	M		M				M
Prothonotary Warbler	*Protonotaria citrea*		B M							
Worm-eating Warbler	*Helmitheros vermivorus*	B M								
Ovenbird	*Seiurus aurocapillus*	B M		M		M				M
Louisiana Waterthrush	*Seiurus motacilla*	B M	M							
Kentucky Warbler	*Oporornis formosus*	B M	M			M				
Common Yellowthroat	*Geothlypis trichas*			B M	B M	B M	B M		B M	B M
Tanagers	**Thraupidae**									
Summer Tanager	*Piranga rubra*	B M				B M				M
Scarlet Tanager	*Piranga olivacea*	B M	B M			B M				M
Grosbeaks & Buntings	**Cardinalidae**									
Northern Cardinal	*Cardinalis cardinalis*	B W M	B W M	B W M		B W M			B W M	B W M
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	B M	B M	B M		B M				M
Indigo Bunting	*Passerina cyanea*	B M	B M	B M		B M			M	
Dickcissel	*Spiza Americana*				B M				B M	
Towhees & Sparrows	**Emberizidae**									
Chipping Sparrow	*Spizella passerina*	B M		M	M	B M				B M
Field Sparrow	*Spizella pusilla*			B W M	B W M	B W M	W M		B M	
Lark Sparrow	*Chondestes grammacus*			B M	B M				B M	
Grasshopper Sparrow	*Ammodramus savannarum*				B M					
Song Sparrow	*Melospiza melodia*			B W M	B W M		B W M		B W M	B W M
White-crowned Sparrow	*Zonotrichia leucophrys*			W M	W M					W M
Blackbirds & Orioles	**Icteridae**									
Bobolink	*Dolichonyx oryzivorus*				M		M			
Red-winged Blackbird	*Agelaius phoeniceus*	W	W	B M	B W M	B M	B M		B W M	B M
Eastern Meadowlark	*Sturnella magna*				B W M				B W M	
Common Grackle	*Quiscalus quiscula*	B W M	B W M			M	B		W M	B W M
Brown-headed Cowbird	*Molothrus ater*	B W M	B W M	B M	B M	B M	B M		B W M	B W M
Baltimore Oriole	*Icterus galbula*	B M	B M	B M		B M				B M

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Finches	**Fringillidae**									
House Finch (I)	*Carpodacus mexicanus*	M	M	B W M		M				B W M
American Goldfinch	*Carduelis tristis*	W M	W M	B W M	B W M	W M				B W M
Old World Sparrows	**Passeridae**									
House Sparrow (I)	*Passer domesticus*								B W M	B W M
Eurasian Tree Sparrow (I)	*Passer montanus*			B W M					B W M	B W M
NUMBER OF SPECIES PER HABITAT TYPE		57	60	51	38	60	51	35	38	62

(1) This TABLE is a shortened version of TABLE found in Appendix B. Species considered to regularly occur in the Project area are taken from IDNR (1998d) and Parker (1981).
(2) Bold type indicates Illinois threatened (ST), Illinois endangered (SE), and/or federally endangered (FE) species.
(3) (I) = Introduced species
(4) Habitats assignments taken from IDNR (1998b); the following habitat codes are used:
UpFor = Upland and mesic forest
ForWet = Forested wetland, including wet floodplain forest and forested swamps)
Shrub = Shrublands (open habitats dominated by shrubs, inclluding old hayfields)
Grass = Grasslands (including pasture and hayfield)
Sav = Savanna
HeWet = Wetlands (seasonally flooded, open habitats such as marshes and sedge meadows)
Water = Lakes, ponds, impoundments, rivers, larger streams
Crop = Crops
Cult = Residential areas (including urban centers and the "urban forest")
(5) Breeding status taken from IDNR (1998b); the following codes are used:
B = Breeding (species that currently or historically have bred in the area)
W = Winter (species present from December through February)
M = Migrant (species present during the March-May and late August-November periods)

3.12.5.6 Mammals. As shown in Table 3-40, there are 41 mammal species that occur or are likely to occur in the Project area. The most diverse groups include the shrews and moles, bats, rodents, and carnivores. The remaining groups of mammals are represented by single species of opossum, rabbit, and deer. Twenty-five of the species have documented occurrences in the Project area. Two species of bats are federally protected, and are discussed in Appendix B in Annex B.14. Two species are not native – the Norway rat and house mouse.

Mammals are found in all habitats of the Project area. Many species inhabit forest, including both upland forests as well as floodplain forests. Most species use a variety of habitats. About half use forests and prairies as well as nonwoody wetlands, such as marshes. Only two species are restricted to prairies and grasslands. Mammals found in cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, are rather diverse. Stray cats and dogs could be added to the 15 species of mammals that inhabit cultural areas.

Since settlement, a number of species have been extirpated from Illinois or on a regional basis within the state. Most of them are carnivores, and/or they require large home ranges. They include the black bear (*Ursus americanus*), badger (*Taxidea taxus*), river otter (*Lutra canadensis*), gray fox (*Urocyon cinereoargenteus*), timber wolf (*Canis lupus*), cougar (*Felis concolor*), bobcat (*Lynx rufus*), elk (*Cervus elaphus*), and bison (*Bison bison*). Franklin's ground squirrel (*Spermophilus franklinii*) may be another example of a locally extinct species. Four of these species deserve mention because they are assumed not to be present within the Project area. Extensive tracts of forest required by the gray fox (Hoffmeister 1989) are not present in the Project area. The badger is not included only because it is apparently uncommon, and there are relatively few records of its occurrence in southwestern Illinois (Hoffmeister 1989). Relatively high levels of human disturbance and impaired water quality in much of the Project area presumably deter the river otter, a state endangered species (IDNR 1998d). However, individuals released not far away by otter reintroduction programs in Illinois or Missouri (or their offspring) may disperse into the Project area, and Horseshoe Lake is considered to be habitat (IDNR 1998d). Human disturbance and forest fragmentation are assumed to deter the bobcat (a state-threatened species), although an individual was killed in Collinsville in 1982, and trappers reported earlier sightings in Madison County (IDNR 1998d).

A number of management recommendations for mammals were provided by IDNR (1998d) in its "Sinkhole Plain Area Assessment" that addresses the Project area as well as a larger contiguous area to the south. First, upland and floodplain forests should be preserved for species dependent on forest, such as the Indiana bat, bobcat, and gray fox. Secondly, riparian forests, or those forests occurring along streams and other waterways, should be preserved and restored to benefit mammals using them, such as the river otter. Thirdly, pollutants such as silt and chemicals that enter aquatic habitats and wetlands as runoff should be reduced to benefit species using these areas, such as the river otter and mink. And, lastly, existing remnant prairies should be preserved along with other grasslands, and prairie restorations should be created to benefit grassland species like the badger and red fox. Restoration of hill prairies by removing encroaching woody vegetation would also benefit grassland small mammals.

Table 3-40 Mammal species that occur or are likely to occur in the Project area (1).

Name (2, 3)			**Habitat (4)**							**Relative Abundance (5)**
Common name	**Order/*Species name***		**For**	**Pra**	**Wet**	**Cre**	**Lake**	**Cave**	**Cult**	
Opossums	**Didelphimorphia**									
Virginia opossum	*Didelphis virginiana*	*	X	X	X	X (e)			X (b)	C
Shrews and Moles	**Insectivora**									
Southeastern shrew	*Sorex longirostris*		X	X	X					C
Northern short-tailed shrew	*Blarina brevicauda*	*	X	X	X					C
Southern short-tailed shrew	*Blarina carolinensis*	*	X	X	X					C
Least shrew	*Cryptotis parva*	*		X						C
Eastern mole	*Scalopus aquaticus*	*	X	X					X	C
Bats	**Chiroptera**									
Little brown bat	*Myotis lucifugus*	*	X			X	X	X	X (b)	C

Table 3-40 Mammal species that occur or are likely to occur in the Project area (1).

Name (2, 3)			Habitat (4)							Relative Abundance (5)
Common name	***Order/Species name***		**For**	**Pra**	**Wet**	**Cre**	**Lake**	**Cave**	**Cult**	
Indiana bat (SE, FE)	***Myotis sodalis (SE, FE)***		**X**			**X**	**X**	**X**		**R**
Gray bat (SE, FE)	***Myotis grisescens (SE, FE)***		**X**			**X**	**X**	**X**		**U**
Northern long-eared bat	*Myotis septentrionalis*	*	X			X	X	X	X (b)	U
Silver-haired bat	*Lasionycteris noctivagans*		X			X	X	X	X	C
Eastern pipistrelle	*Pipistrellus subflavus*		X			X	X	X	X	C
Big brown bat	*Eptesicus fuscus*		X			X	X	X	X (b)	C
Red bat	*Lasiurus borealis*	*	X			X	X			C
Hoary bat	*Lasiurus cinereus*	*	X			X	X			U
Evening bat	*Nycticeius humeralis*		X			X	X		X	U
Rabbits	**Lagomorpha**									
Eastern cottontail	*Sylvilagus floridanus*	*	X (e)	X					X	C
Rodents	**Rodentia**									
Eastern chipmunk	*Tamias striatus*	*	X							C
Woodchuck	*Marmota monax*	*	X (e)	X						C
Gray squirrel	*Sciurus carolinensis*	*	X						X	C
Fox squirrel	*Sciurus niger*	*	X						X	C
Southern flying squirrel	*Glaucomys volans*		X							C
Plains pocket gopher	*Geomys bursarius*	*		X						C?
Beaver	*Castor canadensis*	*			X	X	X			C
Deer mouse	*Peromyscus maniculatus*	*		X						C?
White-footed mouse	*Peromyscus leucopus*	*	X	X	X (mf)					C
Prairie vole	*Microtus ochrogaster*	*		X					X	C
Woodland vole	*Microtus pinetorum*	*	X							U
Muskrat	*Ondatra zibethicus*	*			X	X	X			C
Southern bog lemming	*Synaptomys cooperi*			X	X					U?
Norway rat (I)	*Rattus norvegicus*	*							X (b)	C
House mouse (I)	*Mus musculus*	*							X (b)	C
Meadow jumping mouse	*Zapus hudsonius*		X	X	X					U?
Carnivores	**Carnivora**									
Coyote	*Canis latrans*		X	X	X					C
Red fox	*Vulpes vulpes*		X	X	X					C
Raccoon	*Procyon lotor*	*	X	X	X				X (b)	C
Long-tailed weasel	*Mustela frenata*		X	X	X					C
Mink	*Mustela vison*		X		X	X	X			C
Striped skunk	*Mephitis mephitis*		X	X	X					C
Even-toed Ungulates	**Artiodactyla**									
White-tailed deer	*Odocoileus virginianus*	*	X	X	X					C
NUMBER OF SPECIES PER HABITAT TYPE			31	20	16	14	13	7	15	

Table 3-40 Continued

(1) Known species indicated by "" in middle column, and are based on Parker (1973, 1974, 1981) and Hoffmeister (1989); likely species are based on Hoffmeister (1989) and IDNR (1998d).*
(2) Bold emphasis denotes federally endangered (FE), state endagered (SE) species.
(3) (I) indicates introduced species.
(4) Taxonomy and nomenclature follow Wilson and Reeder (1993). The following habitat codes are used:
For = Forest (wetland and nonwetland)
Pra = Prairie, grassland
Wet = Wetland (not forested)
Cre = Creeks and rivers
Lake = Lakes, ponds, and impoundments
Cave = Caves
Cult = Cultural
Habitat use taken from IDNR (1998d) and Hoffmeister (1989). The following habitat use codes are used:
e = edge
b = buildings
mf = mostly forested
(5) Relative abundance taken from IDNR (1998d). The following relative abundance codes are used:
C = Common
U = Uncommon
R = Rare

3.13 ENDANGERED AND THREATENED SPECIES

This section lists the federally and state-listed endangered and threatened species that may occur within the Project area. Ten federally-listed species are included, as are 47 state-listed species, which include the federally-listed species (Table 3-41). Details concerning the probable occurrence of individual species in the Project area are provided in a biological assessment included in Appendix B in Annex B.14.

The potential presence of such species was determined through consultations with the U.S. Fish and Wildlife Service (USFWS), the Illinois Department of Natural Resources (IDNR) with its Natural Heritage Database, and Corps biologists. Information was also obtained from review of prior reports and publications, and from a field survey conducted for this Project.

In 1998, a survey for federally- and state-listed species was conducted in a portion of the Project area (ZE 1998). Two floodplain sites, Brushy (Levy) Lake and Frank Holten State Park, were assessed for use by listed species. Brushy (Levy) Lake lies about one mile east of Horseshoe Lake in the center of the Project area, between I-255, I-55/70, and Cahokia Canal. Holten State Park, about four miles south of Brushy (Levy) Lake, is in the southern part of the Project area. The survey identified any known historic use, actual use during site visits in the fall of 1998, and potential use by listed species in these areas.

3.13.1 Federally-Listed Species. Under the Endangered Species Act of 1973, federal agencies are required to conserve biological and wildlife species that have been federally listed as endangered or threatened. A species is endangered if it is in danger of extinction throughout all or a significant portion of its range, and threatened if it is likely to become endangered within the foreseeable future. All federal agencies must consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that any actions authorized, funded, or carried out by the agencies are not likely to jeopardize the continued existence of any endangered or threatened species, or to result in the destruction of or substantial damage to its critical habitat. While this consultation is in progress, an agency must not make an irretrievable commitment of resources to its project.

In connection with this East St. Louis and Vicinity, Illinois Project, consultation with the USFWS is required to ensure thorough consideration of potential effects on endangered and threatened species. There may be opportunities for the Corps to restore or protect habitat for threatened and endangered species, or to contribute to endangered species recovery plans, as part of ecosystem restoration projects and initiatives.

The U. S. Fish and Wildlife Service identified eight federally-listed species, and one species of concern (Table 3-41), that may be present in the Project area in a letter dated March 10, 1999 (see Appendix G). The piping plover (*Charadrius melodus*) has been added to this list by the Corps because it has been recently sighted within the Project area.

In its letter, the USFWS indicated that no designated critical habitat exists within the Project area for any of these species. Similarly, there is no designated critical habitat for the piping plover or massasauga. The potential or documented occurrences of federally-listed species in the Project area are discussed in a biological assessment included in Appendix B. In Illinois, all these federally-listed species are also state-listed species, including the massasauga.

3.13.2 State-Listed Species. The 1999 letter from USFWS requested that a list of state-listed species be obtained from IDNR for this Project. IDNR forwarded information about state-listed species in a letter dated May 3, 2000, accompanied by a map of the Project area. State-endangered and state-threatened species that may occur in the Project area are included in Table 3-41.

This list was developed from the information submitted by IDNR, and from lists of plants, amphibians and reptiles, fishes, birds, and mammals that are likely to occur in the Project area (see Appendix B). The potential or documented occurrences of state-endangered species in the Project area are discussed in a biological assessment included in Appendix B.

Table 3-41 Threatened and endangered species occurring or likely to occur in the Project area. E = endangered, T = threatened, C = federal species of concern.

Common Name	Scientific Name	Listing Status	
		State	Federal
Plants			
Pale false foxglove	*Agalinis skinneriana*	T	
Decurrent false aster	*Boltonia decurrens*	T	T
Small burhead	*Echinodorus tenellus*	E	
Mud plantain	*Heteranthera reniformis*	E	
Bead grass	*Paspalum dissectum*	E	
Eastern prairie fringed orchid	*Platanthera leucophaea*	E	T
Royal catchfly	*Silene regia*	E	
Spring ladies' tresses	*Spiranthes vernalis*	E	
Prairie spiderwort	*Tradescantia bracteata*	T	
Freshwater Crustacean			
Illinois cave amphipod	*Gammarus acherondytes*	E	E
Fish			
Pallid sturgeon	*Scaphirhynchus albus*	E	E
Sturgeon chub	*Macrhybopsis gelida*	E	
Flathead chub	*Platygobio gracilis*	E	
Amphibians			
Illinois chorus frog	*Pseudacris streckeri illinoensis*	T	
Reptiles			
Timber rattlesnake	*Crotalus horridus*	T	
Great Plains rat snake	*Elaphe guttata emoryi*	T	
Massasauga rattlesnake	*Sistrurus catenatus*	E	C
Flathead snake	*Tantilla gracilis*	T	
Birds			
Pied-billed Grebe	*Podilymbus podiceps*	T	
American Bittern	*Botaurus lentiginosus*	E	
Least Bittern	*Ixobrychus exilis*	T	
Snowy Egret	*Egretta thula*	E	
Little Blue Heron	*Egretta caerulea*	E	
Black-crowned Night-heron	*Nycticorax nycticorax*	E	

Table 3-41 Continued

Common Name	Scientific Name	Listing Status	
		State	Federal
Yellow-crowned Night-heron	*Nyctanassa violaceus*	E	
Osprey	*Pandion haliaetus*	E	
Mississippi Kite	*Ictina mississippiensis*	E	
Bald Eagle	*Haliaeetus leucocephalus*	T	T
Northern Harrier	*Circus cyaneus*	E	
Red-shouldered Hawk	*Buteo lineatus*	T	
Peregrine Falcon	*Falco peregrinus*	E	
King Rail	*Rallus elegans*	E	
Common Moorhen	*Gallinula chloropus*	T	
Piping Plover	*Charadrius melodus*	E	E
Upland Sandpiper	*Bartramia longicauda*	E	
Wilson's Phalarope	*Phalaropus tricolor*	E	
Common Tern	*Sterna hirundo*	E	
Forster's Tern	*Sterna forsteri*	E	
Least Tern	*Sterna antillarum*	E	E
Black Tern	*Chlidonias niger*	E	
Short-eared Owl	*Asio flammeus*	E	
Brown Creeper	*Certhia americana*	T	
Veery	*Catharus fuscescens*	T	
Loggerhead Shrike	*Lanius ludovicianus*	T	
Henslow's Sparrow	*Ammodramus henslowii*	E	
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	E	
Mammals			
Gray bat	*Myotis grisescens*	E	E
Indiana bat	*Myotis sodalis*	E	E

3.14 CULTURAL RESOURCES

The American Bottom portion of the Project area is arguably the richest, most complex, archaeological region in all of North America. Native American occupation of the Project area began at least 12,000 years ago and continued up until the early nineteenth century when the last groups of Native Americans were displaced from the area by ever-increasing numbers of Euro-American settlers.

The crown jewel of this archaeological legacy is the Cahokia Mounds World Heritage Site, located near the center of the Project area. Eight centuries ago this site covered 5 square miles of the Mississippi River floodplain and was, in turn, surrounded by hundreds of supporting communities. These settlements ranged in size from large towns and villages to individual farmsteads. Research suggests that these settlements were strategically located to garner maximum productivity from the regions bountiful, ecologically diverse, natural resources. Even today, more than six centuries after the last of these prehistoric residents of the Central Mississippi River valley mysteriously abandoned the area, fragments of their discarded tools are commonly observed throughout the Project area by the trained eye of archaeologists.

Unfortunately, the cultural value of these prehistoric remains were not well protected until well into the twentieth century. By then, the remains of many of these sites had been significantly damaged, or destroyed. As metropolitan areas continue to encroach onto the American Bottom portion of the project area, those archaeological remains not in public ownership / protection are increasingly vulnerable to commercial and residential development. Such development has already claimed all, or substantial portions of, three of the largest prehistoric Mississippian Temple Mound centers within the project area. These include the East St. Louis Mound Group, the Mitchell Mound Group, and the Lohman Mound and Village site.

The preponderance of professional archaeological investigations conducted within the project area during the late twentieth century were administered by the Illinois Department of Transportation. For the most part these investigations were associated with interstate highway construction - the largest of those being Interstate 255. The right-of-way for this highway traverses the entire length of the American Bottom portion of the East St. Louis Ecosystem Restoration Project area. Scores of archaeological remains, some deeply buried and dating back more than 4000 years, were identified and excavated in advance of construction related to that project.

Unfortunately, only a small portion of the American Bottom has been systematically surveyed for the presence of archaeological remains. Therefore, it is impossible to reliably estimate the number of archaeological sites that have been lost as a result of commercial and residential development. However, it is safe to assume that the number is large. The scientific value (and corresponding loss to the Nation) of the information once contained in these destroyed archaeological sites is incalculable. Present-day land use within the areas being considered for potential ecosystem restoration includes agricultural fields, former residential and commercial tracts, lakes / sloughs, and public land. The preservation and enhancement of significant archaeological remains within these contexts is a priority of this Project.

3.15 OUTDOOR RECREATIONAL RESOURCES

Special districts and municipal recreation departments provide the majority of close-to-home outdoor recreational opportunities in the state. Local districts provide outdoor recreation sites, facilities, and programs that are nearby and convenient. In addition to providing parkland, facilities, and programs, districts are now providing day care services, senior centers, and other services and programs to accommodate changing public needs.

The voters of Madison and St. Clair Counties approved a metropolitan park and recreation district in November of 2000. The objectives of this park district, which will be supported by tax revenues, are: to preserve natural lands adjacent to waterways to filter pollutants and protect wildlife habitat; to provide safe places for families and children to play by repairing worn equipment and improving maintenance in existing parks; to create trails and paths for walking, biking and other compatible uses; to create new parks in newer communities; and, to provide expanded disabled and public access to recreational areas.

Within the Project area, the State of Illinois owns and maintains Horseshoe Lake State Recreation Area, Cahokia Mounds State Historic and World Heritage Site, Frank Holten State Park. The two parks are managed for both recreational activities and as wildlife management areas. Horseshoe Lake provides seasonal duck hunting opportunities within sight of the Arch. While there are fishing opportunities, they are limited for consumption purposes because of existing contamination. Likewise, the interior drainage canal and borrow sites along the I-55/I-70 highway route provide informal fishing opportunities. Frank Holten provides a more urban recreational experience with the inclusion of an 18-hole golf course while Horseshoe Lake provides both primitive and supported overnight campsite facilities. Within the local communities there are small city parks as well as school and neighborhood recreational areas that support those living in the immediate vicinity with basic recreational facilities. The Southern Illinois University at Edwardsville campus provides a first class soccer facility and ball fields that are used locally and regionally.

3.15.1 Local Focus. The recent focus on urban sprawl has brought to the forefront concerns over a loss of green and open space in the developing areas. This has brought together a coalition of public and private groups working in concert with state and local agencies looking for opportunities to obtain and protect areas for their recreation and wildlife habitat value. The Confluence Greenway Partnership has brought credibility to the notion that multiple agencies can work cooperatively to make a regional concept a reality. Additionally, this partnership has paved the way to demonstrate how recreation benefits can be realized along with the preservation and enhancement of wildlife areas that provide their own inherent benefits to the regional recreational setting. These concepts are being replicated in both the floodplain and the bluff communities. The Project area's physical setting, location and colorful history provide a wide array of potential scenic and cultural attractions to benefit residents of the region as well as tourists from outside the region. The steep, forested bluffs rise upward from the Mississippi River and its flood plain and provide many miles of scenic vistas with the potential for connectivity within the Project area and to other regionally developed/developing recreational opportunities.

Surveys conducted by Trail Net in the region indicate that about half the population will visit a trail system for walking, hiking, jogging, in-line skating and biking. Annual regional visits could number as many as 10 million. Currently, existing features are limited but there are many opportunities in neighboring areas across the region. (Tables 3-42 and 3-43).

Table 3-42 Existing Trails in the Project Area

Existing Trails	County	Sponsor	Length/Surfaced	Links
Delyte-Morris	Madison	SIUE/Edwardsville	5 miles paved	MCT Trail, Glen Carbon Trail,
Glen Carbon Heritage Trail	Madison	City of Glen Carbon	3.2 ,miles paved	Delyte-Morris,
MCT (Vadalabene Nature Trail)	Madison	MCT	8 miles paved	Delyte-Morris Trail,
Vadalabene River Road Trail Confluence Bikeway	Madison, Jersey	IDOT	14.5 miles paved	Pere Marquette St. Park, Alton Bike Trail, Clark Bridge, Katy Trail, American Discovery Trail

Table 3-43 Existing trails in the Metro East area but outside the Project Area

Existing Trails	County	Sponsor	Length/Surfaced	Links
Lewis and Clark National Historic Trail (Millenium Trail)	Madison Co. (Wood River) to Les Shirley Park Oregon		3,700 miles	Confluence Greenway
Mississippi River Trail	St. Louis To New Orleans (Routing complete from Modoc, IL south)	Mississippi River Cycling and Hiking Corridor	1,200 miles	
American Discovery Trail (a segment of Confluence Greenway and a National Millennium Trail)	St. Louis MO to New Haven, IL via the River to River trail		6,350 miles, 6 national trails, 10 national historic trails, 23 national recreation trails, 14 national parks, 16 national forests	Confluence Greenway Cahokia, Monroe Co, Randolph Co., Fort de Chartes, Fort Kaskaskia Historic Site
Bicentennial Transamerica	Randolph Co.		4,500	ADT, Kaskaskia

3.15.2 Greenways/Trails. Greenways offer opportunities to creatively preserve open space in rapidly developing areas, protect important natural resources such as wetlands and wildlife corridors, and provide opportunities for outdoor activities such as bicycling and walking. Greenways and trails have been one of the top public concerns identified through the SCORP Public Participation program for years. Southwestern Illinois offers tremendous greenway opportunities.

Table 3-44 Existing Greenways

	Existing Greenways	County
1	American Discovery Trail	St. Clair and Monroe
2	Delyte Morris Bikeway/Greenway	Madison
3	Glen Carbon Heritage Greenway	Madison
4	Lewis and Clark National Historic Trail	Madison
5	Valdalabene Bikeway (River Road Bikeway) Trail Greenway	Madison
1	Bluff Greenway and Trail	St. Clair and Monroe
2	Mississippi Levee Greenway and Trail	St. Clair and Monroe
3	Schoolhouse Trail Greenway	Madison

3.16 AESTHETICS

The Project area's aesthetic (visual) characteristics run the gamut from less attractive, heavily urbanized/heavy industrial sites to natural areas with pristine-like qualities. The landscape is a smorgasboard of visual stimuli, including upland and bottomland forests, lakes, rivers, canals, marshes, ponds, small and large cities, farmland, and parks. The topographic features include remarkably flat expanses of bottomlands as well as bluff areas in the uplands. Man-made features abound in the form of flood control structures, interstates, highways, roads, utility structures, communication facilities, buildings, signs, billboards, and many other things normally associated with a heavily urbanized area. Unique to this area is the ancient man-made Cahokia Mounds World Heritage Site, and Monks Mound, its primary feature, can be seen from a distance. Also prominent is the highly visible St. Louis Gateway Arch located just across the Mississippi River.

3.17 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

Over 80 hazardous waste sites have been identified in the vicinity of the Project area through the Superfund program. Many of the sites are related to former industrial or landfill operations. These sites fall into four Superfund categories. First, there are 29 CERCLIS sites at which clean up is being considered, and they are listed in the U.S. EPA's Comprehensive Environmental Response, Compensation, and Liability Information System (USEPA 2002a). Second, two sites are on EPA's National Priorities List (USEPA 2002b), and involve long-term remedial response actions. Third, two sites have been proposed for inclusion on the NPL (USEPA 2002c). Lastly, 49 sites have been archived (USEPA 2002d). Archived sites include those for which an assessment has been completed and EPA has determined no steps will be taken to designate the site as a priority by listing it on the NPL, and no further remedial action is planned under the Superfund Program.

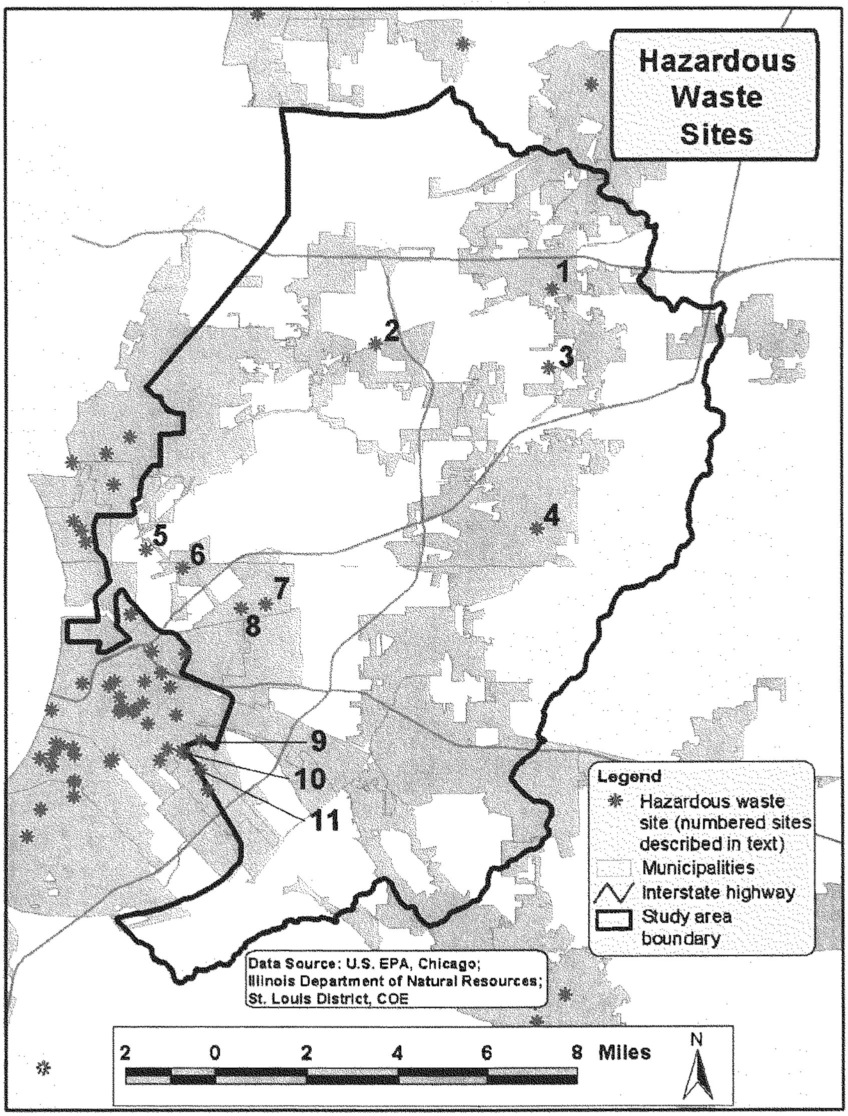
Thirteen hazardous waste sites occur within the Project area (Table 3-45). Of these, six occur in Madison County and seven in St. Clair County. Nine are CERCLIS sites, and four are archived sites. None of the sites in the Project area are NPL sites or proposed for listing on the NPL.

Figure 3-16 shows the location of hazardous waste sites in the Project area and vicinity. Most sites are outside the Project area to the southwest, in the vicinity of East St. Louis and Sauget. The location of these sites has been taken from information maintained by the EPA, and generally represents the business or street address of the site.

Table 3-45 Hazardous waste sites in the Project area.

SITE	EPA ID NO.	NAME	ADDRESS	CITY	COUNTY	STATUS
1	ILD984791665	KETTLE RIVER CREOSOLE WORKS	CENTER GROVE & COUGAR ROADS	GLEN CARBON	MADISON	Cerclis
2	ILD980606925	ILLINOIS PWR CO STALLINGS GAS TURBINE	ST HWY 162	STALLINGS	MADISON	Archived
3	ILD982070799	KOSYAK HORSE ARENA	WEST OF MARYVILLE	MARYVILLE	MADISON	Archived
4	ILD981528409	CENTRAL STATES BATTERY	6349 COLLINSVILLE RD	COLLINSVILLE	MADISON	Archived
4	ILD980677819	COLLINSVILLE/KEEL	ADDRESS UNREPORTED	COLLINSVILLE	MADISON	Cerclis
4	ILD980607006	ST. LOUIS SMELTING & REFINING CO.	CUBA LN	COLLINSVILLE	MADISON	Cerclis
5	ILN000508136	SAINT LOUIS AUTO SHREDDING DRUM DISPOSAL	INTERSECTION BEND ROAD & STATE HIGHWAY 203	MADISON CITY	ST CLAIR	Cerclis
6	ILT180014961	SCA MILAM LDFL	I-55 & RTE 203	EAST ST LOUIS	ST CLAIR	Cerclis
7	ILD059995423	SWIFT AG CHEM FAIRMONT CITY PLT	2501 NORHT KINGS HIGHWAY	FAIRMONT CITY	ST CLAIR	Cerclis
8	IL0000034355	OLD AMERICAN ZINC PLANT	JCT OF 45TH ST & COOKSON RD	FAIRMONT CITY	ST CLAIR	Cerclis
9	ILSFN0508010	ALCOA PROPERTIES	3000 E. MISSOURI AVENUE	EAST ST. LOUIS	ST CLAIR	Cerclis
10	ILD077117992	UNITED STEEL DRUM INCORPORTED	3105 MISSOURI AVENUE (HWY 15)	EAST ST LOUIS	ST CLAIR	Archived
11	IL0000146977	CHILDS PROPERTY	3607 E. MISSOURI AVE.	ALERTON	ST CLAIR	Cerclis

Figure 3-16 Project Area - Hazardous Waste Sites



3.18 SUMMARY

Urbanization has had a profound impact on the Project area since pre-development days. The ecosystem has been significantly disturbed and the Project area's flooding patterns, which historically helped create, develop, and sustain habitat quality, have been significantly altered in order to minimize agricultural and structural damages. Increased runoff and peak flows in the tributary streams has begun the process of stream bank erosion and destabilization, which if untreated will continue to degrade stream resources while sending increased levels of sediment to the floodplain. These factors and their secondary effects combined have created an ecosystem in need of attention and restoration.

The identification and evaluation of the Project area's existing conditions prepares the foundation for a look into the future under a couple of scenarios: first, the future assuming that there will be no project emanating from this study effort (future without project condition); and, secondly, the future as it is expected to look with a recommended plan implemented (future with project condition). The next Section discusses the future without project condition.

SECTION 4 - FUTURE WITHOUT PROJECT CONDITIONS

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SECTION 4 - FUTURE WITHOUT PROJECT CONDITION

This section of the report provides a definition of what is meant by the future without project condition and how and why it is developed. In the context of this Project, the term "plan" refers to the potential modifications and additions to the existing East St. Louis project, and not to the existing project or its components.

4.1 FUTURE WITH AND WITHOUT PROJECT COMPARISONS

The U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G, 1983) provide the policies and procedures for conducting Federal water resource planning studies. One requirement of the P&G is to evaluate the effects of alternative plans by comparing the most likely future conditions in the Project area with and without implementation of each plan. In order to make this comparison, forecasts of future conditions must be made for both with-project and without-project conditions.

The future without project condition describes the characteristics expected to occur in the Project area if none of the alternative plans are implemented. The without-project condition is also referred to as the "no action plan". The Federal regulations implementing the National Environmental Policy Act of 1969 also require that the no action plan be considered as an alternative in assessing the potential effects of all Federal actions.

Future with-project conditions describe what is expected to occur as a result of implementing each alternative plan that is being considered in a Federal water resources study. With-project future conditions are developed for each alternative plan.

The differences between the without-project conditions (i.e., the no action alternative) and the with-project conditions expected to occur with implementation of each "action" alternative are the effects, or impacts, associated with each plan. The formulation of alternative plans is described in Section 6. The evaluation of the environmental effects of the recommended plan is described in Section 7.

4.2 PLANNING HORIZON

The planning horizon encompasses the period of time beginning with the initiation of the Project, through the construction period, the environmental analysis period, and the expected useful life of the project. The environmental analysis period, also known as the period of analysis, is the period of time used to assess both the positive and potential negative effects of a project. The period of analysis does not usually extend to the end of the planning horizon, because many projects (e.g., levee systems) may last more than 100 years. Projecting future conditions over a time period this large is highly speculative. Therefore, the period of analysis used to assess the impacts of water resources projects is typically limited to no more than 50 years, or the duration of significant effects (whichever is shorter). A 50-year period of analysis has been selected for this Project.

4.3 CLIMATE AND WEATHER

No significant climatological changes are expected to occur over the 50-year planning period used for this Project.

4.4 ECOLOGICAL AND NATURAL RESOURCES

This section describes future natural resources and ecological conditions in the Project area if no action is implemented as a result of this Project. A 50-year period of analysis has been used in the forecast of future conditions.

The Project team regarded many future environmental changes to consist of trends representing a continuation of existing ecological problems. There was a need to express natural resource trends in a quantified fashion so that quantitative habitat evaluation methods required for the study could be employed to make comparisons between future without-project and future with-project conditions. Appendix A describes the two methods used in this Project to quantify resource conditions: the Habitat Evaluation Procedures and the Expert HydroGeoMorphic Approach. Because no previous studies were found which quantified environmental trends in the Project area, the Project team developed quantitative trends using the best available information. As a result, natural resource trends presented in this section are the result of the interagency biology team's best professional judgment.

4.4.1 Ecological Resources.

4.4.1.1 Forest. The amount of forest in the Project area has declined significantly since presettlement times. This trend is expected to continue. Given the projections for greater population growth in the Bluff Corridor, the rate of forest loss in tributary watersheds is expected to substantially exceed that on the floodplain in the American Bottom Corridor.

4.4.1.1.1 Forest in Tributary Watersheds. Future rates of upland forest loss are expected to vary by major watershed. Table 4-1 displays expected forest loss in the four major tributary watersheds at selected future points in time. These rates do not reflect any future implementation of tree preservation or "green space" requirements on development by local government as no formula has been established by planning entities within the Project area. The two central watersheds, Cahokia and Harding, are expected to show considerably greater rates of loss than the two peripheral watersheds to the north and south. Most existing upland development is concentrated in the Cahokia watershed (which supports the municipalities of Glen Carbon, Troy, Maryville, and Collinsville) and the Harding watershed (supporting Caseyville, Belleville, Fairview Heights). Outward expansion of residential and commercial developments into adjacent agricultural and forested areas is expected to lead to a reduction of about 75 to 80 percent of all forest in these watersheds (Table 4-1). Remaining forest is expected to be concentrated on the steepest slopes of upland ravines and along narrow creek bottoms. To the north and south, forest losses in the County Ditch and Powdermill watersheds are anticipated to be no more than half that of the central watersheds. Between these two small watersheds, Powdermill is expected to exhibit greater forest losses because land ownership there is mainly private, whereas public lands at Southern Illinois University at Edwardsville comprise a substantial portion of County Ditch watershed.

Table 4-1 Expected Rates of Forest Loss in the Four Major Tributary Watersheds.

Watershed	Future Cumulative Loss (percent) by Year		
	2010	2020	2050
County Ditch	5	10	20
Cahokia	25	50	75
Harding	10	30	80
Powdermill	5	20	40

Using the rates of forest loss in Table 4-1, and the amount of upland forest identified in the Illinois Land Cover Database (ILCD) of the early 1990s (about 19,600 acres), the projected total loss of forest over the next 50 years is 14,000 acres. This total loss is equivalent to an average annual loss of about 280 acres across all tributary watersheds, or about 3.6 acres per square mile per year.

4.4.1.1.2 Ecological Problems of Forest in Tributary Watersheds. Upland forests in the Project area are expected to exhibit further loss of ecological integrity due to additional fragmentation, habitat degradation, and introduction of exotic species.

4.4.1.1.3 Wildlife Habitat of Forest in Tributary Watersheds. Wildlife species diversity in shrinking areas of upland forest is expected to decrease and remaining species are expected to consist mainly of those adapted to human disturbances and suburban/urban conditions. Compared to mammals, reptiles and amphibians, the decline in bird species diversity is expected to be high, especially among breeding species.

To evaluate future quality of forest in tributary watersheds as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the fox squirrel, mink, and wood duck. According to projections of future conditions, average habitat quality of forest is expected to decline below the 0.5 level for the fox squirrel, remain below 0.5 for the mink, and continue to be unsuitable for the wood duck (Table 4-2). Indices potentially range from 0 (no quality) to 1 (optimum quality). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-2 Projected changes in habitat quality of forest in tributary watersheds of the Project area, expressed as habitat suitability indices (average and range) for three evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Fox squirrel	**0.54**	0 - 0.62	0.33	**0 - 0.38**	-0.21
Mink	0.40	0 - 1	0.40	0 - 1	0.00
Wood duck	0.04	0 - 0.17	0.03	0 - 0.09	-0.01

4.4.1.1.4 Forest in the Bottoms. Rates of loss presented here for forested wetlands and forested nonwetlands in the bottoms do not reflect any future implementation of tree preservation or "green space" requirements on development by local government. The interagency biology team assumed that the rate of loss for forested wetlands in the bottoms over the 50-year project life would be 25 percent on privately owned lands and no loss on publicly owned lands. Further explanation for these expected losses is provided below in the section on wetlands. Assuming all forested wetland in the Project area occurs on private property (which is not the case, but establishes a "worst-case" scenario), total losses over the 50-year project life would be about 730 acres, based on Illinois Wetland Inventory data gathered from the mid-1980s. The average annual loss would be about 15 acres, or somewhat less if public forested wetlands were included.

For forested areas in the bottoms that do not occur in wetlands, the rate of loss was assumed to be 75 percent on private property and no loss on public lands. A higher rate of loss is expected in this kind of forest for two reasons. First, no federal program, such as Section 404, provides protection to this kind of forest, and secondly, development of drier sites supporting such forest would be expected to be more feasible than at wetter sites. Using ILCD land use data, total loss of forested nonwetland in the bottoms would be about 3,280 acres, or about 66 acres per year.

4.4.1.1.5 Ecological Problems of Forest in the Bottoms. Additional fragmentation and habitat degradation caused by sedimentation and introduction of exotic species are expected to lead to further loss of ecological integrity in bottomland forests. In addition, forested wetlands will continue to exhibit hydrological regimes that depart from natural conditions either because changes in hydrology have resulted in stabilized water levels, or timing of floods have shifted; either of which may depart too drastically from any natural cycle to permit an adapted forest community to remain or develop on a site (Klimas 1988).

4.4.1.1.6 Wildlife Habitat of Forest in the Bottoms. Wildlife species diversity of bottomland forests is expected to decline with decreasing area of forest. However, because most forested nonwetland is already extremely fragmented, this effect should be most noticeable in forested wetlands.

To evaluate future quality of bottomland forest as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the fox squirrel, mink, great blue heron, wood duck, and slider turtle. Nonwetland bottomland forest was treated separately from wetland bottomland forest. According to projections of future conditions, average habitat quality of bottomland forest is expected to be below 0.5 for all species (Table 4-3). Declines in quality are expected for three species, the most notable being the great blue heron. Quality remains unsuitable for the wood duck, and for the mink in nonwetland forests. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-3 Projected changes in habitat quality of bottomland forest in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Nonwetland bottomland forest					
Great blue heron	**0.52**	0 - 0.52	0.10	0 - 0.1	-0.43
Fox squirrel	0.33	0 - 0.33	0.42	0 - 0.42	0.09
Mink	0.00	0 - 0	0.00	0 - 0	0.00
Wood duck	0.01	0 - 0.01	0.03	0 - 0.03	0.02
Wetland bottomland forest					
Great blue heron	0.45	0 - 0.62	0.24	0 - 0.46	-0.21
Mink	0.29	0 - 1	0.20	0 - 0.55	-0.09
Slider turtle	0.23	0 - 0.46	0.12	0 - 0.24	-0.11
Wood duck	0.02	0 - 0.04	0.03	0 - 0.06	0.01

4.4.1.2 Prairie. Prairies located on public lands were assumed to remain constant in area over the next 50 years. Those found on private lands would be reduced in extent by 75 percent due to development. Given that most prairies in the Project area are on public lands (and consist of restorations), the amount of prairie in the future is expected to remain relatively constant. There are no known plans for future restorations of prairie on public lands.

4.4.1.2.1 Ecological Problems of Prairie. The only known remnant prairie in the Project area is expected to experience further fragmentation. Continuing invasion by exotic species and habitat degradation related to railroad maintenance is expected. Unless additional plant species are added, most existing areas of prairie restorations will continue to show little floristic similarity to historic prairies because of their low native plant species diversity.

4.4.1.2.2 Wildlife Habitat of Prairie. Existing restorations will continue to be too small to attract many species of area sensitive grassland-adapted animals, including breeding birds. Although these areas of prairie may not decline in extent, anticipated development in their vicinity is expected to cause a small decline in diversity of species using them as habitat.

To evaluate future quality of prairie as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the eastern meadowlark. According to projections of future conditions, average habitat quality of restored prairie is expected to remain high for this bird (Table 4-4). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-4 Projected changes in habitat quality of prairie within the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Eastern meadowlark	**0.94**	0 - 0.94	**0.94**	0 - 0.94	0.00

4.4.1.3 Wetlands. Wetlands occurring on private lands are expected to decline in area by 25 percent over the 50-year project life whereas no loss is anticipated for those found in public areas. This assumption applies equally to all kinds of wetlands - forested wetlands, marshes, and scrub-shrub. Assuming existing wetlands in the Project area are represented by data from the Illinois Wetland Inventory of the mid 1980s, the amount of wetlands expected to be lost is about 1,850 acres, or about 37 acres per year. These data are overestimates because publicly owned wetlands are not included.

Wetland loss on private lands was assumed to occur even though two federal programs, Section 404 of the Clean Water Act and the "Swampbuster" provisions of the Food Security Act, offer wetlands protection. Expected losses would result from three sources: 1) future development in wetlands authorized under Section 404; 2) future agricultural conversions of wetlands by farmers that do not participate in agricultural subsidy programs administered by the U.S. Department of Agriculture; and, 3) future unauthorized development or farming activities in wetlands. Mitigation of wetland losses by wetland creation or restoration, often required as part of Section 404 authorizations, is not reflected in the assumed losses principally because of uncertainty about the location of future mitigation sites relative to the Project area.

4.4.1.3.1 Ecological Problems of Wetland. Continuing problems in marshes and scrub-shrub swamps include altered hydrologic regimes, addition of sediments and agricultural chemicals or urban runoff, encroachment by exotic plant species, and disturbance-tolerant native plant species dominating the local plant community. Continuing ecological problems associated with forested wetlands are discussed above and those associated with ponds are given below.

4.4.1.3.2 Wildlife Habitat of Wetland. Wildlife species diversity of marshes and scrub-shrub swamps is expected to decline to a small degree because of decreasing area of these habitats as well as increasing development surrounding wetlands.

To evaluate future quality of marshes and scrub-shrub wetlands as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the great blue heron, marsh wren, mink, slider turtle, and wood duck. According to projections of future conditions, average habitat quality of marsh and scrub-shrub wetlands is expected to decline for three of the five species, and be below 0.5 for three species (Table 4-5). The most notable decline in habitat quality is for the great blue heron. Quality remains unsuitable for the wood duck, and optimal for the mink. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-5 Projected changes in habitat quality of marshes and scrub-shrub wetlands in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Great blue heron	**0.66**	0 - 1	0.30	0 - 0.87	-0.36
Marsh wren	**0.62**	0 - 0.7	**0.59**	0 - 0.71	-0.03
Mink	**1.00**	0 - 1	**1.00**	0 - 1	0.00
Slider turtle	0.29	0 - 0.55	0.18	0 - 0.31	-0.11
Wood duck	0.00	0 - 0.02	0.01	0 - 0.02	0.01

4.4.1.3.3 Functional Capacity of Wetlands. Sources of hydrology driving existing wetland functions are not expected to change in the future. Overbank flooding from the Mississippi River will continue to be excluded from the Project area and overflow from tributary streams will remain confined to floodplain channels of the interior flood control system under normal circumstances. On occasions when storms in tributary watersheds overtop the floodplain flood control system, overflow into adjacent wetlands is expected to continue occurring in a random manner with respect to location and season. Consequently, flooding in wetlands historically adapted to riverine overflows is expected to continue to come primarily from direct rainfall and local runoff. Flood depths under these circumstances are not expected to exceed 1 to 2 feet, which is only a fraction of maximum historic flood depths. Flood duration is not expected to exceed current periods of inundation, which probably varies from several days to several weeks. In those cases of wetlands where ponded water is "land-locked" or semi-permanent, the future development of forest or marsh plant communities is not expected because of prolonged hydroperiods. Periodic flood pulses characteristic of historic conditions, in which water sweeps across wetlands, are expected to remain absent.

The interagency biology team assessed future capacity of three separate wetlands to perform various functions. The same procedures that were used to assess existing capacity were employed (Expert HydroGeoMorphic Approach and draft functional capacity index models).

For connected depressional wetland sites, slight increases in capacity for all functions are projected at Elm Slough, but at Brushy Lake, moderate declines are expected (Table 4-6). At the isolated depressional site, two of the three applicable functions show a slight to moderate increase in capacity, and the third exhibits a decline. Evaluation procedures for these wetlands and functions are discussed in detail in Appendix A.

Table 4-6 Projected changes in functional capacity of wetlands within three sites, expressed as functional capacity indices for seven wetland functions. Indices potentially range from 0 (no capacity) to 1 (optimum capacity); indices ≥ 0.5 shown in bold, negative changes in red, positive changes in blue. NA indicates not applicable.

Wetland Functions	Existing (TY0)	Future Without Project (TY51)	Net Change, TY51-TY0
Isolated depressional wetland - Dobrey Slough (disturbed marsh, forested and scrub-shrub wetland)			
Detain floodwater	NA	NA	NA
Store surface water	**0.86**	**0.76**	-0.10
Cycle nutrients	**0.58**	**0.83**	0.25
Export organic carbon	NA	NA	NA
Remove & sequester elements as compounds	NA	NA	NA
Maintain characteristic plant community	**0.55**	**0.60**	0.05
Maintain wildlife habitat	0.27	0.31	0.04
Connected depressional wetland - Elm Slough (only deep marsh and scrub-shrub wetland)			
Detain floodwater	**0.58**	**0.62**	0.04
Store surface water	NA	NA	NA
Cycle nutrients	**0.73**	**0.74**	0.01
Export organic carbon	0.48	**0.57**	0.09
Remove & sequester elements as compounds	**0.73**	**0.78**	0.05
Maintain characteristic plant community	**0.66**	**0.68**	0.02
Maintain wildlife habitat	**0.62**	**0.64**	0.02

Table 4-6 Continued

Wetland Functions	Existing (TY0)	Future Without Project (TY51)	Net Change, TY51-TY0
Connected depressional wetland - Brushy Lake (only shallow marsh within Levee Lake INAI site)			
Detain floodwater	**0.53**	0.35	-0.18
Store surface water	NA	NA	NA
Cycle nutrients	**0.68**	**0.68**	0.00
Export organic carbon	**0.58**	0.38	-0.20
Remove & sequester elements as compounds	**0.56**	0.38	-0.18
Maintain characteristic plant community	**0.66**	**0.66**	0.00
Maintain wildlife habitat	**0.75**	**0.59**	-0.16

4.4.1.4 Lake and Pond. Future development in the Project area was not assumed to affect lakes and ponds directly. However, lakes and ponds receiving regular inputs of stormwater from the interior flood control system were assumed to decrease in surface area by 1.5 percent every 10 years, or a total of 7.5 percent during the 50-year project life. Reduction in area was expected because of the accumulation of sediment carried by stormwater originating from tributary streams. Lakes and ponds remaining constant in area were assumed to be those that are relatively isolated from stormwater carried by the interior flood control system. Examples of waterbodies experiencing future losses in surface area include Horseshoe Lake and Grand Marais Lake (lake 3) at Frank Holten State Recreation Area. With this assumed rate of surface area loss, about 155 acres at these two lakes would be converted into wetland or terrestrial habitats.

4.4.1.4.1 Ecological Problems of Lake and Pond. Ongoing siltation and habitat degradation will continue to cause problems at lakes and ponds. Not only does siltation cause loss of surface area, but it also causes a gradual decrease in average water depth. Since many natural lakes are only several feet deep, decreasing water depths may at some point threaten fish populations during periods of drought when water levels are low. Local watersheds carrying runoff into lakes and ponds are expected to become less agricultural and more urbanized. Major pollutants in storm water are expected to shift from agricultural chemicals to transportation related pollutants such as oil, antifreeze, and gasoline.

An overall lack of natural aquatic and emergent plant growth in these water bodies, the presence of fish species such as carp that uproot such plants, summer algal blooms that can cause fish mortality, and a general lack of habitat structure are problems that will continue to affect lakes and ponds.

4.4.1.4.2 Wildlife Habitat of Lake and Pond. Expected reductions in surface area of some lakes and ponds and continuing ecological problems probably will lead to small reductions in diversity of animal species using these communities as habitat. Increasing urbanization surrounding lakes and ponds is anticipated to also contribute to this effect.

To evaluate future quality of lakes and ponds as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the great blue heron, mink, slider turtle, and white crappie. According to projections of future conditions, average habitat quality of lakes and ponds is expected to decline for the great blue heron and slider turtle, and fall below 0.5 for three of the four species (Table 4-7). Quality remains unsuitable for the white crappie. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-7 Projected changes in habitat quality of lakes and ponds within the Project area, expressed as habitat suitability indices (average and range) for four evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Great blue heron	**0.61**	0 - 0.71	0.41	0 - 0.58	-0.20
Mink	**0.74**	0 - 1	**0.84**	0 - 1	0.10
Slider turtle	0.44	0 - 0.78	0.40	0 - 0.69	-0.04
White crappie	0.00	0 - 0	0.00	0 - 0	0.00

4.4.1.5 Streams. The area or extent of floodplain streams has been assumed to remain constant in the future. Periodic maintenance of the floodplain's interior flood control system, including cleanout of ditches and canals that carry storm water, is expected to maintain existing channel dimensions. Future development in the tributary watersheds is expected to directly affect headwater reaches of many tributaries, but not downstream reaches. In order to maximize the amount of developable land in the uplands, headwater streams are expected to be lost by either channelization or replacement by underground pipe over which fill material would be placed (with authorization under Section 404 of the Clean Water Act and appropriate mitigation for stream impacts). Additional channelization of floodplain streams is unlikely in the future. Future stream losses were not quantified.

4.4.1.5.1 Ecological Problems of Streams. Floodplain channels will continue to be affected by the lack of riparian vegetation, transport of sediment into channels, inflows of agricultural and urban runoff, and encroachment by exotic plant species, such as Japanese hops (*Humulus japonicus*). In the tributary watersheds, additional urbanization is expected to continue encroaching upon streams and their adjacent floodplains. Existing instability of tributary stream banks and channel bottoms is expected to continue and become more widespread without intervention. Habitat degradation of tributary streams will continue, despite new storm water regulations in the project area that affect new development.

4.4.1.5.2 Wildlife Habitat of Streams. Expected adverse changes in physical and chemical characteristics of streams are expected to be greater in tributary watersheds than on the floodplain. Consequently, the capacity of tributary streams to serve as habitat for fish and other wildlife is expected to decline to a greater degree than that of floodplain channels.

To evaluate future quality of floodplain streams as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the great blue heron, mink, slider turtle, black crappie, and wood duck. According to projections of future conditions, average habitat quality of floodplain streams is expected to decline for the great blue heron and mink, and fall below 0.5 for three of the five species (Table 4-8). Quality remains unsuitable for the wood duck. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-8 Projected changes in habitat quality of lakes and ponds within the Project area, expressed as habitat suitability indices (average and range) for four evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Black crappie	**0.55**	0 – 0.79	**0.58**	0 - 0.79	0.03
Great blue heron	**0.54**	0 – 0.79	0.44	0 - 0.66	-0.10
Mink	**0.72**	0 – 0.87	**0.57**	0 - 0.88	-0.15
Slider turtle	0.27	0 – 0.45	0.25	0 - 0.37	-0.02
Wood duck	0.01	**0 – 0.16**	0.01	0 - 0.16	0.00

To evaluate future habitat quality of tributary streams, the team employed the Qualitative Habitat Evaluation Index procedure used by Ohio to assess its warm water streams. Projections of future habitat quality show a decline from existing conditions for the community of invertebrates and fishes that these streams support. Physical stream characteristics assessed for existing conditions yielded a habitat suitability index of 0.64, whereas the value for future conditions in 50 years was 0.55.

4.4.1.6 Cultural. Due to anticipated development, new cultural habitats consisting of residential, commercial, and industrial areas will arise from future losses of forests, prairies, and various wetlands. Similarly, these kinds of cultural habitats will come from future losses of agricultural land. To conduct the habitat assessment for this Project, the interagency biology team assumed that 75 percent of existing floodplain agricultural areas would be developed in 50 years. Therefore, the ongoing shift in cultural habitats, from agricultural to suburban and urban, is expected to continue.

4.4.1.6.1 Wildlife Habitat of Cultural Areas. Over the next 50 years, wildlife species using cultural habitats in the Project area are expected to gradually shift in composition from a mixture of agricultural and suburban-urban species to mainly suburban-urban species. The overall number of species is expected to decline. The interagency biology team assessed existing quality of old fields in the floodplain as habitat for the eastern meadowlark. In 50 years future quality of this habitat type would be reduced to zero because natural succession would have occurred and converted old fields to forest that has no suitability for this bird species.

To evaluate future quality of cultural areas (fields) as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the eastern meadowlark. According to projections of future conditions, average habitat quality of floodplain streams is expected to increase slightly (Table 4-9). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-9 Projected changes in habitat quality of cultural areas (fields) within the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold.

Species	**Existing (TY0)**		**Future Without Project (TY51)**		**Net Change, TY51-TY0**
	Average	**Range**	**Average**	**Range**	
Eastern meadowlark	0.34	0 - 0.34	0.38	0 - 0.39	0.04

4.4.2 Natural Resources.

4.4.2.1 Plants. Future anticipated development would continue the ongoing destruction of vegetation of various natural communities. Some native plant species are expected to disappear from the Project area due to physical destruction. Those plant species escaping destruction would be confined to smaller and more isolated fragments of natural communities. Of these species, some are expected to eventually become locally extinct because of the inability to maintain viable populations. With the loss of some native species, the overall diversity of the local flora is expected to decline, and the proportion of the flora consisting of exotic species would increase. Abundance of many persisting native species is likely to decline also.

4.4.2.2 Invertebrates. Loss and fragmentation of natural habitats is expected to continue in the area due to development. Most habitats provided by existing lakes, ponds, and streams are not expected to disappear, however physical and chemical conditions will continue to deteriorate. Like most other groups, the composition of the invertebrate community will continue to shift towards those species (i.e. artificial container breeding mosquitoes, houseflies) adapted to cultural habitats, such as urban forests, residential areas, and industrial parks. The abundance of species not capable of using cultural habitats is expected to decline.

4.4.2.3 Fishes. Overall species composition and diversity of fishes in the future is not expected to differ much from existing conditions for several reasons. First, many existing fish species are generalists and tolerant of considerable fluctuations in water temperature, flow, turbidity, and dissolved oxygen. Secondly, most habitats provided by existing lakes, ponds, and streams are not expected to diminish in area because of development. Lastly, the future influx of fishes into the Project area from the Mississippi River will continue to be greatly impeded by the existing flood control system along the River and the closure of gravity drains during rising river stages. The abundance of some species would also decline with continuing deterioration of physical and chemical habitat conditions.

4.4.2.4 Reptiles and Amphibians. The number of reptile and amphibian species occurring in the Project area is expected to decline with increasing development and fragmentation of remaining habitats. Habitat fragments are expected to become increasingly isolated from each other, and the potential for movement between these habitats by reptiles and amphibians would become increasingly unlikely. Abundance of species not adapted to cultural environments is expected to decline.

4.4.2.5 Birds. Bird species diversity is anticipated to decline because of the expected loss of forest and wetland habitats. Composition of common species is expected to shift toward those adapted to cultural habitats such as urban forests, residential areas, and industrial parks. Fewer species of area sensitive birds will continue to use habitats undergoing further fragmentation. Nesting of breeding species in forest fragments is not expected to sustain local populations because of anticipated high levels of nest predation and nest parasitism. A decline in abundance of species not adapted to cultural habitats is expected.

4.4.2.6 Mammals. Additional loss and fragmentation of natural habitats is expected to cause mammal species diversity to decline. Like most other groups of vertebrates, composition of mammal species will continue to shift toward those kinds adapted to cultural habitats. The abundance of species not capable of using cultural habitats is expected to decline.

4.4.3 Endangered and Threatened Species. Some species of plants and animals are expected to decrease in abundance or perhaps become locally extinct due to anticipated future development and associated losses of natural vegetation in the Project area. The probable effects of future trends on listed species, either federally or state endangered or threatened, are discussed below. The current status of all listed species is described in Appendix B.

Diminishing upland forests would be expected to offer decreasing opportunities for some bird species, including the Mississippi kite (*Ictina mississippiensis*), brown creeper (*Certhia americana*), and veery (*Catharus fuscescens*). One mammal, the Indiana bat (*Myotis sodalis*), and three snakes, the timber rattlesnake (*Crotalus horridus*), great plains rat snake (*Elaphe guttata emoryi*), and flathead snake (*Tantilla gracilis*), would also be expected to become less abundant because of forest loss, assuming each is still present. No listed species of plants are expected to be similarly affected.

A decline of wetlands in the Project area, either forested or herbaceous, is expected to adversely affect numerous listed birds and some other species. Fewer nesting or feeding opportunities would be available to as many as twenty-one listed bird species known or likely to occur in the Project area. These birds include the pied-billed grebe (*Podilymbus podiceps*), American bittern (*Botaurus lentiginosus*), least bittern (*Ixobrychus exilis*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nyctanassa violaceus*), Mississippi kite (*Ictina mississippiensis*), bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), red-shouldered hawk (*Buteo lineatus*), king rail (*Rallus elagans*), common moorhen (*Gallinula chloropus*), piping plover (*Charadrius melodus*), Wilson's phalarope (*Phalaropus tricolor*), Forster's tern (*Sterna forsteri*), black tern (*Childonias niger*), brown creeper (*Certhia americana*), veery (*Catharus fuscescens*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*). Among reptiles and amphibians, the Illinois chorus frog (*Pseudacris streckeri illinoensis*) would be adversely affected by a loss of wetlands.

However, areas for protection of this species have recently been established within the Project area. The massasauga rattlesnake (*Sistrurus catenatus*) would potentially experience further declines from a loss of herbaceous wetlands, assuming it is still present within the Project area. Among mammals, the Indiana bat (*Myotis sodalis*) would potentially be adversely affected by declining areas of forested wetlands. Four listed plants would also be potentially adversely affected, and they include the decurrent false aster (*Boltonia decurrens*), small burhead (*Echinodorus tenellus*), mud plaintain (*Heteranthera reniformis*), and bead grass (*Paspalum dissectum*). The latter three species are only known from historic and not recent records, and it is assumed that they are still present within the Project area, since no comprehensive inventory has been performed showing that they are not present.

Anticipated future conditions of streams, lakes, and ponds are not expected to adversely affect any listed plant or animal species.

The expected loss of agricultural lands, including cropland and pastures, would adversely affect a number of listed birds restricted to open (nonforested) habitats. These include the northern harrier (*Circus cyaneus*), upland sandpiper (*Bartramia longicauda*), short-eared owl (*Asio flammeus*), loggerhead shrike (*Lanius ludovicianus*), and Henslow's sparrow (*Ammodramus henslowii*). No other listed species of plants, mammals, reptiles, or amphibians are expected to be similarly affected by the loss of agricultural lands.

4.5 POPULATION AND SOCIO-ECONOMIC CONDITIONS

4.5.1 Population. Within Madison County, the overall population is projected to grow by 20% over the next 50 years. Seventy five percent of that increase is expected to occur within the Bluff Corridor and 25 percent within the American Bottom Corridor. Specifically, the population growth is projected to be as follows:

Madison County: 2004 (Year 1) - 263,100
2029 (Year 25) - 289,400
2054 (Year 50) - 315,700

Within St. Clair County, the overall population is projected have a short-term decline. In the short-term it is anticipated that the population in the American Bottom Corridor will decrease at about the same rate that the population of the Bluff Corridor increases. Further, by the year 2029, the population of the American Bottom Corridor is expected to have stabilized (due to job increases) while the Bluff Corridor is expected to continue its current rate of growth to the year 2054. Population growth for selected years is as follows:

St. Clair County: 2004 (Year 1) - 253,000
2029 (Year 25) - no change
2054 (Year 50) - 291,000

4.5.2 Age. Over the next 25 years, the median age of the population within Madison and St. Clair Counties is projected to increase. For Madison County, the change is expected to be from 40.2 years of age for 2004 to 47.7 years of age for 2029. As the "baby boomer" generation ages, a proportionally greater percentage of the population in the 17-65 year old median age category is expected over the next 20 years by which time it will gradually decrease in that category as a proportional increase occurs in the over 65 age group.

4.5.3 Education. Due to an increasing median age of the population, Madison and St. Clair Counties are expected to experience a reduced percentage in primary and secondary school enrollments and an increased percentage of those that have completed 12 years of education.

4.5.4 Employment. Within the manufacturing industries, employment in Madison County is expected to decline in a manner similar to the state-wide and national trend from 1960 to 1990 or about -0.9 percent per year. For St. Clair County, the same assumption applies yielding a decline expected to be -1.4 percent per year on average.

In raw numbers, the projections for manufacturing workers are as follows:

Madison County:	2004 (Year 1) - 27,100
	2029 (Year 25) - 21,000
	2054 (Year 50) - 14,900
St. Clair County:	2004 (Year 1) - 11,900
	2029 (Year 25) - 7,700
	2054 (Year 50) - 3,600

For employment other than in manufacturing, increases are projected as below. It is assumed that the retail/ services jobs will be about equal to the total future jobs in the county (estimated population divided by about 2.8 people per job) minus the above estimated manufacturing jobs. Hospitals, colleges, the gaming industry, and Scott Air Force Base will be major components of this jobs category.

Madison County:	2004 (Year 1) - 66,800
	2029 (Year 25) - 82,300
	2054 (Year 50) - 97,800
St. Clair County:	2004 (Year 1) - 78,500
	2029 (Year 25) - 82,600
	2054 (Year 50) - 100,400

4.5.5 Income. Per capita income and median household income in St. Clair County are projected to continue to fluctuate in the future consistent with statewide trends, especially during the 1980-1994 time period. As in the past, manufacturing jobs are expected to pay earnings 1.5 times greater than services jobs and 3 times greater than retail/trade jobs. The percentage of all persons at the poverty level during the next 20-50 years is projected to remain fairly constant, but the rate for St. Clair County is assumed to remain half again higher than the prevailing statewide rate. Over the next 25 years, approximately 12 percent of the Madison County population is expected to be below the poverty level and approximately 18 percent in St. Clair County.

4.5.6 Financing. No financing projections were made for this Reevaluation study since this parameter fluctuates greatly with the state of the economy. However, an infusion of revenue from the gaming industry and allied enterprises is expected to ensure that basic city services such as trash removal, water and sewer service, street repairs, police and fire protection, will occur within riverfront communities.

4.5.7 Health. The overall annual mortality rate is anticipated to stay or drop slightly from its present rate of about 900-1,000 deaths per 100,000 people. It is assumed that heart disease, cancer and stroke will continue as the leading causes of mortality in the region. Improvements in diet and exercise will cause the cardio-vascular factor to diminish as a mortality factor. In the short-term, cancer may continue to increase as a mortality factor. New cancer cures and environmental quality initiatives may eventually contribute to a decline in the cancer rate. Drug and gambling addiction is likely to hold steady and more likely increase in response to a continued gaming industry presence.

4.6 LAND USE AND RELATED ITEMS

4.6.1 Future Land Use - Madison County.

4.6.1.1 American Bottom Corridor Plan. Madison County's land use proposals discussed below utilize the 2020 Plan's land use strategy, municipal land use plans, the Greenway Plan and the Madison County Long-Range Transportation Plan (MCLRTP). The county anticipates that the majority of its new industrial development will take place in the American Bottom corridor due to this zone's substantial existing infrastructure and availability of large suitable land tracts. The enterprise zones (including the newly established Southwestern Madison County Enterprise Zone, and the Gateway Commerce Center Enterprise Zone) are also anticipated to attract development to this corridor. With regard to specific future activities, the County supports: 1.) the protection and expansion of the Horseshoe Lake State Recreational area and the Cahokia Mounds State Park; 2.) the furtherance of the Southwestern Illinois Greenways Plan (SWIGP); 3.) the strengthening the downtown areas and the residential neighborhoods (including infilling and maintenance) of corridor municipalities as a way of slowing down the premature conversion of agricultural lands outside of those municipalities; and, 4.) wetlands retention areas to provide for surface drainage.

Specific planning corridor recommendations by the County include: 1.) the formation of planning and development partnerships to implement the corridor plan and its Enterprise Zones; 2.) the rezoning of areas for consistency with the corridor plan; 3.) the development of a storm water management system that includes facility improvements meeting County standards; 4.) the approval of only those subdivisions that provide an IEPA acceptable waste water system; 5.) the connection of un-sewered developed areas to the existing system; 6.) the protection of wetlands by avoiding their destruction; 7.) developing new wetlands via wetlands banking; 8.) preserving crop lands for specialty crops (e.g. horseradish); and, 9.) the implementation of the recommendations of the MCLRTP and the SWIGP.

4.6.1.2 Bluffs Corridor Plan. The land use proposals for the Bluffs Corridor reflect the components of the County's 2020 land use strategy, municipal land use plans, and the Transportation and Greenway Plans. This corridor is expected to experience a significant conversion of land to residential uses, along with supporting commercial and industrial development expansion near major highway areas. Aggressive residential growth is anticipated within 1.5 miles of the Bluff Corridor municipalities by the year 2020. Future commercial growth is expected to occur within the existing municipalities and along the I-55/70 corridor between I-70 East and U.S. Route 40. Industrial land uses are expected to be limited and within existing municipalities, or along I-55/70 from Troy to Edwardsville.

Agricultural lands will remain a significant form of large land use, but increasingly, these lands will be converted to other uses. Open space/greenways, recreation and transportation reflects the recommendations of the MCLRTP and the SWIGP. The Bluff Corridor strategy calls for open space preservation in new development areas, coordination of transportation and land use, community character enhancement, balanced land use and water resource management, and the minimizing of impervious surface in new developments.

Specific Madison County planning corridor recommendations include: 1.) the formation of development partnerships; 2.) the adoption of uniform standards and ordinances for water and sediment control; 3.) the application of open space standards in residential zoning; 4.) the creation of "green buffers" between communities; 5.) the creation of demonstration sub-watersheds; 6.) the incorporation of the 2020 expansion area into existing municipal plans; 7.) the incorporation of residential areas lacking sewers into the existing wastewater management system; 8.) the restriction of individual private sewage systems; 9.) the avoidance of destruction to existing wetlands; 10.) the development of new wetlands (via wetlands banking); 11.) the direction of new sewer system improvements to areas not presently served; and, 12.) the preparation of interstate interchange plans before the areas become developed.

4.6.1.3 County-wide Considerations. The Madison County land use strategy plan also identifies and recommends various methods and planning tools for its overall management effort. These methods and tools are: 1.) increasing county-municipal planning partnerships to work out problems; 2.) increasing county "in-house" planning capability for addressing land use problems; 3.) reviewing and revising county zoning and subdivision regulations; 4.) adopting strict stormwater/watersheds management standards;

5.) supporting beneficial flood control and ecosystem measures from the Corps of Engineers' East St. Louis and Vicinity project; 6.) working with other governmental entities to upgrade aging storm water drainage facilities in the bottoms, and to extend public water and sewer facilities; 7.) forming residential and agricultural zoning districts to manage location and support facilities consistent with the management plan; 8.) applying zoning and subdivision regulations to implement existing municipal commercial development plans, to reduce non-managed growth in agricultural areas ant their premature conversion to other land uses; 9.) guiding new development to non-environmentally sensitive areas (including the enterprise zones); 10.) extending infrastructure; 11.) banking wetlands; 12.) partnering; 13.) continuing efforts to install a network of bike trails while preserving open space and greenways; 14.) working with the new Metropolitan Park and Recreation District to further the trails concept; and, 15.) working in cooperation with the Madison County Transit (MCT) District to support the construction of a new Mississippi River bridge, extending MetroLink into Madison County, and completing road projects funded through the "Illinois First" program (e.g. IL-255 extension and widening Illinois Routes 157 and 159).

4.6.1.4 Madison County Land Use and Related Projections. The projections for land use and related items for Madison County follow:

Agricultural (Farm):	2004 - 274,800 acres; 2029 - 247,500 acres; 2054 -195,000 acres.
No. of Housing Units:	2004 - 112,400; 2029 - 134,900; 2054 - 157,400.
No. of Households:	2004 - 97,900; 2029 - 107,700; 2054 - 117,500.

4.6.2 Future Land Use - St. Clair County.

4.6.2.1 American Bottom Corridor Plan. St. Clair County has identified the American Bottom Corridor as having major opportunities for revitalization and diversification of the County's economic base. Advantages provided by this corridor include transportation (highway network, MetroLink, river access, St. Louis-Parks Airport) and its proximity to various state and federal parks. These attributes provide opportunities to develop the area along the lines of tourism and recreation as well as warehousing and distribution. The County recommends the use of creative and cooperative investment approaches to future development efforts.

In the northern portion of this corridor, the County seeks to stabilize and expand the economic base by improving entryways into the urbanized core and to provide a more positive image. Their plan is to open up public access to the Mississippi riverfront. This is intended to serve as a basis for evolving a future tourism and recreation-based economy. Their plan includes recommendations for providing strategic highway intersections, optimizing the use of MetroLink, recognizing rail, water, and highway transit opportunities, and improving linkages between urban portions of the corridor and downtown St. Louis.

Specific north corridor development recommendations include: 1.) the creation of a warehousing and distribution center in the vicinity of the National City stockyards with access from the interstates to Illinois Route 3 and Illinois Route 203 plus a river dock connection; 2.) the establishment of a national park between the Poplar Street Bridge and the Martin Luther King Bridge; 3.) the creation of a new commercial development zoning overlay which would be compatible with the adjacent Metro-Link infrastructure and with residences; 4.) the creation of a special highway interchange overlay to disperse highway service activity such as fast food restaurants, gas stations, and hotels subject to consistency approval by the Planning Commission.

In the south American Bottom Corridor section, St. Clair County recommends: 1.) to use the Downtown St. Louis-Parks Airport as a source of development opportunity; 2.) to encourage residential infill in the East Carondelet and Dupo areas; 3.) establish an air operations dependent industrial/business park in the vicinity of Parks Airport; 4.) create a regional commercial district (ideally an office park) near the intersection of I-255 and Mousette Road linked to wetlands mitigation and a wetlands banking program; 5.) establish zoning districts in the East Carondelet and Dupo areas for small homes in planned developments; and, 6.) establish a recreation/conservation area near Prairie Du Pont Canal.

4.6.2.2 Bluffs Corridor Plan. Within the Project area, this is the fastest growing area of St. Clair County. Within the Bluffs Corridor portion of the County, the overall vision is to seek orderly and coordinated growth with community development in areas where infrastructure presently exists or is planned. More specific development strategies include: 1.) the use of PUD regulations to ensure a quality housing design with open space provisions and a mix of housing types and densities; 2.) the use of development compacts to help ensure continuity and integrity of land uses through the zoning process; 3.) overlay zoning for Metro-Link station development; 4.) utility improvements and consolidations; 5.) special highway interchange overlay districts for various intersections with I-64; 6.) various roadway circulation improvements, such as improved linkage between south St. Louis County and the Scott Air Force Base joint-use area; and, 7.) special development strategies for a Scott Air Force Base joint-use area such as the implementation of enterprise and foreign trade zones, the establishment of a development compact, and the reservation of the site for light industrial/assembly uses, distribution and warehousing, aircraft research and development, aircraft modification shops, and business services/corporate office uses.

4.6.2.3 St. Clair County Land Use and Related Projections. The projections for land use and related items for St. Clair County follows.

Agricultural (Farm):	2004 - 232,300 acres; 2029 - 198,000 acres; 2054 -132,000 acres.
No. of Housing Units:	2004 - 113,600; 2029 - 133,400; 2054 - 153,300
No. of Households:	2004 - 97,600; 2029 - 104,900; 2054 - 112,300

4.7 WATER QUALITY

The surface water quality within the project area has a wide variety of impairments with causes originating from agricultural uses, urban-runoff, tributary stream bank erosion, point source discharges (industrial and public/private treatment works), and land development. The general trend in population and commercialization/industrialization is increasing within the project area. New stormwater ordnances and attention by the counties to EPA Phase II regulations address future problems. However, the degradation that has begun from past practices in the tributary streams will not be fixed without direct intervention. If action is not taken, tributary streams will continue to experience increasing destabilization of stream banks, putting heavier sediment loads into the system, and further degrading environmental quality. Based upon these increasing trends, surface water quality would most likely have additional impairment loads placed upon it over time. The surface water quality would degrade with an increased impairment load. Downstream receiving water would then have an increased impairment load which decreases water quality within those regions. The degrading water quality condition, with time, within the project area would result in a decreased amount of possible designated uses.

4.8 PHYSICAL FACILITIES AND OPERATIONS

The current capacity of the interior ditching system in the Bottoms area has been re-established through the recent channel cleanouts that were performed using either Corps of Engineers' Rehabilitation funding or FEMA funding. These cleanouts occurred after the 1995 through 1997 flooding. Under the future without project condition, continued sedimentation in the Bottom's channels and degradation of the bluff stream channels is expected. Any loss of channel capacity as a result of inadequate maintenance will reduce future flood protection. Degradation of bluff stream channels will continue to adversely impact existing infrastructure. It is assumed that the channel cross-sections attained after the recent Corps of Engineers' and FEMA cleanouts will be maintained by MESD or other responsible parties thereby continuing an expensive operation and maintenance program in the future.

4.9 OUTDOOR RECREATIONAL RESOURCES

4.9.1 Greenways/Trails. Greenways offer opportunities to creatively preserve open space in rapidly developing areas, protect important natural resources such as wetlands and wildlife corridors, and provide opportunities for outdoor activities such as bicycling and walking. Greenways and trails have been one of the top public concerns identified through the Statewide Comprehensive Outdoor Recreation Plan (SCORP) Public Participation program for years. Southwestern Illinois offers tremendous greenway opportunities. Currently, the Metro East region has three of the 16 National Millennium Trails designated in 1999 and there are three major greenway systems proposed for the region. The Millennium Trails program is an initiative of the White House Millennium Council in partnership with the U.S. Department of Transportation and the Rails-to-Trails Conservancy.

Millennium Trails will recognize, promote and support trails as a means to preserve open spaces, interpret history and culture, and enhance recreation and tourism. The greenways and Millennium Trails are shown by priority in Table 4-10. The majority of the systems are located in Madison County where they are expected to be expanded to form a comprehensive regional network.

The following priority regional greenways are listed alphabetically and represent critical greenway connections. Each is important to the development of a strong regional greenway system and meets at least four or more of the key function criteria listed above. Participants in the public involvement program also identified these greenways repeatedly as most important at the sub-regional planning sessions.

Table 4-10 Greenways/Trails.

	Proposed Greenways	County
1	Bluff Greenway and Trail	St. Clair and Monroe
2	Mississippi Levee Greenway and Trail	St. Clair and Monroe
3	Schoolhouse Trail Greenway	Madison

4.9.2 Future Facilities Needed. As urban growth continues, the demand for open space preservation and the development of recreational opportunities is expected to increase. Both counties future land use plans document these needs.

SECTION 5 – PROBLEMS AND OPPORTUNITIES

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5.1 INTRODUCTION

Water resource studies are initiated in response to actual and perceived water resource problems within a given geographic area. The purpose of a water resources study is to identify and diagnose the causes of these problems and to formulate potential solutions. The first step in the planning process is to identify problems and opportunities. This provides a focus for the planning effort and aids in developing objectives for the planning study. Planning objectives are statements which describe what a plan should achieve and communicate the intent of the planning study. Problems and opportunities can be viewed as local and regional water resource conditions that could be changed in response to public needs. This section of the report describes the problems and opportunities of the Project area and the planning objectives developed for the study.

The identification of problems and opportunities and the development of clear operational objectives was the initial challenge in the formulation process for the Project team. The identification of problems and opportunities began with the assessment of the information compiled for the preparation of Sections 3 (Existing Conditions) and 4 (Future Without Project Condition) of this Report, in addition to the input received during the public involvement process.

During the identification and validation process of problems facing the Project area, it became clear that there was a logical connection between these problems and the degradation of the natural ecosystem from a variety of causes. In every instance, there appeared to be a compelling reason to address Project area problems as environmental opportunities. As the Project team delved into the history of the area and the operation of the natural system during pre-settlement times, the picture that evolved provided a focus for the plan formulation process.

5.2 PUBLIC INPUT AND CONCERNS

In an effort to identify the concerns of the public in the affected area and to gain a clear understanding of solutions that would receive public support, the Project Team worked cooperatively with a number of significant public outreach efforts in addition to conducting the Corps' own public involvement process. Previous planning efforts conducted by the Corps and other agencies were reviewed and carried into this public scoping process in order to ensure long standing issues were accurately defined and addressed. The Corps, along with a number of other State and Federal agencies, participated as a technical resource on the Metro East Storm Water Committee which is a three county body representing St. Clair, Madison and Monroe Counties. This Committee is chaired by members designated by each of the County Boards and addresses issues related to stormwater. Ongoing Project activities were addressed and discussed monthly as a part of this forum. The Corps also served over several years as a technical resource to a number of planning efforts in the Project area that the Natural Resource Conservation Service (NRCS) conducted to identify solutions to various watershed problems. The NRCS, in a manner similar to the Corps, formulates their plans and projects through the process of identifying problems and potential solutions with public/stakeholder involvement.

On May 7, 1999, the Metro East Storm Water Committee adopted as their priority a compilation of public concerns developed from the numerous Resource Plans created over a 3-4 year period by the NRCS. A copy of this summary is contained in Appendix G. This summary groups concerns into three broad categories: natural resources, cultural resources and human resources concerns.

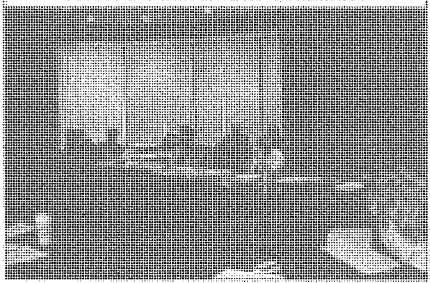


Figure 5-1 Stormwater Committee

The Corps also participated as a technical resource for the East West Gateway Initiative of the U.S. Environmental Protection Agency, Region 5. This was a public outreach project for Madison and St. Clair Counties that was organized to identify concerns related to the complex issues surrounding the impacts of urban sprawl. Public sensing sessions were done through a series of facilitated public workshops over a two-year period. The outcome of these workshops was the identification by the public of concerns over loss of greenspace, open space and habitat, flood damages, and erosion/sedimentation. Finally, dozens of requests from public action groups for presentations on Project formulation were accommodated over the period of the Project. In each instance, public comment was received and a free exchange of information occurred. Section 10 of this report provides additional information regarding public involvement during the planning process.

In order to initiate the formal environmental impact statement (EIS) process, a formal public scoping meeting was conducted in February of 1999. This event was well attended and the input from this, as well as other public involvement efforts, was used to guide the Project planning process.

5.3 PROBLEMS AND OPPORTUNITIES

5.3.1 Ecological Resources. A recent report on trends in Illinois' environmental and ecological conditions concluded, "Existing data suggest that the condition of natural ecosystems in Illinois is rapidly declining as a result of fragmentation and continual stress." (IDENR/NIF 1994b:iv). Over the last two centuries, the historic natural ecosystem of the Project area has been reduced to a fraction of what it once was. Ecological problems that are identified and addressed include loss of biodiversity, fragmentation of natural systems, loss of historic ecosystem disturbances, loss of habitat quality, and degradation of water quality.

5.3.1.1 Loss of Biodiversity. Much of the historical biodiversity of the Project area, consisting of numerous natural communities and their constituent plant and animal species, has been lost due to intensive economic development. The loss of much of the natural heritage within the Project area is illustrative of a larger pattern in Illinois – "the trend toward simpler natural systems" (IDENR/NIF 1994b:72). The once complex historical natural environment has been replaced with one that is fairly simple biologically. Spatial losses in the Project area due to habitat destruction are significant.

Only about 30 percent of the Project area, collectively, now consists of remnant forests, prairies, wetlands, lakes and ponds, and streams. Built-up areas, agriculture, and non-native grassland represent the remaining 70 percent, which supports low levels of biodiversity as compared to natural habitats. Losses also consist of declines in the diversity of natural communities. Some types of forest, prairie, and stream natural communities have disappeared entirely. The case of prairie losses is the most extreme. About 99.9% of the historic prairie is gone. Once extending over roughly 35,000 acres and consisting of seven distinct communities, only about 35 acres comprising two communities remain. Widespread natural disturbances, such as flooding and wildfire, added a temporal dimension to the spatial complexity of the historic ecosystem that is gone today. Biodiversity losses also include the loss of some native plant and animal species that once inhabited the Project area as a result of the presence of introduced or exotic species that can out-compete native plants and animals. This shift in species composition illustrates another broader pattern in Illinois – "the trend toward non-native species" (IDNR 1994:73). Continuing urbanization is expected to be the chief cause of future losses of biodiversity, especially to forests in the uplands.

Opportunities exist within the Project area to restore some of the lost and diminished components of the historic ecosystem. These include floodplain prairies, forests, marshes, and streams. Economic and agricultural activities prevent the re-creation of an entire stream traversing the floodplain, but there are locations where partial restorations could occur. Likewise, undeveloped areas exist where natural areas such as forests and prairies could be restored. Restoration of such features would replicate, albeit on a much reduced scale, the historic natural ecosystem.

5.3.1.2 Fragmentation of Natural Systems. As a result of development, natural areas within the Project area have become highly fragmented and remnants are generally too small to support all plant and animal species characteristic of functional ecosystems. The fragmented character of natural areas within the Project area is illustrative of a broader pattern in Illinois, which exhibits a "trend toward fragmented natural systems" (IDENR/NIF 1994b:74). Fragmentation is the transformation of continuous areas of natural ecosystems into smaller and smaller pieces as a result of development. Along with habitat destruction, fragmentation is considered by many ecologists to be among the chief causes of loss of biodiversity worldwide. Maintaining biodiversity for the long term in fragmented systems is problematic for several reasons. First, some plants and animals living in a formerly continuous but now fragmented system face higher risks of extinction because each species' population in a fragment consists of relatively few individuals. Second, fragments have higher edge-to-interior ratios, meaning that much of their area is near an edge and the interior or "core" area in small. Because a number of animals are area-sensitive and require large "core" areas to live in, fragments are often not large enough to fulfill their needs. Third, surrounding areas can influence fragments more than large, extensive areas. Human disturbances from adjacent urban or suburban areas can have a greater effect on fragments than large, continuous areas. Similarly, encroachment of adjacent woody vegetation into remnant prairies can transform fragments into wooded habitats quicker than large grassland remnants. Lastly, fragmented landscapes typically present barriers to the movement and dispersal of animals that travel by land, such as many mammals, reptiles, and amphibians. Structures like highways and railroad embankments or broad areas of unsuitable habitats that surround fragments of natural areas can inhibit the movement of some animals between fragments.

Requirements for the establishment and maintenance of self-sustaining and functional natural ecosystems in Illinois have yet to be defined. However, guidelines for forest and grassland establishment and management in Illinois are available to benefit native bird species that breed in these two habitat types (Herkert et al. 1993). Because some bird species are area-sensitive (they need relatively large continuous tracts of habitat for breeding), the size of a habitat area is an important determinant of the diversity of its breeding bird species. Robinson et al. (2000) recommend 500 acres as the minimal area for forest restoration or preservation efforts intended to benefit songbirds in Illinois. Areas smaller than 500 acres are not considered to be beneficial because such areas tend to support fewer area-sensitive species, the abundances of birds in these smaller areas is often low, cowbird parasitism on the young of resident bird species is often high, and nest predation by animals such as raccoons that tend to use forest edges is often more serious because of high edge-to-interior ratios (Robinson et al. 2000). For grasslands, Herkert et al. (1993:14) state that the minimal area for prairie restorations that are intended to benefit area-sensitive grassland breeding birds "should be at least 125 acres and preferably more than 250 acres in area." Tracts of forest or grassland greater than 1,000 acres are needed to attract all bird species that are most sensitive to habitat fragmentation (Herkert et al. 1993).

In addition to size requirements for forest and grassland establishment and management, Herkert et al. (1993) describe numerous other management guidelines that are either common to both habitat types or specific to each. Guidelines common to both include: 1) avoid fragmentation of existing habitats, and restore existing habitats, especially larger ones that support bird species of moderate and high sensitivity to fragmentation; 2) establish or restore circular or square habitat areas to minimize the edge-to-interior ratio; and, 3) either build onto existing areas of forest or grassland, or fill in gaps in existing habitats to create larger habitat areas.

Opportunities exist within the Project area to restore forested areas and to create prairie restorations that are large enough to support animals sensitive to habitat fragmentation, including birds.

5.3.1.3 Loss of Historic Ecosystem Disturbances. Remaining natural areas cannot be expected to retain much similarity to their former structure and function if periodic ecosystem disturbances are not introduced to mimic historic flooding and wildfire. Natural flooding and wildfire sustained the historic natural ecosystem. With the elimination of these natural forces, today's remaining natural areas cannot maintain much similarity with their former historic condition without intervention.

In this sense, the Project area's condition is representative of a broader pattern across Illinois - the "trend toward managed ecosystems" (IDENR/NIF 1994b:75). In the case of fire, the ecological benefits of conducting periodic controlled burns in remnant prairies, marshes, and those forested areas historically influenced by wild fire have been apparent to ecologists and natural resource managers for many years. Plant communities occurring in these habitats have adapted to fire. The managed burns maintain species composition and patterns of relative abundance in these plant communities.

Additionally, in forested areas, fire can maintain variably aged populations of tree species. Without fire, remnant prairies turn into wooded areas over time through the encroachment of trees from adjacent areas. The lack of natural fire in many upland forests and drier floodplain forests in Illinois has led to the overabundance of sugar maple (*Acer saccharum*) in areas where oaks and hickories once dominated. Sugar maple is not fire tolerant and in historic times, its abundance was kept relatively low by wild fire. With the suppression of wild fire, it frequently out-competes shade-intolerant species like oaks and hickories.

With regard to flooding, intensive efforts to economically develop the American Bottoms over the last 100 years have treated riverine overflows from the Mississippi River and tributaries as something to engineer out of the human environment. This form of natural disturbance has been nearly eliminated by construction of the main levee along the Mississippi River, the diversion of Cahokia Creek to the river, and the building of the interior drainage system on the floodplain. Consequently, remaining floodplain wetlands are no longer connected to their former dominant sources of hydrology. The source of hydrology for many wetlands is now limited to rainfall and local runoff and groundwater influences. In historic times, the seasonal ebb and flow of floodwaters established a complex web of linkages on the floodplain between wetlands, floodplain lakes and ponds, and river and creek channels. Now remaining wetlands are hydrologically isolated from each other by various kinds of development.

Fragmentation of natural areas and the loss of linkages between wetlands, streams and rivers in the Project area have reduced the ability of many wetlands to perform historic functions, such as to temporarily store overland flows of water, or to remove natural nutrients and other elements and compounds from floodwaters. The elimination of disturbance factors such as flooding and fire from much of today's environment has also diminished the ability of wetlands to serve as support systems for some plant and animal species. For example, the decurrent false aster (*Boltonia decurrens*), a federally threatened species, is an herbaceous plant that historically occurred in open habitats on the floodplain of the Illinois and Mississippi Rivers, such as wet prairies, shallow marshes, and the shores of rivers, creeks, and lakes. It is found within the Project area today in old or mowed fields, marshes, and at the edges of active fields, farm facilities, golf courses, and a railroad (USDOT 2000). The plant requires high levels of light to survive. Riverine flooding apparently benefits this species by disbursing seeds to new areas for colonization and suppressing the encroachment of woody vegetation that would create shady conditions. Likewise, wildfire would also have maintained open habitats in areas such as wet prairies and marshes.

Opportunities exist within the Project area to re-establish lost linkages between wetlands and tributary streams and re-introduce periodic flooding to existing floodplain natural areas. Such flooding could mimic the predevelopment flood pulse. Although the Mississippi River is no longer a feasible source, storm water from tributary watersheds could serve as the basis for the desired flood pulse. Prescribed fire is currently used to maintain some small prairie restoration areas within the Project area. Its use could be expanded into other natural areas to provide the same ecological benefits.

5.3.1.4 Loss of Habitat Quality. While habitat quality in the Project area ranges from poor to good, many areas of fish and wildlife habitat in the urbanizing Project area are poor to fair as a result of human activities and influences. This assessment is based on data gathered for this Project in the spring of 1999 by an interagency group of biologists studying 228 individual sites in floodplain (terrestrial, wetland, aquatic) and tributary stream (terrestrial) habitats.

These quality ratings represent the ability of sampled habitats to fulfill the food, cover, or reproductive needs of eight fish and wildlife species occurring in the Project area. These species, which include the black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, and wood duck, were selected to serve as representative of a broad number of other species that are present or desirable and that also use forest, marsh, prairie, lake, stream, and cultural habitats. These animals, and the current quality of habitats they use, serve in this Project as the benchmark against which the expected effects of alternative solutions for ecosystem restoration can be compared. Further details about the habitat assessment method are found in Appendix A. According to the habitat assessment method employed in this Project, the absence or insufficiency of one or more measurable habitat characteristics judged to be important to a given species can reduce habitat quality below the optimum condition under which all requirements are fully met. Examples of habitat conditions for a few species follow for illustration.

Habitat quality for the wood duck was found to be consistently poor across the Project area. This species nests in natural cavities of mature trees in floodplain or upland forests and raises its young in floodplain marshes and shrub swamps. The primary factor leading to low habitat quality is the lack of natural tree cavities or artificial boxes in which to nest. This most likely is due to the lack of mature trees, rather than those tree species that produce suitable natural cavities. Because few mature stands of woods were noted in the floodplain, this suggests that tree cutting occurs frequently enough on a widespread basis to prevent attainment of mature timber. In the future without project condition, the assessment projected that habitat quality for this species is expected to remain poor.

Many of the remaining natural lakes and ponds do not have sufficient water depth to serve as over wintering sites for fish species. Likewise, these water bodies, as well as man-made borrow pits, often have either little to no submergent or emergent vegetation along their shores, or woody debris, all of which offer resting and feeding areas for young and adult fish. The floodplain ditches that have replaced historic streams are similar in simplicity. Woody vegetation is prevented from growing along these channels. The woody vegetation would otherwise offer shading and helps keep water temperatures during summertime from becoming too stressful to aquatic organisms. With regard to floodplain forests, tree species composition is often a small subset of the historic condition because valuable species like oaks and hickories were removed long ago for commercial purposes. Under the assessments of these types of habitats, the future without project condition is not expected to yield improved conditions, nor benefit the species using them.

With regard to the existing habitat quality for the fox squirrel, it is most often found to be good. This common species is most frequent in the tributary stream forests of the Project area. Optimal habitat consists of small stands of mature oaks and hickories having little understory vegetation that are interspersed with agricultural lands. Conditions close to these currently occur, for the most part. However, under the future without project condition, habitat quality of the remaining upland forests is expected to decrease because new development is expected to use much existing agricultural land and fragment existing wood lots into smaller pieces.

Opportunities exist within the Project area to make numerous improvements to habitat quality. Native plant communities can be restored in existing forests by introducing historically occurring tree species that are now lacking or underrepresented. Oaks can be planted in developed areas to benefit birds. Lakes and ponds can be improved for fishes by creating deep-water areas to serve as overwintering habitat. Emergent vegetation can be increased along the margins of these water bodies to benefit resident fishes, birds that feed in such areas, and enhance the production of macro invertebrates that serve as food sources for such animals. Buffer zones of natural vegetation can be added around the perimeter of natural areas to minimize human disturbances. Wetlands can be improved by restoring native grassland around them or by adding wooded buffers. Invasions of exotic plant species in the Project area can be controlled or eliminated. Existing narrow riparian zones along streams can be widened to benefit greater numbers of species. Connections or linkages consisting of natural vegetation can be established between various habitats to provide corridors for animal movements. Levels of sediment and chemicals carried by runoff into natural areas can be reduced.

5.3.1.5 Degradation of Surface Water Quality. The surface water quality within the Project area has a wide variety of impairments with causes originating from agricultural uses, tributary stream bank erosion, urban-runoff, point source discharges (industrial and public/private treatment works) and land development. In particular, sediment makes a significant contribution to the degradation of water quality that adversely impacts aquatic habitats, such as streams and lakes. Likewise, water quality is adversely impacted by non-point source water pollution that enters the tributary streams, the interior drainage system, and then on to the Mississippi River. Water passing over the land, either from rain, car washing, watering of crops, or lawns, picks up an array of contaminants including oil from roadways, agricultural chemicals from farmland, and nutrients and toxic materials from urban and suburban areas. This runoff is defined by the Water Resource Advisory Council as non-point source water pollution and finds its way into waterways either directly or through storm drain collection systems.

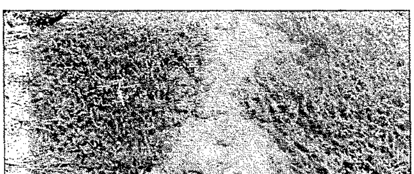


Figure 5-2 Alcal growth in floodplain channel due to excessive nutrient levels.

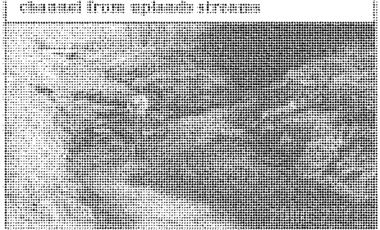
The general trend in population/urbanization/ industrialization and tributary stream degradation for the Project area and vicinity is increasing. Based upon this increasing trend, it is concluded that increased degradation of water quality will continue to be a problem. The adverse effects of this degraded water quality are not limited to large lakes or rivers but can be found in local streams, ponds, and natural areas.

Opportunities exist within the Project area to improve surface water quality for the benefit of restoring and protecting important aquatic habitat. Measures implemented in tributary stream watersheds could reduce impairments with upland origins and reduce sediment loads before they reach the bottoms via tributary streams. Natural areas such as existing or constructed wetlands could be protected from the debilitating affects of degraded water quality while serving as an additional filtration system to improve water quality before surface waters are released into the Mississippi River.

5.3.2 Erosion and Sedimentation. Erosional processes occurring in the Project area related to rain events, increased peak flows due to storm water runoff, and head cutting and rotational bank slumping in tributary streams are causing excessive sedimentation in the bottoms and degradation of tributary stream resources. Community leaders and the local people who participated in the public involvement program ranked sedimentation and erosion problems on a par with flooding problems. Urban sprawl and the loss of greenspace and open space were believed to contribute to both the flooding and sedimentation problems. Federal and State resource agencies that participated in the study expressed concern about the adverse environmental effects of the sediment and erosion problems.

In general, the runoff from the hillside creeks enters the canals in the Bottoms area at a high velocity capable of transporting heavy loads of sediment out of the bluffs. However, when these high velocity flows reach the Bottoms, the velocity of the water drops substantially because the gradient flattens and the water in the canal is no longer able to transport the sediment load. This sediment is then transported through follow-on storm events through the drainage canal system eventually finding its way to the Mississippi River or remaining captured in the canal system reducing its capacity.

Figure 5-3 Sedimentation in floodplain channel from uplands streams



As documented in the Corps of Engineers' study of 1984, an analysis performed by the U.S. Department of Agriculture, Soil Conservation Service, determined that approximately 196,000 tons of sediment were being generated by the Cahokia Canal tributary drainage area, and approximately 78,000 tons of sediment per year from the Harding Ditch tributary drainage area. Very little sediment was found to originate from the bottomland sources because of the flat topography and sluggish runoff velocities. Studies performed in 1998 through 2000 by the Soil Conservation Service for the restudy effort determined that this is still a serious problem. The total existing gross erosion delivered by the tributary streams is estimated to be 202,700 tons per year. This analysis is discussed in Appendix E.

Sedimentation creates several serious problems in the bottomlands of the Project area. As sediment collects in the already undersized drainage channels, the flow area is reduced even further so that a given amount of runoff is more likely to overflow the channel or break through the spoilbank levees. To deal with this problem, the Metro-East Sanitary District and other agencies responsible for operating and maintaining the drainage systems have incurred greater maintenance costs.

Sediment has also degraded the environmental quality of numerous wetland and aquatic areas in the bottomlands, including Horseshoe Lake and the lake resources at Frank Holten State Park. At Frank Holten State Park, sediment presently accumulates in the lake adjacent to Harding Ditch.

The other two lakes are completely separated from Harding Ditch to protect them from further degradation. Horseshoe Lake's location makes complete segregation impossible. Relief valve type flows from large rainfall events designed to travel into the Lake through a diversion channel from Cahokia Canal have been effectively eliminated by the formation of a sediment delta in Horseshoe Lake. This delta has become a bottomland forest over much of its area. Sedimentation of Horseshoe Lake has dramatically impacted its fisheries quality. It is now approximately two feet deep on average and provides less than desired habitat for aquatic resources. Sediment also has degraded the quality of tributary streams in the Project area. Aquatic habitat no longer supports the variety of species that were present during pre-settlement times. Urban development has increased the volume, duration, and frequency of stormwater entering the stream system and has affected the stability and habitat functions of streams. This degradation, once begun, will continue to adversely impact stream functions.

Sediment being left behind in drainage canals also contributes to loss of flood conveyance capacity. Following the severe flooding experienced by the area between 1996 and 2001, approximately $10,000,000 in federal, state and local funds have been expended in removing sedimentation from the interior drainage system. This is a continuing effort and expense.

Opportunities exist within the Project area to reduce sedimentation. Measures sited within the tributary watersheds would be located closest to the "problem" and address both the problem of sediment transfer to the floodplain and degradation of stream quality and function. Measures could also be implemented in the Bottoms to detain sediment separate from any action in tributary streams.

5.3.3 Tributary Stream Channel Instability. Many tributary stream channels in the Project area have responded to growing development in their watersheds with bank instability and head cutting. Increasing areas of developed, impermeable land surfaces in tributary watersheds have allowed greater amounts of storm water to pass through stream systems per unit time. These increased flows have led to channel instability by creating unstable bank lines. In addition, base flows in some watersheds have increased due to the addition of effluent from septic systems in some subdivisions. Increased base flow can also lead to channel bottom instability and headcutting. Head cutting in tributary streams and tributaries has contributed to some dramatic losses and destabilization of banks throughout the system. This situation not only contributes large volumes of sediment to the system that ultimately reaches the floodplain, but it also degrades stream quality, threatens bluff infrastructure, existing developments, and habitat quality.

Figure 5-4 Tributary stream channel instability

While this type of geological succession is not a new phenomena, after the initial investigation it became clear that it is happening at a faster rate in the Project area than would normally be expected of a natural system. Stream degradation will continue to worsen if not addressed, despite actions being taken today to address storm water runoff from new development. For this reason, solving these tributary stream problems on a systematic watershed basis became an important facet of the overall Project focus.

The NRCS has done several stream bank stabilization projects designed to protect existing infrastructure. Approximately $1,000,000 was expended in 1995 to fix a bank along East O'Fallon Drive. Little Canteen Creek was threatening the road, a primary sewer line, water line, utilities, and homes in several locations. As these banks continue to erode, homes, highways, and other infrastructure are impacted as is the quality of the stream and its aquatic resources.

An opportunity exists within the Project area to address the instability of tributary streams. For the purposes of this Project, this opportunity could beneficially address the sediment problem in a way that could provide increased and sustainable environmental viability for the tributary streams while protecting the floodplain from unwanted sediment deposition. These tributary streams represent a finite resource that once lost will not be able to be replaced. Their location within the urban area makes them an important environmental resource. The NRCS was brought in to analyze the problems associated with sediment and to explore opportunities to address this problem. Appendix E includes the detailed findings and recommendations from these analyses. For purposes of this Project, the ability to find solutions for loss of sediment from the tributary streams was viewed as an environmental opportunity to improve water quality and aquatic habitat. Evaluation of potential measures to reduce sediment and stabilize and restore tributary streams became a focus of the plan formulation process.

5.3.4 Flooding and Flood Damages. Flooding that currently occurs when storm water overtops the existing water conveyance system in the bottoms will continue to cause significant flood damages. As discussed earlier, the Project area bottomlands are protected from direct flooding from the Mississippi River by a series of levees and floodwalls. However, the Project area has a history of serious interior flooding which is caused by storms producing interior flows that exceed the capacity of the canals in the bottomlands area. Interior flooding associated with large rainfall events producing widespread damages across the floodplain occurred in the Project area as a result of the storms of August 1915, July 1942, August 1946, July 1952, June 1957, May 1961, and May 1995. Perhaps the most damaging event occurred in August 1946 when approximately 19 ½ inches of rain fell over Madison and St. Clair Counties during an eight-day period. This storm produced an average depth of 15.1 inches over the entire Project area. Flood damage from this event was estimated to be $6 million (approximately $56,800,000 in 2001 dollars) and the event was estimated to be more rare than the 100-year storm in terms of inches of rainfall.

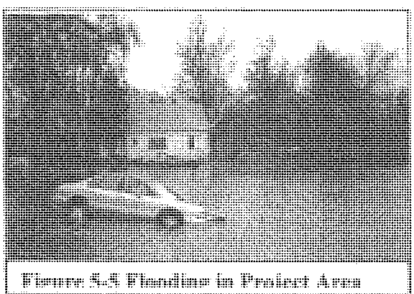


Figure 5-4 Flooding in Project Area

Flooding caused by a 14-inch rainfall over a two-day period in June 1957 caused approximately $4 million ($25,000,000 in 2001 dollars) in damages. This event and the 1995 event produced approximately a 100-year rainfall with average depths of over 8 inches across the Project area.

Between 1993 and 1996, the area experienced both widespread and specific drainage area flooding which prompted a federal disaster area declaration in each of these years involving millions of dollars.

In 1993, the declaration covered both Madison and St. Clair County while in the spring of 1994 it covered St. Clair County. In the spring of 1995 and the spring of 1996, the declaration covered Madison and St. Clair Counties. Since the Corps was not involved in any analysis of the Project area at the time these disasters occurred, information from disaster relief agencies is the only documentation of the devastation created by these flooding events available, but they appear to have been consistent with the type seen by the area with some frequency.

Figure 5-6 Flooding in Project Area

Most interior flooding in the bottomlands occurs from heavy runoff discharges from the tributary (bluff) areas. In May 1961, excessive runoff caused just this type of damage to the Project area. This type of flooding occurs when the capacity of the drainage canals is exceeded and/or when interior ponding in low-lying areas occurs when ponded water cannot get into the drainage canals quickly enough. Interior ponding occurs in low-lying areas (eg: old sloughs and shallow lake beds) within which surface water runoff collects. Most of these areas are undeveloped or partially farmed and the water that collects during most small rain events causes very little or minor crop damage. Infrequently, interior flooding can be indirectly impacted by the Mississippi River. This can occur either when the interior pump station capacity is insufficient to remove the run-off quickly enough from the drainage area when high Mississippi River stages prevent gravity flow or and when high river stages increase ground water levels decreasing absorption.

More frequent events affecting a specific drainage area create damages limited to a particular watershed. These problems are widespread across the area. These interior floods occur typically every two to five years.

Unlike the other problems identified in this Project, the problem of interior flooding has been the subject of numerous reports prepared by a number of different local, state and federal agencies. However, to date no definitive solution has proved to be economically viable to address the situation and as a result, the cycle of flooding and disaster relief continues. Nevertheless, an opportunity exists to address flood damage reduction as part of the efforts to restore the historic flood pulse to the Project area. This opportunity occurs because of the multi-faceted nature of the flood pulse restoration measures.

5.3.5 Cultural Resources. Literally hundreds of prehistoric and historic archeological resources are located throughout the Project area and are under constant threat from the pressures of development. The most well known site is the world-renowned Cahokia Mounds which is a World Heritage Site recognized by the United Nations. Despite the fact that more than 2,000 acres of the Cahokia Mounds site are publicly designated, more than one third of the site is still in private hands and is highly vulnerable to commercial or residential development.

Recent archaeological and archival investigations conducted at, or near Cahokia Mounds, reveal that the prehistoric site of Cahokia Mounds was built in the middle of a large prairie. This prairie, known by the early European settlers as Cold Prairie, undoubtedly supported a diverse group of animal and plant species that were important to the prehistoric residents of Cahokia and its surrounding villages.

Unfortunately, the conversion of the land for farming and urban development during the twentieth century have not only eliminated the former prairie habitat, but also has destroyed the physical remains of a significant percentage of the prehistoric settlement that once dotted the floodplain landscape surrounding Cahokia and throughout the Project area. Investigations have confirmed that the entire Project area was intensively utilized by successive waves of Native Americans for thousands of years prior to the arrival of European settlers.

The Project Team has concluded that if present growth rates throughout the Project area continue unabated during the twenty-first century, virtually all of the archaeological sites not currently in public ownership will be destroyed by commercial and residential development. If that is allowed to occur, the loss of the information contained in these sites will have a profound effect upon the ability of future generations to accurately interpret the prehistory of the Project area – one of the most significant prehistoric regions in all of North America.

An opportunity exists where feasible to incorporate the locations of archeological sites present in the Project area into the boundaries of the habitat areas developed for this Project. In this manner, the irreplaceable information contained within these sites will be protected and available for the benefit and enjoyment of future generations of all Americans. .

5.3.6 Outdoor Recreation. The area is fortunate to have both the Horseshoe Lake and Frank Holten State Park systems and a start in implementing a "rails to trails" program. However, as the Project area continues to develop, there will be a growing need for additional outdoor recreation areas. As the surrounding land becomes increasingly urban, additional pressure is placed on the wildlife areas managed in the Horseshoe Lake State Park. Each of the counties have plans to enhance their outdoor recreational resources to attempt to keep pace with the growing population and ever expanding interest in outdoors activities. Opportunities exist within the Project area to improve outdoor recreational opportunities through the restoration, protection and enhancement of existing ecosystem resources. Eco-education and related tourism is a new pastime of a society chiefly separated from natural areas and environmental resources. The opportunity also exists to adapt the existing flood protection system to meet outdoor recreational needs while the restoration and expansion of natural areas could create connectivity to augment and expand existing outdoor recreational opportunities.

5.3.7 Summary. As noted above, the main problems within the Project area are loss and degradation of ecological resources, excessive rates of sediment transfer from tributary watersheds to the floodplain (which contributes to degradation of water quality and aquatic habitats), and persistent recurring flooding that damages property. After looking at the cause and effect of these problems in depth, it becomes clear that they are inter-related and require a watershed-based focus in the search for potential opportunities and solutions. Natural ecosystem areas must be restored now in order to protect them from extinction on the floodplain. Likewise tributary streams must be restored now in order to protect them from being lost. Stormwater is the only viable floodplain hydrology source that remains to re-create and revitalize the natural ecosystem.

The beneficial uses of this water provide the possibility of identifying numerous environmental opportunities that could not otherwise be realized. An investigation of the pre-settlement hydrology of the area provides a picture of a vibrant natural ecosystem sustained by over-bank flooding coming from the Mississippi River as well as from the tributary watersheds. This investigation, coupled with an inventory of existing natural areas, provides a roadmap for restoration possibilities.

Ecosystem services are the "conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life" (Daily et al. 1997). They are essential to our civilization, in that we cannot replace them with existing technology. A principal service of natural ecosystems is the maintenance of biodiversity and the production of economically important goods. Examples of fundamental life support services are numerous, and include air and water purification, flood and drought abatement, soil generation and preservation and replenishment of soil fertility, and pollination of agricultural and native plants, among others (Daily et al. 1997). Society often takes these services for granted and views them as available at no cost. Yet, economic developments that modify or destroy natural ecosystems may diminish the flow of "free" services, and generate long-term costs that can exceed the short-term gains of development (Daily et al. 1997).

For the purposes of this Project, the interior flooding problems will be viewed as an ecosystem service opportunity, and the evaluation of the use of stormwater events to restore a flood pulse necessary to mimic pre-settlement ecosystem conditions as a foundation of the formulation process. In taking this approach the protection of restored floodplain resources from sediment being transported out of the tributary stream system and the improvement of the quality of water now carrying heavy sediment loads will be essential to consider in the development of alternative plans.

It is believed that through the identification of the ecosystem services gained from environmental restoration actions, the cost of ecological restoration activities can be competitive with other demands for limited public financial resources. By clearly demonstrating the many contributions to social well being that ecosystem restoration achieves, a restoration project can become the focal point of an area's master plan. From the onset of this Project, the potential mitigation of floods by the natural ecosystem has been highlighted as the most important service to provide social well-being for the Project area.

5.4 PLANNING OBJECTIVES

5.4.1 Introduction. Protection of the Nation's environment is achieved when damage to the environment is eliminated or avoided and important cultural and natural aspects of our nation's heritage are preserved. Various environmental statutes and executive orders assist in ensuring that water resources planning is consistent with protection. The objectives and requirements of applicable laws and executive orders are considered throughout the planning process in order to meet the Federal objective. The Federal objective for the relevant planning setting should be stated in terms of an expressed desire to alleviate problems and realize opportunities related to the output of goods and services or to increased economic efficiency consistent with protecting the environment. Water and related land resources project plans will be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. (Engineering Regulation 1105-2-100)

Specific objectives for this Project have been developed in response to the problems and opportunities identified during the scoping, public involvement, and early Project research efforts. The analysis of pre-settlement land cover and conditions in the Project area became the guide to establishing restoration planning targets for the Project. The comparison of historic land cover mapping with today's existing conditions provided insight into restoration possibilities.

In general, planning objectives are specific operational statements that provide the direction for the development of specific alternative plans. The planning objectives for this Project are identified below, in no particular order of importance. Planning targets were developed for each objective based on an analysis of pre-settlement conditions and existing conditions in order to provide information to the team during the iterative evaluation and assessment process. These planning targets served as guideposts for developing alternative plans, and for comparing the desired restoration to the level of restoration expected to be achieved through the implementation of any alternative plan.

5.4.2 Planning Objectives.

5.4.2.1 Planning Objective 1 - Restore Natural Areas.

Objective: Increase the overall spatial extent of under-represented natural communities by restoring and expanding existing natural areas wherever possible.

Planning target: Natural areas to be restored by the Project should contain ten percent of the historic amount of Mississippi River floodplain forest in the Project area (1,880 acres), five percent of the historic amount of floodplain prairie in the Project area (1,612 acres), and 100 acres of created (new) floodplain marsh. Floodplain forest is to consist of one-third existing forest (627 acres) and two-thirds new forest (1,253 acres).

This objective addresses losses in the Project area of forest and prairie, the two natural communities in the historic ecosystem that were most abundant spatially. The objective also addresses the fragmentation of today's natural communities, and focuses expansion efforts on enlarging existing natural areas. (The term "natural area" as used in the context of the Project objectives refers to natural habitats, as opposed to cultural habitats, like cropland or developed areas, and not the natural or relatively undisturbed areas recognized by the Illinois Natural Areas Inventory.)

The target for forest emphasizes the creation of new forest around existing forested areas. Because there is very little remnant prairie today, the target for prairie represents new prairie to be created by the Project. Unlike forest and prairie, the target for marsh was not based on an estimate of historic spatial extent because none was available.

The interagency team of biologists working on this Project established the planning target for this objective. The target was set using professional judgment without the benefit of any guidelines suggesting the area required for sustainable ecosystems located within urban settings.

Unfortunately, no such guidelines were available to the team. The combined area of forest, prairie, and marsh is about 3,500 acres, which represents about six percent of the floodplain Project area, excluding water. The team believed that the specified amounts of forest, prairie, and marsh were attainable in the Project area given remaining open space.

A plan formulated for this Project would achieve this objective if it were to incorporate 1,880 acres of new and/or protected forest, 1,612 acres of new prairie, and 100 acres of new marsh.

5.4.2.2 Planning Objective 2 - Restore Flood Pulse.

Objective: Reintroduce a flood pulse into floodplain natural areas that mimics the historic hydrological condition.

Planning target: The maximum flood pulse will not exceed the depth of the Mississippi River flood of 1844 at St. Louis, or 14 days in duration.

This objective addresses the loss of seasonal riverine overflows on the floodplain due to the construction of the Mississippi River levee and the channelization of tributary streams that has isolated most remaining floodplain wetlands from their principal historic source of hydrology, and has resulted in the reduction of the wetlands' capacity to perform various functions.

Like the first objective, the biology team developed the planning target for this objective using professional judgment. The team desired to restore a flood pulse that would mimic historic hydrological conditions on the presettlement floodplain. In terms of timing, restored flooding would vary from season to season and year to year. Depth and duration of restored flooding would also vary from one event to another. All events would exhibit a natural rise and fall, and there would be a continuum of events in terms of depth and duration, from shallow and brief to deep and prolonged.

Like the natural hydrological cycle, shallow flood events would occur more frequently than deeper ones. Controlled or managed flooding that follows a predetermined schedule in terms of timing, depth and duration was not desirable.

The biology team identified three biological concerns associated with reintroduction of surface flooding into study area wetlands. First, water used for this purpose would need to be relatively free of pollutants associated with agricultural runoff and urban storm water. Second, restored floodplain habitat resources would need to be protected against the introduction of large sediment loads coming out of the tributary streams. Third, because flooding of long duration (on the order of weeks and months) can kill submerged vegetation, introduced flood events, especially those of greatest depth, would need to recede in a shorter amount of time than what the Mississippi River once did, in order to maintain the integrity of plant communities occurring in existing wetland resources that are relatively scarce today. Without a limit, flood durations of weeks or months would have the potential to cause extensive mortality in plant communities, especially forested ones, much like what occurred infrequently in predevelopment times.

To address the second concern, the team decided to establish a limit to the duration of flood events introduced into floodplain wetlands. The team chose 14 days as the maximum duration based on best professional judgment. In other words, the duration of the rise and fall of a flood event would not exceed two weeks. Many wetland plant species can tolerate flooding of this duration without harm, especially if portions of individual plants are not submerged and remain exposed to air. Along these lines, the biology team believed that the introduction of a restored flood pulse as characterized here into study area wetlands would be incompatible with the long-term sustainability of local populations of threatened or endangered plant and animal species that are historically adapted to dynamic floodplain habitats.

In brief, the team desired to restore a flood regime as if the main levee along the Mississippi River was not present, and the river could overflow the floodplain once again. But because reestablishment of such a connection with the river could never occur in today's environment, other sources of water would need to substitute for what the Mississippi once did. As such, the team found it necessary to identify an upper bound to the continuum of restored flood events. Because there was no good estimate of the stage-discharge relationship of the Mississippi River at St. Louis under predevelopment conditions, the team chose the 1844 flood as the upper limit for depth of restored flooding. At its peak, this event inundated nearly the entire floodplain. Depending on local topography, flood depth often ranged from five to ten feet, and at some locations it exceeded 20 feet. The analysis of the 1844 flood indicates it was about a 30-year event and as such was determined to provide a reasonable upper limit based on best professional judgment.

A plan formulated for this study would achieve this objective if it were to incorporate restoration of a flood pulse having a maximum depth not to exceed that of the 1844 flood, and a maximum duration not to exceed 14 days.

5.4.2.3 Planning Objective 3 - Restore Habitat Quality.

Objective: Restore habitat quality in existing and re-created natural areas.

Planning target: Develop and maintain, at a minimum, moderate habitat quality for all evaluation species in restored natural areas.

This objective addresses the problem of generally low habitat quality within the Project area. The biology team desired to improve habitat conditions. Existing habitats incorporated into any plan, as well as new habitats created by a plan, would be improved if needed or modified to achieve at least "average" quality. The method to be used to assess habitat quality would be the same procedure employed to evaluate baseline or existing conditions within the Project area. Under the Habitat Evaluation Procedures (HEP), the team used nine wildlife species as indicators of conditions in a variety of existing terrestrial, wetland, and aquatic habitats (Appendix A). These same species, along with their habitat requirements, would be used to assess future habitat conditions, both with and without any project.

According to HEP, no habitat quality is represented by a habitat suitability index (HSI) of 0, and optimal quality by 1. The team defined average or moderate quality as an HSI of 0.5. Under this objective, an HSI of 0.5 or better was desired in all habitats used by the nine evaluation species. The team thought that this target was attainable.

A plan formulated for this Project would achieve this objective if it were to provide at least moderate habitat quality in all habitats used by the nine evaluation species.

5.4.2.4 Planning Objective 4 - Improve Water Quality.

Objective: Improve the quality of surface waters.

Planning target: Reduce levels of sedimentation in as many surface tributaries as possible.

This objective addresses the problem of degradation of surface water quality. Multiple sources of water quality impairment exist in the Project area, including agricultural uses, urban runoff, point source discharges (industrial and public/private treatment works) and land development. It was beyond the scope of this Project to address and develop measures to ameliorate all these sources of impairment. However, sedimentation resulting from head cutting and bank failures originating in tributary watersheds was within the scope of the Project and was found to be the source of much of the sediment carried by floodplain tributaries. The Project objective to restore connectivity between tributary streams and floodplain resources in order to restore a floodpulse made the issue of water quality directly related to the protection of restored habitat resources. Improving surface water quality prior to its being carried into restored natural areas was a basic requirement to ensure sustainability of resources.

In response, the planning team focused on reducing existing, excessive levels of sediment transported by surface tributaries. (Objective 5 addresses control of erosion from tributary watersheds.) Potential measures to do this could be implemented in tributary watersheds as well as on the Mississippi River floodplain. The planning target established for this objective was not a particular benchmark, but a relative one, i.e. reduce levels of sedimentation in as many surface tributaries as possible.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by spatial extent of surface tributaries in the Project area receiving improved water quality through reductions in sedimentation.

5.4.2.5 Planning Objective 5 - Reduce Erosion.

Objective: Reduce erosion in the tributary watersheds.

Planning target: Reduce the total amount of sediment reaching the bottoms by 70 percent.

This objective addresses the problem of erosion and sedimentation occurring in the Project area. Excessive levels of sediment are being transported from tributary watersheds to the floodplain.

The National Resources Conservation Service (NRCS) predicted that measures could be implemented in the tributary streams to reduce sediment loads to the floodplain by 70 percent (Appendix E). At this level of reduction, much sediment would be retained in the tributary stream system, but some sediment would remain suspended to minimize the potential for scouring to occur in floodplain channels once flows leave the bluffs. The Project team adopted NRCS' figure of 70 percent as the planning target for this objective.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by whether or not they reduce the amount of sediment reaching the bottoms by 70 percent.

5.4.2.6 Planning Objective 6 - Restore Tributary Streams.

Objective: Restore the stability of tributary streams in order to restore stream quality and aquatic functions.

Planning target: Stabilize banks and channel bottoms and create riffle and pool complexes in as many watersheds as possible.

This objective addresses the problem of unstable tributary stream channels and degradation of finite stream resources. Many streams in the tributary watersheds exhibit unstable bank lines and/or channel bottoms. One of the major sources of sediments transported to the floodplain is sloughing stream bank lines and head cutting. Stabilization of tributary streams would restore and sustain aquatic habitat conditions in the streams, minimize damages to private property and local infrastructure, and reduce the amount of sediment transported to the floodplain.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by whether or not they include measures to stabilize banks and channel bottoms and create riffle and pool complexes in tributary streams.

5.4.2.7 Planning Objective 7 - Restore Floodplain Streams.

Objective: Restore floodplain streams and associated riparian corridors.

Planning target: Recreate flowing floodplain streams with associated riparian corridors for a distance equivalent to 10 percent of the floodplain length of historic Cahokia Creek (four miles) and establish three miles of riparian corridor linkages between existing or proposed natural areas.

This objective addresses the loss of biodiversity, or more specifically, floodplain streams and their associated riparian habitats. Wooded or riparian forests adjacent to stream channels are ecologically important areas because they support a wide variety of plant and mammal, amphibian, reptile, and bird species. Streams themselves serve not only as sources of water for wildlife, but adjacent forest is often used as a travel corridor. Such corridors often serve as links between landscape features, including floodplain-floodplain and floodplain-upland linkages.

Design criteria for riparian zones to be established as wildlife habitat vary depending on the kind of animals to be benefited. Relatively narrow corridors (≤ 328 feet, or 100 meters) can support a number of small mammals and various amphibians and reptiles, whereas area-sensitive birds need much wider riparian zones (Burbrink et al. 1998, Fischer 2000). The biology team did not consider riparian zones wide enough to support area-sensitive bird species to be feasible in the Project area because of the intense land use pressures that are present. A riparian zone with a width of 328 feet (100 meters) was viewed as feasible by the team, and a zone less than 328 feet wide was considered to be of lesser suitability for wildlife.

The biology team established the planning target for this objective using professional judgment. The 4-mile channel restoration target was chosen based on an analysis of existing conditions and was considered to be attainable within the Project area. This target consists of incorporating existing remnants of floodplain streams with the reopening of historic channels that have been filled in by development. Adjacent to the restored streams, a riparian zone up to 328 feet wide would be created on both sides of the channel.

The team also set the 3-mile corridor target based on an analysis of existing urban conditions. Given the number of miles of existing floodplain ditches in the Project area, it also was considered to be achievable. The establishment of one or more landscape linkages would center upon these existing floodplain channels. A corridor would be created on both sides of the channel, with a width up to 328 feet on either side. The corridor would consist of one-third existing habitat, and two-thirds restored habitat. In other words, restored corridor habitats would be added to existing corridor habitats. Restored corridors could consist of forest or other natural types of vegetation.

A plan formulated for this Project would achieve this objective if it were to provide four miles of restored floodplain streams and establish three miles of riparian corridor linkages between existing or proposed natural areas.

5.4.2.8 Planning Objective 8 - Incidental Social Objectives

The interrelationship between problems and opportunities that was identified through the public involvement process dictated the need to identify and measure incidental Project contributions to the social well being of the area. As previously discussed, it was deemed important to quantify the ecosystem services that would be provided as a natural by-product of the restoration Project in order to ensure the public had a full appreciation of the many positive benefits to be realized from an ecosystem restoration project. Objectives designed to focus on these issues were developed to ensure that ecosystem services incidentally provided by the Project could be tracked and quantified.

Objective 8a - Reduce flood damages in urban and agricultural areas.

Planning target: To the maximum extent possible as an incidental occurrence of restoring a floodplain flood pulse.

This objective addresses the problem of flooding and resulting flood damages within the Project area. The three co-sponsors of this Project deem the measure of this objective essential: the Illinois Department of Natural Resources (Office of Water Resources); Madison County, Illinois; and St. Clair County, Illinois.

Stormwater remains the most viable source of water to restore the flooding regime in restored natural areas. A reconnection of this naturally occurring resource within the watershed to the floodplain restored natural areas would serve the purpose of restoring a flood pulse. As a result of this inseparable connection between flood pulse restoration and flood damage reduction, a sub-objective was created so it could be tracked and ultimately measured.

To gauge performance against this objective, plans formulated for this Project would be analyzed using a traditional risk-based flood damage reduction analysis to quantify incidental benefits.

Objective 8b - Enhance Outdoor Recreation.

Objective: Increase and enhance outdoor recreational opportunities within natural areas.

Planning target: Provide passive outdoor recreational opportunities at as many sites as possible.

This objective addresses the problem of a growing public need for outdoor recreational resources as the Project area continues to urbanize. Passive outdoor recreational opportunities that are compatible with the out-of-doors, preservation of green space, and protection of natural habitats would be incorporated into plans developed for the Project. Examples of such activities include hiking/walking, recreational fishing, outdoor education, photography, bird watching and nature study.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by relative number of sites and their ability to create connectivity with existing outdoor recreation facilities.

Objective 8c - Protect Cultural Resources.

Objective: Protect cultural and archeological resources and enhance their values.

Planning target: Envelop known archaeological sites into Project lands rather than attempt to avoid them.

This objective addresses the problem of continuing loss of significant cultural resources to development and urbanization. The existing Cahokia Mounds State Historic Site includes only about 2,000 acres of land. Expansion of this public area to protect significant archaeological resources now located on private lands would safe guard these locations for future generations. Because prehistoric occupation of the Project area was extensive, incidental protection of cultural resources could result within the study area. A geospatial database of known archaeological sites, maintained by the Illinois State Museum and Illinois Historic Preservation Agency, can serve as an indicator of site presence or absence.

To gauge performance against this objective, the area of known sites incorporated within the boundaries of each plan would be compared.

5.5 PLANNING ASSUMPTIONS AND CONSTRAINTS

5.5.1 Assumptions:

- The existing levee system and interior flood control system will remain functional and operational.
- The existing pump station capacities are adequate and will not be impacted by Project recommendations.
- Pre-development conditions can be used to guide the development of ecosystem restoration plans in order to address multiple problems.
- Ecosystem restoration can provide incidental flood damage reduction and be competitive for scarce sponsor financial resources.
- Watershed based solutions will be essential based on the Project area characteristics and the limited remaining resources.

5.5.2 Constraints:

- Limitations within the Corps of Engineers' program prevent the investigation of problems associated with combined sewers under the flood control and environmental restoration authority and thus presents a constraint to this study's ability to address problems of combined sewer overflow, as expressed by the citizens in areas like East St. Louis.
- Limitations within the Corps of Engineers' program prevent the investigation of interior drainage problems impacting less than one square mile and thus presents a constraint to this study's ability to address floodplain flooding caused by the ponding of stormwater falling on the floodplain itself.
- Limitations established by the existing flood protection system and drainage canal system.
- Limitations of available land suitable for ecosystem restoration.

5.6 SUMMARY AND CONCLUSION

The primary focus of this Project is to develop a comprehensive, integrated solution to the ecosystem degradation that is adversely impacting the area. As discussed, the Project area problems are highly inter-related. Ecosystem degradation varies throughout the Project area due to changing land uses, the influence of sedimentation, the quantity and quality of surface waters and streams, and the inability of surface water to connect to natural areas. Similarly, throughout the Project area, there are varying levels of flood protection primarily due to land use changes that have occurred since construction of the existing flood protection project in the early 1900's.

As the focus on the need for flood protection has increased, the response has been to attempt to control available water resources in a ditch and channel system. The control of this important resource has in turn adversely affected the biodiversity of the area. As agricultural and urban developments continue, existing natural areas will be lost. Urban runoff will continue to adversely impact the quality of water resources and stability and functions of streams, and cause flood damages in the Project area, while making no positive contribution to the ecosystem.

The problems and opportunities identification process discussed in this Section has established linkages between opportunities for ecosystem restoration and problems associated with the loss of natural habitat, sedimentation and flooding. By focusing on watershed-based solutions to restoring natural areas and reconnecting them with the available hydrology (stormwater), it appears that significant improvements can be made to the ecosystem of the Project area. Next, the formulation process will focus on the development of alternative plans to address the planning objectives.

SECTION 6 PLAN FORMULATION AND EVALUATION

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SECTION 6 - PLAN FORMULATION AND EVALUATION

The East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project has been conducted in accordance with the procedures specified in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (1983); Guidance for Conducting Civil Works Planning Studies (ER 1105-2-100, 28 December 1990); and Ecosystem Restoration in the Civil Works Program (EC 1105-2-210, 20 April 1995). Plan formulation activities were conducted following the six step planning process described in Chapter 5 of ER 1105-2-100. Plan formulation efforts on the East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project included the following activities:

1. Specified the water and related land resource problems and opportunities of the project area. Identified planning goals and constraints to meet the Federal interests and address specific state and local concerns.

2. Inventoried forecast and analyzed the water and related land resource conditions in the project area. Developed future without-project conditions for the project area over the planning period (i.e., 50 years).

3. Identified and formulated structural and non-structural alternatives that met the problems and opportunities of the project area and contributed to Federal objectives. Alternatives were developed in an iterative process, with increasing level of detail as preliminary plans were screened and the final set of alternatives were developed.

4. Assessed the impacts of each alternative. The effects of each alternative that survived the initial screening process are presented and displayed.

5. Compared the alternative plans. The comparison of alternatives focused on the differences between each plan in terms of their beneficial and adverse impacts and contributions to the planning objectives.

6. Identified a preferred plan after considering the final set of alternatives and their effects, and receiving public input. Identified and selected the NER plan, unless an exception was granted.

The basis for formulation and selection of the preferred plan for the East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project is fully documented below, including the logic used in the plan formulation and selection process.

6.1 PLAN FORMULATION AND EVALUATION METHODOLOGY

6.1.1 Plan Formulation. As a re-evaluation study, for an authorized project, the formulation process involved the analysis of previously preferred plans and the development of a new strategy that built on the previous lessons learned while taking full advantage of the added project purpose for environmental restoration. This allowed for a broader focus than those previously employed in order to seek viable solutions for identified problems and opportunities.

The purpose of this Section is to explain the formulation process used to re-evaluate the area. The process included the identification of potential restoration sites, evaluation and assessment of these sites, the identification of project action areas, the development of alternative plans within these distinct action areas, and the comparison of several plans enveloping all of these action areas. This method provided the information necessary to assess and evaluate alternatives within the project area in order to develop a recommended project plan.

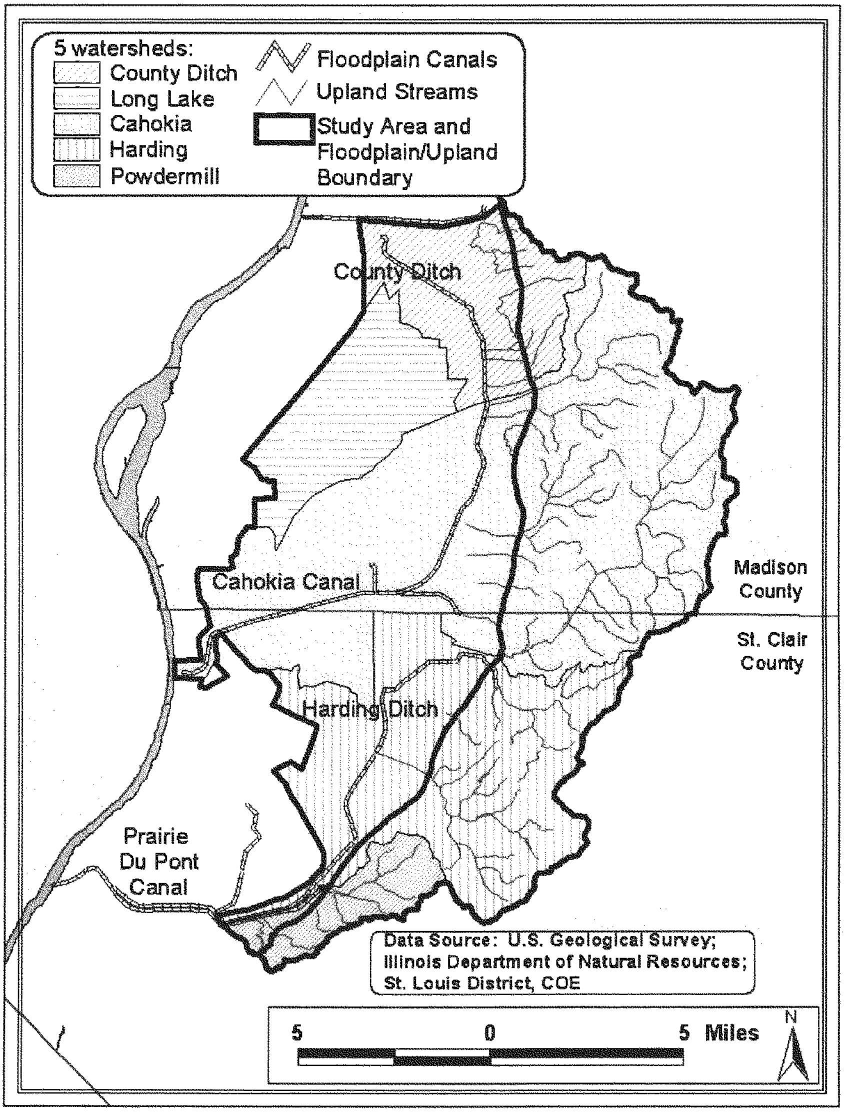
In order to ensure the broadest focus possible, it was necessary to assemble a team dedicated to the project that represented the full spectrum of Federal and State interests. The team assembled included the following: the U.S. Environmental Protection Agency Region 5, a cooperating agency in the preparation of this Project's Draft Environmental Impact Statement (DEIS), who not only contributed the efforts of many experts within their agency during the study process but also provided a dedicated member to the biology team; the Natural Resource Conservation Service, a cooperating agency in preparing the DEIS, who provided the efforts of experts within their State and local District Offices for the duration of the analysis while also providing a dedicated member to the biology team; the U.S. Fish and Wildlife Service, whose local office provided guidance through the process and the dedicated participation of a member to the biology team; the Illinois Department of Natural Resources, who provided engineering support and a dedicated member to the biology team; and the Corps' Engineer Research and Development Center (Waterways Experiment Station), who provided technical guidance and support throughout the environmental assessment and alternative/incremental analysis process.

The plan formulation process was a repetitive or iterative process that was initiated with the identification of potential sites, developing applicable measures for attaining project objectives for each site, and assessing each site's viability. Based on their relative inability to contribute to project objectives, less effective sites were removed after an initial screening. From this assessment and evaluation process, potential project action areas were identified, and they also were screened through an iterative process to identify and eliminate less effective action areas. Once project action areas were selected, an array of alternative plans for each was designed to achieve the planning objectives. Alternatives for each action area were then modified and re-evaluated as additional information was developed.

This process met the goals of the Corps' planning guidance, scoping requirements contained in the National Environmental Policy Act, and agency implementing regulations. Each iteration of this process provided an opportunity to refine and sharpen the planning focus based on more detailed technical investigation, and public and agency input. The biology team used results from incremental cost analyses to further refine the assessment process. From the final incremental cost analysis a final two-phase screening process was used to determine the Preferred plan.

6.1.2 Evaluation Methodology. The evaluation methodology progressed through a series of steps that took the analysis from the general to the specific. The first step involved the inventory of the entire project area to identify specific sites that had the potential based on location, existing habitat, soils, or hydrology to contribute to the project objectives. Based on the size and complexity of the project area (166 square miles) it was decided by the team to utilize the same watershed approach used in the 1984 study to assist in organizing the initial formulation process of "site" inventory. The pre-settlement hydraulic and biological conditions, coupled with an inventory of the remaining natural areas and analysis of the hydraulic alterations to the natural system, made the utilization of this watershed approach a logical initial organizing tool. Figure 6-1 shows the 5 major watershed drainage areas used to organize the floodplain and bluff drainage areas for analysis purposes. The primary screening tools used during the study were the Habitat Evaluation Procedures (HEP) for assessing quality of floodplain habitats, the Qualitative Habitat Evaluation Index (QHEI) for evaluating stream quality in the tributary watersheds, and the National Environmental Restoration (NER) cost effectiveness and incremental cost analysis procedures specified in EC 1105-2-210 for ecosystem restoration features, and the public and agency involvement process. There was an attempt to use the HydroGeoMorphic Approach to assess wetland functions to more objectively demonstrate the benefits of floodplain flood pulse restoration using storm water, however the model was not completed in time for such an analysis to occur for every action area. HGM models were applied at the Dobrey Slough, Brushy Lake and Elm Slough action areas. For the remainder of the areas, best scientific judgment was used to quantify these benefits. The process, findings and results of the plan formulation are presented below.

Figure 6-1 Project Area Watershed Divisions



6.2 PLANNING OBJECTIVES AND MEASURES

During the identification of problems and opportunities described in Section 5, seven primary planning objectives were developed to address the public's major concerns for environmental degradation, loss of open/green space, erosion control, and stream bank stability in the project area. Three incidental social planning objectives were identified as ecosystem services anticipated being a consequence of an environmental plan. These objectives were related to the public's desire for reduced flood damage, increased recreational opportunities, and protection of unique cultural resources.

Objective 1. Increase the overall spatial extent of under-represented natural communities by expanding existing natural areas wherever possible.
[Short name: Restore natural areas]

Objective 2. Reintroduce a flood pulse into floodplain natural areas that mimics the historic hydrological condition. [Short name: Restore flood pulse]

Objective 3. Restore and enhance habitat quality in existing and re-created natural areas.
[Short name: Restore habitat quality]

Objective 4. Improve the quality of surface waters. [Short name: Improve water quality]

Objective 5. Reduce erosion in the tributary watersheds. [Short name: Reduce erosion]

Objective 6. Restore the stability of tributary streams.
[Short name: Restore tributary streams]

Objective 7. Restore floodplain streams and associated riparian corridors.
[Short name: Restore floodplain streams]

Objective 8. Incidental Social Objectives (ecosystem services)

a. Reduce flood damages in urban and agricultural areas.
[Short name: Reduce flood damages]

b. Increase and enhance recreational opportunities within natural areas.
[Short name: Enhance recreation]

c. Protect cultural and archaeological resources and enhance their values.
[Short name: Protect cultural resources]

6.2.1 Measures. The Project Team identified and developed a number of measures that could be implemented in support of each objective. They are listed below by project objective.

Objective 1. Restore natural areas
Measures:
1-Obtain land (existing or new habitats)
2-Create habitats (forest, prairie, marsh)

Objective 2. Restore flood pulse
Measures:
1-Modify existing channels
2-Construct new channels
3-Divert surface flow into habitat areas
4-Construct earthen berms to contain flood pulse in habitat areas
5-Detain surface flow in habitat areas

Objective 3. Restore habitat quality
Measures:
1-Increase tree species diversity and abundance in existing upland and floodplain forests (implement tree stand improvements, or selective clearing and planting of underrepresented species, such as oaks)
2-Install nesting boxes in existing marshes and floodplain forest (i.e., wood duck)
3-Add flood pulse to existing floodplain wetlands, lakes, ponds, borrow pits
4-Remove standing water from areas of "drowned" forest
5-Create overwintering areas for fish in existing floodplain lakes and ponds
6-Add woody debris in floodplain lakes and ponds
7-Add shoreline plantings in existing floodplain channels, lakes, ponds, borrow pits
8-Augment base flow in existing floodplain channels with new pump station
9-Add riffle and pool complexes in tributary streams
10-Protect natural areas by restricting them to compatible uses

Objective 4. Improve water quality
Measures:
1-Construct buffer strips and tile outlet terraces to control erosion in upland agricultural areas
2-Construct in-stream sediment detention basins in tributary streams or on the floodplain to capture sediment
3-Create riffle and pool complexes in tributary streams to capture sediment and oxygenate the water
4-Construct in-channel grade control structures in tributary streams to prevent headcutting
5-Plant grassy or prairie buffers in floodplain swales to capture sediment

Objective 5. Reduce erosion
Measures:
1-Construct tributary sediment detention basins
2-Construct terraces in the uplands
3-Construct underground outlet & subsurface drains in the uplands
4-Construct water and sediment control basins in the uplands
5-Install critical area plantings in the uplands
6-Construct diversions in the uplands
7-Install filter strips in the uplands
8-Install grass waterways in the uplands
9-Stabilize banks of tributary streams
10-Install grade control structures in tributary streams
11-Create riffle and pool complexes in tributary streams
12-Allow for natural deposition of sediment on alluvial fans
13-Construct lowland dry sediment detention basins

Objective 6. Restore tributary streams
Measures:
1-Stabilize banks of tributary streams
2-Create riffle and pool complexes
3-Construct in-channel grade control structures
4-Implement bio-erosion control techniques

Objective 7. Restore floodplain streams
Measures:
1-Obtain land
2-Reconnect historic stream channel fragments
3-Plant natural vegetation
4-Create connectivity corridors between natural areas that are centered along existing streams, by planting natural vegetation
5-Create connectivity corridors between natural areas that are centered along existing ditches, by modifying existing ditch system (set back one or both levees) and planting natural vegetation within levees
6-Create connectivity corridors between natural areas that are centered along existing ditches, by planting natural vegetation outside levees

Objective 8. Incidental Social Objectives

8a. Reduce flood damages
Measures:
8a-1-Modify existing channels
8a-2-Construct new channels
8a-3-Divert surface flow into temporary storage areas
8a-4-Construct earthen berms
8a-5-Detain surface flow in temporary storage areas

8b. Enhance recreation
Measures:
8b-1-Construct trails
8b-2-Provide interpretive areas
8b-3-Provide signage
8b-4-Provide access areas

8c. Protect cultural resources
Measures:
8c-1-Obtain selected sites
8c-2-Plant historic natural vegetation
8c-3-Add historic flood pulse
8c-4-Provide interpretive areas

6.2.2 Planning targets. As described in Section 5.4.2, achievement of each of the eight planning objectives is to be measured by comparing plan outputs with a planning target established for each objective. These planning targets are as follows:

Planning Target 1. Restore natural areas
Restore ten percent of the Project area's historic amount of Mississippi River floodplain forest (1,880 acres), five percent of the Project area's historic amount of floodplain prairie (1,612 acres), and increase the amount of the Project area's existing floodplain marsh by100 acres.

Planning Target 2. Restore flood pulse
The maximum flood pulse would not exceed the depth of the Mississippi River flood of 1844 at St. Louis, or 14 days in duration.

Planning Target 3. Restore habitat quality
Develop and maintain, at a minimum, moderate habitat quality for all evaluation species used in the Habitat Evaluation Procedures in existing and re-created natural areas (moderate = 0.5 Habitat Suitability Index, no quality is represented by 0.0 HSI, optimal quality by 1.0 HSI).

Planning Target 4. Improve water quality
Reduce levels of sedimentation in as many surface tributaries as possible.

Planning Target 5. Reduce erosion
Reduce the total amount of sediment reaching the bottoms by 70 percent.

Planning Target 6. Restore tributary streams
Restore physical characteristics of streams in tributary watersheds, such as substrate, in-stream cover, channel morphology, bank and channel bottom stability, pool and riffle quality, and gradients, in as many watersheds as possible.

Planning Target 7. Restore floodplain streams

Restore flowing streams with associated riparian corridors on the Mississippi River's floodplain for a distance equivalent to 10 percent of the length of historic Cahokia Creek in the study area's floodplain (four miles), and restore three miles of riparian corridor linkages between existing or proposed natural areas.

Planning Target 8. Incidental Social Objectives (ecosystem services)

8a. Reduce flood damages
To the maximum extent possible within the flood pulse restoration target

8b. Enhance recreation
Provide passive outdoor recreational opportunities at as many sites as possible.

8c. Protect cultural resources

Expand, to the extent possible, the total public ownership of land within the Cahokia Mounds World Heritage Site, re-create the predevelopment environmental setting at Cahokia Mounds World Heritage Site, and incorporate archeological site boundaries into proposed project areas.

6.2.3 Constraints. In the development of restoration planning targets, which were based on the analysis of predevelopment conditions, the Project Team realized that planning targets needed to be balanced with constraints based on existing conditions. Urbanization in the area itself imposed many constraints on areas that could be considered for restoration. A number of different soils exist in the project area that are considered prime for the production of agricultural crops, and they are found not only on the Mississippi River floodplain but also in the tributary watersheds. Prime soils are those that produce the highest yields with the least amount of cost and effort, and with the least damage to the environment. Prime soils in the project area support the production of familiar row crops such as corn, soybeans, and wheat, but on the Mississippi River floodplain, they are often used to grow horseradish, a unique agricultural commodity for the region and nation. For over one hundred years, horseradish has been cultivated in the American Bottoms. Today about 60% of the world's supply is grown within the project area and immediate vicinity. Farmland in the project area is increasingly being converted to development and other nonagricultural uses. Additionally the desire to protect existing habitat quality, to avoid mitigation requirements, and to maintain the character of the project area resulted in the following project constraints and overall planning targets that would also be used to gauge restoration success.

Constraint 1: Avoid and minimize project-related impacts to wetlands and other natural habitats.

Target: No net loss of wetlands (forested wetland, marsh, prairie wetland), 100 acres maximum loss of upland forest.

Constraint 2: Minimize project-related impacts to prime and unique (specialized) farmland.

Target: Acquire for project-related purposes no more than 5% of all horseradish lands located in the floodplain portion of the Project area.

6.2.4 Assumptions. The planning team made several fundamental assumptions regarding the objectives. First, because a significant portion of the tributary watersheds that historically drained into the study area were diverted to the Mississippi River, restoration of a flood pulse would have to be made by using available surface waters. Second, the use of maps displaying predevelopment conditions would provide the key roadmap to the re-creation of floodplain natural systems.

6.3 IDENTIFICATION OF POTENTIAL RESTORATION SITES

The initial array of possible restoration sites for each watershed was developed based on insight provided by analysis of the pre-settlement land cover and hydrology, project restoration planning targets, public outreach, previous reports, identification of existing habitat sites and the knowledge of agency personnel. In this manner the Project Team developed a list of potential sites for the project area, which were organized and identified in relation to the five area watersheds.

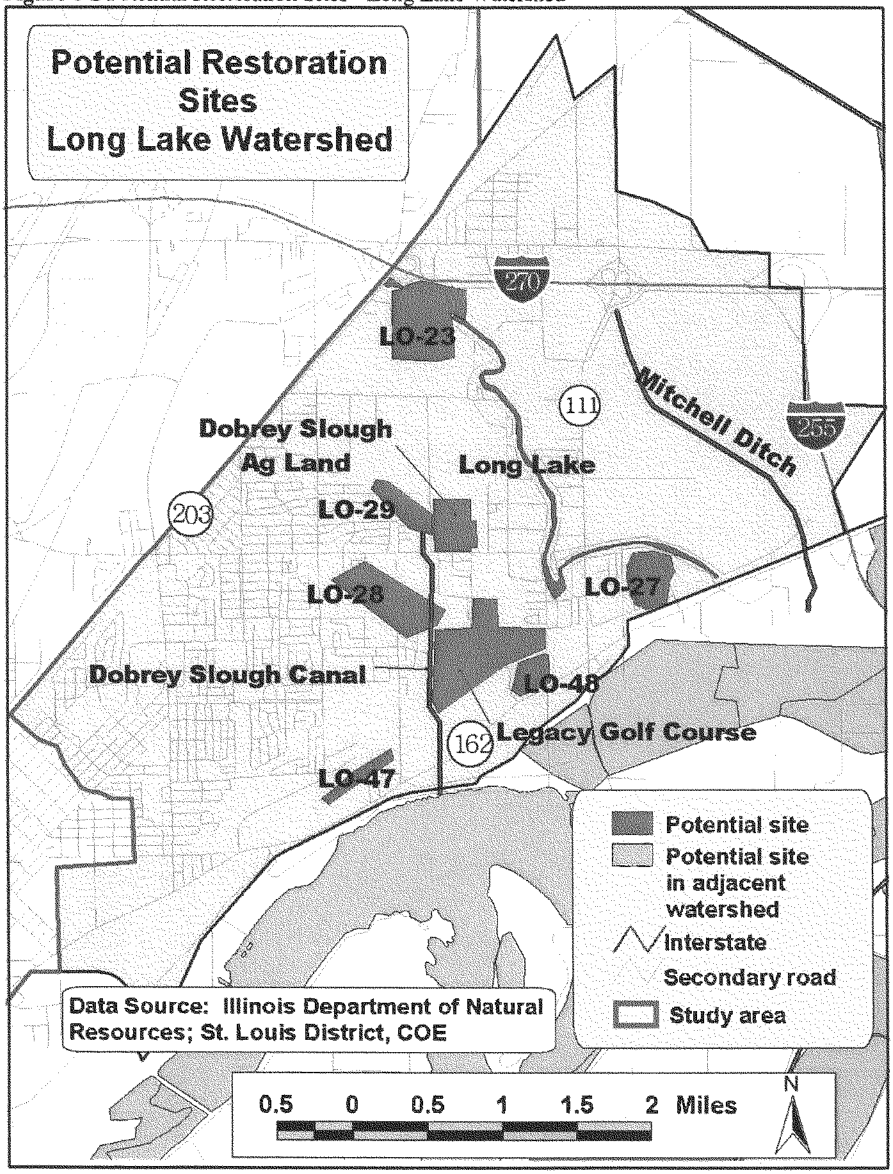
The following five watershed tables indicate the initial source of information for each site and provide the nomenclature used to identify each site within the watershed. For example LO represents the Long Lake watershed, CO – County Ditch, CA-Cahokia Canal, HA – Harding Ditch, and PO – Powdermill. Information sources were the Illinois Wetlands Inventory (IWI), Agency Personnel (AP), the Natural Resources Conservation Service's Wetland Inventory (NRCSW), the NRCS Upland Inventory (NRCS), various Reports (Rpts) and Public Involvement (PI).

The table for each watershed is accompanied by a figure showing the location of every site (Figures 6-2, 6-3, 6-4, 6-5, 6-6). Figure 6-7 displays all of the sites identified in all five watersheds.

Long Lake Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCSW	NRCS	Rpts	PI
Borrow Pits near Long Lake, south (LO-23)	X					
Borrow pit between Rte 162 and Long Lake (LO-27)	X					
Wetland along railroad track Granite City (LO-28)	X					
Dobrey Slough (LO-29)	X					X
Dobrey Slough Agricultural land east of tracks		X				
Wetland near Horseshoe Lake, Route 162, west (LO-47)	X					
Wetland West side of Lake Road Route 162, east (LO-48)	X					
Long Lake		X				X
Mitchell Ditch						X
Dobrey Slough Canal (concept)					X	X
Legacy Golf Course						X

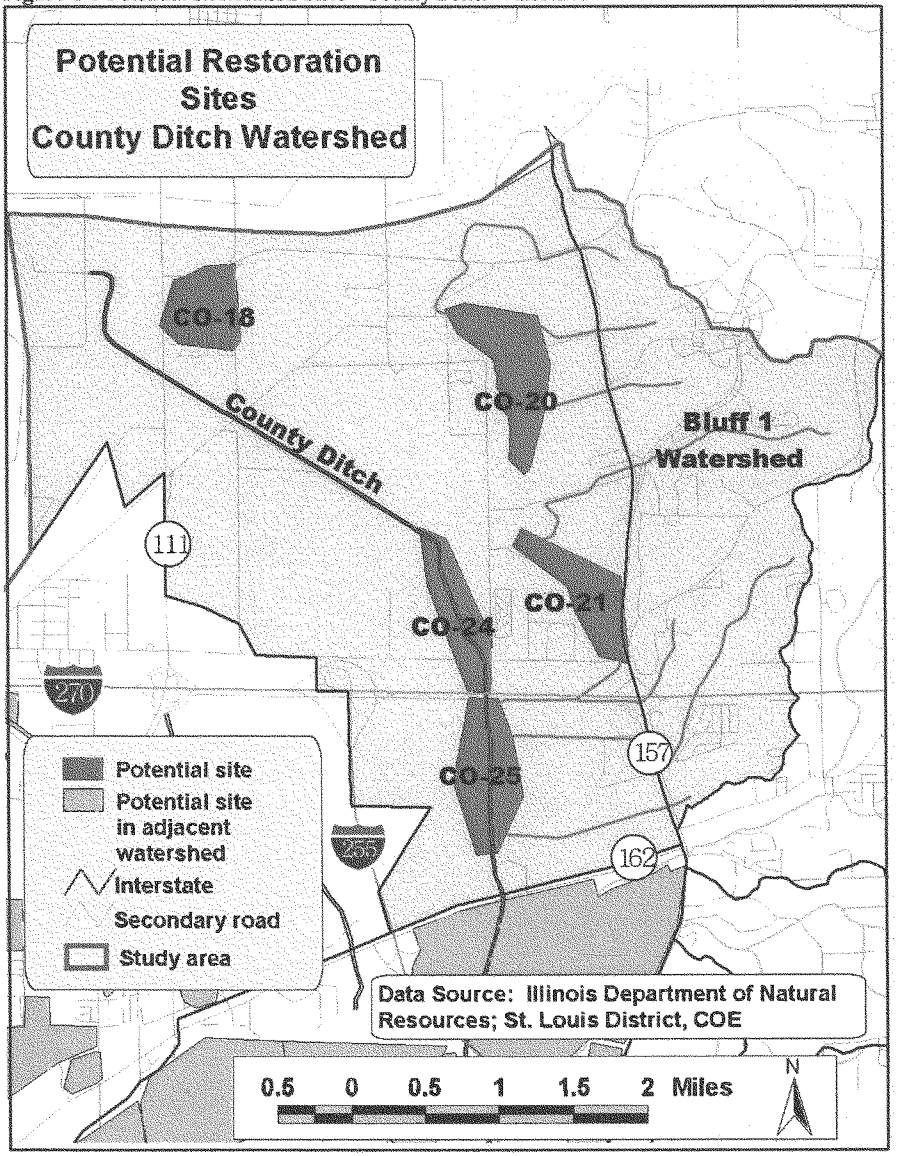
Figure 6-2 Potential Restoration Sites - Long Lake Watershed



County Ditch Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCSW	NRCS	Rpts	PI
Wetland near Rte. 111 (CO-18)	X					
Wetland along Old Cahokia Creek, north (CO-20)	X					
Wetland along Old Cahokia Creek, south (CO-21)	X					
Wetland along County Ditch, north (CO-24)	X					X
Wetland along County Ditch, south (CO-25)	X					X
County Ditch		X				X
Bluff 1 Tributary Watershed		X		X		

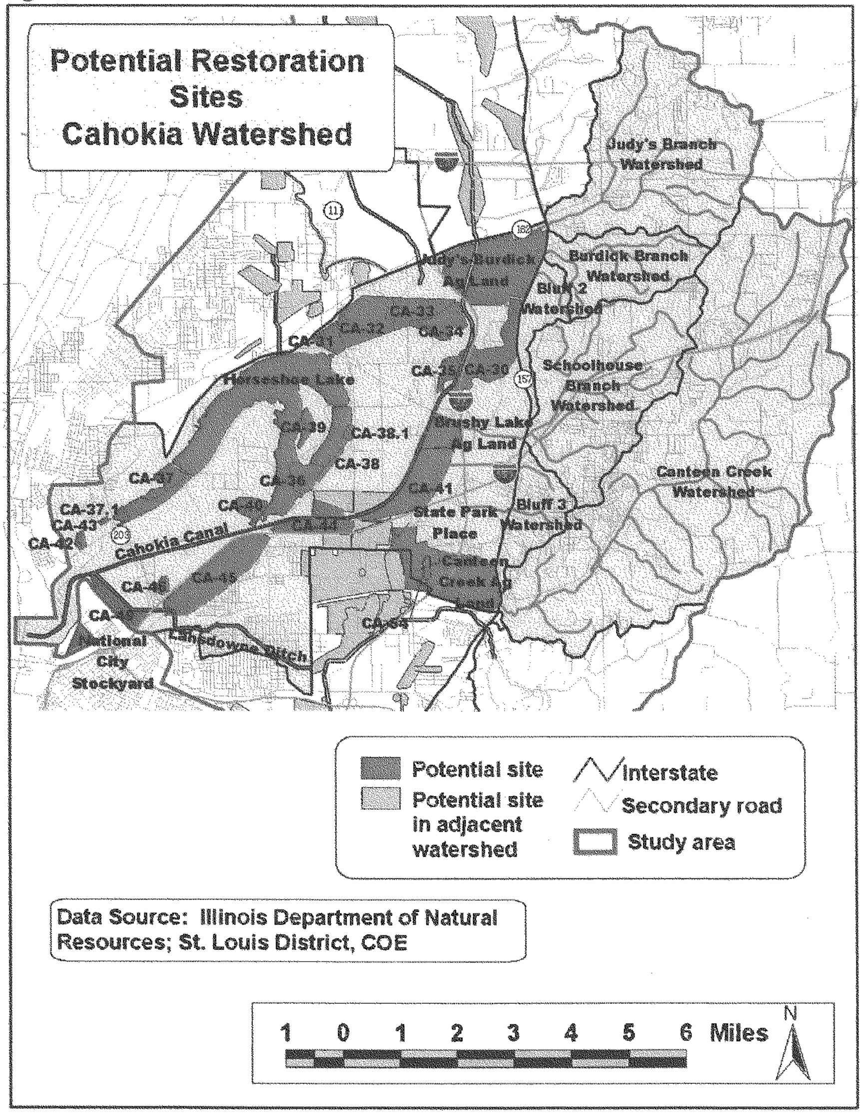
Figure 6-3 Potential Restoration Sites - County Ditch Watershed



Cahokia Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCSW	NRCS	Rpts	PI
Wetland McDonough Lake (CA-30)	X					
Wetland Edelhardt Meander Scar, Rte. 111 west (CA-31)	X					
Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32)	X				X	
Agricultural land Edelhardt Meander Scar, middle (CA-33)		X				
Wetland Edelhardt Meander Scar, east (CA-34) Arlington Subdivision	X					
Wetland Edelhardt Meander Scar, south (CA-35) Arlington Subdivision area	X					X
Wetland Horseshoe Lake, delta at Cahokia Diversion Canal (CA-36)	X	X				
Wetland Horseshoe Lake, west fringe (CA-37)	X					
Wetland Horseshoe Lake, Rte. 203 east (CA-37.1)	X					
Wetland Horseshoe Lake, east fringe (CA-38)	X					
Wetland Horseshoe Lake, northeast fringe (CA-38.1)	X					
Wetland Horseshoe Lake, Walker Island (CA-39)	X					
Wetland, Milam mitigation site, Horseshoe Lake (CA-40)		X				
Horseshoe Lake	X	X			X	X
Wetland Brushy Lake (CA-41)	X	X			X	
Agricultural land, Brushy Lake North		X				
Wetland Eagle Park west (CA-42)	X				X	
Wetland Eagle Park east (CA-43)	X				X	
Wetland Cahokia Canal borrow pits along I-55/70 (CA-44)	X	X				
Wetland at Indian Lake, Fairmont City (CA-45)	X	X			X	
Wetland East of Route 203, North of I-55/70(CA-46)	X					
Wetland Lansdowne Ditch (CA-49)	X					
Lansdowne Ditch		X				X
Wetland Canteen Creek (CA-54)	X					
State Park Place		X				
Judy's Branch Watershed		X		X	X	
Burdick Branch Watershed		X		X	X	
Agricultural land Judy's/ Burdick		X				
Schoolhouse Branch Watershed		X		X	X	
Canteen Creek Watershed		X		X	X	
National City Stockyard						X
Cahokia Canal		X			X	X
Bluff 3 Watershed		X		X		

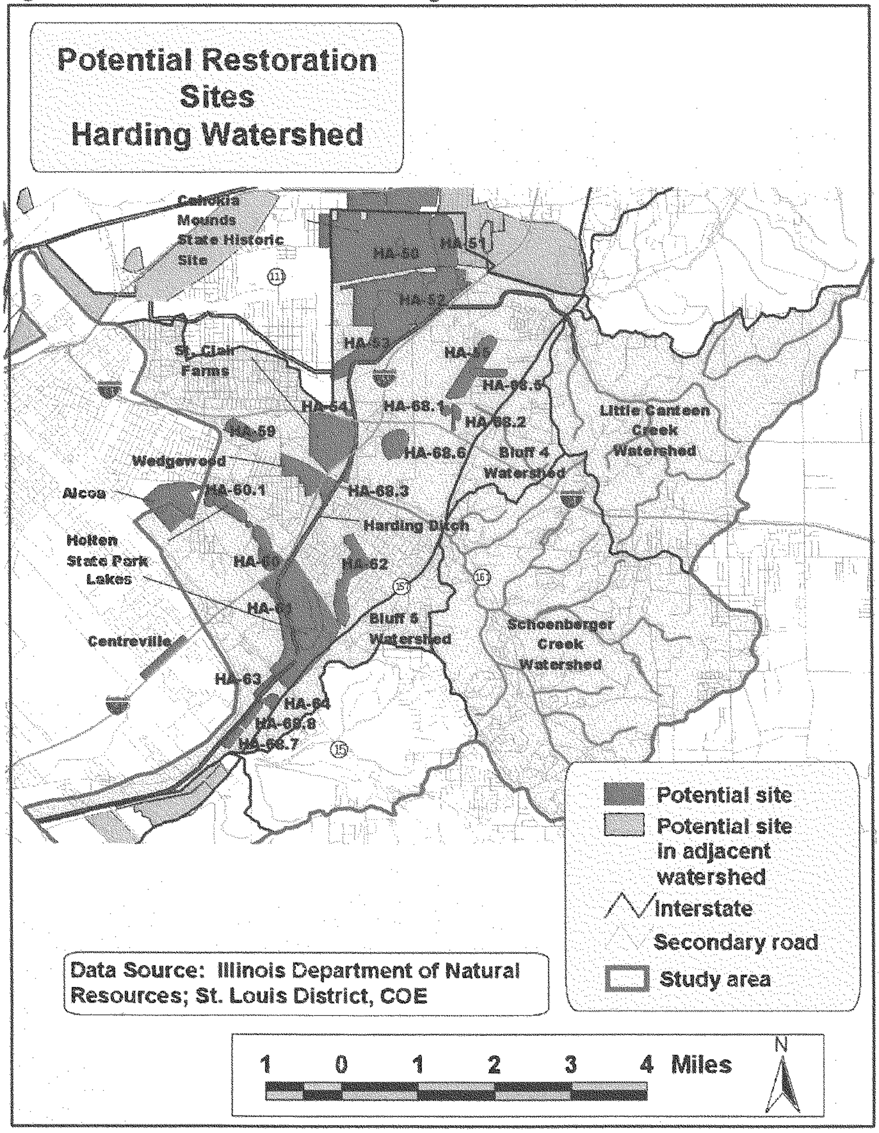
Figure 6-4 Potential Restoration Sites - Cahokia Watershed



Harding Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCS W	NRCS	Rpts	PI
Wetland Cahokia Mounds (HA-50)	X					
Cahokia Mounds State Historic Site		X				
Wetland Spring Lake meander scar, north (HA-51)	X					
Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52)	X					
Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53)	X					
St. Clair Farms		X				X
Farmed wetland along Harding Ditch, Bunkum Rd. (HA-54)			X			
Wedgewood						X
Centerville						X
Wetland Crooked Lake (HA-55)	X					
Wetland East St. Louis (HA-59)	X					
Wetland Holten State Park, north (HA-60)	X					
Wetland Holten State Park, northwest (HA-60.1)	X					
Wetland, Holten State Park, south (HA-61)	X				X	
Lakes 1 and 2, Holten State Park Lake	X	X			X	
ALCOA Site		X				
Wetland Canal No. 1, north (HA-62)	X					
Wetland Mary Spencer (HA-63)	X					
Wetland near Mary Spencer (HA-64)	X					
Farmed wetland North of Sterling Place City of Caseyville (HA-68.5)			X			
Farmed wetland by Crooked Lake (HA-68.1)	X		X			
Farmed wetland by Crooked Lake (HA-68.2)	X		X			
Farmed wetland along Harding Ditch, south (HA-68.3)	X		X			
Area along Harding Ditch, north near Centerville (HA-68.6)		X				
Area along Harding Ditch, south near Centerville (HA-68.7)		X				
Farmed wetland East of I-255 South of I-64 (HA-68.8)			X			
Little Canteen Creek Watershed		X		X	X	
Schoenberger Creek Watershed		X		X	X	
Bluff 2 Watershed				X	X	
Bluff 4, Bluff 5 Watershed		X		X	X	
Harding Ditch		X			X	X

Figure 6-5 Potential Restoration Sites - Harding Watershed



Powdermill Watershed

SITE	Basis for Site Selection					
	IWI	A P	NRCS W	NRCS	Rpts	PI
Wetland Mullen Slough (PO-66)	X	X				
Wetland Fishing Pond (PO-67)	X					
Wetland Canal No. 1 (PO/HA-67)	X	X				
Agricultural Land Mullens Slough		X				
Powder Mill Creek Watershed		X		X	X	
Bluff 6 Watershed		X		X		

Figure 6-6 Potential Restoration Sites - Powdermill Creek Watershed

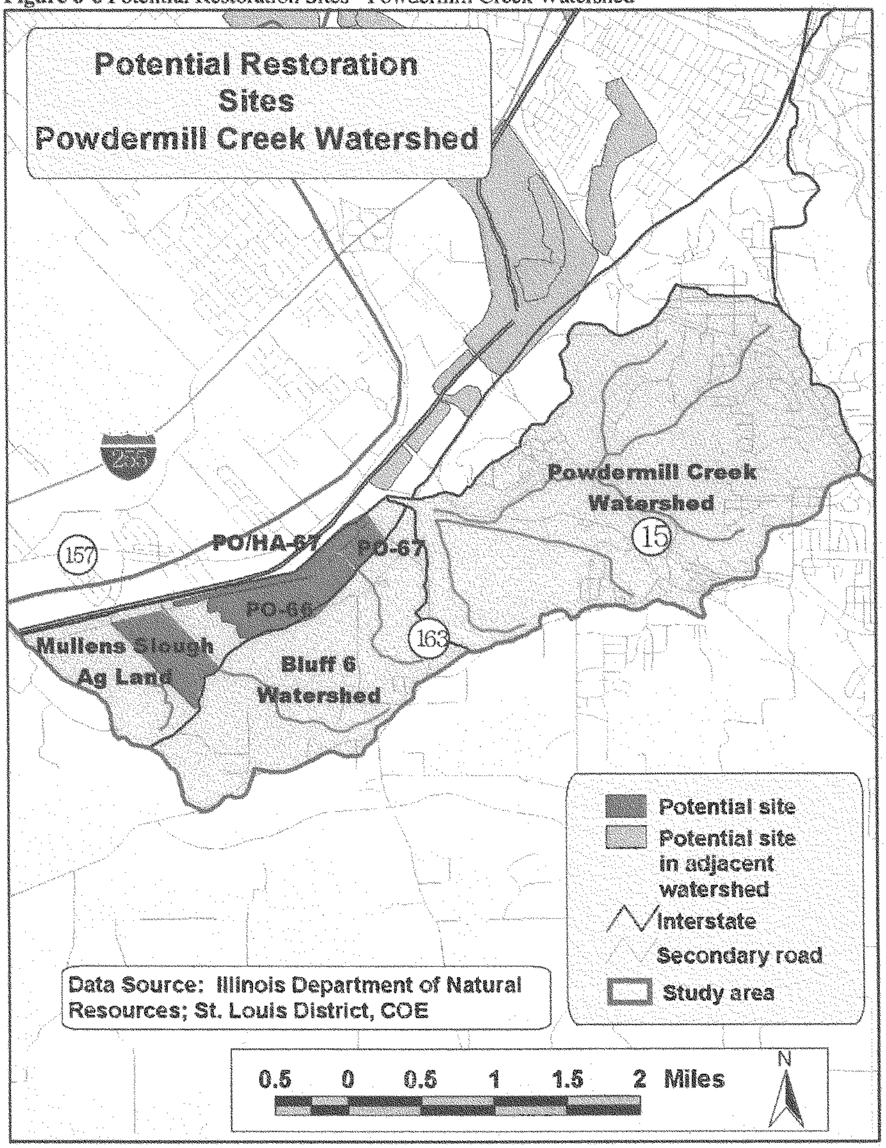
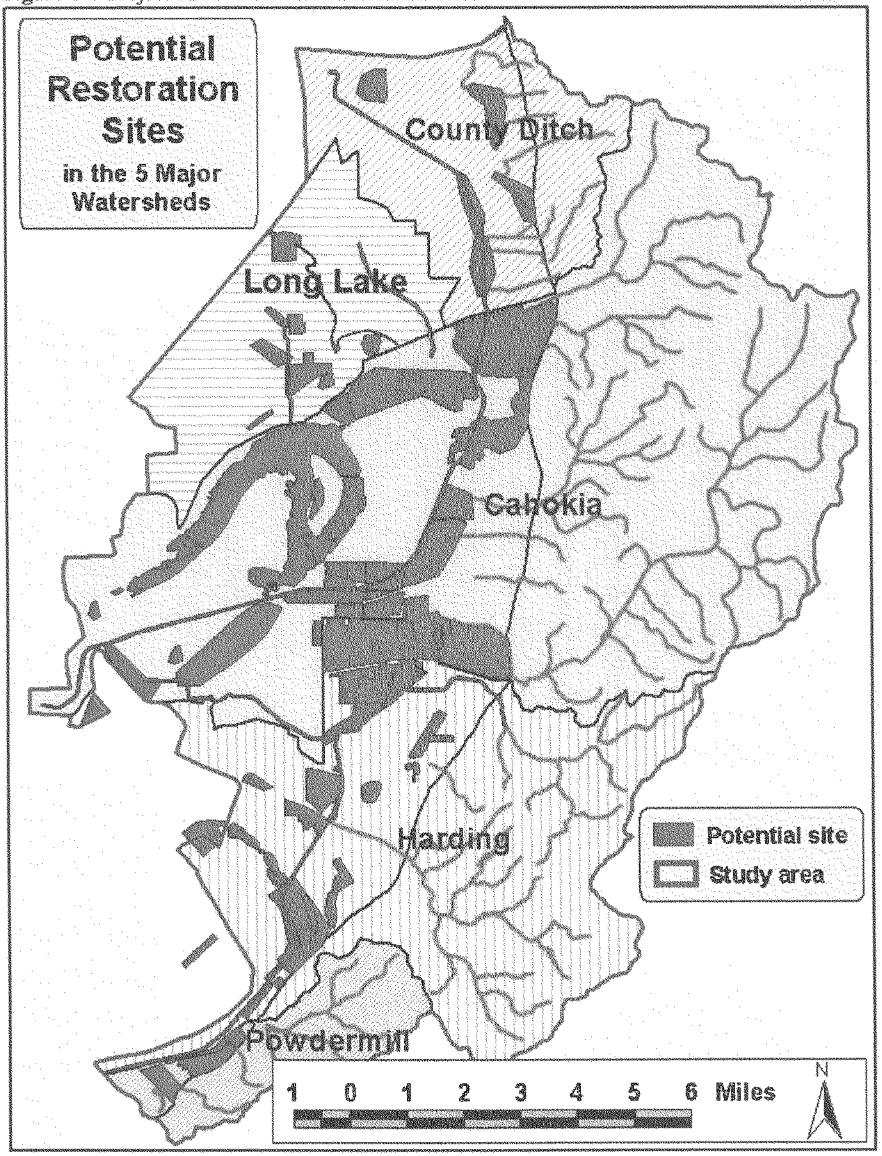


Figure 6-7 Project Area - Potential Restoration Sites



6.4 IDENTIFICATION OF POTENTIAL MEASURES

Figures 6-8 and 6-9 show sites visited in the spring of 1999 to establish baseline habitat conditions in the Project area. In all some 112 sites were evaluated using the HydroGeoMorphic Approach to assessing wetland functions (HGM), and 160 sites were evaluated using the Habitat Evaluation Procedures (HEP) as apart of the initial baseline assessment process. Floodplain sites and bluff sites were subjected to a baseline evaluation using HEP, and wetland sites were additionally assessed using HGM. Tributary or upland streams were assessed at 17 sites using the Qualitative Habitat Evaluation Index (QHEI) model. As mentioned previously, time and funding did not permit development of HGM models to assess functions in five different types of wetlands, as was originally planned, that would assist in quantifying the benefits gained from the use of storm water to restore a flood pulse. HGM models completed were used to assess three sites, Dobrey Slough, Brushy Lake and Elm Slough. Detailed information regarding the HEP, HGM, and QHEI sampling protocols is contained in Appendix A. The sampling procedures utilized to establish baseline conditions for each site were further used to establish baseline conditions for each watershed. The first hand experience gained from the HEP, HGM, and QHEI analyses at each site assisted in the identification of potential measures at these sites.

Figure 6-8 HGM Sample Sites

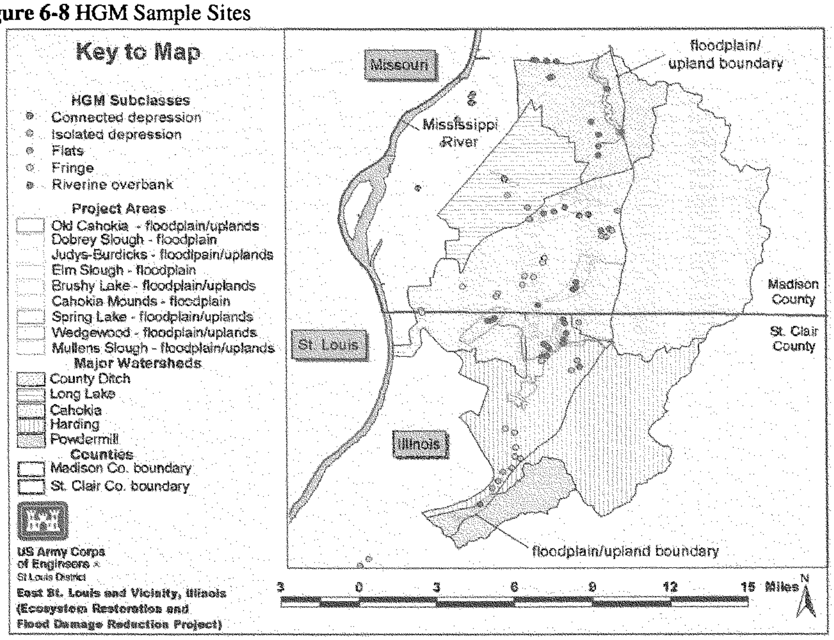
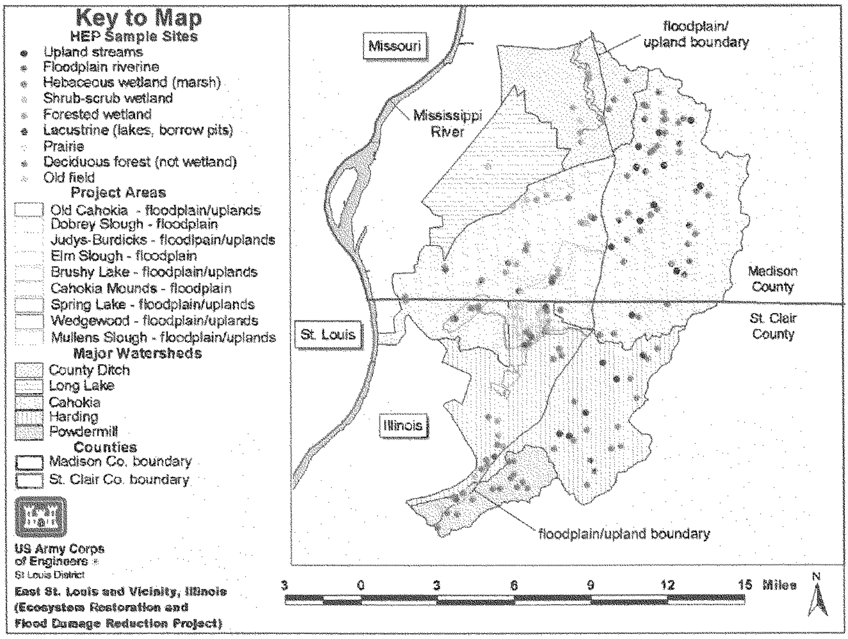


Figure 6-9 HEP Sample Sites



The following table displays the full array of objectives and measures that could potentially be applicable to each of the sites identified in the five watersheds. It forms the template for display of actual objectives and measures that could potentially be implemented at each site.

SITE	Potential Measures Applicable to Sites By Objective		
Site Name	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-8 Pump Station 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-5 Buffers in swales	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-5 Critical area planting 5-6 Diversion 5-7 Filter strips 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools 5-12 Natural deposition 5-13 Lowland detention **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-2 Connect channels 7-3 Stream corridor 7-4 In channel corridor 7-5 Along channel corridor	**Reduce flood damages** 8a-1 Modify channels 8a-2 New channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic vegetation 8c-3 Add flood pulse 8c-4 Interpretive areas

The following set of five tables identifies potential measures for each site. Sites are displayed within their respective watersheds.

Long Lake Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Borrow Pits near Long Lake, south (LO-23)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-6 Woody debris 3-7 Shoreline plants		
Wetland Borrow pit between Rte 162 and Long Lake (LO-27)	**Restore habitat quality** 3-1 Plant trees 3-6 Woody debris 3-7 Shoreline plants		
Wetland along railroad track Granite City (LO-28)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-6 Buffers strips		**Reduce flood damages** 8a-4 Build berm **Enhance recreation** 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Dobrey Slough (LO-29)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Long Lake Watershed – Continued

SITE	Potential Measures Applicable to Sites By Objective		
Dobrey Slough East Agricultural land	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build Berm 2-5 Detain flow		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Wetland near Horseshoe Lake Route 162, west (LO-47)	**Improve water quality** 4-6 Buffer strips		
Wetland West side of Lake Road Route 162, east (LO-48)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-10 Protect **Improve water quality** 4-6 Buffer strips		
Long Lake	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-5 Over wintering 3-6 Woody debris **Improve water quality** 4-6 Buffer strips	**Restore floodplain streams** 7-3 Riparian corridor	**Reduce flood damages** 8a-1 Modify channels
Dobrey Slough Canal			**Reduce flood damages** 8a-2 New channels 8a-3 Divert flow
Legacy Golf Course			**Reduce flood damages** 8a-1 Modify channels 8a-2 New channels 8a-3 Divert flow
Mitchell Ditch			**Reduce flood damages** 8a-1 Modify channels

County Ditch Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland near Hwy 111 (CO-18)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Enhance recreation** 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Wetland along Old Cahokia Creek, north (CO-20)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-8 Pump Station 3-10 Protect **Improve water quality** 4-2 Detention Basin	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg 8c-3 Add flood pulse
Wetland along Old Cahokia Creek, south (CO-21)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-8 Pump Station 3-10 Protect **Improve water quality** 4-2 Detention Basin	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse
Wetland along County Ditch, north (CO-24)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Reduce flood damages** 8-1 Improve Channel **Enhance recreation** 8b-1 Trails

County Ditch Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland along County Ditch, south (CO-25)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Reduce flood damages** 8-1 Improve Channel **Enhance recreation** 8b-1 Trails
County Ditch		**Restore floodplain streams** 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8-1 Improve Channel
Bluff 1, Watershed	**Restore habitat quality** 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion	

Cahokia Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland McDonough Lake (CA-30)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas
	Restore habitat quality 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-10 Protect **Improve water quality** 4-6 Buffer strips		

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland at Edelhardt Meander Scar, Rte. 111 west (CA-31)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes **Improve water quality** 4-6 Buffer strips		
Wetland at Edelhardt Meander Scar, Rte. 111 east (CA-32)	**Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect **Improve water quality** 4-5 Buffers in swales 4-6 Buffer strips		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Agricultural land, Edelhardt Meander Scar, middle (CA-33)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-3 Add flood pulse **Improve water quality** 4-5 Buffers in swales 4-6 Buffer strips		**Reduce flood damages** 8a-2 New channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage
Wetland at Edelhardt Meander Scar, east Arlington Subdivision (CA-34)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes **Improve water quality** 4-6 Buffer strips		

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland at Edelhardt Meander Scar, south Arlington Subdivision area (CA-35)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, delta at Cahokia Diversion Canal (CA-36)	**Restore habitat quality** 3-2 Nest Boxes 3-5 Over wintering		**Reduce flood damages** 8a-1 Modify channels
Wetland Horseshoe Lake, west fringe (CA-37)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes **Improve water quality** 4-5 Buffer strips		
Wetland Horseshoe Lake, Rte. 203 east (CA-37.1)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, east fringe (CA-38)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, northeast fringe (CA-38.1)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, Walker Island (CA-39)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes None		
Wetland, Milam mitigation site Horseshoe Lake (CA-40)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Improve water quality** 4-6 Buffer strips		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Horseshoe Lake	**Restore habitat quality** 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants **Improve water quality** 4-6 Buffer strips		
Wetland at Brushy Lake (CA-41)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect **Improve water quality** 4-5 Buffers in swales	**Reduce erosion** 5-13 Lowland detention **Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse 8c-4 Interpretive areas
Agricultural Land Brushy Lake North	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow	**Reduce erosion** 5-7 Lowland detention **Restore floodplain streams** 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Wetland Eagle Park, west (CA-42)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-6 Buffer strips		

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Eagle Park, east (CA-43)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		
Wetland Cahokia Canal borrow pits Along I-55/70 (CA-44)	**Restore flood pulse** 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails
Wetland Indian Lake Fairmont City (CA-45)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Wetland East of Route 203 North of I-5/70 (CA-46)	**Improve water quality** 4-6 Buffer strips		
Wetland Lansdowne Ditch (CA-49)	**Restore natural areas** 1-1 Obtain land **Restore flood pulse** 2-1 Modify channel Restore habitat quality 3-3 Add flood pulse		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Lansdowne Ditch			**Reduce flood damages** 8a-1 Modify channels
Wetland at Little Canteen Creek (CA-54)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse **Improve water quality** 4-6 Buffer strip		**Reduce flood damages** 8a-4 Build Berm 8a-5 Detain flow
State Park Place	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow	**Reduce erosion** 5-7 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-2 Plant historic veg
Agricultural Land Canteen Creek	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow **Improve water quality** 4-2 Sediment basin	**Reduce erosion** 5-12 Natural deposition 5-13 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-2 Interpretive areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 10-3 Add historic flood pulse 8c-4 Interpretive areas

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Judy's Branch Watershed	**Restore habitat quality** 3-1 Plant trees 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels Enhance recreation 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Burdick Branch Watershed	**Restore habitat quality** 3-1 Plant trees 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Agricultural Land Judy's-Burdick	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow	**Reduce erosion** 5-7 Lowland detention **Restore floodplain streams** 7-2 Reconnect channels 7-3 Stream corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Schoolhouse Branch Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Canteen Creek Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools 5-12 Natural deposition 5-13 Lowland detention **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
National City Stockyard	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-4 Interpretive areas
Cahokia Canal			**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Bluff 3 Watersheds	**Restore habitat quality** 3-10 Protect	**Reduce erosion** 5-1 Tributary detention 5-4 Water & sediment basins	
Bluff 2 Watershed	**Restore habitat quality** 3-10 Protect	**Reduce erosion** 5-1 Tributary detention 5-4 Water & sediment basins	

Harding Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Cahokia Mounds (HA-50)	**Restore natural areas** 1-2 Create habitat		**Reduce flood damages** 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-2 Plant historic veg
Cahokia Mounds State Historic Site	**Restore natural areas** 1-2 Create habitat **Restore habitat quality** 3-10 Protect		**Protect cultural resources** 10-2 Plant historic
Wetland Spring Lake meander scar, north (HA-51)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-2 Nest Boxes 3-3 Add flood pulse **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Spring Lake meander scar, North of Forest Blvd (HA-52)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Spring Lake meander scar, South of Forest Blvd (HA-53)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse 8c-4 Interpretive areas
St. Clair Farms	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-3 Add flood pulse 3-10 Protect **Improve water quality** 4-6 Buffer strips	**Restore floodplain streams** 7-5 Along channel corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse
Farmed wetland along Harding Ditch at Bunkum Rd (HA-54)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat	**Restore floodplain streams** 7-5 Connectivity corridor	

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wedgewood	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-2 Detention Basin	**Reduce erosion** 5-13 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-2 Plant historic veg
Centerville			**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow
Wetland Crooked Lake (HA-55)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-10 Protect **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Wetland East St. Louis (HA-59)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Holten State Park, north (HA-60)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Holten State Park, northwest (HA-60.1)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-2 Nest Boxes 3-3 Add flood pulse		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Holten State Park, south (HA-61)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Holten State Park Lakes 1 and 2	**Restore habitat quality** 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow
ALCOA Site	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant tree 3-7 Shoreline plants **Improve water quality** 4-5 Buffers in swales 4-6 Buffer strips		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Canal No. 1, north (HA-62)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Mary Spencer (HA-63)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland near Mary Spencer (HA-64)	**Restore habitat quality** 3-1 Plant trees		
Farmed wetland North of Sterling Place, City of Caseyville (HA-68.5)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-4 Build Berm 8a-5 Detain flow
Farmed wetland by Crooked Lake (HA-68.1)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Improve water quality** 4-6 Buffer strips		**Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Farmed wetland by Crooked Lake (HA-68.2)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-2 Nest Boxes 3-10 Protect		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Farmed wetland along Harding Ditch, south (HA-68.3)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		**Protect cultural resources** 8c-1 Obtain sites
Area along Harding Ditch, north near Centerville (HA-68.6)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat	**Restore floodplain streams** 7-5 Connectivity corridor	

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Area along Harding Ditch, south near Centerville (HA-68.7)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat	**Restore floodplain streams** 7-5 Connectivity corridor	
Farmed wetland East of I-255 South of I-64 (HA-68.8)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-10 Protect **Improve water quality** 4-6 Buffer strips		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Little Canteen Creek Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-5 Critical area planting 5-6 Diversion 5-7 Filter strips 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Schoenberger Creek Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-5 Critical area planting 5-6 Diversion 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control	**Reduce flood damages** 8a-3 Divert flow
Bluff 4, Bluff 5 Watersheds	**Restore habitat quality** 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins	
Harding Ditch		**Restore floodplain streams** 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas

Powdermill Creek -Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Mullen Slough (PO-66)	**Restore flood pulse** 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect	**Reduce erosion** 5-13 Lowland detention	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas

Powdermill Creek -Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Mullen Slough (PO-66) – Cont.	**Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse 8c-4 Interpretive areas
Agricultural Land at Mullen Slough	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build Berm 2-5 Detain flow		**Reduce flood damages** 8a-4 Build berm **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Wetland Fishing Pond (PO-67)	**Restore flood pulse** 2-3 Divert flow **Restore habitat quality** 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect	**Reduce erosion** 5-13 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Canal No. 1 (PO/HA-67)	**Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool		**Reduce flood damages** 8a-4 Build berm **Enhance recreation** 8b-1 Trails 8b-3 Signage

Powdermill Creek -Continued

SITE	Potential Measures Applicable to Sites By Objective		
Powder Mill Creek Watershed	**Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control	**Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas
Bluff 6 Watershed	**Restore habitat quality** 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion 5-8 Grass Waterways	

6.5 SCREENING OF SITES

Following the assessment and evaluation of measures by site, the team began evaluation of sites and site combinations based on location, topography, area hydrology, soils, and existing conditions to contribute to project objectives. This next iteration of assessment and evaluation addressed each site's ability to stand alone or work effectively in combination with others to achieve project objectives. Based on the large number of potential sites, the Biology Team agreed that in order to formulate viable alternative plans, the focus had to be on the identification of a few areas that could contribute in a meaningful way to project objectives. It was not feasible to develop a large number of small fragmented sites across the Project area that contributed to only to a few project objectives, and hope to achieve restoration-planning targets.

Therefore, it was determined by the team that sites or combination of sites needed to meet multiple objectives to have a chance of making a meaningful change in the existing conditions of the Project area. Sites were evaluated based on their ability to contribute individually or in combination to multiple project goals and objectives, and have potential to meet planning targets. In this way potential action areas were to be identified. The following table shows the sites across the project area and how they were evaluated.

Site	Site Evaluation	Result
Long Lake Watershed		
LO-23	This site, an 86-acre area of borrow pit lakes and wetlands, could address only 1 ecological objective. Site is surrounded on three sides by development. Site not able to be combined with other sites to increase benefits.	Not carried forward
LO-27	This site, a 40-acre borrow pit lake, could address only 1 ecological objective. Site is surrounded by urbanization and railroad tracks and is not able to be expanded. Site not able to be combined with other sites to increase benefits.	Not carried forward
LO-28	This site, a 30-acre wetland complex, could address 4 ecological and 1 social objectives. Site could be expanded into a somewhat larger environmental area but is ultimately restricted by homes and a railroad track. Site not able to be combined with other sites to increase benefits. Site is an urban wetland of moderate quality and could be protected by local action.	Not carried forward
LO-29	This site, a 15-acre wetland complex, could address 3 ecological and 2 social objectives. Site is restricted by homes on most sides but could be expanded into a larger environmental area. Site could be combined with Dobrey Slough East agricultural land to increase habitat benefits and provide incidental flood damage reduction.	Carried forward
Dobrey Slough East Ag land	This site, about 40 acres of farmland, could address 2 ecological and 3 social objectives. Site could be used in combination with LO-29 to increase habitat benefits and achieve incidental social objectives.	Carried forward
LO-47	This site, an 11-acre wetland complex, could address only 1 ecological objective. Site not able to be expanded because of surrounding development. Site not able to be combined with other sites to increase benefits.	Not carried forward
LO-48	This site, a 13-acre wetland complex, could address 3 ecological objectives. Site could be expanded to some degree to create a larger environmental area, but is restricted on three sides by roads and a railroad track. Site not able to be combined with other sites to increase benefits.	Not carried forward
Long Lake	This site, a 76-acre natural lake, could address 3 ecological, and 1 social objectives. Action at Long Lake itself is constrained by various factors: residential and urban development along lakeshore, number of impacted private residences, restricted nature of public access, and potential for lake bottom sediments to be contaminated. However, Long Lake has potential to be combined with CA-32 and CA-33 to achieve habitat restoration while providing incidental flood damage reduction.	Carried forward
Mitchell Ditch	This site, a 2.6-mile long man-made ditch, could address only 1 social objective. Surrounding land is mostly agricultural. Urban constraints and inability to meet economic benefit requirements for a flood damage reduction project make any action at this site a low priority. However, site could be combined with CA-32 and CA-33 to achieve habitat restoration and provide incidental flood damage reduction.	Carried forward

Site	Site Evaluation	Result
Long Lake Watershed - Continued		
Dobrey Slough Canal	This site does not exist, but is the concept to build a 1.9-mile long man-made ditch to carry stormwater from Dobrey Slough to Horseshoe Lake. It would address only 1 social objective (flood damage reduction). Urban constraints, IDNR water quality concerns for Horseshoe Lake, and the inability to meet economic benefit requirements for a stand-alone flood damage reduction project make action at this site infeasible.	Not carried forward
Legacy Golf Course	This site, a 200-acre development with man-made lakes, could address only 1 social objective. This site was briefly explored in combination with LO-28, but golf course landowners did not provide hydraulic system information for analysis.	Not carried forward
County Ditch Watershed		
CO-18	This site, a 109-acre wetland complex, could address 2 ecological and 1 social objectives. Site is segmented by a railroad track, and adjacent to a highway. Site has limited potential for expansion into a larger environmental area. Site not able to be combined with other sites to increase benefits.	Not carried forward
CO-20	This site, a 29-acre wetland complex, could address 5 ecological, and 3 social objectives. Site could be expanded into surrounding farmland to create a larger environmental area. Site could be combined with CO-21, Bluff 1 watershed, and Cahokia Canal to enhance achievement of ecological and social objectives.	Carried forward
CO-21	This site, a 60-acre wetland complex, could address 5 ecological, and 3 social objectives. Site could be expanded into surrounding farmland to create a somewhat larger environmental area. Site could be combined with CO-20, Bluff 1 watershed, and Cahokia Canal to enhance achievement of ecological and social objectives.	Carried forward
CO-24	This site, a 55-acre wetland complex, could address 2 ecological and 2 social objectives. Site could be expanded into surrounding farmland to create a somewhat larger environmental area. Site could be combined with CO-25 and County Ditch to increase environmental benefits.	Carried forward
CO-25	This site, a 67-acre wetland complex, could address 2 ecological and 2 social objectives. Site could be expanded into surrounding farmland to create a somewhat larger environmental area. Site could be combined with CO-24 and County Ditch to increase environmental benefits.	Carried forward
County Ditch	This site, a 5.6-mile long man-made ditch, could address 1 ecological and 1 social objective. Action at this site only to reduce flood damages would be a low priority because of the inability to meet economic benefit requirements. Site could be combined with CO-24 and CO-25.	Carried forward
Bluff 1 watershed	This site, a 2,895-acre tributary watershed, could address 3 ecological objectives. This site could be combined with CO-20, CO-21, and Cahokia Canal to address all three project objectives.	Carried forward

Site	Site Evaluation	Result
Cahokia Watershed		
CA-30	This site, a 348-acre wetland and aquatic complex, could address 5 ecological, and 2 social objectives. Site could be expanded to some degree to create a larger environmental area. Site could be combined with Cahokia Canal to increase benefits, but would be difficult due to urban constraints, especially connecting to Cahokia canal to create a floodplain creek flowing through the area from north to south. Site has relatively high ecological diversity, and should as a minimum be protected by local action.	Carried forward
CA-31	This site, a 41-acre wetland complex, could address 2 ecological objectives. Site is restricted by urban development, and not able to be expanded. Site not able to be combined with other sites to increase benefits.	Not carried forward
Bluff 2 watershed	This site, a 666-acre tributary watershed, could address 2 ecological objectives. This site could be combined with CA-30.	Carried forward
CA-32	This site, a 248-acre wetland complex, could address 3 ecological and 2 social objectives. Site is bordered by urban development on two sides, but could be expanded somewhat into adjacent farmland to create a larger environmental area. Site could be combined with farmland at CA-33 and Long Lake and Mitchell Ditch, to increase habitat restoration benefits and achieve incidental flood damage reduction.	Carried forward
CA-33	This site, about 125 acres of farmland, could address 4 ecological and 2 social objectives. Site could be combined with wetland at CA-32 and Long Lake and Mitchell Ditch, to increase habitat restoration benefits and achieve incidental flood damage reduction.	Carried forward
CA-34	This site, a 147-acre wetland complex, could address 2 ecological objectives. Site surrounded on three sides by urban development. This site is currently being developed as a subdivision.	Not carried forward
CA-35	This site, a 74-acre wetland complex, could address only 1 ecological objective. There is no potential for expansion. Site not able to be combined with other sites to increase benefits.	Not carried forward
CA-36	This site, a 96-acre wetland complex, could address 1 ecological and 1 social objective. Site created by sediment carried into Horseshoe Lake by Cahokia Canal. Site owned by IDNR, and already under a management plan. IDNR declined consideration of any action at this site.	Not carried forward
CA-37	This site, a 70-acre wetland complex, could address 2 ecological objectives. Site has limited potential for expansion to create a larger environmental area. Site not capable of being combined with other sites to increase benefits. Most of site owned by the Corps as mitigation for the new Lock and Dam 26.	Not carried forward
CA-37.1	This site, a 12-acre wetland complex, could address only 1 ecological objective. Site has limited potential for expansion to create a larger environmental area. Site not capable of being combined with other sites to increase benefits.	Not carried forward
CA-38	This site, a 13-acre wetland, could address only 1 ecological objective. Site owned by IDNR, and already under a management plan. IDNR declined consideration of any action at this site.	Not carried forward
CA-38.1	This site, an 8-acre wetland complex, could address only 1 ecological objective. Site owned by IDNR, and already under a management plan. IDNR declined consideration of any action at this site.	Not carried forward

Site	Site Evaluation	Result
Cahokia Watershed - Continued		
CA-39	This site, a 20-acre wetland complex, could address only 1 ecological objective. Site not able to be expanded or combined with other sites. Owned by IDNR who already has the site under a management plan. IDNR did not want to be considered in this planning effort.	Not carried forward
CA-40	This site, an 11-acre wetland complex, could address 2 ecological and 1 social objectives. Site could be expanded to some degree to create a larger environmental area. Site not able to be combined with other areas to create a larger environmental area. Already a wetland mitigation area.	Not carried forward
Horseshoe Lake	This site, a 2,245-acre natural lake, could address 2 ecological objectives. Improvements would require dredging lake bottom sediments collected in the lake over historic times. Much of site owned by IDNR, and already under a management plan. Likelihood of lake bottom sediments being contaminated from industrial dumping would impact any dredging plans. IDNR declined to be considered in this planning effort.	Not carried forward
CA-41	This site, a 311-acre wetland and aquatic complex, could address 6 ecological and 3 social objectives. Site is surrounded on three sides by development, but could be expanded into farmland to create a somewhat larger environmental area. Site could be combined with Brushy Agricultural land, Cahokia Canal, Schoolhouse Branch, and Schneider Ditch to enhance achievement of ecological and social objectives.	Carried forward
Agricultural Land Brushy Lake North	This site, about 325 acres of farmland, could address 5 ecological and 3 social objectives. Site is surrounded on two sides by development. Site could be combined with CA-41, Cahokia Canal, Schoolhouse Branch, and Schneider Ditch to increase habitat restoration benefits as well as enhance achievement of all social objectives.	Carried forward
Schoolhouse Branch watershed	This site, a 4,546-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Site could be combined with CA-41, Brushy agricultural land, Bluff 2 and Bluff 3 watersheds, and Cahokia Canal to increase ecological benefits as well as enhance achievement of all social objectives.	Carried forward
CA-42	This site, a 17-acre wetland, could address 3 ecological objectives. Site is surrounded by urban development on three sides, and is not capable of being expanded. Site not capable of being combined with other sites.	Not carried forward
CA-43	This site, a 6-acre wetland, could address only 1 ecological objective. Site is surrounded by urban activity, and is not capable of being expanded. Site not capable of being combined with other sites.	Not carried forward
CA-44	This site, a 204-acre wetland and aquatic complex, could address 2 ecological and 2 social objectives. Site is surrounded by urban development on three sides. Site not capable of being expanded. Site could be combined with Cahokia Canal to increase ecological benefits as well as achieve incidental flood damage reduction benefits.	Carried forward

Site	Site Evaluation	Result
Cahokia Watershed - Continued		
CA-45	This site, a 620-acre terrestrial, wetland and aquatic complex, could address 5 ecological and 2 social objectives. Site is surrounded by urban development. Site could be combined with Cahokia Canal and Lansdowne Ditch to increase ecological benefits and provide incidental flood damage reduction benefits. Site could also be combined with HA-53 in the Harding Ditch watershed (via Lansdowne Ditch, or a similar connection) to achieve the same kind of benefits.	Carried forward
CA-46	This site, a 24-acre wetland complex, could address only 1 ecological objective. Site is surrounded by urban activity, and is not capable of being expanded. Site not capable of being combined with other sites.	Not carried forward
CA-49	This site, a 119-acre wetland complex, could address 3 ecological and 1 social objectives. Site surrounded by urban development. Site could be combined with Lansdowne Ditch and Cahokia Canal to increase ecological benefits and provide flood damage reduction benefits. Area is in known area of contamination and not viable for recommendation here.	Not Carried forward
Lansdowne Ditch	This site, a 4.6-mile long man-made ditch, could address only 1 social objective. Channel improvements would require substantial impact to existing residential area. Action at this site only to reduce flood damages would be infeasible because of the inability to meet economic benefit requirements. Upper portion of the channel has potential to be combined with other sites to provide hydraulic connectivity with CA-45 and Cahokia Canal.	Carried forward
CA-54	This site, an 11-acre wetland, could address 3 ecological and 1 social objectives. Site is adjacent to a residential area. Site could be expanded into farmland to create a larger environmental area. Site able to be combined with HA-51, HA-52, and Canteen Creek to increase environmental benefits and achieve incidental flood damage reduction.	Carried forward
State Park Place	This site, a 215-acre existing residential area, could address 3 ecological and 2 social objectives. Site is located within Cahokia Mounds World Heritage Site. Site could be combined with Canteen Creek, CA-54, HA-51, and HA-52 to provide increased habitat restoration as well as achieve incidental flood damage reduction. Requires relocation of a significant number of homes.	Carried forward
Agricultural Land Canteen Creek	This site, about 565 acres of horseradish farmland, could address 4 ecological and 3 social objectives. Site is surrounded on all sides by development. Site could be combined with State Park Place, Canteen Creek and CA-54 to increase ecological benefits and enhance achievement of social objectives.	Carried forward
Canteen Creek Watershed	This site, a 14,538-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Size of channel improvements needed on floodplain for flood damage reduction alone would impact existing urban areas, identified areas of cultural significance, and requires the replacement of numerous bridges. Urban and cultural constraints and inability to meet economic benefit requirements for flood damage reduction make this a low priority as a stand-alone site. Site could be combined with State Park Place, CA-54, HA-51, and HA-52 to achieve multiple planning objectives. Site could also be combined with Harding Ditch and HA-53 in the Harding Ditch watershed to achieve the same planning objectives.	Carried forward

Site	Site Evaluation	Result
Cahokia Watershed - Continued		
Judy's Branch Watershed	This site, a 5,453-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Site could be combined with Judy's/Burdick agricultural land, Burdick Branch, and Cahokia Canal to increase ecological benefits and enhance achievement of social objectives.	Carried forward
Burdick Branch Watershed	This site, a 1,829-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Site could be combined with Judy's/Burdick agricultural land, Burdick Branch, and Cahokia Canal to increase ecological benefits and enhance achievement of social objectives.	Carried forward
Agricultural Land Judy's/Burdick	This site, about 500 acres of farmland, could address 4 ecological and 3 social objectives. Site is bounded by urban development on one side. Site could be combined with Judy's Branch, Burdick Branch, and Cahokia Canal to increase ecological benefits and enhance achievement of social objectives.	Carried forward
National City Stockyard	This site, a 51-acre terrestrial and wetland complex, could address 1 ecological and 2 social objectives. Site includes a historic remnant of Cahokia Creek, and is surrounded by urban development. Site not able to be combined with other sites to increase benefits. Public comment indicates site is very close to significant prehistoric cultural resources. A minor investment could enhance and protect the site for significant historical and cultural purposes. Cultural resource significance enhances site importance.	Carried forward
Cahokia Canal	This site, a 12.4-mile long man-made ditch, could address 1 ecological and 2 social objectives. Size of channel improvements required for flood damage reduction would impact existing urban areas, require the replacement of numerous bridges and enlargement of pumping capacity at North pump station. Urban constraints and inability to meet economic benefit requirement for flood damage reduction make this a low priority as a stand-alone site. However, site could be combined with Cahokia Canal borrow pits, CA-41 and Brushy Lake agricultural land, and Judy's/Burdick agricultural land to enhance ecological restoration while providing incidental flood damage reduction.	Carried forward
Bluff 3 Watershed	This site, a 1,026-acre watershed, could address 2 ecological objectives. Site could be combined with CA-41, Brushy Lake agricultural land, and Schoolhouse Branch, to increase ecological benefits.	Carried forward
Harding Watershed		
HA-50	This site, a 3-acre wetland, could address 1 ecological and 2 social objectives. Site consists of a prehistoric borrow pit, and is not expandable. Site not capable of being combined with other sites to increase benefits.	Not carried forward
Cahokia Mounds State Historic Site	This site, a 525-acre terrestrial complex (hay leases), could address 2 ecological and 1 social objectives. Site could provide for the planting of historic prairie vegetation to create a significant environmental area. Site not capable of being combined but site significance warrants further investigation.	Carried forward
HA-51	This site, an 85-acre wetland complex, could address 4 ecological and 1 social objectives. Site bordered by development on two sides, and not able to be expanded. Site could be combined with CA-54, Canteen Creek, HA-52, and HA-53 to achieve multiple benefits.	Carried forward

Site	Site Evaluation	Result
Harding Watershed - Continued		
HA-52	This site, a 243-acre wetland complex, could address 3 ecological and 2 social objectives. Site bordered by development on one side, and not able to be expanded. Site could be combined with CA-54, Canteen Creek, and HA-51 to achieve multiple benefits.	Carried forward
HA-53	This site, a 111-acre wetland and aquatic complex, could address 3 ecological and 3 social objectives. Site bordered on two sides by development. Site could be expanded to create a larger environmental area. Site could be combined with Harding Ditch, Canteen Creek, Little Canteen Creek, St. Clair Farms, and CA-45 to increase habitat restoration and attainment of ecological and social objectives.	Carried forward
St Clair Farms	This site, about 180 acres of farmland, FEMA buyout areas, and several existing residences, could address 5 ecological and 3 social objectives. Site bordered on three sides by development. Site could be combined with Harding Ditch, HA-53, and HA-54 to achieve multiple benefits including creation of a significant habitat restoration area that achieves all social objectives.	Carried forward
HA-54	This site, a 2-acre farmed wetland, could address 2 ecological objectives. Site is bordered by development on three sides. Site could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-53 and Harding Ditch to increase environmental benefits.	Carried forward
Wedgewood	This site, about 125 acres of FEMA buyouts and terrestrial and wetland habitats, could address 5 ecological and 3 social objectives. Site is encircled by development. Site could be combined with Harding Ditch and Schoenberger Creek to provide enhanced habitat restoration benefits and incidental flood damage reduction. Requires closing of an east/west artery (Summit Avenue) under I-255.	Carried forward
Centerville	This site, a small town, could address 1 social objective. Inability to meet economic benefit requirement for stand alone flood damage reduction makes any action at this site a low priority. IDNR is continuing to pursue solutions in this area outside of this project.	Not carried forward
HA-55	This site, a 41-acre wetland complex, could address 4 ecological and 2 social objectives. Site is bordered in part by development, but could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-68.5, HA-68.1, HA-68.2, and Bluff 4 to increase habitat benefits.	Carried forward
HA-59	This site, a 38-acre wetland complex, could address only 1 ecological objective. Site is bordered by development on three sides, but could be expanded into adjacent farmland to create a larger environmental area. Site could not be combined with other sites to gain environmental benefits.	Not carried forward
HA-60	This site, a 25-acre wetland complex, could address 3 ecological and 2 social objectives. Site is within Holten State Park, and could be expanded to a degree into adjacent recreational areas to create a larger environmental area. Site could be combined with HA-60.1, HA-61, Harding Ditch, and two other lakes in the state park to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward

Site	Site Evaluation	Result
Harding Watershed - Continued		
HA-60.1	This site, a 17-acre wetland, could address 3 ecological and 2 social objectives. Site is within Holten State Park, and could be expanded to a degree into adjacent recreational areas to create a larger environmental area. Site could be combined with HA-60, HA-61, Harding Ditch, and two other lakes in the state park to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward
HA-61	This site, a 432-acre wetland and aquatic complex, could address only 1 ecological objective. Site is within Holten State Park, and could be expanded to a degree into adjacent recreational areas to create a larger environmental area. Site could be combined with HA-60, HA-60.1, Harding Ditch, and two other lakes in the state park to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward
Holten State Park Lakes 1 and 2	This site, two natural lakes totaling 87 acres, could address 1 ecological and 1 social objectives. These lakes, Whispering and Wouldow Lakes, are in Holten State Park. Site is surrounded by recreational areas, and could be expanded to create a larger environmental area. Site could be combined with HA-60, HA-60.1, HA-61, and Harding Ditch to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward
ALCOA	This site, a 240-acre former industrial area with some terrestrial and wetland areas, could address 3 ecological and 2 social objectives. Site is surrounded by development, and has numerous contamination issues, which eliminate it at this time from consideration. Work on this site is continuing under the Brownfield program.	Not carried forward
HA-62	This site, a 69-acre wetland complex, could address 1 ecological objective. Site is surrounded by development, and not able to be enlarged. Site could be combined with Bluff 5 to achieve increases ecological benefits.	Carried forward
HA-63	This site, a 9-acre wetland, could address only 1 ecological objective. Site is surrounded by development and not able to be enlarged. Site could not be combined with other sites. Site already addressed by resource agencies during recent clean out of Harding Ditch.	Not carried forward
HA-64	This site, a 14-acre wetland complex, could address only 1 ecological objective. Site is bordered by development on two sides, and not capable of being expanded. Site not able to be combined with other sites.	Not carried forward
HA-68.5	This site, about 20 acres of farmland and farmed wetland, could address 2 ecological and 1 social objectives. Site could be expanded to create a larger environmental area. Site could be combined with HA-55, HA-68.1, HA-68.2, and Bluff 4 to provide greater ecological benefits and achieve incidental flood damage reduction.	Carried forward

Site	Site Evaluation	Result
Harding Watershed - Continued		
HA-68.1	This site, about 14 acres of farmed wetland, could address 2 ecological and 2 social objectives. Site could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-55, HA-68.5, HA-68.2, and Bluff 4 to increase ecological benefits and achieve incidental flood damage reduction.	Carried forward
HA-68.2	This site, an 11-acre wetland complex, could address 2 ecological and 1 social objectives. Site could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-55, HA-68.5, HA-68.1, and Bluff 4 to increase ecological benefits and achieve incidental flood damage reduction.	Carried forward
HA-68.3	This site, an 8-acre farmed wetland, could address 1 ecological and 1 social objectives. Site is surrounded by development. Site not capable of being combined with other sites.	Not carried forward
HA-68.6	This site, a 15-acre terrestrial area, could address 2 ecological. Site is surrounded by development. Site not capable of being combined with other sites.	Not carried forward
HA-68.7	This site, a 12-acre terrestrial area, could address 2 ecological objectives. Site is surrounded by development. Site not capable of being combined with other sites.	Not carried forward
HA-68.8	This site, about 30 acres of farmed wetland, could address 3 ecological and 1 social objectives. Site could be expanded into adjacent farmland to create a somewhat larger environmental area. Site not able to be combined with other sites.	Not carried forward
Little Canteen Creek	This site, a 5,069-acre tributary watershed, could address 5 ecological and 2 social objectives. Site could be combined with Harding Ditch and HA-53 to meet all planning objectives. Combination could provide enhanced environmental benefits while providing incidental flood damage reduction.	Carried forward
Schoenberger Creek	This site, a 7,741-acre tributary watershed and its associated floodplain channel, could address 4 ecological and 1 social objectives. Site could be combined with Harding Ditch and Wedgewood to meet all planning objectives. Combination could provide enhanced environmental benefits while providing flood damage reduction	Carried forward
Bluff 4 watershed	This site, a 960-acre tributary watershed, could address 3 ecological objectives. Site could be combined with HA-55, HA-68.1, HA-68.2, and HA-68.5 to increase ecological benefits.	Carried forward
Bluff 5 watershed	This site, a 979-acre tributary watershed, could address 2 ecological objectives. Site could be combined with HA-62 to increase ecological benefits.	Carried forward
Harding Ditch	This site, a 10.9-mile long man-made ditch, could address 1 ecological and 2 social objectives. Site could be combined with Canteen Creek, Little Canteen Creek and HA-53, St. Clair Farms, and Wedgewood to meet all planning objectives.	Carried forward

Site	Site Evaluation	Result
Powdermill Watershed		
PO-66	This site, a 141-acre wetland (currently a lake called Mullens Slough), could address 4 ecological 3 social objectives. The site is surrounded by man-made features on all sides, and is not capable of being expanded. Site could be combined with PO-67, PO/HA-67, Mullens Slough agricultural lands, and Powdermill Creek and Bluff 6 to enhance ecological restoration and achievement of social objectives.	Carried forward
PO-67	This site, an 18-acre aquatic area (man-made fishing lake), could address 3 ecological and 2 social objectives. Site is surrounded by development. Site could be combined with PO-66, PO/HA-67, Mullens Slough agricultural lands, Powdermill Creek, and Bluff 6 to enhance habitat restoration.	Carried forward
PO/HA-67	This site, a 39-acre wetland complex, could address 3 ecological and 1 social objectives. Man-made features surround site, and is not capable of being expanded. Site could be combined with PO-66, PO-67, Mullens Slough agricultural lands, Powdermill Creek, and Bluff 6 to enhance habitat restoration and provide incidental flood damage reduction.	Carried forward
Mullens Slough Agricultural land	This site, about 31-acres of farmland, could address 4 ecological and 2 social objectives. Site is bounded by man-made feature on one side, and could be expanded into adjacent farmland to increase size of environmental area. Site could be combined with PO-66, PO-67, PO/HA-67, Powdermill Creek, and Bluff 6 to enhance ecological restoration.	Carried forward
Powdermill Creek	This site, a 840-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 1 social objectives. Site could be combined with PO-66, PO-67, PO/HA-67, Mullens Slough agricultural lands, and Bluff 6 to enhance ecological restoration and provide incidental flood damage reduction.	Carried forward
Bluff 6 watershed	This site, a 1,178-acre tributary watershed, could address 3 ecological objectives. Site could be combined with PO-66, PO-67, PO/HA-67, Mullens Slough agricultural lands, and Powdermill Creek to enhance ecological restoration.	Carried forward

6.6 SCREENING OF POTENTIAL ACTION AREAS

Sites screened and identified to be carried forward as having potential for meeting project objectives were put through further engineering and biological analysis in order to identify the relative effectiveness of sites and site combinations. These analyses are detailed in the Hydraulic, Geotechnical, and Sediment Appendixes. At this point areas were again screened for having the ability to achieve multiple project goals and objectives and to make a significant contribution to attaining project planning targets. Habitat restoration and the ability to reasonably attain hydraulic reconnection for flood pulse restoration to enhance ecosystem functions were key to the assessment process. Those determined to have less potential were identified for removal. The action areas carried forward from this assessment were to be put through the alternative plan development process. The following table details this next iteration of assessment and evaluation that lead to the identification of action areas:

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
LO-29, Dobrey Slough Ag land	Connection of these sites provides the ability to enhance existing habitat and restore an historic wetland slough area. The re-introduction of a flood pulse for its ecosystem benefits to the ag land also provides incidental flood damage reduction for the surrounding urban area. The hydraulic analysis of the site supports area viability.	Carried Forward as Dobrey Slough
CO-24, CO-25, County Ditch	Further evaluation of these combined sites demonstrates limited potential. Cahokia canals backwater effect impedes drainage of local stormwater run off via County Ditch. Because no natural stream existed in or along the alignment of county ditch environmental enhancement of this manmade feature was determined to be a low priority. Hydraulic assessment indicates that if Cahokia Canal conveyance is improved backwater problems in County Ditch should be eliminated.	Not Carried Forward
CO-20, CO-21, Bluff 1, and Cahokia Canal	Further evaluation of these combined sites demonstrates that a quality habitat area can be re-created by restoring the historic creek and flood pulse function. This restoration also achieves incidental flood damage reduction. Area already has some existing habitat features and an interested local planning group. The hydraulic analysis of the site supports area viability.	Carried Forward as Old Cahokia Creek
CA-30, Bluff 2 and Cahokia Canal (McDonough Lake)	The tributary watershed that drains directly into McDonough Lake is quite small and does not deliver flows large enough to introduce a flood pulse or require consideration for flood damage reduction. Introduction of a flood pulse into these wetlands would provide substantial ecological benefits. The only source of water available to introduce a flood pulse would be from Cahokia Canal/ Judy's/ Burdick Branch. Opportunities to introduce a flood pulse into the McDonough area would come from either backwater from Cahokia Canal at the lower end or from Burdick Branch at the North end. A Burdick Branch connection could also provide an opportunity for restoration of an historic floodplain creek. Further evaluation of these options showed that connection to Cahokia Canal was infeasible because of the location of I-255 and connection via Burdick Branch would impact horseradish land, would require connection through a rapidly developing area and create induced flooding problems. The difficulty and expense of connecting these sites make it infeasible. While the team agrees the area should be protected this project did not appear to be a viable mechanism for achieving such protection.	Not Carried Forward

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
Long Lake, Mitchell Ditch, CA-32 and CA-33	Further evaluation of these combined sites determined that improving the connection between Long Lake and Mitchell Ditch with the existing wetlands at CA-32 would allow the re-introduction of a flood pulse to enhance environmental quality. Restoration of the adjacent ag land (CA-33) to historic wetland conditions allows for the creation of a core habitat area providing substantial ecological benefits. These combined sites also have potential to provide flood damage reduction. The hydraulic analysis of the combined sites supports area viability.	Carried Forward as Elm Slough
Judy's Branch, Burdick Branch and Judy's/Burdick ag land	Further evaluation of these combined sites demonstrates that a quality habitat area would result from their being associated with each other. The ag land identified provides an area for the restoration of historic prairie and a small remnant of the historic Cahokia Creek. The hydraulic analysis of the site further supports area viability and creates a diversion out of Cahokia Canal in a proximity that could assist in stopping backwater effects in County Ditch.	Carried Forward as Judy's/ Burdick Branch
CA-41, Brushy Ag Land, Bluff 3, School Branch	Further evaluation of these combined sites determined that restoration of the agricultural land to historic wetland condition in combination with existing wetland habitat allows for the creation of a core habitat area providing substantial ecological benefits. Creating a connection with School House Branch in combination with its improvement would allow the introduction of a flood pulse to enhance environmental quality and permit the restoration of a remnant of the historic Cahokia Creek through the site. These combined sites also have potential to provide flood damage reduction. The hydraulic analysis of the combined sites supports area viability. Part of area is already in public ownership.	Carried Forward as Brushy Lake
CA-44 and Cahokia Canal	Further evaluation of these combined sites demonstrates that there would be ecological benefits to making a hydraulic connection between the two sites. Such a connection would be simple to accomplish and would also provide additional temporary storage of floodwaters. Recommended for action by others.	Carried Forward as I-55/70 Borrow Pits
National City Stockyard	Further evaluation of this site demonstrates that there would be enhanced ecological benefits connected to the protection and restoration of this culturally significant site that is also located in a brownfield area. Recommended for action by others.	Carried Forward as National City Stockyard

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
Canteen Creek, CA54, HA51, HA 52 and Canteen Creek Ag Land (State Park Place)	The Canteen Creek watershed drains in the direction of these combined sites. As indicated in the previous screening process improvement to the floodplain portion of Canteen Creek is not feasible because of cultural resource and urban constraints. Restoring the residential area of State Park Place and adjacent Canteen Creek Ag land to wetlands and other natural habitats, coupled with re-introduction of a flood pulse would allow for the creation of a core habitat area providing substantial ecological benefits and providing incidental flood damage reduction. Additionally, land now designated as part of the World Heritage Site would be protected by removal from private ownership. After exhaustive evaluation of these combined sites it was determined that impediments of I-255, the loss of valuable horseradish production land and the displacement of a large number of residents eliminated these combined sites from further consideration. This left the Canteen Creek watershed, the largest of the bluff watershed open for consideration in conjunction with other site combinations.	Not Carried Forward
Cahokia Mounds and HA-50	Further evaluation of these combined sites demonstrates that quality habitat could be restored here. IHPAs opposition to permitting the re-introduction of a creek overflow on this portion of the World Heritage site eliminated CA-50 and any opportunity of restoring a flood pulse from consideration. The focus of restoration efforts on these publicly owned lands was directed to re-establishment of historic prairie.	Carried Forward as Cahokia Mounds
Canteen Creek, Harding Ditch, Little Canteen Creek, HA-53 and HA-52 (Spring Lake Action Area)	Initial evaluation proceeded under the assumption that Canteen Creek would connect to Harding Ditch and stormwater along with its sediment load would reach the dredged sand plant site within HA-53. From here clean water could back up into HA-53 and HA-52 to provide a flood pulse to enhance environmental quality. Hydraulic analysis showed this to be an infeasible scenario because Harding Ditch sediment load would drop out before reaching the dredged site, the necessity to close Forest Boulevard and IHPA's objection to placing water within the boundaries of the World Heritage Site. At this point with HA-52 no longer available, HA-53 was evaluated for its ability to be connected to St. Clair Farms.	Considered Further as Spring Lake

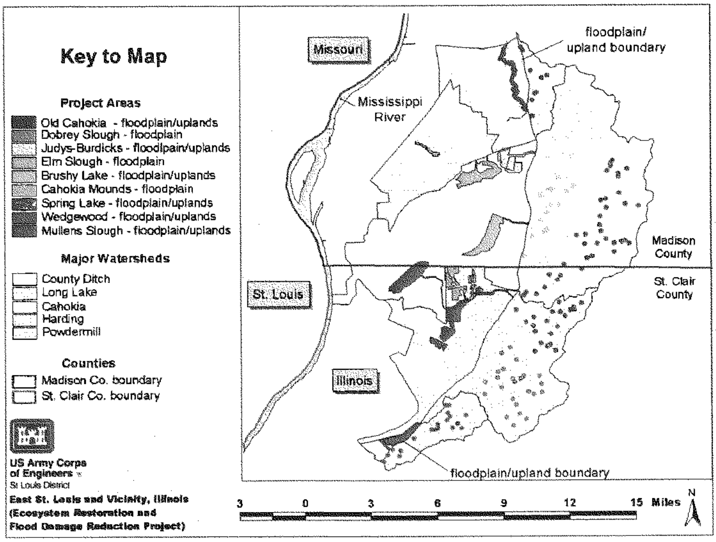
Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
Harding Ditch and St. Clair Farms (St Clair Farms Action Area)	As indicated in the previous screening process improvement to the Harding Ditch channel required for flood damage reduction would impact existing urban areas and require the replacement of numerous bridges and enlargement of the pumping capacity at South pump station. Urban constraints and inability to meet required economic benefits for flood damage reduction make this approach infeasible. The introduction of a flood pulse to the combined HA-53 and St. Clair Farms significantly improved ecosystem functions and provides incidental flood damage reduction. Under this scenario Harding Ditch would be an important component to ecosystem restoration objectives. The introduction of Canteen Creek to this scenario however, exceeds the desired depth and duration of a flood pulse, and requires enlargement of the flood protection features (Harding Ditch and South Pump Station) downstream of these sites that is not feasible.	Considered Further as Spring Lake
HA-53, Lansdowne Ditch, CA-45 (Indian Lake)	Because of the constraints downstream of combined HA-53 and St. Clair Farms sites, it was clear that Canteen Creek flows needed to be returned to the Cahokia watershed and the flood control system associated with it. Connection of HA-53 to an improved Lansdowne Ditch through Washington Park was evaluated as a method of connecting HA-53 and CA-45. This connection would allow the restoration of a flood pulse in CA-45 for its ecosystem benefits by permitting water to back up into Indian Lake from the south end via a connection to Lansdowne Ditch. The hydraulic analysis demonstrated that the size of the conveyance required through Washington Park was not feasible and could potentially induce flooding in the already existing urban area. The concept of connecting HA-53 near the upper end of Indian Lake via a new channel through Fairmont City was evaluated. The analysis of this connection proved to not only allow for the re- introduction of a beneficial flood pulse to Indian Lake but also make the re-creation of the historic Cahokia Creek channel through the site feasible. This connection additionally ensures the Cahokia and Harding watersheds remain balanced by returning Canteen Creek flows to the Cahokia Canal. In this manner the originally designed pump station capacity at the main line levee is not be exceeded and the possibility of inducing flooding is eliminated. The creation of this connection produces significant ecosystem benefits while providing incidental flood damage reduction.	Carried Forward with Canteen Creek, Little Canteen Creek Harding Ditch and St. Clair Farms as Spring Lake

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
HA-55, HA-68.1, HA-68.2, HA-68.5, and Bluff-4 (Crooked Lake)	The tributary watershed that drains directly into these combined sites (bluff 4) is relatively small. However, these sites form a natural low spot that collects this local runoff during larger events. Excess water from this area eventually makes its way into the Harding Ditch via a small pump. These sites serve a valuable storm water retention function for the area. While the improvement of these sites could provide environmental benefits the area is not able to be expanded greatly based on urban constraints. Relative to other sites investigated these combined sites would provide a less effective action area. The team agrees however that this natural ponding are should be enhanced by local action to improve environmental quality while protecting a natural stormwater detention site for the community.	Not Carried Forward
Harding Ditch, Schoenberger Creek and Wedgewood	During high flows the Schoenberger Creek currently spills out into East St. Louis neighborhoods. Harding Ditch does not have the capacity to accept and to carry this water away fast enough to prevent flooding. A connection with the FEMA buyout area of Wedgewood could introduce a flood pulse to the site to enhance ecosystem function and provide incidental flood damage reduction. However, the segmentation of the site by I-255 makes the closing of Summit Avenue the only viable method of introducing such a connection. Coordination with IDOT and East St. Louis indicated that this was a possibility so full evaluation of these combined sites was performed. The hydraulic analysis of the combined sites with the closing of Summit Road supports area viability.	Carried Forward as Wedgewood
Powdermill Creek, PO-66, Mullen's Slough Ag Land, PO-67, PO/HA-67, and Bluff 6	Further evaluation of these combined sites demonstrates that better utilization of the connection of Powdermill flows under Hwy 163 could re-introduce a flood pulse to the historic slough area. Environmental enhancement of the combined sites could provide substantial aquatic and terrestrial benefits and allowing the restoration of an historic prairie remnant. The hydraulic analysis of the combined sites further supports area viability.	Carried Forward as Mullen Slough

6.7 ACTION AREAS SELECTED FOR ALTERNATIVE PLAN DEVELOPMENT

With the selection of final action areas the formulation moved into a new phase of alternative development. In order to ease the identification process for the public, other agencies and the team historic or commonly known names were given to the action areas. In this way the public and others could easily identify with their geographic location. Figure 6-10 shows their location in the Project area and the following table summarizes their retention for alternative plan development. Dots displayed in Figure 6-10 show the location of sites where tributary stream sediment detention basins could be built, as determined by the NRCS.

Figure 6-10 Action Area Locations



Selected Project Action Areas	Results of Action Area Screening	Rationale
Dobrey Slough	Selected Action Area	Combined sites address 4 ecological and 3 social objectives. Provides acceptable potential for effective restoration and ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Old Cahokia Creek	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting several project planning targets, has existing habitat features. Interested local planning group. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Elm Slough	Selected Action Area	Combined sites address 4 ecological and all social objectives. High potential for effective restoration meeting several project planning targets, has existing habitat features. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Judy's/Burdick	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting several project planning targets. Ability to benefit from flood pulse introduction. Ability to meet social (ecosystem service) objectives.

Selected Project Action Areas	Results of Action Area Screening	Rationale
Brushy Lake	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting several project planning targets, has existing habitat features. Part of area in public ownership. Ability to benefit from flood pulse restoration. Ability to provide temporary flood diversion area. Ability to meet social (ecosystem service) objectives.
Cahokia Mounds State Historic Site	Selected Action Area	While the site only addresses 2 ecological and 1 social objective it has high potential for effective prairie restoration helping to meet project target by providing an increased level of bio-diversity.
Spring Lake	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting numerous project planning targets, has existing habitat features. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Wedgewood	Selected Action Area	Combined sites address 6 ecological and all social objectives. Coordination with IDOT and City eliminated highway constraint issues. Public land with existing habitat with potential to meet ecological needs. Acceptable potential for effective restoration meeting several project planning targets. Ability to benefit from flood pulse introduction. Ability to meet social (ecosystem service) objectives.
Mullens Slough	Selected Action Area	Combined sites address all planning objectives. Acceptable potential for effective restoration meeting several project planning targets, has existing habitat features. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
I-55/70 Borrow Pit	Selected Area for Action by Others	Acceptable potential for effective restoration. Public ownership. Ability to benefit from partial flood pulse restoration. This site would be recommended to partner agencies for potential action or studied further under a separate plan.
National City Stockyard	Selected Area for Action by Others	Potential for restoration meeting habitat goals and protection of culturally significant area. This site would be recommended to partner agencies for potential action or studied further under a separate plan.

A characterization is provided for each of these eleven selected action areas, and it describes location, local topography and soils, principal natural communities and ecosystem disturbances during presettlement times, current conditions, and site-specific problems and opportunities. This information was essential to the alternative plan development process.

6.7.1 Dobrey Slough.

Location. This action area is in Madison County, in the north half of Nameoki Township (T3N, R9W). It is located north of Horseshoe Lake, near Granite City and Pontoon Beach. Pontoon Road forms the south boundary, and Maryville Road the west limit. The action area extends northwest to southeast over a distance of about 1.25 miles.

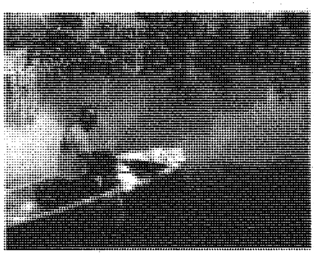
Components of Action Area. This action area is restricted to the floodplain because no tributary stream drains into or near Dobrey Slough. It envelops about 100 acres.

Surface Geology, Topography, and Soils of Floodplain. Dobrey Slough lays along the border of two geological features, a broad belt of old meander scars of the Mississippi River to the north, and a point bar to the south. It is a long, linear depression without any well-defined points of surface inflow or outflow. Ground elevations lie between 410 and 425 feet NGVD. Most of the lowest topography consists of Darwin silty clay loam and Darwin silty clay. Both soils are indicative of historic wetland conditions. Topographically higher soils include a variety of loams.

Predevelopment Natural Communities. Historic vegetation in this low area probably consisted of marsh, along with some woody species. The higher ground historically supported mesic prairie, which apparently surrounded most of the action area. Mesic floodplain forest broke this prairie perimeter on the north side of the slough.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic floodplain ecosystem. Flooding by overflow from the Mississippi River probably occurred about once every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 426 feet NGVD. At its peak, water depths over the action area would have ranged from about one to 16 feet. Rainfall and associated local runoff would have ponded in the historic slough very often, essentially any time a rain event occurred.

Existing Conditions. Residential areas built in the 1950s surround Dobrey Slough on most sides. Some of this development has encroached into the historic slough.



Remnant marsh is narrow, and often disturbed by mowing. A thin border of trees lies adjacent to some of the marsh. Surrounding undeveloped land consists of cropland.

There are no publicly owned lands within the action area.

Problems and Opportunities. Significant rainfall events, such as those that occurred in the mid-1990s, turn Dobrey Slough into a lake.

This surface water floods homes adjacent to the historic slough. A pump station located at the south end of the slough is not designed to handle more than small storm events. Also, groundwater levels under the influence of the Mississippi River can cause flooding to occur in the basements of some homes located on sandy soils.

The historic slough and adjacent woody vegetation is of low value to wildlife because it is fragmented, narrow in width, and in close proximity to existing development.

Opportunities exist within the action area to restore the historic marsh, create a larger natural area, and reintroduce periodic ecosystem disturbance in the form of flooding. The creation of this action area would reduce damages from surface flooding in the adjacent residential areas. Solutions would not address belowground flooding due to localized high groundwater conditions. The Illinois Department of Natural Resources is currently addressing groundwater flooding.

6.7.2 Old Cahokia Creek.

Location. This action area is in Madison County, in southwestern Edwardsville Township (T4N, R8W).

Components of Action Area. Remnants of the historic Cahokia Creek and its adjacent floodplain comprise the action area's floodplain component. This area generally lies parallel to the bluff, and extends north to south about 3.5 miles, from the Cahokia Creek Diversion Channel to the south side of I-270. Route 157 and Bluff Road lie to the east, and Sand Road to the west. It envelops about 450 acres.

Bluff 1 watershed, to the east of the floodplain component, is this action area's tributary component.

Surface Geology, Topography, and Soils of Floodplain. The floodplain portion of this action area is located on a terrace or elevated area in the Mississippi River's floodplain. Cahokia Creek meandered through this area from north to south until it was diverted to the Mississippi River via the diversion channel about 90 years ago. Ground elevations range from about 425 to 440 feet NGVD. Most of the soils adjacent to the creek consist of a variety of loams and sands. Further to the east, land gently slopes upward toward the bluff.

Predevelopment Natural Communities. In predevelopment times, mesic floodplain forest likely bordered the creek, and mesic sand prairie may also have been present. In the adjacent uplands, the tributaries that drained into Cahokia Creek were low to medium gradient creeks. Mesic floodplain forest grew in the narrow bottoms along the creek channels, and mesic upland forest was found along the base of the adjacent ravines.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this portion of the historic ecosystem. In the bottoms, flooding by overflow from the Mississippi River was rare because of the terrace's relatively high ground. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 428 feet NGVD, inundating only the lowest areas.

However, Cahokia Creek probably overflowed its banks at least annually. Extreme events probably did not exceed a couple of feet in depth or several days in duration. Flooding in the uplands was confined to creek bottoms. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. At this action area, diversion of Cahokia Creek to the Mississippi River eliminated the creek's tributary watershed of 260 square miles. As a result, the tributary drainage area associated with the historic creek channel was diminished to four square miles (Bluff 1 watershed). Four small ditches from the Bluff 1 watershed carry drainage west to the historic creek.

Within the floodplain component, cropland is the most prevalent kind of land cover. Most farmland is used for row crops and grass sod production. Horseradish is also grown in some fields. Riparian forest is the next most common land cover type. Narrow fragments of riparian forest remain along some remnants of historic creek channel. The remaining cover types are uncommon, and include the historic channel, ditches, grassland, and development. Portions of the historic creek have been filled over the years to facilitate agricultural activities. To the west of the floodplain component lie relatively small areas of residential development, mainly along Sand Road, but these are expanding.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists a known occurrence of the Illinois chorus frog in close proximity to the floodplain component. This amphibian is listed as state threatened. The database also lists four areas of "precision habitat" for this species in the vicinity of the floodplain component. These areas fulfill the species' life history requirements. Two of the four areas overlap with the action area. One is located near the middle, and the other near the southern end; both areas of "precision habitat" include lands on both sides of the historic creek channel.

The terrace where the floodplain component lies is rich with prehistoric cultural resources.

In the Bluff 1 watershed, forest accounts for about 30 percent of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 5,000 tons of sediment is currently delivered to the floodplain per year from this tributary watershed.

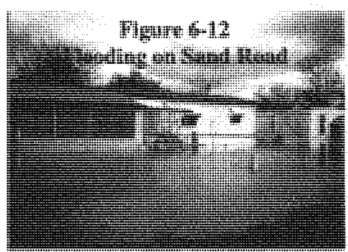


Figure 6-12
Flooding on Sand Road

Notable publicly owned lands within the action area include portions of the Southern Illinois University-Edwardsville campus.

Problems and Opportunities. Various ecological problems are present. First, storm water is also causing environmental degradation by carrying sediment and depositing it into the historic channel remnants and adjacent riparian forest.

Second, the several remnants of Cahokia Creek no longer function as a stream because they are isolated from each other. Third, most fragments of forest along the channel remnants do not function effectively as riparian corridors for wildlife because they are too narrow. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding of residential areas along Sand Road has occurred on a number of occasions over the last 10 years. Storm water from the Bluff 1 watershed is often the major source of flooding.

Opportunities exist within the action area to restore a portion of the historic Cahokia Creek to a flowing condition, establish a functional riparian corridor on both sides of the restored creek, reintroduce periodic ecosystem disturbance in the form of flooding and prescribed fire, and implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance would provide incidental flood damage reduction for the area west of the creek.

6.7.3 Elm Slough.

Location. This action area is in Madison County northeast of Horseshoe Lake. Most of it is in northeastern Nameoki Township (T3N, R9W), and the remainder is in northwestern Collinsville Township (T3N, R8W).

The action area extends east to west about 2 miles, and north to south about 1.5 miles. Route 162 bounds it on the north, I-255 on the east, and Route 111 on the west.

Components of Action Area. Because no tributary stream drains into the action area, it is restricted to the floodplain. It encompasses about 700 acres.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, named the Edelhardt Lake meander loop (White et al. 1984), constitutes the floodplain action area. The meander scar extends roughly east-west in this area. Long Lake, a narrow slough-like water body, historically traversed the meander scar in the eastern portion of the action area. Outside the action area, the lake connected with historic Cahokia Creek about one mile south.

Within the action area, ground elevations generally slope east to west, and range from about 415 feet NGVD along Long Lake, to about 405 feet NGVD close to Horseshoe Lake. Darwin silty clay loam and Darwin silty clay comprise most of the soils in the action area. Both are indicative of historic wetland conditions. Smaller areas of Beaucoup silty clay loam and Birds silt loam are present, and they too reflect historic wetlands. Small areas of nonwetland soils include a variety of silts and loams, and they tend to be located along Long Lake.

Predevelopment Natural Communities. In predevelopment times, the action area was dominated by forested wetland. Wet-mesic floodplain forest extended over most of the old meander scar. Lower ground to the west supported some wet floodplain forest. Shrub swamp probably occurred in the lowest elevations near Horseshoe Lake. North of the forested wetlands, prairie was found within the action area.

Predevelopment Ecosystem Disturbance Dynamics. Flooding was a primary force that periodically disturbed this area of the historic floodplain ecosystem. Seasonal fluctuations of Horseshoe Lake overflowed into the action area, and probably occurred annually on a repeated basis within the lower elevations. Overflow from the Mississippi River may have inundated the entire site about once every one to two years. The flood of 1844, the greatest on record, is estimated to have crested in this area at about 426 feet NGVD. At its peak in late June, water depths over the action area ranged from about 11 to 21 feet. Duration from beginning to end was several months.

Long Lake also spilled over its banks and sent floodwater into the action area, presumably on an annual basis. Depending on local conditions, it could flow in either direction. From the north, flooding consisted of "upstream" floodplain drainage, as well as floodwaters from Wood River. This tributary entered the American Bottom about 12 miles north near Alton, and was connected to or continuous with Long Lake, at least during periods of high flow created by storm events in its tributary watershed. Reverse flow in Long Lake occurred when floodwaters from Cahokia Creek came up from the south as backwater. Flooding from Long Lake probably was represented by shallow sheet flow that moved slowly down the old meander scar through the wet-mesic and wet floodplain forests, and eventually into Horseshoe Lake.

Wild fire typically did not affect the forested wetlands because of the usual high moisture levels in the ground surface, but it would have enveloped the prairie to the north.

Existing Conditions. Due to development of the floodplain, the action area, called "Elm Slough" by local residents, receives far less flooding than it did historically. Seasonal overflow from Horseshoe Lake is very minor compared to what it was historically. Overflow from the Mississippi River no longer exists. Long Lake rarely overflows its banks because it has been segmented and its watershed reduced, and the historic connection with Cahokia Creek is gone. Currently, periodic flooding of Elm Slough consists of storm water from Long Lake and Mitchell Ditch. The latter tributary drains a relatively small portion of the floodplain north of the action area and east of Long Lake. Storm water from both sources comes together on the south side of Route 162, and is carried into Elm Slough by a man-made ditch. This ditch enters Elm Slough about one mile west of where Long Lake used to traverse the old meander scar. Once in Elm Slough, storm water flows west for about 0.75 miles before reaching Route 111 and eventually Horseshoe Lake.

Over the last 60 years, most of the forested wetlands in Elm Slough have been converted into cropland. This conversion was facilitated by a drainage ditch that runs east-west through the historic slough. The ditch was created about 100 years ago in a failed attempt to divert Cahokia Creek into Horseshoe Lake. Farmland also constitutes most of the land south of Route 162 and north of the historical forested wetlands. Scattered residences are located in this area, and many are adjacent to Long Lake. Other agricultural lands lie just southwest of the action area, and various types of development occur just northwest and southeast. Some development has encroached into Elm Slough.

A relatively large fragment of forested wetlands (120 acres) remains in the west portion of the action area. It consists of about equal amounts of wet-mesic floodplain forest and wet floodplain forest. This block of forested wetlands provides for the needs of some species sensitive to habitat fragmentation; a pileated woodpecker, which has high sensitivity to forest fragmentation (Herkert et al. 1993), was observed here in the spring of 1999. The ditch that carries storm water from Long Lake and Mitchell Ditch enters this block of forested wetlands near its northeast corner. West of the forested wetlands and east of Route 111, there is a mixture of marsh and shrub swamp. These types of vegetation also occur in Long Lake within the action area. A narrow and often sparse riparian zone borders the lake.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists two known occurrences of state listed animal species in close proximity to the action area. The common moorhen, a state threatened bird, is known from a location just west of Route 111. The massasauga, a federally listed species of concern and state endangered snake, is known from a location to the southeast, on the west side of Cahokia Canal.

There are no publicly owned lands within the action area.

Problems and Opportunities. Various ecological problems are present. First, because of its relatively small area, the remnant of forested wetland has limited value for supporting many species highly sensitive to forest fragmentation, such as interior forest nesting birds. Second, wet-mesic floodplain forest within the action area contains low tree species diversity. Many of the native nut-bearing species, such as oaks and hickories, were commercially removed years ago, and the local seed source for regeneration is scarce. Third, over the past 10 years or so, much of the wet floodplain forest has died or is now dying from drowning; an increased pool level in Horseshoe Lake may be the cause. Fourth, strips of riparian forest along Long Lake do not function effectively as wildlife corridors because they are too narrow. Finally, within the action area, less than half of the remaining forested wetlands are subject to disturbance by flooding. Flood damages can occur in the vicinity of the action area. After large storm events, Long Lake north of Route 162 can spill over and flood numerous backyards and residences that border its banks.

Opportunities exist within the action area to enlarge the existing area of forested wetlands to support more species of highly area-sensitive animals, to reintroduce seasonal flooding as a periodic ecosystem disturbance over this larger natural area, to establish a functional riparian zone along a portion of Long Lake, and to replace "lost" tree species that once grew in this area. The reintroduction of periodic flooding as an ecosystem disturbance dynamic would provide incidental flood damage reduction "upstream" along Long Lake and Mitchell Ditch.

6.7.4 Judy's-Burdicks Branch.

Location. This action area is in Madison County, in the south half of Edwardsville Township (T4N, R8W), and north half of Collinsville Township (T3N, R8W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. It consists of Judy's Branch and Burdick Branch, and an area at their confluence with Cahokia Canal. This floodplain component extends east to west about 1.5 miles, and north to south about one mile. Route 162 bounds it on the north, I-255 on the southwest, and Route 157 on the east. It envelops about 600 acres.

To the east, the tributary component consists of the lower part of the Bluff 1 watershed, and Judy's Branch and Burdick Branch watersheds.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, the McDonough Lake meander loop (White et al. 1984), crosses much of the floodplain action area from northwest to southeast. Backswamp deposits make up the remainder of local geological features. Cahokia Creek meandered through this area from north to south until it was diverted to the Mississippi River about 90 years ago. The ground is relatively flat, and elevations vary from about 418 to 420 feet NGVD. Darwin silty clay, a soil indicative of historic wetland conditions, is most prevalent in this area. The east portion of the floodplain action area consists of an alluvial fan deposited by Judy's and Burdick Branches along the base of the bluff. It consists of various silt loams.

Predevelopment Natural Communities. The floodplain component lies at the south end of historic Rattan's Prairie, a 15,000-acre prairie once found in the northeast part of the American Bottom. Wet-mesic prairie most likely occurred on the Darwin soil. Drier prairie as well as mesic floodplain forest probably occurred on the alluvial deposits. In the uplands, Judy's and Burdick Branches had low to medium gradients. Narrow strips of mesic floodplain forest grew adjacent to their channels, and mesic upland forest along the base of adjacent ravine slopes.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this portion of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 426 feet NGVD. At its peak, water depths over the area ranged from about six to eight feet. Cahokia Creek would have overflowed its banks at least annually, as well as Judy's and Burdick Branches near their confluence with the creek. Because of the flat topography and clayish soils, shallow ponding of rainfall would have occurred in the wet-mesic prairie after significant storms. Flooding in the uplands was confined to creek bottoms. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. At this action area, diversion of Cahokia Creek to the Mississippi River about 90 years ago eliminated the creek's upland drainage area of 260 square miles. At about the same time, the historic creek was replaced by Cahokia Canal. Judy's and Burdick Branches still flow west, but enter Cahokia Canal. In the vicinity of this junction, these three waterways are canals, and are bordered on both sides by earthen berms to prevent overtopping.

Cropland is the most prevalent kind of land cover in the floodplain component. Most farmland supports row crops, and horseradish is grown in some fields, primarily on the alluvial deposits. Other lesser types of land cover include lacustrine or lake-like borrow pits, grassland, ditches, forested wetland, riparian corridor, and development. Stormwater rarely floods narrow strips of riparian forest along Judy's Branch and upper Burdick Branch. The entire historic channel of Cahokia Creek has been filled to facilitate agricultural activities. A relatively small area of residential development lies between I-270 and Cahokia Canal, and a few scattered residences lie along both tributaries.

In the tributary portions of Judy's and Burdick Branches, forest accounts for less than half of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 12,000 tons of sediment is currently delivered to the floodplain per year from the Judy's and Burdick Branch watersheds.

The alluvial area along the base of the bluff is rich with prehistoric cultural resources.

Notable publicly owned lands within the action area include Cahokia Canal.

Problems and Opportunities. Various ecological problems are also present. First, excessive levels of sediment transported by storm water from tributary streams can smother aquatic habitat and degrade water quality by increasing turbidity levels. Second, Cahokia Canal is not a functional riparian corridor for wildlife because periodic maintenance for flood control purposes removes any natural (woody) vegetation growing along its channel, and along its outside, most adjacent lands are either agricultural or developed. Third, strips of riparian forest along Judy's and Burdick Branches also do not function effectively as wildlife corridors because they are too narrow. Fourth, except for a small disturbed remnant along a railroad track to the north, historic Rattan's Prairie has disappeared. On the floodplain, flooding occurs infrequently when storm water overtops the Judy's or Burdick Branch channels. On such occasions, floodwater sheet flows south, mainly across farmland.

Opportunities exist within the action area to recreate a natural area on the floodplain, restore a portion of the historic Cahokia Creek within this area to a flowing condition, reintroduce periodic ecosystem disturbances in the form of flooding and prescribed fire, establish a floodplain-upland linkage for wildlife between the natural area and adjacent uplands via a riparian corridor along either Judy's or Burdick Branch, and implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance dynamic would also reduce Cahokia Canal backwater effects "upstream" in County Ditch.

6.7.5 Brushy Lake.

Location. This action area is in Madison County east of Horseshoe Lake. It is in southeastern Nameoki Township (T3N, R9W) and western Collinsville Township (T3N, R8W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. This area consists of Schoolhouse Branch, and an area of land located south of its confluence with Cahokia Canal. The floodplain component extends east to west about 3 miles, and north to south about 2 miles. Horseshoe Lake Road bounds it on the north, Route 157 and Fairmont Avenue on the east, I-55/70 and Canteen Creek on the south, and Cahokia Canal on the west. It envelops about 750 acres.

To the east, the tributary component consists of the Schoolhouse Branch and Bluff 3 watersheds.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, named Edelhardt Lake meander loop (White et al. 1984), comprises most of the floodplain component. Backswamp deposits make up the remainder of local geologic features, and they area located between the meander scar and the bluff. Within this old meander scar, Cahokia Creek meandered from north to south. Schoolhouse Branch joined Cahokia Creek at the north end of the action area. Ground elevations in the old meander scar range from about 405 to 420 feet NGVD. Most land is below 410 feet NGVD. Moderately higher ground occurs at the north and south ends of the meander scar. Most soils consist of Beaucoup silty clay loam, Birds silt loam, and Darwin silty clay loam. All are indicative of historic wetland conditions. Nonwetland soils are concentrated in the north and south ends of the action area, where elevations are higher, and they include a variety of silt loams. The east portion of the floodplain action area consists of an alluvial fan deposited by Schoolhouse Branch along the base of the bluff. It gently slopes upward to the bluff, and consists of other silt loams.

Predevelopment Natural Communities. Diversity of natural communities was high at this floodplain action area in predevelopment times. A floodplain stream, Cahokia Creek, meandered through it. A contact zone between forest and prairie was also present within the old meander scar. Extensive forest encircling Horseshoe Lake to the west met with prairie extending east from the bluff. Forest was more prevalent, and consisted of three kinds, mesic floodplain, wet-mesic floodplain and mesic upland forest. Mesic floodplain forest occupied higher ground at the north and south ends of the old meander scar, as well as at the base of the bluff along Schoolhouse Branch. Within the meander scar, wet-mesic floodplain forest occupied intermediate elevations, and wet floodplain forest lower elevations. A small core of shrub swamp occupied a low depression in the middle of the action area. A lake-like water body apparently occurred a short distance to the northeast. Prairie within the old meander scar probably consisted of wet prairie and wet-mesic prairie. All forests and prairies were wetlands except for the mesic forms. Most of the alluvial fan by the bluff supported mesic prairie. The tributary component of the action area consisted of low- to medium-gradient creeks. Mesic floodplain forest grew in the narrow bottoms along these creek channels, and mesic upland forest was found along the base of the adjacent ravines.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding affected the entire floodplain action area. Flooding by overflow from the Mississippi River probably occurred once every one to two years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 424 feet NGVD. At its peak, water depths over the action area ranged from roughly 5 to 15 feet. Cahokia Creek would have overflowed its banks several times annually. Additional flooding came from Schoolhouse Branch and Canteen Creek. The latter joined Cahokia Creek inside the old meander scar just outside the southern end of the action area.

Wild fire typically did not affect the forested wetlands because of the usual high moisture levels in the ground surface, but it would have enveloped the prairie. Wild fire was the dominant force that periodically disturbed the uplands.

Existing Conditions. Diversion of Cahokia Creek to the Mississippi River about 90 years ago eliminated the creek's drainage area of 260 square miles. At about the same time, the historic creek was replaced by Cahokia Canal. The canal is bordered on both sides by earthen berms to prevent overtopping. Schoolhouse Branch still flows west, but enters Cahokia Canal instead of the creek. Schneider Ditch, a tributary from the Bluff 3 watershed, enters the action area south of Schoolhouse Branch.

Development has notably reduced the extent and diversity of historical natural communities in the floodplain. Cropland comprises more than half the land in the old meander scar. After cropland, forested wetland is most common. Less well-represented habitats include meadow/grassland, scrub shrub wetland, mesic floodplain forest, open water, and emergent wetland or marsh. Much of historic Cahokia Creek has been filled, mainly for agricultural purposes. Portions of historic channel remain, but they are no longer connected to Cahokia Canal. Native prairie has disappeared, but a small restoration exists in the southwest corner between Cahokia Canal and Canteen Creek.

Lands bordering Schoolhouse Branch are mainly cropland. Sparse, narrow strips of riparian forest exist along either side of its channel. Horseradish is grown in fields adjacent to Schoolhouse Branch, and in fields adjacent to the old meander scar, as well as within it at the north end. A few scattered residences lie along Fairmont Avenue and Schoolhouse Branch. I-255 borders the northeast portion of the floodplain component.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists the Levee Lake INAI (Illinois Natural Area Inventory) site as occurring within this floodplain action area. This 230-acre tract was identified during the Inventory in the mid-1970s as important because it represented the largest remaining example of a wet floodplain forest/shrub swamp/pond complex in the American Bottom, and the shrub swamp and pond elements were of high quality (IDNR, 1978). Since the mid-1970s, creation of a ditch network for drainage of cropland adjacent to the Natural Area has permanently lowered the level of water in its wetlands. Consequently, the shrub swamp has diminished in size due to the encroachment of woody species, such as wouldows.

The floodplain action area provides for the needs of a variety of rare plants and animals, according to a biological survey conducted for this project. Of 51 animal species observed at the floodplain action area in 1998, four are on the Illinois list of state endangered species, and include birds that forage at the site - little blue heron, snowy egret, black-crowned night heron, northern harrier (Zambrana Engineering 1998). The decurrent false aster, a Federally and state threatened plant, may also occur at the site, as well as the Federally listed species of concern and state-endangered massasauga rattlesnake (Zambrana 1998). Because of the relatively large remaining natural habitat, represented chiefly by a block of 200 acres of forested wetlands, this floodplain action area is expected to provide for the needs of some species highly sensitive to habitat fragmentation.

In terms of ecosystem disturbances, flooding is very limited at the floodplain action area. The Mississippi River is isolated from its floodplain, and Cahokia Canal keeps storm water confined within its banks. Only Schneider Ditch from the Bluff 3 watershed occasionally carries storm water directly into the area. Prescribed fire is used to maintain the prairie restoration area only.

In the Schoolhouse Branch and Bluff 3 tributary watersheds, forest accounts for less than half of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 17,000 tons of sediment is currently delivered to the floodplain per year from these two tributary watersheds.

The alluvial area along the base of the bluff is rich with prehistoric cultural resources.

Notable publicly owned lands within the action area involve Metro East Sanitary District (Cahokia Canal and most of Levee Lake Natural Area) and the Illinois Historic Preservation Agency (in the southwest corner of the site).

Problems and Opportunities. Various ecological problems are present. First, flooding plays a very minor role as a periodic ecosystem disturbance in the action area. Second, habitat diversity is low. Cahokia Creek as a floodplain stream no longer exists, and native prairie has disappeared. Mesic floodplain forest is largely gone. Third, wet-mesic floodplain forest contains low tree species diversity. Many native nut-bearing species, such as oaks and hickories, that used to exist are gone, and the local seed source for regeneration is scarce. Fourth, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity level. Sediments from Schneider Ditch are being deposited within forested wetlands inside Levee Lake Natural Area. Fifth, Cahokia Canal is not a functional riparian corridor for wildlife. Periodic maintenance for flood control purposes removes any natural (woody) vegetation growing inside along its channel, and along its outside, a riparian zone is also often lacking where cropland is adjacent. Sixth, strips of riparian forest along Schoolhouse Branch also do not function effectively as wildlife corridors because they are too narrow. On the floodplain, flooding occurs infrequently when storm water overtops the Schoolhouse Branch or Schneider Ditch channels. On such occasions, floodwater sheet flows south, across farmland as well as developed areas.

Opportunities exist within the action area to enlarge the existing forest to support more species of area-sensitive animals, restore a portion of the historic Cahokia Creek to a flowing condition, reintroduce periodic ecosystem disturbance in the form of flooding, create a riparian zone adjacent to Cahokia Canal effective for wildlife, and implement measures designed to restore tributary stream and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance would also reduce Cahokia Canal backwater effects "upstream" of this action area.

6.7.6 Cahokia Mounds.

Location. This action area is in St. Clair County in northeastern Canteen Township (T2N, R9W).

It lies within Cahokia Mounds State Historic Site, southeast of Horseshoe Lake. The action area extends east to west and north to south about 1.5 miles. Collinsville Road bounds it on the north, State Park Place on the east, Forest Boulevard on the south, and railroad tracks on the west.

Components of Action Area. Because no tributary stream drains into the action area, it is restricted to the floodplain. It envelops about 525 acres.

Surface Geology, Topography, and Soils of Floodplain. Two geological features represent this action area. Two separate meander scars of the Mississippi River as well as adjacent point bars occur locally. Except for prehistoric mounds, ground elevations generally lie between 410 and 420 feet NGVD. Most land is at about 415 feet NGVD. Darwin silty clay loam, Darwin silty clay, and Fults silty clay comprise most of the soils. All are indicative of historic wetland conditions. Small areas of nonwetland soils include a few kinds of silt loam.

Predevelopment Natural Communities. Historic Cold Prairie, a 15,000-acre prairie once found in the southeast part of the American Bottom, enveloped the action area. When the General Land Office surveyors worked in this area in the early 1800s, they noted that most of this prairie was wet. Wet-mesic prairie probably formed most of the native grassland. Wet prairie and marsh probably occurred in localized depressions within the wet-mesic prairie.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic floodplain ecosystem. Overflow from the Mississippi River inundated the action area about once every ten years. The flood of 1844, the greatest on record, is estimated to have crested in this area at about 422 feet NGVD. At its peak in late June, water depths over the action area ranged from over five feet to less than 15 feet. Duration from beginning to end was a couple of months.

Flooding from Cahokia Creek or other upland tributaries to the east, such as Canteen Creek or Little Canteen Creek, apparently did not affect this area. The ground was either too high to be flooded by any of these tributaries, or "protected" from overland flooding coming from the east by a wide depression consisting of the east-most meander scar (Spring Lake meander loop). Rainfall and associated local runoff may have been important sources of wetland hydrology for the historic prairie.

Existing Conditions. The publicly owned Cahokia Mounds State Historic Site lies within the Cahokia Mounds World Heritage Site. The latter is one of only two sites established in the U.S. for the protection of internationally significant prehistoric cultural resources.

Most of the 2,200 acre State Historic Site includes various types of natural vegetation, such as old fields, forest, and marsh. Prairie restorations total less than 100 acres, and prescribed fire is used to maintain them. Most interpretive areas are grassy and periodically mowed. Over 500 acres of both grassy and old-field areas are leased for hay production.

Problems and Opportunities. No remnants of Cold Prairie exist today. Because of their small area, the existing prairie restorations at the State Historic Site have limited value for supporting breeding populations of many grassland bird species.

Opportunities exist within the action area to restore native prairie vegetation on areas currently used for hay production, and create areas of grassland capable of supporting more species of area-sensitive birds.

6.7.7 Spring Lake.

Location. This action area is in St. Clair and Madison Counties, and is the largest of this project. Most of it is in St. Clair County, in the north halves of Canteen Township (T2N, R9W) and Caseyville Township (T2N, R8W). In Madison County, the action area is also located in southwest Nameoki Township (T3N, R9W), eastern Collinsville Township (T3N, R8W), and western Jarvis Township (T3N, R7W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. Nearly all of it is in St. Clair County, either adjacent to Harding Ditch or Lansdowne Ditch. At its widest points, the floodplain component extends east to west about 6 miles, and north to south about 4 miles. The floodplain component consists of Harding Ditch, from Route 157 to St. Clair Avenue, as well as three major areas: 1) Cell 1, adjacent to Harding Ditch (about 375 acres, bounded by Forest Boulevard to the north, I-255 to the east, Bunkum Road to the south), 2) St. Clair Farms, also adjacent to Harding Ditch (about 180 acres, bounded by I-64 to the North, Harding Ditch and I-255 to the east, St. Clair Avenue to the south), and 3) Indian Lake, adjacent to Lansdowne Ditch (about 625 acres, bounded by I-55/70 to the north, Route 111 to the east, Collinsville Road to the south, Route 203 to the west). In addition to these three major areas, a small area north of Cell 1 is also included in the floodplain component. The floodplain component encompasses about 1,500 acres.

To the east, the tributary component consists of the Canteen Creek and Little Canteen Creek watersheds.

Surface Geology, Topography, and Soils of Floodplain. Four geological features comprise the floodplain components - old meander scars, point bars, chutes and bars, and backswamps. Various old meander scars represent most of their area. Two meanders scars, the Spring Lake and Rock Road meander loops (White et al. 1984), represent about half of Cell 1, and the remainder consists of point bars. The Rock Road meander loop represents most of St. Clair Farms, and a point bar makes up the rest. Horseshoe Lake meander loop constitutes nearly all of Indian Lake, and a chute and bar area comprises the remainder. Backswamp deposits comprise the area extending from the bluff to I-255, and along the bluff they are overlain by alluvial fans deposited by Canteen and Little Canteen Creeks.

Most undisturbed ground elevations at Cell 1 vary from about 410 to 415 feet NGVD, but some reach 420 feet NGVD. The same pattern occurs at St. Clair Farms. At Indian Lake, elevations range from about 400 to 405 feet NGVD. East of Cell 1, ground surfaces along Harding Ditch rise gently to the bluff.

According to the digital soil surveys of Madison and St. Clair Counties, nearly all undisturbed soils at Cell 1 consist of Darwin silty clay loam, Darwin silty clay, or Fults silty clay, which all reflect historic wetland conditions. Only a small undisturbed area does not reflect historic wetland conditions. At St. Clair Farms, extensive areas of Darwin silty clay and Darwin-Urban land complex indicate historic wetland conditions. Sandy soils on higher ground along the west side of the Rock Road meander loop at St. Clair Farms were not historically wetland. At Indian Lake, Darwin silty clay loam, Darwin silty clay, loamy fluvaquents, and McFain silty clay loam comprise nearly all of the area, and each reflects historical wetland conditions. Small areas consist of disturbed soils or water.

Predevelopment Natural Communities. Two centuries ago, the principal types of vegetation occurring in the three floodplain components appear to have been marsh (Cell 1), prairie (St. Clair Farms), and forest (Indian Lake). Native grasslands of Cold Prairie enveloped the areas of Cell 1 and St. Clair Farms, and forest surrounding Horseshoe Lake reached Indian Lake. Aquatic features consisting of ponds and floodplain streams were present at two of these sites.

At Cell 1, one water body was present, and probably consisted of pond and shrub swamp that was encircled by marsh. It eventually became known as Spring Lake. Wet-mesic prairie probably occurred on the slightly higher surrounding areas. Two tributaries, Little Canteen and Schoenberger Creeks, flowed into Spring Lake from the east. Floodwaters from these tributaries passed south and west within the Spring Lake meander scar to Spring Lake, and eventually west through a slough that is now Lansdowne Ditch.

At St. Clair Farms, wet-mesic prairie probably occupied most of the area. Mesic prairie was found along higher ground on the western edge. The map depicting land cover in the early 1800s shows a water body within St. Clair Farms, but later historic maps do not. Perhaps part of St. Clair Farms was marsh.

At Indian Lake, roughly the southwest half was a water body, and probably consisted of pond and shrub swamp. Cahokia Creek meandered through the northeast half. Wet and wet-mesic floodplain forests were found in the northeast half adjacent to the creek. An herbaceous border along the southeast side may have consisted of marsh and wet prairie.

The tributary component of the project area included low- to medium-gradient creeks. Mesic floodplain forest grew in the narrow bottoms along these creek channels. Mesic upland forest was found along the base of ravines adjacent to these tributaries.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years at Cell 1 and St. Clair Farms, and at least annually at Indian Lake. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 420-422 feet NGVD, depending on the floodplain component. At its peak, water depths over Cell 1 and St. Clair Farms ranged from roughly 5 to 10 feet, and at Indian Lake from 15 to 20 feet. Duration from beginning to end lasted for several months. In addition to the Mississippi River, repetitive flooding from Little Canteen and Schoenberger Creeks inundated much of the area of Cell 1 (Spring Lake) every year. Likewise, Cahokia Creek would have overflowed its banks several times a year in the area of Indian Lake. Because no floodplain channels of upland tributaries were located near St. Clair Farms, flooding from the bluffs apparently was not an important component of historic wetland hydrology. However, runoff from lands to the north and west apparently passed periodically through this low area on its way to Pittsburg Lake.

Periodic wild fire was also an important factor in disturbance dynamics in the floodplain. But among the three floodplain components, Indian Lake probably was least influenced because typically high moisture levels in the ground surface of its forested wetlands inhibited the passage of fire. Prairie and marsh would have burned, at least during dry periods. In the uplands, wild fire was also an important ecosystem disturbance factor.

Existing Conditions. Harding Ditch passes through Cell 1. This canal is bordered on both sides by earthen berms to prevent overtopping. An active sand plant occupies about half the area, and as a land cover type is considered development. Remnants of "Spring Lake" comprise most of the other half, and consist of a pond surrounded by marsh and forested wetlands. The rest of Cell 1 consists of cropland along the western boundary, and urban field, old field, and grassland.

The urban field consists of a residential neighborhood obtained by the Federal Emergency Management Agency (FEMA) as buyouts due to flooding in the mid-1990s. Nearly all of the buildings have been removed. As a cover type, this area is a mixture of scattered trees, shrubs, and open areas supporting weedy vegetation. A few scattered occupied residences occur within this component of the action area. Little Canteen Creek and Schoenberger Creek no longer flow through this area, but instead are diverted into Harding Ditch.

Harding Ditch also passes through St. Clair Farms. Most of the area is a FEMA buyout, or urban field. Cropland, the next most common land cover type, is used for row crops and horseradish. Some forested wetland occurs within the FEMA buyouts, and small areas of marsh, scrub-shrub wetland, and grassland are present. A few scattered occupied residences occur within this component of the action area.

Lansdowne Ditch borders the southwest corner of Indian Lake. This canal is also bordered on both sides by earthen berms to prevent overtopping. Several distinct areas of marsh and scrub-shrub wetlands comprise much of this area. Riparian forest occurs adjacent to remnants of historic Cahokia Creek. Some forested wetlands are found along the area's perimeter. Scattered borrow pits lie near I-55/70, and several areas of development are along the perimeter. Chief among these is a golf course along Collinsville Road. Rising levels of permanently ponded water have drowned trees in some forested areas, mostly at the north end by I-55/70. Cahokia Creek was replaced by Cahokia Canal over 90 years ago.

Among the three floodplain components, Indian Lake has the greatest potential to support area-sensitive animal species. Both Cell 1 and St. Clair Farms are physically smaller, and consist of a higher proportion of disturbed and fragmented habitats. The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists the Fairmont City INAI (Illinois Natural Area Inventory) site as occurring at Indian Lake. This site, represented by a roughly 40-acre area of marsh near the middle of this floodplain component, supports a population of a Federally and state threatened plant, the decurrent false aster.

Lands along Harding Ditch from the bluff to St. Clair Avenue are mainly agricultural, and some adjacent fields are used to grow horseradish. A 35-acre area north of Cell 1 within Cahokia Mounds State Historic Site Land consists of drowned trees due to permanent ponding by local beaver dams. Surrounding the three floodplain components, land use is mainly agricultural to the east of Cell 1 and St. Clair Farms, and a mixture of residential and commercial to the west.

In terms of periodic ecosystem disturbances, flooding of the floodplain action area is very limited. The Mississippi River is isolated from its floodplain, and Harding and Lansdowne Ditches usually keep storm water confined within their banks. Occasionally, flooding from Harding Ditch occurs, and usually enters a portion of Cahokia Mounds State Historic Site and Cell 1. Fire has been suppressed for many years.

In the Canteen and Little Canteen Creek watersheds, forest accounts for less than half the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 39,000 tons of sediment is currently delivered to the floodplain per year from these two tributary watersheds.

Prehistoric cultural resources are often found on alluvial soils along the bluff and adjacent to Harding Ditch.

Notable publicly owned lands include the FEMA buyouts at Cell 1 and St. Clair Farms are publicly owned.

Existing Problems and Opportunities. Various ecological problems are also present. First, Cell 1 and St. Clair Farms are not expected to provide for the needs of many area-sensitive species because of the fragmented nature of remaining habitats. Second, flooding and fire play a very minor role as periodic ecosystem disturbances in these three areas. Third, habitat diversity is low. Cahokia Creek as a floodplain stream no longer exists, and development has eliminated native prairie from the action area. Fourth, floodplain forests contain low tree species diversity. Many native nut-bearing species, such as oaks and hickories, that used to exist are gone, and the local seed source for regeneration is scarce. Fifth, Harding Ditch does not serve as a functional floodplain stream or riparian corridor for wildlife. Earthen berms adjacent to the ditch have eliminated any floodplain, and periodic maintenance for flood control purposes removes any natural (woody) vegetation growing inside along its channel; along it's outside, a riparian zone is also often lacking where cropland is adjacent. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding occurs when storm water overtops Canteen Creek and Harding Ditch. On such occasions, floodwaters can inundate farmland and mixed residential and commercial areas.

Opportunities exist within the action area to enlarge the existing areas of natural habitats to support more species of area-sensitive animals, restore prairie, restore a portion of the historic Cahokia Creek to a flowing condition, reintroduce periodic ecosystem disturbances in the form of flooding and prescribed fire, create a floodplain and riparian zone along Harding Ditch, replace "lost" tree species that once grew in this area, and implement measures designed restore tributary streams and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance would also incidentally reduce Harding Ditch and Canteen Creek flood damages "upstream" of this action area.

6.7.8 Wedgewood.

Location. This action area is in St. Clair County, north of Frank Holten State Park. It overlaps portions of four townships: southeastern Canteen Township (T2N, R9W), southwestern Caseyville Township (T2N, R8W), northwestern St. Clair Township (T1N, R8W), and northeastern Stookey Township (T1N, R9W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. This area is at the confluence of Schoenberger Creek Ditch and Harding Ditch. It extends east to west and north to south about 0.75 miles. Metrolink railroad tracks bound it on the north, Harding Ditch on the east, the I-255 interchange at State Street on the south, and Kings Highway (Route 111) on the west. The floodplain component encompasses about 125 acres.

To the east, the tributary component consists of the Schoenberger Creek watershed.

Surface Geology, Topography, and Soils of Floodplain. The east half of the floodplain component lies within an old meander scar of the Mississippi River (Rock Road meander loop, White et al. 1984). A second local geological feature, a point bar, represents the west half. Ground elevations range from about 410 to 415 feet NGVD, and are generally lower in the east half. Soils consist of Darwin silty clay loam, Darwin silty clay, and Darwin-Urban land complex. All are indicative of historic wetland conditions.

Predevelopment Natural Communities. A contact zone between forest and prairie was present within the floodplain component in predevelopment times. Forest around Pittsburg Lake to the south met with native grasslands in Cold Prairie to the north. Prairie was more prevalent. Wet-mesic prairie and wet-mesic floodplain forest probably were the natural communities comprising these types of vegetation. Within the lowest elevations of the prairie, marsh probably occurred. All these natural communities were wetlands. The tributary component of the action area included low- to medium-gradient creeks. Mesic floodplain forest grew in the narrow bottoms along these creek channels, and mesic upland forest was found along the base of the adjacent ravines. Wet-mesic floodplain forest occurred along the lower portions of Schoenberger Creek.

Predevelopment Ecosystem Disturbance. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 421 feet NGVD. At its peak, water depths over the action area ranged from roughly 5 to 10 feet.

Because no floodplain channels of upland tributaries were located near this area, flooding from the bluffs apparently was not an important component of historic wetland hydrology. However, runoff from several square miles of lands to the north and west apparently passed periodically through this low area on its way to Pittsburg Lake. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. Most of the floodplain action area consists of residential areas obtained by the Federal Emergency Management Agency as buyouts due to flooding in the mid-1990s. Nearly all of the buildings have been removed. In these former neighborhoods, forested wetland is the predominant land cover. Because of local infrastructure and recent residential use, this forest is highly fragmented, and remaining blocks are no larger than about 20 acres. Other less well-represented cover types include urban old fields, marsh, scrub-shrub wetland, grassland, and development. Only one building currently in use is found within the action area. Surrounding lands are mainly residential.

Summit Avenue currently passes through the floodplain component in an east-west direction, and an interstate (I-255) embankment bisects its east half from north to south. The site's east border, Harding Ditch, is a major component of the flood control system, and is joined by Schoenberger Creek Ditch. Both canals are bordered on both sides by earthen berms to prevent overtopping. In terms of periodic ecosystem disturbances, flooding of the floodplain action area is very limited.

The Mississippi River is isolated from its floodplain, and Harding Ditch keeps storm water confined within its banks. Only runoff from surrounding neighborhoods occasionally floods portions of the area. Fire has been suppressed for many years.

In the Schoenberger Creek tributary watershed, forest accounts for about half of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 9,000 tons of sediment is currently delivered to the floodplain per year from this tributary watershed.

Nearly all of the floodplain action area is publicly owned (City of East St. Louis).

Problems and Opportunities. Various ecological problems are present. Because remaining forested areas are relatively small, they have limited value for supporting species that are highly sensitive to forest fragmentation, such as some interior forest nesting birds. Second, native prairie is completely absent. Third, wet-mesic floodplain forest within the action area contains low tree species diversity. Many of the native nut-bearing species, such as oaks and hickories, were removed years ago, and the local seed source for regeneration is scarce. Fourth, flooding and fire, the primary ecosystem disturbance factors from presettlement times, exert little to no influence on natural habitats existing today at the site. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding occurs when stormwater over tops Schoenberger Creek. On such occasions, floodwaters can inundate mixed residential and commercial areas.

Opportunities exist within the action area to enlarge the existing area of natural habitats to support more species of area-sensitive animals, to replace lost prairie, to reintroduce seasonal flooding as an ecosystem disturbance factor, to replace "lost" tree species that once grew in this area, and to implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of periodic flooding as an ecological disturbance factor would incidentally reduce flooding "upstream" along Harding Ditch and Schoenberger Creek Ditch.

6.7.9 Mullens Slough.

Location. This action area is in St. Clair County, southwest of Frank Holten State Park. It is in northern Stookey Township (T1N, R9W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. This area is at the confluence of Powdermill Creek and Canal No. 1. At its maximum, it extends east to west about 2 miles, and north to south about 1 mile. Features that delimit its boundaries include railroad tracks along Powdermill Creek on the north, the bluff line on the southeast, and Canal No. 1 on the northwest. It envelops about 425 acres.

To the east, the tributary component consists of the Powdermill Creek and Bluff 6 watersheds.

Surface Geology, Topography, and Soils of Floodplain. Nearly the entire floodplain component lies within an old meander scar of the Mississippi River (Grand Marais meander loop, White et al. 1984). Backswamp deposits to the southwest make up the remainder of local geological features. Ground elevations across the area range from about 405 to 420 feet NGVD. Most ground lies between about 410 and 415 feet NGVD. The highest elevations are adjacent to the bluff, and the lowest are within Canal No. 1. In the digital St. Clair County soil survey, most of the floodplain action area is mapped as water. Small areas of undisturbed ground at the north and south end consist of either Beaucoup silty clay loam or Otter silt loam, which are indicative of historic wetland conditions. Most undisturbed soils consist of a variety of silty loams that do not reflect historic wetland conditions.

Predevelopment Natural Communities. The 1800 land cover map displays prairie, or at least non-woody vegetation, at the floodplain action area. Later historic maps depict a large water body in this area, which is the south end of Pittsburg Lake. This water body presumably was a large shallow pond with marsh at its borders. Within the action area, mainly mesic prairie and some wet-mesic prairie occurred adjacent to the pond. The areas of marsh and wet-mesic prairie were wetlands. In the uplands, Powdermill Creek and its adjacent tributaries had low to medium gradients. Narrow strips of mesic floodplain forest grew adjacent to their channels, and mesic upland forest along the base of adjacent ravine slopes.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 419 feet NGVD. At its peak, water depths over the action area ranged from roughly 5 to 10 feet. Because Powdermill Creek and smaller adjacent upland tributaries emptied onto the floodplain, less dramatic but more frequent periodic flooding affected this area. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. About half the floodplain component consists of Mullens Slough, a large lake-like water body lying between the bluff and Canal No. 1. Until about 10 years ago, this area was cropland that drained into Canal No. 1 by gravity flow. The farmland turned into a lake when impaired drainage within the canal caused surface drainage to permanently pond in the fields. Water depths apparently range up to about six feet, and average about 3-4 feet. Little to no emergent or submergent vegetation exists in the lake. A variety of fish in the lake provide for recreational fishing. The location of Mullens Slough approximates the portion of Pittsburg Lake that existed in this area long ago.

Aside from the lake, forested wetland is the most prevalent land cover type, and it occurs in and along Canal No. 1. Other less well-represented cover types include cropland, grassland, scrub-shrub wetlands, creek channel, and development. Cropland is found southwest of Mullens Slough. Grassland consists of mowed areas adjacent to Mullens Slough and a man-made fishing lake within the action area.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists the known occurrence of the bald eagle within the floodplain component near the south end of Mullens Slough. This bird is listed as Federally threatened and state endangered.

A few residences lie near the edge of the lake at the base of the bluff. Route 163 (Millstadt Road) bisects the action area near its north end. Canal No. 1, a component of the flood control system, represents the channel of Powdermill Creek after it reaches the floodplain. The canal is bordered on both sides by earthen berms to prevent overtopping.

Surrounding lands are mainly urban in the floodplain and rural in the uplands.

In terms of periodic ecosystem disturbances, flooding of the floodplain action area is very limited. The Mississippi River is isolated from its floodplain, and Canal No. 1 usually keeps storm water confined within its banks. Consequently, flooding from Powdermill Creek only occasionally enters the floodplain action area. Fire has been suppressed for many years.

In the Powdermill Creek and Bluff 6 tributary watersheds, forest accounts for about 45 percent of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 6,000 tons of sediment is currently delivered to the floodplain per year from these two tributary watersheds. Canal No. 1 is choked with such sediments.

Cropland south of Mullens Slough is rich with prehistoric cultural resources on the higher elevations.
A small part of the floodplain action area is publicly owned (St. Clair County Soil and Water Conservation District). The Natural Resources Conservation Service has obtained permanent flood easements from landowners of Mullens Slough.

Problems and Opportunities. Various ecological problems are also present. First, Mullens Slough as fisheries habitat lacks deep water for overwintering, as well as vegetative cover or structural diversity for reproduction and rearing of young. Areas greater than 8 feet deep as well as woody debris and emergent or submergent plants are needed. Second, native prairie is completely absent. Third, because floodplain forest along Canal No. 1 is narrow and relatively small, it has limited value for supporting species that are highly sensitive to forest fragmentation, such as some interior forest nesting birds. Fourth, floodplain forest contains low tree species diversity. Many of the native nut-bearing species, such as oaks and hickories, were removed years ago, and the local seed source for regeneration is scarce.

Fifth, flooding and fire, the primary ecosystem disturbance factors from presettlement times, exert little to no influence on natural habitats existing today at the site. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding occurs infrequently when stormwater overtops Canal No. 1. On such occasions, floodwater can flow west, across farmland, mixed residential and commercial areas, and Route 163.

Opportunities exist within the action area to improve Mullens Slough as a fisheries resource, restore prairie, enlarge the existing area of natural habitats to support more species of area-sensitive animals, reintroduce seasonal flooding and prescribed fire as ecosystem disturbance factors, replace "lost" tree species that once grew in this area, and implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of periodic flooding as an ecological disturbance factor would also incidentally reduce flooding along Canal No. 1.

6.7.10 National City Stockyard (Recommended for Action by Others)

Location. This area is in St. Clair County, in northeast East St. Louis Township (T2N, R10W).

It is located southwest of Horseshoe Lake, and north of I-55/70. Route 3 (St. Clair Avenue) bounds it on the east, railroad tracks on the south, and a former railroad yard to the northwest. The area extends north to south over a distance of about 0.6 miles.

Components of Area. The area is restricted to the floodplain; there is no tributary component. It envelops about 100 acres.

Surface Geology, Topography, and Soils of Floodplain. The area is within a geological feature consisting of chutes and bars along the Mississippi River. Cahokia Creek historically flowed through the area from north to south. Ground elevations apparently varied from about 405 to 415 feet NGVD with most of the area between 410 to 415 feet NGVD.

Predevelopment Natural Communities. Historic vegetation adjacent to the creek consisted of forest, most likely mesic floodplain forest. Prairie was found a short distance away to the southeast.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic floodplain ecosystem. Overflow from the Mississippi River may have inundated the entire site once or twice every five years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 422 feet NGVD. At its peak, water depths over the area ranged roughly from 5 to 15 feet. Cahokia Creek probably overflowed its banks at least annually.

Existing Conditions. The area is near the former East St. Louis stockyards, and adjacent to a former railroad yard. The historic Cahokia Creek was replaced by Cahokia Canal about 90 years ago. A remnant of the historic creek lies within the area, and is isolated from Cahokia Canal. The channel remnant has been partially filled by the dumping of various materials along its historic bank line. It ponds rainfall and associated local runoff, and supports marsh vegetation.

Trees border some of the historic channel's banks. The ground surrounding the historic channel has been previously disturbed by various development activities. Vegetation in this area is typical of abandoned urban sites, and resembles an old field with scattered saplings. Previous archaeological investigations in the vicinity suggest that significant prehistoric cultural resources are present within this area. The area is within the East St. Louis mound group, a satellite community associated with the prehistoric settlement at Cahokia Mounds.

None of the area is publicly owned.

Problems and Opportunities. The urban area in which this area is located supports few environmental resources. Existing habitats in the area are of limited value to wildlife, and include a number of invasive plant species. Sediments in the bottom of the historic creek may be contaminated. Water fluctuations in the historic creek are rather static and limited to those created by rainfall.

An opportunity exists within the area to restore the remnant of Cahokia Creek as aquatic and wetland habitat. Fill and accumulated sediments would be removed to return the channel to its former dimensions. An abandoned road crossing would be removed from the channel. Forest would be planted in the area surrounding the historic channel.

6.7.11 I-55/70 Borrow Pit (Recommended for Action by Others)

Location. This area is in southern Madison County, in southeast Nameoki Township (T3N, R9W).

It is located southeast of Horseshoe Lake. The area is bounded by I-55/70 on the south, Sand Prairie Road on the east, Cahokia Canal and Canteen Creek on the north, and railroad tracks on the west. It extends west to east over a distance of about 0.75 miles.

Components of Area. The area is restricted to the floodplain; there is no tributary component. It encompasses about 115 acres.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, named Edelhardt Lake meander loop (White et al. 1984), crosses through the area and its vicinity in an east-west direction. Cahokia Creek historically flowed through this meander scar from east to west. Canteen Creek, a second tributary, joined Cahokia Creek in this area. Historical ground elevations were about 405 feet NGVD.

Predevelopment Natural Communities. Historical vegetation adjacent to the creek most likely consisted of forested wetlands consisting of wet-mesic and wet floodplain forest.

Predevelopment Ecosystem Disturbance Dynamics. Flooding was a primary force that periodically disturbed this area of the historic floodplain ecosystem. Flooding by overflow from the Mississippi River probably occurred at least annually. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 423 feet NGVD.

At its peak, water depth over the area would have been close to 20 feet. Cahokia Creek probably overflowed its banks several times a year. Wild fire typically did not affect forested wetlands because of the usual high moisture levels in the ground surface.

Existing Conditions. Historic Cahokia Creek was replaced by Cahokia Canal about 90 years ago. The main feature of the area is a man-made borrow pit lake. Remnants of forested wetland border about half of the borrow pit lake. Various earthen embankments border the area. An earthen berm lies between the borrow pit lake and Cahokia Canal and Canteen Creek.

The area is publicly owned and part of Cahokia Mounds State Historic Site.

Problems and Opportunities. The borrow pit lake is isolated from Cahokia Canal and Canteen Creek. Water fluctuations are rather static and limited to those created by rainfall. In its present condition, the lake and adjacent wetlands cannot receive a "flood pulse" typical of predevelopment lakes, ponds, and forested wetlands in the American Bottom.

An opportunity exists within the area to introduce flows from either Cahokia Canal or Canteen Creek, and thereby reintroduce periodic ecosystem disturbance in the form of flooding. The reintroduction of flooding as an ecosystem disturbance dynamic would also reduce backwater effects "upstream" in Cahokia Canal and Canteen Creek.

6.8 ALTERNATIVE PLAN DEVELOPMENT

Preliminary alternative plans were next formulated for each action area. A variety of combinations of measures were developed at each site that could be evaluated for their effectiveness and cost efficiency in achieving project objectives.

By this stage of formulation the biological team had determined the combination of species that would be used to predict habitat outputs for the various alternative plans. Appendix A provides detailed information regarding the rationale and selection process for these predictor species, which are used to measure habitat outputs for the different combinations of measures in an alternative plan. The potential array of measures was developed based on analysis of pre-settlement land cover and hydrology, and project restoration planning targets. As described previously the selected action areas were initially screened for their existing habitat, soils, hydraulic connectivity and spatial area. In this manner the Project Team was able to develop a full array of ecosystem and social measures, for efficiency and effectiveness competition at each action area. In the development of alternative plans for each action area, several conclusions from engineering and biological analysis were used to assist in guiding the process. It had been determined during the action area screening process that each of the designated project action areas could receive hydraulic input with the potential to provide disturbance depths having limited durations that would be considered beneficial for biological purposes (defined as meeting Objective 2, Flood Pulse Restoration) and could accept storm water for flood damage reduction purposes (Objective 8a, Reduce Flood Damages).

Varying hydraulic events were analyzed at each site to determine the optimum for a site based on planning targets and cost factors. As noted previously the inability to finalize an HGM model for the Project area made it impossible to independently verify best scientific judgment. A more detailed discussion of this analysis is contained in Appendix A.

Tributary stream sediment detention measures recommended by NRCS were considered together within each watershed as an "all or nothing" unit for alternative development. This was necessitated by the inability to attribute improvements to the system in any smaller increments of action. This is in concert with the NRCS' study, which is further detailed in Appendix E. Based on the NRCS' analysis, land treatment measures such as filter strips, grass waterways and terraces on private land were eliminated in alternative plans. These measures proved to be unreliable because of their voluntary nature, and uneconomical because of the rapid urbanization projections for the bluff, which meant these measures would be temporary in nature. This analysis is further discussed in Appendix E.

Tributary stream and floodplain sediment detention measures were retained and analyzed during this iteration as a method for the removal of sediment for each action area that had a tributary stream connection. Appendix C and E provide more detail on tributary stream and floodplain sediment detention measure analysis that determined the acceptability of measures designed to meet the Planning Target established for Objective 5 (Reduce Erosion) and Objective 4 (Improve Water Quality).

The measures at this stage of formulation had attained more specificity based on additional hydraulic, geotechnical and sediment analysis performed. From these preliminary plans cost curves were developed for measures that were required at multiple sites. These cost curves were utilized to identify those measures providing a similar benefit that proved less effective because of their higher costs. This allowed for the initial reduction of alternative plans prior to running action area alternative plans through the HEP/ ICA analysis. The chart below shows the number of alternatives carried through to more detailed iterations of assessment and evaluation.

Watershed	Site Name	Alternative Counts		
		Generated	Dropped	Evaluated
County Ditch	Old Cahokia Creek	24	12	12
Cahokia	Judy's-Burdick Branches	40	20	20
Cahokia	Brushy Lake	30	24	6
Cahokia	Elm Slough	6	1	5
Cahokia/Harding	Spring Lake	126	117	9
Harding	Wedgewood	6	2	4
Harding	Cahokia Mounds	12	6	6
Powdermill	Mullens Slough	6	0	6
Long Lake	[illegible] Slough	6	3	3
	Totals	256	185	71

6.9 ALTERNATIVE PLAN ASSESSMENT BY ACTION AREA

Planning level cost estimates were developed for each alternative plan within an action area. These estimates included lands, construction (including environmental treatments) and operation and maintenance costs and were annualized at the current interest rate over the 50-year project life. These estimates were to be used in the incremental cost analysis. Using this methodology the predicted average annual habitat unit benefits (effectiveness) could be compared to the predicted annualized costs (efficiency) in order to generate a comparison of alternative plans for assessment and evaluation purposes. Appendix A describes these procedures in detail and provides data on results obtained. This process resulted in the final set of alternatives for each action area that was carried through the final incremental cost analysis process.

6.10 FINAL ARRAY OF ALTERNATIVE PLANS

The screening process used on the alternative plans resulted in a final set of alternatives for each action area that were analyzed using the incremental cost effectiveness analysis process. The following is a recap of final alternatives that were competed through the incremental cost effectiveness analysis. Common measures are those measures common to all alternatives in a particular array and variable are measures are those that differ between alternative plans in an array. Appendix A provides complete detail on this process.

Dobrey Slough
The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages in the residential neighborhoods adjacent to Dobrey Slough, in the Long Lake watershed.

Dobrey Slough is a relatively small historic slough of the Mississippi River without any significant natural drainage ways going in or out of it. Historic vegetation of the slough apparently was non-woody.

<u>Measures Under Evaluation:</u> A total of 3 different alternatives were evaluated.

<u>Common measures:</u>

1. The establishment of a habitat area with the existing "slough" (marsh-based vegetation) serving as its core.

2. The restoration of existing marsh, and the creation of new marsh, inside the habitat area supported by utilization of the stormwater events delivered by local runoff. Excavation would be necessary to support the creation of the new marsh as well. In addition, modification of the existing drainage structures, located under the railroad embankment, would be necessary.

Variable measures:

1. The creation of a forested corridor, inside the habitat area, surrounding the existing marsh. Trees would be planted (where they currently do not occur) on the west side of the railroad embankment in undeveloped areas. The forested corridor would provide habitat, and serve as a filter strip to enhance water quality in the marsh. The width of the forested corridor was considered when developing alternatives. Three corridor size options [i.e., 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters)] were designed for this site. These corridor widths would be created on both sides of the channel/ditch.

Dobrey Slough Alternatives (n = 3 + No Actions)

Options	**No connection to Uplands** **Croplands planted to marsh** **Both sites excavated** **No ditch** **Increase species diversity by planting seedling trees (hardmast spp) in existing trees (PFO)** **Marsh from croplands (natural succession)**
100-m NEWFCORR	5A-X
75-m NEWFCORR	5A-Y
50-m NEWFCORR	5A-Z
Build ditch to Horseshoe Lake (GRASS)	5B-XYZ
	Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

-X = 100-m forested corridor strips (HSI weight = 1.0) along northern side of ditch

-Y = 75-m forested corridor strips (HSI weight = 0.75) along northern side of ditch

-Z = 50-m forested corridor strips (HSI weight = 0.50)

Old Cahokia Creek

The purpose of this action area is to restore a portion of Cahokia Creek on the floodplain to a free-flowing stream, with an adjacent forested corridor supporting natural plant and animal communities, and a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the "Bluff 1" watershed and to incidentally reduce flood damages in the bottoms in the County Ditch watershed, with a focus on Sand Road and vicinity.

Measures Under Evaluation A total of 18 different alternatives were evaluated.

Commonly shared measures:

1. The reopening of a portion of the Cahokia Creek channel on the floodplain. Segments of historic channel that were filled over the years would be reopened under these alternatives, and existing channel areas would be excavated to remove accumulated sediment to recreate a floodplain stream that once flowed from north to south.

2. The creation of a continuous forested corridor along the reopened channel. In all alternatives, trees would be planted on both sides of the creek where they currently do not occur.

3. The construction of an earthen hydraulic feature along the west side of the reopened channel. This feature, located along the west edge of the forest on the west side of the creek, would allow for a riverine overflow regime to be reestablished, while restricting overflow from the creek to the forested corridor and adjacent lands to the east.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 10 new tributary stream sediment detention basins in the "Bluff 1" watershed, and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in about 7 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in the new habitat restoration area itself.

2. Length of channel restoration – two lengths of channel restoration were considered. From the south end of the project area, the shorter channel option would extend north along the creek for a distance of approximately 2.9 miles. The longer channel option would extend the length of the diversion channel for a distance of approximately 4.2 miles.

3. Augmentation vs. no augmentation of stream flows – for the longer channel alternatives, a new pump station could be installed at the diversion channel, and would be used to augment low stream flows to enhance environmental returns.

4. Width of forested corridor – on each side of the creek, widths of approximately 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters) were considered.

Following the first Incremental Cost Analysis evaluation the long channel alternatives were eliminated from final competition. It was determined that these 6 alternatives were not acceptable based on the need for a pumping facility to support them. These alternatives were not carried into the final ICA analysis.

Old Cahokia Creek alternative Matrix

Options	Uplands On	Uplands Off (Sedimentation Expected)
	Restoration of the Cahokia Creek channel to recreate a floodplain stream Creation of NEWRIPAR in three widths = XYZ (100m, 75m and 50m) Construction of an earthen berm along Cahokia Creek All sediment detention basins = AGCROP converted	Restoration of the Cahokia Creek channel to recreate a floodplain stream Creation of NEWRIPAR in three widths = XYZ (100m, 75m and 50m) Construction of an earthen berm along Cahokia Creek No DETENTION Sedimentation expected = area dredged every
Short channel (~2.9 mi.) (extends north from I-270 along the creek)	2A-1-(0)-X	2B-1-(0)-X
	2A-1-(0)-Y	2B-1-(0)-Y
	2A-1-(0)-Z	2B-1-(0)-Z
	2A-1-(1)-X	2B-1-(1)-X
	2A-1-(1)-Y	2B-1-(1)-Y
	2A-1-(1)-Z	2B-1-(1)-Z
Long channel (~ 4.2 mi.) (extends all the way to the diversion channel)	2A-2-(0)-X	2B-2-(0)-X
	2A-2-(0)-Y	2B-2-(0)-Y
	2A-2-(0)-Z	2B-2-(0)-Z
	2A-2-(1)-X	2B-2-(1)-X
	2A-2-(1)-Y	2B-2-(1)-Y
	2A-2-(1)-Z	2B-2-(1)-Z

Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

"2" denotes Old Cahokia Creek Site
A/B denotes presence/absence of an Uplands detention basin
1/2 denotes length of channel (1 = ~2.9 miles, 2 = ~4.2 miles)
(1)/(0(denotes presence/absence of pumping station
XYZ denotes width of ripirian corridor on each side of the creek
**Alternative dropped from the analysis due to design inconsistencies, biologically ineffective configurations and/or cost ineffectiveness

Elm Slough

The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages within the Long Lake watershed. Much of the project area is an old meander scar of the Mississippi River, and forest was the predominant type of vegetation two centuries ago.

Measures Under Evaluation A total of 5 different alternatives were evaluated.

Commonly shared measures:

1. The creation of a 670-acre forested habitat area to utilize stormwater events delivered by Long Lake and Mitchell Ditch. Trees would be planted in areas where they do not currently occur. The construction of earthen hydraulic features around the perimeter of the habitat area would also be included in this option, as well as the simulation of hydrologic conditions (in a large area of the newly planted wetland forest), similar to those of the existing wetland forest. Excavation of an area about 175 acre in size, would be necessary to temporarily store water.

2. The replacement of the two "funnel-shaped" waterways referred to as Mitchell Ditch and Long Lake Ditch on the south side of Route 162. Stormwater from these two floodplain tributaries would be carried south into Elm Slough in a sheet-flow manner. Earthen hydraulic features constructed along the edges of these waterways would restrict stormwater to the habitat area. Culverts under Route 162, and the adjacent railroad embankments, would be modified as well.

3. Grassy vegetation would be planted inside the "funnel-shaped" drainage ways to act as filters that intercept sediment carried by stormwater.

Variable measures:

1. Replacement of under-represented tree species - three levels of management would be considered (i.e., simple vs. intensive activities). Simple improvements would focus on of selective thinning and planting of mast tree species in the existing forest. Intensive improvements would involve the removal of existing dead (drowned) timber, and the planting of appropriate tree species. The "No Action" management strategy defers improvements.

2. Presence or absence of a prairie-based vegetative buffer - the proposed buffer would be created at the location where sheet flows are anticipated to enter Elm Slough, in front of the main forested habitat area. The buffer would be designed to intercept sediment carried by flows from Long Lake and Mitchell Ditch.

Elm Slough- Continued

Elm Slough Alternatives (n = 5 + No Actions)

Options	No connection to uplands Croplands planted to forested wetlands Prairie Buffer Strips Used as Filter Strip	No connection to uplands Croplands planted to forested wetlands No Buffer Strip
No Treatment of Existing Forest	6A-1	6B-1
Simple Treatment	6A-2	6B-2
Intensive Treatment	6A-3	6B-3

(Shaded) Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

Prairie buffers (PBUFFER)
Wetter prairies with less depth due to sedimentation trapping.
Quality is higher when sediment captured in buffers
AGCROP converts to prairie

#2 (Simple) Treatments:
Planting trees in existing PFO

#3 (Intensive) Treatments
Combination of # 2 treatments & changing PSS innudated forest to PFO through a form of draining exercise

Riparian Corridor = Long Lake & Mitchell Ditch with PFO along sides & riverine in bottom

Judy's-Burdick

The purpose of this action area is to create an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Judy's, Burdick, and "Bluff 1" watersheds and to incidentally reduce flood damages in the bottoms within the Cahokia watershed. The floodplain component lies at the southern end of historic Rattan's Prairie, a 15,000-acre wet prairie once located in the northeast part of the American Bottoms.

Measures Under Evaluation A total of 16 different alternatives were evaluated.

Commonly shared measures:

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Judy's and Burdick Branches combined.

2. The modification of the existing levee, along the south side of Burdick Branch, to ensure delivery of stormwater events from the Judy's and Burdick tributaries into the new habitat area.

3. The creation of a 330-foot (100-meter) wide prairie buffer surrounding the perimeter of the habitat area's earthen hydraulic feature.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 28 new tributary stream sediment detention basins (23 in the Judy's Branch, 4 in the Burdick Branch, and 3 in the "Bluff 1" watersheds) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 32 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in a floodplain sediment detention basin within the new habitat restoration area.

2. Size of habitat area – given existing urban constraint, three options were considered to provide a variety of habitat options and hydrologic regimes (the "small" option would restore 131 acres, the "medium" option would restore 230 acres and a "large" option would restore 350 acres). Under the small and medium size, options, a moderate to extensive excavation activity would support the development of a new marsh. For the larger option, prairie would be created with little or no excavation needed.

3. Restoration of the historic Cahokia Creek channel within the habitat area – a channel would be excavated to replace the historic channel that has degraded over time with a floodplain stream similar to the one that once flowed from north to south across the site.

4. Create a 330-foot (100-meter) wide forested corridor along the north side of Burdick Branch extending from Cahokia Canal to Route 157.

	Uplands ON (no Detention basin)		Uplands OFF (Dentention basin needed)
Options	Prairie Only	Marsh Only	Prairie with Marsh Detention Basin
Small Site (131 ac)	3A-1-X	3B-1-X	3C-1-X
Medium Site (230 ac)	3A-2-X	3B-2-X	3C-2-X
Large Site (350 ac)	3A-3-X	3B-3-X	3C-3-X
Large Site (350 ac) - Horseradish Lands Excluded	3A-4-X	3B-34-X	3C-4-X
Small Site (131 ac) w/o NEWFCORR	3A-1-(0)	3B-1-(0)	3C-1-(0)
Medium Site (230 ac) w/o NEWFCORR	3A-2-(0)	3B-2-(0)	3C-2-(0)
Large Site (350 ac) w/o NEWFCORR	3A-3-(0)	3B-3-(0)	3C-3-(0)
Large Site (350 ac) w/o NEWFCORR - Horseradish Lands Excluded	3A-4-(0)	3B-4-(0)	3C-4-(0)

[Shaded] Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.
-X = 100-m forested corridor strips (100-m width needed for optimum conditions)
- (0) = No forested corridor strips present

Brushy Lake

The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Schoolhouse Branch and "Bluff 3" watersheds, and to incidentally reduce flood damages within the Cahokia watershed.

Much of the floodplain component is an old meander scar of the Mississippi River. Two centuries ago, Cahokia Creek flowed through this area, and forest was the predominant type of vegetation.

Measures Under Evaluation A total of 6 different alternatives were evaluated.

Common measures:

1. The creation of a 710-acre forested habitat area on the floodplain to utilize stormwater events delivered by both Schoolhouse Branch and Snyder Creek that would include planting of trees where they do not currently exist.

2. The restoration of the historic Cahokia Creek channel within the habitat area. Segments of channel that have been filled, would be reopened, and existing remnants would be excavated to remove accumulated sediments. These actions would recreate a floodplain stream similar to that which once flowed from north to south across the site.

3. Modification of the existing channels and levees of Schoolhouse Branch and Snyder Ditch to ensure delivery of stormwater events from these two bluff tributaries into the new habitat area. The current channel conditions (i.e., grassy side-slopes and earthen bottom) would be utilized.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 15 new tributary stream sediment detention basins (14 in the Schoolhouse Branch watershed and 1 in the "Bluff 3" watershed) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in about 25 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in a floodplain sediment detention basin within the new habitat restoration area.

2. Presence or absence of a prairie filter – under the Bottomland sediment detention option, a 330-foot (100 meter) wide vegetative buffer would be established in the habitat area outside the detention basin. The buffer would consist of prairie plantings to intercept sediment carried by stormwater overtopping the basin.

Brushy Lake - Continued

Brushy Lake Alternatives (n = 12 + No Actions)			
	Uplands ON (No Detention Basin)	Uplands OFF (Detention Basin Needed)	
Channel Type and Corridor Type Options	Croplands planted to forested wetlands, Corridor bringing water in, Always have riparian meander down the middle	Croplands planted to forested wetlands, Corridor bringing water in and Detention Basin, AGCROP converts to urban Grassland along berm, Always have riparian meander down the middle	Croplands planted to forested wetlands, Prairie buffer strip added around sediment basin, Corridor bringing water in and Detention Basin, Always have riparian meander down the middle, Quality of forest is higher due to capture of sediment in the buffers
Concrete Sides, Dirt Bottoms	4A-1-0	4B-1-0	4C-1-0
	4A-1-X	4B-1-X	4C-1-X
Concrete Channel	4A-2a-0	4B-2a-0	4C-2a-0
	4A-2a-X	4B-2a-X	4C-2a-X
	4A-2b-0	4B-2b-0	4C-2b-0
	4A-2b-X	4B-2b-X	4C-2b-X
Grass-lined	4A-3-0	4B-3-0	4C-3-0
	4A-3-X	4B-3-X	4C-3-X
Riparian/Meander	4A-4-0	4B-4-0	4C-4-0
	4A-4-X	4B-4-X	4C-4-X

(shaded) Alternatives dropped from consideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.
All Detention Basins = degraded Marshlands
Prairie buffers surrounding marshlands are wetter prairies with less depth due to sedimentation trapping.
With detention basins, basins dredged every 3-5 years, no external dredging necessary. (outside detention basin, but still within project boundary).

Ditch Options Considered:
- -1 Ditch Option: Straight channel/concrete sides/dirt bottoms
- -2a Ditch Option: Straight, all concrete - Rectangular
- -2b Ditch Option: Straight, all concrete - Trapezoidal
- -3 Ditch Option: Straight, grassy-slopes, dirt bottom
- -4 Ditch Option: Meandering, riparian corridor

Forested Corridor Options Considered:
- -(0) = No FCORRIDOR
- -(1) = 100-m forested corridor strips (HSI weight = 1.0)

Spring Lake

The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Canteen and Little Canteen Creek watersheds, and to incidentally reduce flood damages within the Cahokia and Harding watersheds. The three floodplain areas lie in separate historic meander scars of the Mississippi River. Two centuries ago, the principal type of vegetation occurring in these areas appears to have been marsh (Cell 1), prairie (St. Clair Farms), and forest (Indian Lake).

Measures Under Evaluation A total of 9 different alternatives were evaluated.

Common measures:

1. The establishment of three floodplain areas, namely Cell 1 (370 acres), St. Clair Farms (180 acres) and Indian Lake (620 acres), as habitat areas that would utilize stormwater events from Canteen and Little Canteen Creeks with the construction of earthen hydraulic features around these areas, when necessary. At Indian Lake, remnants of Cahokia Creek would be reopened to create a flowing floodplain stream, and trees would be planted along both sides of the channel (where they currently do not exist), to create a continuous forested corridor 330 feet (100 meters) wide. Impaired drainage at the northern end would be improved and standing water removed, to allow the forest to become reestablished.

Spring Lake - Continued

2. The creation of a 330-foot (100-meter) wide forested corridor on both sides of Harding Ditch between Cell 1 and St. Clair Farms.

3. The re-establishment of forest in the dead timber area north of Forest Boulevard, within the Cahokia Mounds State Historic Site. The permanent standing water within a 35-acre tract of dead (drowned) timber would be drained and appropriate tree species planted under this option.

4. The construction of a new Canteen Creek relief channel to ensure that stormwater from the Canteen Creek watershed enters into the Harding Ditch system, and ultimately into the habitat areas. The channel would have concrete sides, a concrete bottom and earthen levies along both banks.

5. The modification of Harding Ditch, from Route 157 to Cell 1, and from Cell 1 to St. Clair Farms, in order to ensure the transference of stormwater events from Canteen and Little Canteen Creeks to the habitat areas. The channels would have grassy sides, an earthen bottom and an earthen levee along both banks.

6. The construction of a new "Fairmont City Ditch," from Cell 1 to Indian Lake, which would provide the hydraulic connection from Canteen Creek back to Cahokia Canal. The channel would have grassy sides, an earthen bottom and an earthen levee along both banks in low elevations.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 58 new tributary stream sediment detention basins (37 in the Canteen Creek watershed and 21 in the Little Canteen Creek watershed) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 99 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in the new habitat restoration area itself.

2. Presence or absence of a new "floodplain" along "Reach 3B" of Harding Ditch. By setting back the existing levees along a 2,000-foot long reach of Harding Ditch, a "floodplain" area would be re-established.

3. Vegetative cover across the habitat areas – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site. In Cell 1, a restoration marsh option that requires extensive excavation was compared to an option that produced a combination of marsh and forested habitat with minimal excavation required. In the St. Clair Farms area, an option that restores prairie and forested habitats to the site with no excavation activities was compared to the restoration of marsh habitat requiring minimal excavation. In "Reach 3B" of the Harding Ditch, a prairie restoration option implemented in the floodplain was evaluated. Throughout the evaluation of options, the habitat conditions in the Indian Lake area were held constant.

Following the first Incremental Cost Analysis evaluation the floodplain channel alternatives were eliminated from final competition. It was determined that these 6 alternatives were not acceptable based on their increased consumption of prime farmland. These alternatives were not carried into the final ICA analysis.

Spring Lake – Continued

Channel Type & Corridor Type Options	Uplands ON Sediment Trapped in Uplands			Uplands OFF Floodplain will act as Natural Sediment Basin		
	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to Prairie	Cell 1: Minimal excavation Cell 2: Expected to Dry Out St. Clair Farms: Excavation necessary, Planted to MARSH	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to NEWFOREST	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to Prairie	Cell 1: Minimal excavation Cell 2: Expected to Dry Out St. Clair Farms: Excavation necessary, Planted to MARSH	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to NEWFOREST
Straight Channel with Concrete Sides	1A-1-X	1B-1-X	1C-1-X	1D-1-X	1E-1-X	1F-1-X
	1A-1-Y	1B-1-Y	1C-1-Y	1D-1-Y	1E-1-Y	1F-1-Y
	1A-1-Z	1B-1-Z	1C-1-Z	1D-1-Z	1E-1-Z	1F-1-Z
All Concrete Channel	1A-2a-X	1B-2a-X	1C-2a-X	1D-2a-X	1E-2a-X	1F-2a-X
	1A-2a-Y	1B-2a-Y	1C-2a-Y	1D-2a-Y	1E-2a-Y	1F-2a-Y
	1A-2a-Z	1B-2a-Z	1C-2a-Z	1D-2a-Z	1E-2a-Z	1F-2a-Z
	1A-2b-X	1B-2b-X	1C-2b-X	1D-2b-X	1E-2b-X	1F-2b-X
	1A-2b-Y	1B-2b-Y	1C-2b-Y	1D-2b-Y	1E-2b-Y	1F-2b-Y
	1A-2b-Z	1B-2b-Z	1C-2b-Z	1D-2b-Z	1E-2b-Z	1F-2b-Z
Straight Grass-lined Channel	1A-3-X	1B-3-X	1C-3-X	1D-3-X	1E-3-X	1F-3-X
	1A-3-Y	1B-3-Y	1C-3-Y	1D-3-Y	1E-3-Y	1F-3-Y
	1A-3-Z	1B-3-Z	1C-3-Z	1D-3-Z	1E-3-Z	1F-3-Z
Earthen Sides	1A-6-X	1B-6-X	1C-6-X	1D-6-X	1E-6-X	1F-6-X
	1A-6-Y	1B-6-Y	1C-6-Y	1D-6-Y	1E-6-Y	1F-6-Y
	1A-6-Z	1B-6-Z	1C-6-Z	1D-6-Z	1E-6-Z	1F-6-Z
Floodplain with Concrete Sides	1A-7-X	1B-7-X	1C-7-X	1D-7-X	1E-7-X	1F-7-X
	1A-7-Y	1B-7-Y	1C-7-Y	1D-7-Y	1E-7-Y	1F-7-Y
	1A-7-Z	1B-7-Z	1C-7-Z	1D-7-Z	1E-7-Z	1F-7-Z
Floodplain with Earthen Sides	1A-8-X	1B-8-X	1C-8-X	1D-8-X	1E-8-X	1F-8-X
	1A-8-Y	1B-8-Y	1C-8-Y	1D-8-Y	1E-8-Y	1F-8-Y
	1A-8-Z	1B-8-Z	1C-8-Z	1D-8-Z	1E-8-Z	1F-8-Z

Spring Lake – Continued

Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

All Alternatives: Indian Lake: Re-establish Old Cahokia Reach, Send flood pulse into area, Drain out through Landsdowne Channel to promote tree growth, Expect Golf Course to naturally suceed NEWMARSH/NEWFOREST
Forested Corridor Options:
-X = 100m forested corridor strips (HSI weight = 1.0)
-Y = 75m forested corridor strips (HSI weight = 0.75)
-Z = 50m forested corridor strips (HSI weight = 0.5)
Channel Options:
-2b Ditch Option: Straight channel/concrete sides/concrete bottoms/Trapezoidal shaped
-3 Ditch Option: Straight channel/grass-lined sides/dirt bottoms
-6 Ditch Option: Straight channel/Earthen sides/dirt bottoms
-7 Ditch Option: Straight Channel/grass-lined sides/dirt bottoms/Floodplain between setback levees and channel with PRAIRIE & RIPARIAN
-8 Ditch Option: Straight Channel/grass-lined sides/dirt bottoms/Floodplain between setback levees and channel with PRAIRIE & RIPARIAN

Wedgewood

The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resouces in the Schoenberger Creek watershed and to incidentally reduce flood damages within the Harding watershed. The area of the floodplain component is located in the southern portion of historic Cold Prairie that interfaced with forest.

Measures Under Evaluation A total of 4 different alternatives were evaluated.

Common measures:

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Schoenberger Creek.

2. The modification of the existing levee, along the west side of Harding Ditch, to ensure delivery of stormwater events from Schoenberger Creek into the new habitat area.

3. The enclosure of Summit Avenue in the new habitat area, extending from Kings Highway on the west, to Harding Ditch on the east, to form a contiguous habitat area.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 24 new tributary stream sediment detention basins in the Schoenberger Creek watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 36 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in a floodplain sediment detention basin within the new habitat restoration area.

2. Vegetative cover across the habitat area – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site, wet supported by excavation activities.

Wedgewood - Continued

	Uplands ON (no Detention basin)			Uplands OFF (Dentention basin needed)		
Options	Prairie Only	Marsh Only	Newly Planted Forested Wetlands Only	Prairie with Marsh Detention Basin	Marsh with Marsh Detention Basin	Newly Planted Forested Wetland with Marsh Detention Basin
Small Site (112.9 ac) w/o NEWFCORR	9AB-1-(0)	9B-1-(0)	9C-1-(0)	9D-1-(0)	9E-1-(0)	9F-1-(0)

[shaded] Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

9E & 9F ruled out because of cost of maintenance and re-vegetation is too high.
All Detention Basins = degraded Marshlands
All outside buffer strips = drier prairies. Where outside = outside the original 112.9 acres project boundary (does not refer to buffers surround n
Prairie buffer filter strips surrounding marshlands are wetter prairies with less depth due to sedimentation trapping. - Only used for 9D-9F Alte h
With detention basins, basins dredged every 3-5 years, external to basins dredged every 50 years for Uplands off.

Mullens Slough
The purpose of the restoration at the Mullen's Slough action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Powdermill and "Bluff 6" watersheds and to incidentally reduce flood damages within the Powdermill/Canal No. 1 watershed. In the floodplain, much of the project area lies in an old meander scar of the Mississippi River. The historic Pittsburg or Big Lake occupied this area, and Mullens Slough now lies within its footprint. Prairie once extended south and west of this historic backwater lake.

Measures Under Evaluation A total of 6 different alternatives were evaluated.

Common measures:

1. The establishment of a 310-acre floodplain habitat area to utilize stormwater events delivered by the Powdermill watershed.

2. The creation of overwintering fisheries habitat in Mullens Slough. To accomplish this, a series of deep pools (water depth greater than 8 feet) would be created (by excavation), to provide suitable conditions for winter survival.

3. The creation of islands in Mullens Slough. Material excavated to create overwintering habitat would, in turn, be placed in the slough to create a series of islands. These would be planted to prairie habitat.

Mullens Slough - Continued

4. The improvement of habitat structure in Mullens Slough. Woody debris would be added to the slough, and various aquatic plant species would be planted around its perimeter.

5. The restoration of historic floodplain prairie habitat. Within the new habitat area, prairie would be planted on a 31-acre floodplain area south of Mullens Slough.

6. The creation of a 17-acre marsh area (Cell 1). Stormwater from Powdermill Creek would be passed through this area on its way to Mullens Slough.

7. The improvement of tree species diversity in the existing forests along Canal No. 1 and Mullens Slough by selective thinning and planting of mast tree species.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 20 new tributary stream sediment detention basins (14 in the Powdermill watershed and 6 in the "Bluff 6" watershed) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 16 miles of tributary streams, or sediment would be detained in the Bottoms in a 17-acre detention basin (Cell 1) and in a second 23-acre detention basin (Cell 2) within the proposed habitat area.

3. Maintenance of prairie vegetation – three maintenance options were considered: Burning, Burning/Mowing, and Mowing.

	Uplands On	**Uplands Off (Sedimentation Expected)**
Options	**Cell 1**-DETENTION Marsh - low quality **Cell 2**-LACUST sediment trap for Cell 1 overflow, sedimentation will fill deep holes - 1/2 ft/10 yrs **Cell 3**-Excavate deep pools, sed. rate = 1/2 ft/10 yrs **Cell 4**-AGCROP to PRAIRIE **Cell 5**-In PFO sed. rate = 1/2	**Cell 1**-DETENTION Marsh - higher quality **Cell 2**-LACUST sediment trap for Cell 1 overflow, sedimentation will fill deep holes at a rate of 3 ft/10 yrs **Cell 3**-Excavate deep pools, sed. rate = 3 ft/10 yrs **Cell 4**-AGCROP to PRAIRIE **Cell 5**-In PFO sedsed. rate =
Prairie Treatment: (H) - BURN Mimicking Cahokia Mounds 8-1-(H)	7A-1	7B-1
Prairie Treatment: (VH) - BURN Mimicking Cahokia Mounds 8-1-(VH)	7A-2	7B-2
Prairie Treatment: (H) - BURN/MOW Mimicking Cahokia Mounds 8-2-(H)	7A-3	7B-3

All Alternatives will connect the cells - water flow will be from Cell 1=>Cell 2=>Cell 3=>Cell 4; and Cell 3=>Cell 5 at bottom of Cell 3

- **(H)**: Intensive Treatment Actions - Plant 50 acres per year (500 acres in 10 years)
- **(VH)**: Very Intensive Treatment Actions - Plant 100 acres per year (500
- **BURN**: Burning O&M Activities every 3 years in a rotational cycle
- **BURN/MOW** - Burn 1 time per 10 years & Mow 2-3 yrs every 5 years

Cahokia Mounds

The purpose of this action area is to restore an area on the floodplain that supports prairie plant and animal communities as similar to presettlement (ca. 1800) conditions as practicable. The project area lies within historic Cold Prairie, a 15,000-acre prairie once found in the southeast part of the American Bottoms.

Measures Under Evaluation A total of 6 different action alternatives were considered.

Variable measures:

1. Replacement of hay production areas with prairie plantings that would be completed within a 5 or 10- year time period. In terms of area, these rates corresponded to either ~105 or ~52.5 acres planted per year.

2. Three maintenance plans were designed to maintain the integrity of prairie plant communities by periodically removing dead plant materials.

a. Burning - the entire prairie would be burned every three years on a rotational cycle (a portion would be treated every year).

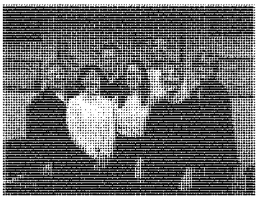
b. Burning and mowing - the entire prairie would be mowed once every two to three years, and burned once every ten years. Both treatments would be implemented on a rotational cycle.

c. Mowing only - the entire prairie would be mowed once every three years on a rotational cycle.

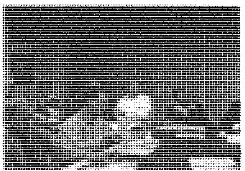
Options	Reestablish PRAIRIE from FIELD and AGCROP; Plant in various size increments per year (50, 25,10 acres/year) High Species Composition Necessary
BURN (Burning O & M Activities - every 3 years on a rotational cycle) Max HSI = 1.0	8-1-(VH)
	8-1-(H)
	8-1-(M)
	8-1-(L)
BURN/MOW (Burn 1 time per 10 years and Mow 2-3 yrs every 5 years) Max HSI = 0.90	8-2-(VH)
	8-2-(H)
	8-2-(M)
	8-2-(L)
MOWING (Mowing O & M Activities - every 3 years on a rotational cycle) Max HSI = 0.75	8-3-(VH)
	8-3-(H)
	8-3-(M)
	8-3-(L)
	Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

- (VH) Very Intensive Treatment Actions; Plant 100 acres per year (500 acres in 5 years); High species composition (TY11 HSI Higher than - (H) alternative)
- (H) Intensive Treatment Actions; Plant 50 acres per year (500 acres in 10 years); High species composition
- (M) Moderate Treatment Actions; Plant 25 acres per year (500 acres in 25 years); High species composition
- (L) Light Treatment Actions; Plant 10 acres per year(500 acres in 50 years); High species composition

6.11 REVIEW AND EVALUATION OF INCREMENTAL COST ANALYSIS RESULTS (ICA)



The ICA results for each action area's array of alternative plans provided comparable information that could be used in the evaluation and assessment process of selecting a preferred plan. From this documentation a two-phase recommended plan selection process was facilitated by the WES project team members Kelly Burks and Tisa Webb. The Biological Team (Tim George, USACE, Ellen Starr, NRCS, Pat Malone, IDNR, Mary White, EPA Region 5, Brian Wiebler and Myra Myoshi USFWS) was assembled to evaluate incremental differences between plans in order to determine which alternative at each site achieved the best results in relation to project objectives and restoration planning targets. Each action area was addressed and ICA results systematically reviewed and compared in order to select the alternatives that would form the preferred plan. Following the Biology Teams assessment, the sponsor representatives (Dave Dietzel, Joe Parente, and Dick Worthen, Madison County, Pam Hogan, Bill Polka and Mike Mitchell, St. Clair County, Gerry Duff and Walter Greathouse Jr., MESD, Mel Allison and Rita Lee, IDNR, Debbie Roush, USACE) went through the full assessment and evaluation process to identify the Sponsor Representatives preferred plan.



Sponsor Representatives

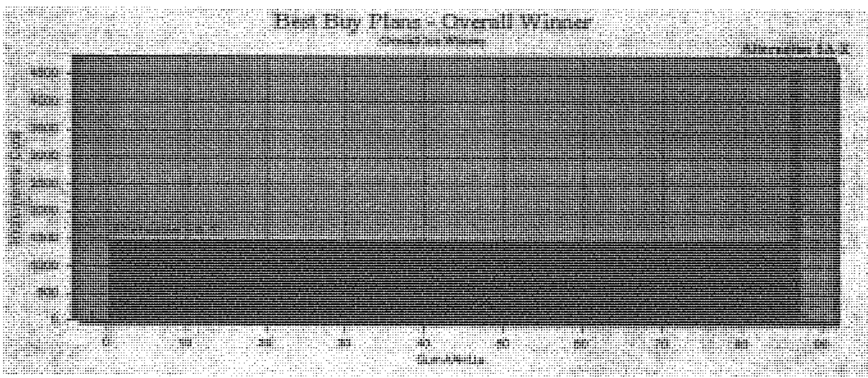
During this phase the Biology Team, and NRCS representatives from Madison, St. Clair County and the state office were present to answer questions and participate in discussions as appropriate. The following details the team assessments for each action area.

The process utilized to assess ICA results was to look at each action site's incremental output results, make an evaluation of these results and recommend an alternative that would be carried into the Preferred Project Plan. Comments received on the draft report indicated that additional benefit assessment was needed on the tributary streams in order to accurately characterize their existing, future without and future with project condition. It was determined that the Qualitative Habitat Evaluation Index (QHEI), developed by the Ohio EPA would provide the best tool to use in the assessment of tributary streams. The QHEI is a community-based model designed to provide a measure of the qualitative habitat corresponding to the physical features that affect fish and invertebrate communities. QHEI is further discussed in Appendix A where the analysis results are also displayed. The addition of this information required the re-calculation of the incremental cost analysis displayed in the draft report. Alternative outputs changed as a result of the inclusion of the QHEI assessment and the new analysis is provided in this final report. It should be noted that in no case did the originally recommended alternative change, nor did the incrementally cost effective alternative change; however the outputs and their incremental costs did.

6.11.1 Dobrey Slough

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
3	3	5A-Z	83	$121,700	$1,471
[redacted]	2	5A-Y	86	$128,100	$1,491
2	[redacted]	5A-X	87	$134,200	$1,539

Computation of Costs and Benefits. Costs and benefits for three Dobrey Slough alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 5A-Y as the most cost effective and incrementally effective alternative (ICA winner). This plan includes a restored marsh buffered in part by a 75-meter wide forested corridor. Alternative 5A-X, with a 100-meter wide corridor, was labeled as the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 5A-Y (ICA winner) provides 86 AAHUs at an average cost of $1,491 per AAHU, whereas alternative 5A-X (HEP winner) produces an additional increment of 1 AAHU at an average cost of $4,611 per AAHU. Of the three evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team did not consider the additional 25-meter corridor width of alternative 5A-X as ecologically significant, given that existing suburban development immediately surrounding much of the project area would prevent the establishment of a continuous, wider corridor. Therefore, the team chose alternative 5A-Y (ICA winner) as its preferred plan at this site. The proposed 75-acre floodplain habitat area, consisting of a restored marsh buffered by a forested corridor 75-meter wide near an existing subdivision, would provide significant ecosystem restoration benefits. The plan supports four primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, and improve water quality.

The proposed restoration of aquatic floodplain resources consisting of marsh and wetland forest habitats is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and several conservation initiatives for bird species of concern.

The alternative's proposed increase in marsh and wetland forest supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl.

The proposed increase of these aquatic habitats also supports the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more marsh and forest on the Mississippi River's floodplain from St. Louis to Cairo. The Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is expected to be supported by the alternative because quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, sedge wren, and marsh wren, are expected to benefit from the proposed marsh restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 5A-Y as the biology team's preferred plan at Dobrey Slough. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 5A-Y.

Given the rational described above, 5A-Y was advanced as the preferred alternative at Dobrey Slough.

6.11.2 Elm Slough

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
[redacted]	[redacted]	6A-2	745	$389,500	$523
2	3	6B-1	633	$372,100	$588
3	2	6B-2	633	$383,700	$606
0	4	6A-3	591	$398,100	$674
0	5	6B-3	476	$392,200	$824

Computation of Costs and Benefits. Costs and benefits for five Elm Slough alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative
6A-2 as the most cost effective and incrementally effective alternative (ICA winner), as well as the alternative producing the greatest number of habitat units (HEP winner). This alternative involves restoration of wetland forest in a floodplain habitat area by improving tree species diversity in existing wetland forest, restoring former wetland forest adjacent to existing wetland forest, and establishing prairie buffers between floodplain tributaries that are proposed to supply a restored flood pulse (Long Lake and Mitchell Ditch) to wetlands in the habitat restoration area.

Of the 5 evaluated alternatives, only one (6A-2) was determined to be a least cost plan, as shown in the bar chart below. Alternative 6A-2 produces 745 AAHUs at an average cost of $523 per AAHU.

Significance. The multi-agency biology planning team chose alternative 6A-2 (ICA and HEP winner) as its preferred plan at this site. The proposed 670-acre floodplain habitat area, consisting primarily of a restored wetland forest, would provide significant ecosystem restoration benefits. The plan supports four primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, and improve water quality. The proposed restoration of aquatic floodplain resources consisting of wetland forest habitat is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and several conservation initiatives for bird species of concern.

The alternative's proposed increase in wetland forest supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl.

The proposed increase of this aquatic habitat also supports the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more forest on the Mississippi River's floodplain from St. Louis to Cairo. The Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is expected to be supported by the alternative because quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, wood duck, American woodcock, cerulean warbler, prothonotary warbler, rusty blackbird, and Louisiana waterthrush are expected to benefit from the proposed wetland forest restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 6A-2 as the biology team's preferred plan at Elm Slough. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 6A-2.

Given the rational described above, 6A-2 was advanced as the preferred alternative at Elm Slough.

6.11.3 Old Cahokia Creek
Incremental Analysis of Alternatives

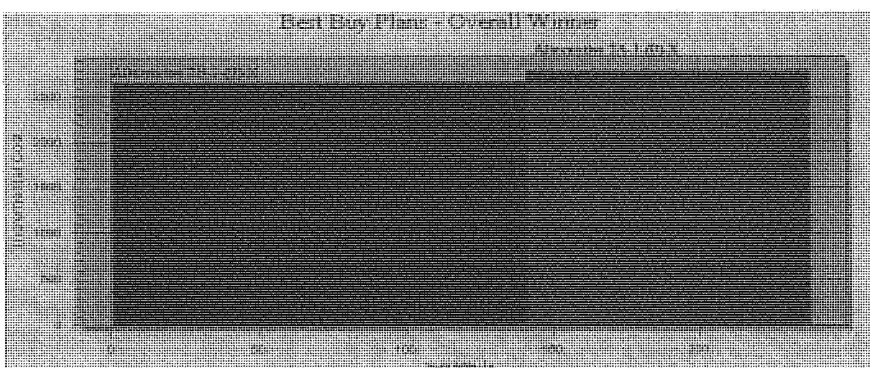
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	4	2B-1-(0)-X	141	$377,000	$2,671		
2	1	2A-1-(0)-X	238	$647,000	$2,723	97	$2,784
3	2	2A-1-(0)-Y	219	$621,000	$2,835	78	$3,128
4	3	2A-1-(0)-Z	185	$596,600	$3,217	44	$4,991
5	5	2B-1-(0)-Y	101	$350,000	$3,480	-40	
6	6	2B-1-(0)-Z	64	$326,300	$5,126	-77	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
2B-1-(0)-X	141	$377,000	$2,671	$377,000	141	$2,671
2A-1-(0)-X	238	$647,000	$2,723	$270,000	96	$2,798

Computation of costs and benefits. Costs and benefits for six Old Cahokia Creek alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 2B-1-(0)-X as the most cost effective and incrementally effective alternative (ICA winner). Alternative 2A-1-(0)-X was identified as the plan producing the greatest number of environmental outputs (HEP winner), and was second most cost effective. Under both alternatives, a floodplain habitat area of 314 acres would envelop 3.4 miles of restored floodplain stream and a 328-foot (100-meter) wide forested corridor along both sides of the restored creek channel. Under alternative 2A-1-(0)-X (HEP winner), restoration of floodplain aquatic habitat would be coupled with restoration of about seven miles of tributary streams in the Bluff 1 watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include ten sediment detention basins and creation of pool and riffle complexes.

The fundamental difference between these two alternatives is tributary stream restoration. Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 2B-1-(0)-X (ICA winner) provides 141 AAHUs at an average cost of $2,671 per AAHU, whereas alternative 2A-1-(0)-X (HEP winner) produces an additional increment of 96 AAHUs at an average cost of $2,798 per AAHU. Of the six evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 2A-1-(0)-X (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 2B-1-(0)-X (ICA winner). The incremental benefits provided by alternative 2A-1-(0)-X (HEP winner) accrue from restoration of tributary streams in a watershed that drains into the proposed floodplain habitat restoration area. This alternative takes a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated. The absence of tributary stream restoration in alternative 2B-1-(0)-X (ICA winner) would allow excessive levels of sediment carried by tributary streams in the Bluff 1 watershed to enter the proposed floodplain habitat area, and degrade aquatic floodplain resources restored by the plan.

Alternative 2A-1-(0)-X (HEP winner) would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watershed is expected to contribute to the goals of several national or regional interagency programs. These programs include the Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain stream and forest habitat under alternative 2A-1-(0)-X supports the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more forest on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is expected to be supported by the alternative. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands as well as riparian corridors on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, wood duck,

American woodcock, black-crowned and yellow-crowned night-herons, and Louisiana waterthrush, are expected to benefit from the proposed floodplain habitat restoration, which supports the conservation efforts of the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

The proposed tributary stream restoration under alternative 2A-1-(0)-X would contribute to the Clean Water Action Plan, by restoring seven miles of streams in a small watershed (JN02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 2A-1-(0)-X as the biology team's preferred plan at Old Cahokia Creek. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 2A-1-(0)-X. The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 2A-1-(0)-X was advanced as the preferred alternative at Old Cahokia Creek.

6.11.4 Judy's-Burdick

Incremental Analysis of Alternatives

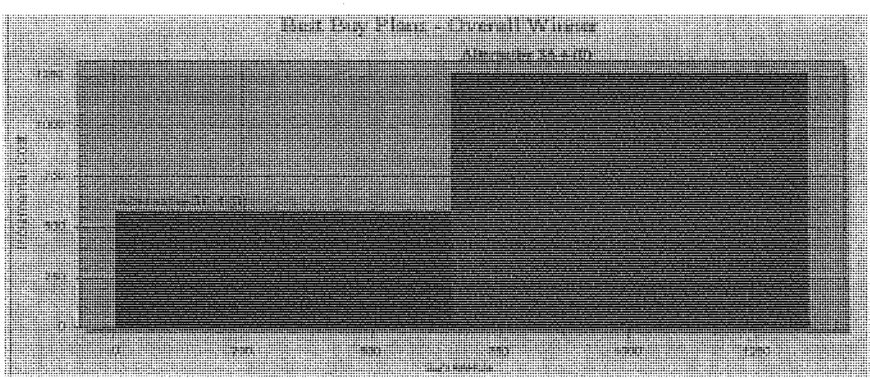
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	12	3C-4-(0)	655	$379,500	$579		
3	11	3C-4-X	660	$398,200	$603	5	$3,740
2	1	3A-4-(0)	1,350	$1,255,700	$930	695	$1,261
4	2	3A-4-X	1,342	$1,262,400	$941	-8	
5	13	3C-2-X	508	$645,700	$1,272	-147	
6	4	3A-2-(0)	1,156	$1,496,500	$1,294	501	$2,230
7	3	3A-2-X	1,163	$1,505,700	$1,295	508	$2,964
8	5	3B-2-(0)	1,132	$1,477,400	$1,305	477	$2,302
9	14	3C-2-(0)	484	$631,700	$1,305	-171	
10	6	3B-2-X	1,120	$1,493,300	$1,333	465	$2,395
11	8	3A-1-(0)	808	$1,721,100	$2,131	153	$8,769
12	7	3A-1-X	809	$1,735,100	$2,144	154	$8,803
13	9	3B-1-X	720	$1,724,600	$2,394	65	$20,694
14	10	3B-1-(0)	695	$1,706,200	$2,456	40	$33,168
15	15	3C-1-X	238	$888,700	$3,730	-417	
16	16	3C-1-(0)	227	$874,800	$3,850	-428	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
3C-4-(0)	655	$379,500	$579	$379,500	655	$579
3A-4-(0)	1350	$1,255,700	$930	$876,200	694	$1,262

Computation of Costs and Benefits. Costs and benefits for 16 Judy's-Burdick alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 3C-4-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 3A-4-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of wet prairie in a 507-acre habitat area would occur on the floodplain. Under alternative 3A-4-0 (HEP winner), the floodplain habitat area would include 0.8 miles of stream restoration, and would be coupled with restoration of about 32 miles of tributary streams in the Judy's and Burdick Branch watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 28 sediment detention basins and creation of pool and riffle complexes. Alternative 3C-4-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

The fundamental difference between these two alternatives is tributary stream restoration. Incremental differences between these two plans are displayed in the bar chart below. Alternative 3C-4-0 provides 655 AAHUs at an average cost of $579 per AAHU, whereas alternative 3A-4-0 produces an additional increment of 694 AAHUs at an average cost of $1,262 per AAHU. Of the 16 evaluated alternatives, both are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 3A-4-(0) (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 3C-4-(0) (ICA winner). The incremental benefits provided by alternative 3A-4-0 (HEP winner) accrue primarily from restoration of tributary streams in watersheds that drain into the proposed floodplain habitat restoration area. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

The absence of tributary stream restoration in alternative 3C-4-(0) (ICA winner) would allow excessive levels of sediment carried by tributary streams in the two watersheds to be captured in the habitat restoration area within a sediment detention basin. This basin would lessen the area of prairie restored in the habitat area.

Alternative 3A-4-(0) (HEP winner) would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain wet prairie under alternative 3A-4-(0) supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl. Prairie restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more prairie on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The alternative is expected to support the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, black-crowned and yellow-crowned night-herons, northern harrier, sedge wren, grasshopper sparrow, and Le Conte's sparrow, are expected to benefit from the proposed floodplain prairie restoration, which supports the conservation efforts of the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

The proposed tributary stream restoration under alternative 3A-4-(0) would contribute to the Clean Water Action Plan, by restoring about 32 miles of streams in a small watershed (JN02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 3A-4-(0) as the biology team's preferred plan at the Judy's-Burdick action area. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 3A-4-(0).

The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 3A-4-0 was advanced as the preferred alternative at Judy's-Burdick action area.

6.11.5 Brushy Lake

Incremental Analysis of Alternatives

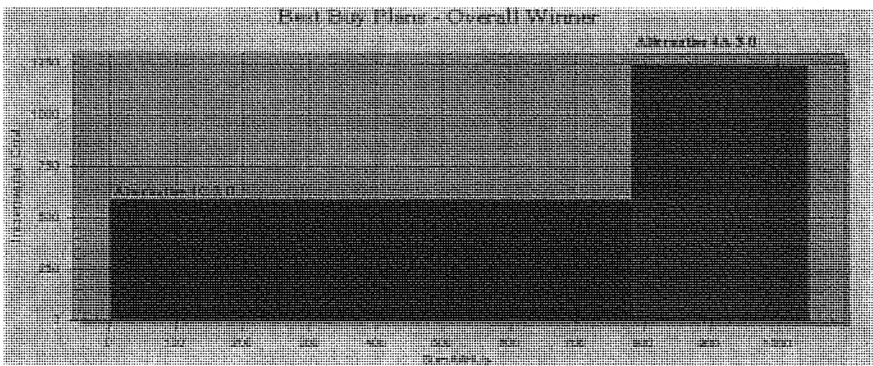
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	3	4C-3-0	782	$459,800	$588		
3	5	4B-3-0	759	$456,300	$602	-23	
2	1	4A-3-0	1,047	$787,300	$752	265	$1,237
5	4	4C-1-0	764	$888,200	$1,162	-18	
4	2	4A-1-0	1,029	$1,215,900	$1,182	247	$3,061
6	6	4B-1-0	741	$884,400	$1,193	-41	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
4C-3-0	782	$459,800	$588	$459,800	782	$588
4A-3-0	1047	$787,300	$752	$327,500	265	$1,237

Computation of Costs and Benefits. Costs and benefits for 6 Brushy Lake alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 4C-3-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 4A-3-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of forested wetland in a 717-acre habitat area would occur on the floodplain. Under alternative 4A-3-0 (HEP winner), the floodplain habitat area would include 3.5 miles of stream restoration, and would be coupled with restoration of about 25 miles of tributary streams in the Schoolhouse watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 15 sediment detention basins and creation of pool and riffle complexes. Alternative 4C-3-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

The fundamental difference between these two alternatives is tributary stream restoration. The bar chart below displays the incremental differences between these two plans. Alternative 4C-3-0 provides 782 AAHUs at an average cost of $588 per AAHU, whereas alternative 3A-4-0 produces an additional increment of 265 AAHUs at an average cost of $1,237 per AAHU. Of the 6 evaluated alternatives, both were identified to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 4A-3-0 (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 4C-3-0 (ICA winner). The incremental benefits provided by alternative 4C-3-0 (HEP winner) accrue primarily from restoration of tributary streams in a watershed that drains into the proposed floodplain habitat restoration area. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

The absence of tributary stream restoration in alternative 4C-3-0 (ICA winner) would allow excessive levels of sediment carried by tributary streams in the watershed to be captured in the habitat restoration area within a sediment detention basin. This basin would lessen the area of prairie restored in the habitat area.

Alternative 4A-3-0 (HEP winner) would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain wetland forest under alternative 4A-3-0 supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl.

Wetland forest restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more forest on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The alternative is expected to contribute to the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force.

Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, wood duck, American woodcock, cerulean warbler, prothonotary warbler, rusty blackbird, and Louisiana waterthrush are expected to benefit from the proposed wetland forest restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

The proposed tributary stream restoration under alternative 4A-3-0 would contribute to the Clean Water Action Plan, by restoring about 25 miles of streams in a small watershed (JN02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 4A-3-0 as the biology team's preferred plan at Brushy Lake. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 4A-3-0. The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 4A-3-0 was advanced as the preferred alternative at Brushy Lake.

6.11.6 Cahokia Mounds

Incremental Analysis of Alternatives

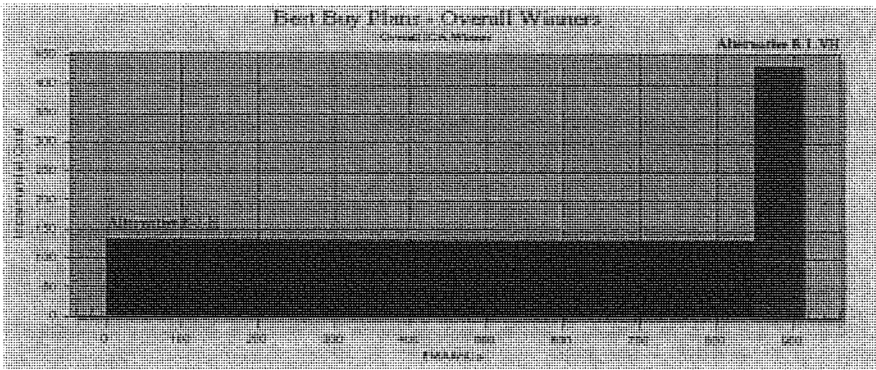
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	2	8-1- (H)	849	$113,200	$133		
2	1	8-1- (VH)	915	$141,700	$155	66	$432
3	4	8-2- (H)	631	$115,900	$184	-218	
4	3	8-2- (VH)	710	$144,500	$204	-139	
0	5	8-3- (VH)	277	$146,100	$528	-572	
0	6	8-3- (H)	207	$117,300	$567	-642	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
8-1-H	849	$113,200	$133	$113,200	849	$133
8-1-VH	915	$141,700	$155	$28,500	66	$432

Computation of Costs and Benefits. Of the six plans evaluated for Cahokia Mounds, the incremental cost analysis identified alternative 8-1-(H) as the most cost effective alternative (ICA winner). This plan restores 525 acres of floodplain prairie over a 10-year period, and uses burning for prairie maintenance. Alternative 8-1-(VH) was labeled as the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs).

This plan restores 525 acres of floodplain prairie over a 5-year period, and maintains prairie habitat by burning. Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 8-1-(H) (ICA winner) provides 849 AAHUs at an average cost of $133 per AAHU, whereas alternative 8-1-(VH) (HEP winner) produces an additional increment of 66 AAHU at an average cost of $432 per AAHU. Of the six evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The difference in habitat units produced by plans 8-1-(H) (ICA winner) and 8-1-(VH) (HEP winner) reflects a five year difference in duration of prairie implementation, and the multi-agency biology planning team agreed that this difference was not substantial. The team chose alternative 8-1-(H) (ICA winner) as its preferred plan at this site. The proposed 525 acres of floodplain prairie restoration would provide significant ecosystem restoration benefits. The plan supports two primary study objectives: restore natural areas and restore habitat quality. The proposed restoration of aquatic floodplain resources consisting of floodplain prairie is expected to contribute to the goals of several national or regional interagency programs. These programs include the Upper Mississippi River System Environmental Management Program and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain prairie under alternative 8-1-(H) contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more prairie on the Mississippi River's floodplain from St. Louis to Cairo.

Bird species of concern, such as the mallard, northern harrier, sedge wren, grasshopper sparrow, and Le Conte's sparrow, are expected to benefit from the proposed floodplain prairie restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 8-1-(H) as the biology team's preferred plan at Cahokia Mounds. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 8-1-(H).

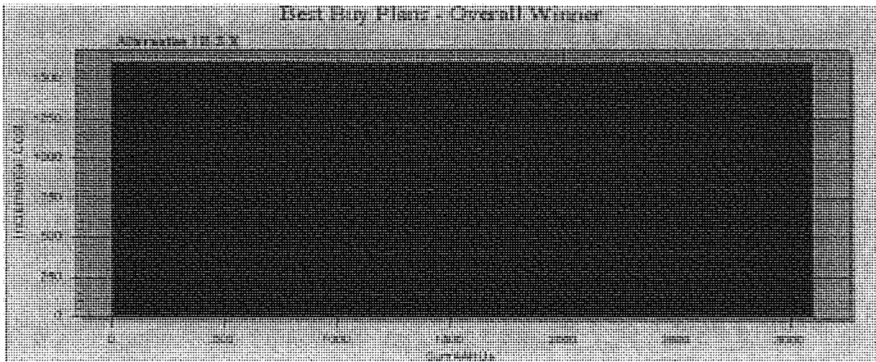
Given the rational described above, 8-1-(H) was advanced as the preferred alternative at Cahokia Mounds.

6.11.7 Spring Lake

Incremental Analysis of Alternatives

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
1	1	1B-3-X	3,105	$4,975,075	$1,602
2	2	1A-3-X	3,026	$4,985,891	$1,648
3	4	1E-3-X	1,901	$3,156,737	$1,661
4	3	1C-3-X	2,787	$4,971,933	$1,784
5	5	1D-3-X	1,746	$3,167,487	$1,814
6	6	1F-3-X	1,602	$3,153,528	$1,969

Computation of Costs and Benefits. Costs and benefits for 6 Spring Lake alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 1B-3-X as the most cost effective and incrementally effective alternative (ICA winner). Of the 6 evaluated alternatives, only 1B-3-X was determined to be a least cost plan, as shown in the bar chart below. It produces 3,105 AAHUs at an average cost of $1,602 per AAHU. A 1,364 acre floodplain habitat area consisting mainly of marsh and forested wetlands is to be established at three separate locations adjacent to Harding and Lansdowne Ditches. Under this alternative, the floodplain habitat area would include 3.1 miles of stream restoration, and would be coupled with restoration of about 99 miles of tributary streams in the Little Canteen and Canteen Creek watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 58 sediment detention basins and creation of pool and riffle complexes.



Significance. The multi-agency biology planning team accepted alternative 1B-3-X (ICA and HEP winner) as its preferred plan at this site. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

Alternative 1B-3-X would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in marsh and floodplain wetland forest under alternative 1B-3-X supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl. Marsh and wetland forest restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more marsh and forest on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The alternative is expected to contribute to the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff.

The proposed tributary stream restoration under alternative 1B-3-X would contribute to the Clean Water Action Plan, by restoring about 99 miles of streams in a small watershed (JNA01 and JMAC02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 1B-3-X as the biology team's preferred plan at Spring Lake. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 1B-3-X. The study sponsors acknowledged and accepted the cost of this alternative, and recognized the environmental benefits it affords from tributary stream restoration.

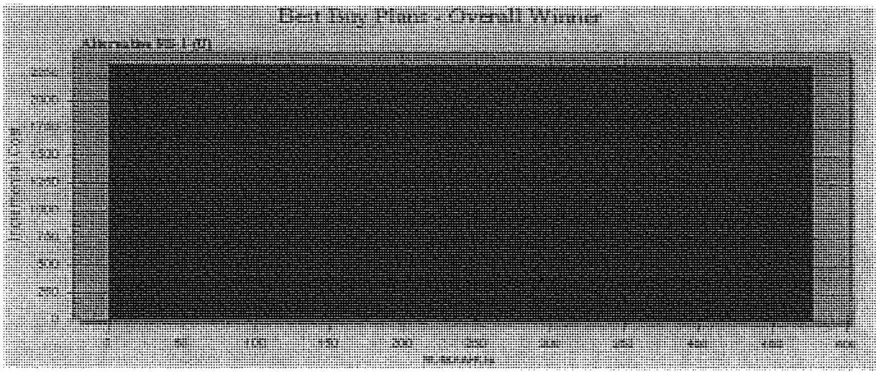
Given the rational described above, 1B-3-X was advanced as the preferred alternative at Spring Lake.

6.11.8 Wedgewood.

Incremental Analysis of Alternatives

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
1	1	9B-1-(0)	478	$1,115,000	$2,334
2	2	9A-1-(0)	371	$1,097,100	$2,959
3	3	9C-1-(0)	332	$1,093,700	$3,290
4	4	9D-1-(0)	-54	$388,538	($7,228)

Computation of Costs and Benefits. Costs and benefits for 4 Wedgewood alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 9B-1-(0) as the most cost effective and incrementally effective alternative (ICA winner). Of the 4 evaluated alternatives, only 9B-1-(0) was determined to be a least cost plan, as shown in the bar chart below. It produces 478 AAHUs at an average cost of $2,334 per AAHU. A 124-acre floodplain habitat area consisting of marsh would be established adjacent to Harding Ditch. This alternative also includes restoration of about 37 miles of tributary streams in the Schoenberger Creek watershed, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 24 sediment detention basins and creation of pool and riffle complexes.



Significance. The multi-agency biology planning team accepted alternative 9B-1-(0) (ICA and HEP winner) as its preferred plan at this site. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

Alternative 9B-1-(0) would provide significant ecosystem restoration benefits. The plan supports six primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, and restore tributary streams. The proposed restoration of marsh in the floodplain and streams in adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Acceptability. As a result of comments received during public review of the draft report, which occurred between 28 February and 7 May 2003, this Action Area was eliminated and is not carried forward into the Recommended Plan. Additional information is contained in Appendix G regarding this action.

Given the rational described above, no alternative was advanced for Wedgewood.

6.11.9 Mullens Slough.

Incremental Analysis of Alternatives

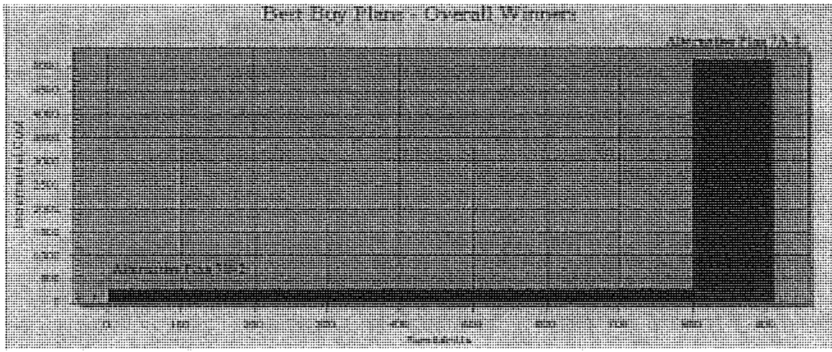
ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	4	7B-2	730	$234,700	$322		
3	5	7B-3	712	$233,900	$328	-18	
5	6	7B-1	695	$233,700	$336	-35	
2	1	7A-2	912	$794,400	$871	182	$3,079
4	2	7A-3	894	$796,900	$892	164	$3,432
6	3	7A-1	877	$794,200	$906	147	$3,816

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
7B-2	730	$234,700	$322	$234,700	730	$292
7A-2	912	$794,400	$871	$559,700	182	$3,079

Computation of Costs and Benefits. Costs and benefits for 6 Mullens Slough alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 7B-2 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 7A-2 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was the second-most cost effective plan. Under both alternatives, a 312-acre floodplain area consisting of lake, prairie, and herbaceous wetland habitats is to be established adjacent to the confluence of Powdermill Creek and Canal No. 1. Under alternative 7A-2 (HEP winner), the floodplain habitat area would be coupled with restoration of about 16 miles of tributary streams in the Powdermill Creek watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 20 sediment detention basins and creation of pool and riffle complexes. Alternative 7B-2 (ICA winner) would include two floodplain sediment detention basins within the habitat area, and no tributary stream restoration.

The fundamental difference between these two alternatives is tributary stream restoration. The bar chart below displays the incremental differences between these two plans. Alternative 7B-2 provides 730 AAHUs at an average cost of $322 per AAHU, whereas alternative 7A-2 produces an additional increment of 182 AAHUs at an average cost of $3,079 per AAHU. Of the 6 evaluated alternatives, both were identified to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 7A-2 (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 7B-2 (ICA winner). The incremental benefits provided by alternative 7A-2 (HEP winner) accrue primarily from restoration of tributary streams in watersheds that drain into the proposed floodplain habitat restoration area. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated. The absence of tributary stream restoration in alternative 7B-2 (ICA winner) would allow excessive levels of sediment carried by tributary streams in the watershed to be captured in the habitat restoration area within a sediment detention basin. This basin would lessen the area of forested wetland restored in the habitat area

Alternative 7A-2 would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, and restore tributary streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the restoration of fringe wetlands around the lake under alternative 7A-2 supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl. Prairie restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more prairie on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams.

The alternative is expected to contribute to the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Numerous bird species of concern, consisting of various waterfowl, waterbirds, and shorebirds, are expected to benefit from the proposed aquatic restoration, which supports the conservation efforts of the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels. Such bird species include the American wigeon, northern pintail, canvasback, least bittern, common moorhen, greater yellowlegs, Hudsonian godwit, and stilt sandpiper.

The proposed tributary stream restoration under alternative 7A-2 would contribute to the Clean Water Action Plan, by restoring about 16 miles of streams in a small watershed (JMA01) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 7A-2 as the biology team's preferred plan at Mullens Slough. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 7A-2. The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 7A-2 was advanced as the preferred alternative at Mullens Slough.

6.12 REVIEW AND EVALUATION OF PLANS.

This section assesses performance of the Biological, Incremental, and Preferred Plans. These plans are comprised of one alternative from each of the proposed action areas. The Biological Plan consists of those alternatives that produced the greatest environmental outputs (HEP winners). The Incremental Plan consists of the cheapest, most cost effective and cost efficient alternatives (ICA winners). The Preferred Plan consists of those alternatives preferred by the biology team and study sponsors.

Evaluation of these plans included comparison with a No-Action Plan. Section 4 - Without Project Conditions addresses the effects of a No-Action Plan recommendation. The No-Action Plan is a "do nothing" scenario, and makes no contribution to any of the planning objectives. Several criteria have been used to assess performance of the Biological, Incremental, Preferred, and No-Action Plans.

First, the planning objectives and targets presented in Section 5 facilitate quantitative comparisons of effectiveness of the four plans. Second, comparison of costs and benefits using cost analysis was used as another quantitative tool to assist in the evaluation process. Lastly, qualitative indicators, including acceptability, completeness, efficiency, significance, and reasonableness of costs, allow for further assessment of these plans. The evaluation of plan performance against all of these criteria facilitates the selection of one of these plans as the Recommended Plan.

6.12.1 Effectiveness – Achievement of Planning Objectives.

Table 6-1 presents a summary of the effectiveness of the four plans. Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives. The Biological and Preferred Plans are more effective than the Incremental Plan in achieving the planning objectives. The table is followed by discussions of performance against each of the seven primary objectives and one social (incidental) objective.

Table 6-1 Summary of the performance of each plan with respect to each of the planning objectives their targets.

Objective	Target	Biological Plan	Incremental Plan	Preferred Plan	No-Action Plan
1 – Restore natural areas	Total area of habitat restored (acres)	4,885	4,440	4,830	0
2 – Restore flood pulse	% of action areas with depth of design flood < depth of 1844 flood	83	83	83	N/A
3 – Restore habitat quality	% of action areas with at least moderate habitat quality (average for 9 species)	75	60	76	N/A
4 – Improve water quality	Relative area affected	tributaries & floodplain	floodplain	tributaries & floodplain	N/A
5 – Reduce tributary erosion	% estimated sediment reduction	70	0	70	N/A
6 – Restore tributary streams	Total length of restored streams (miles)	178	99	178	N/A
7 – Restore floodplain streams	Total length of restored stream (miles)	10.8	9.7	10.8	N/A
8a – Reduce flood damages	Damages reduced by design event incidental to restoration of flood pulse (dollars)	$1,300,000	$1,300,000	$1,300,000	N/A
8b– Enhance outdoor recreation	Relative area affected	floodplain	floodplain	floodplain	N/A
8c – Protect cultural resources	Total area of known archaeological sites within action areas (acres)	999	990	989	N/A

Objective No. 1. Restore Natural Areas. Each of the three action plans establishes over 4,000 acres of restored and created habitats. Table 6-1 displays the area of various natural habitats established by each plan. This information comes from the Habitat Assessment in Appendix A. The Biological Plan affects the largest area, and the Preferred Plan is intermediate in size, or 55 acres less than the Biological Plan.

The Incremental Plan affects the smallest area, or 385 acres fewer than the Biological Plan. The greatest difference among the plans is the lack of riparian forest restoration along tributary streams in the Incremental Plan. Table 6-2 displays the area of restored habitats by natural community.

Table 6-2 Comparison of major plans showing area of restored habitats by natural community.

Natural Community	Area (acres)			
	Biological Plan	Incremental Plan	Preferred Plan	No Action Plan
Riparian forest - tributary streams	378	0	378	0
Floodplain nonwetland forest	131	131	131	0
Floodplain wetland forest	1,666	1,606	1,658	0
Prairie	1,158	1,074	1,111	0
Herbaceous wetland	857	951	857	0
Lake & pond	522	522	522	0
Stream	161	145	161	0
Cultural	11	11	11	0
Total Area	4,885	4,440	4,830	0

Based on the planning targets for this objective, the three action plans would achieve similar levels of expansion for each of four main types of natural communities. The three action plans would attain nearly 90 percent of the expansion target for forested wetland, and about 70 percent for prairie (Table 6-3). Targets for new marsh and restored floodplain streams would be exceeded by all three action plans. While the plans fall short of the targets for forested wetland and prairie, they should not be considered unsuccessful, as these targets were established for planning purposes and acted as benchmarks against which to compare plans. The planning team found that existing development on the floodplain acted as the greatest constraint on opportunities for expansion of existing habitats into larger contiguous areas. The desire to avoid horseradish fields also limited opportunities for habitat expansion. Targets for new marsh and restored streams were exceeded because they were relatively small compared to the targets for forested wetland and prairie, and more opportunities for marsh creation and stream restoration arose than were originally anticipated.

Table 6-3 Achievement of objective 1 (restore natural areas) by the major plans.

Natural Community	Target	Percent of Target Achieved			
		Biological Plan	Incremental Plan	Preferred Plan	No-Action Plan
Forested wetland (existing & new)	1,880 acres	89%	85%	88%	0%
Prairie (existing & new)	1,612 acres	72%	67%	69%	0%
Marsh (new)	100 acres	857%	951%	857%	0%
Restored channel (existing & new, excluding ditches)	3.0 miles	360%	323%	360%	0%

Objective No. 2. Flood Pulse. The three action plans do not differ in any substantial manner with regard to restoration of a flood pulse. All three action plans are designed to restore a flood pulse to habitats in the bottoms. The historic hydrological condition would be mimicked using storm water from the tributary streams. The amount of storm water to be used is the same for all three plans.

Under each plan, restored flood pulses would affect up to roughly 3,800 acres of habitats. All affected areas experienced historic flooding from the Mississippi River and tributary streams.

A flood pulse would be restored to seven action areas: Old Cahokia Creek, Judy's-Burdicks, Elm Slough, Dobrey Slough, Brushy Lake, Spring Lake, and Mullens Slough. Because the amount of storm water entering these action areas and the area of habitats to be flooded do not substantially differ from one plan to another, the three plans are expected to be very similar in regard to the depth and duration of a variety of flood pulses resulting from a range of storm water events.

The planning target for this objective is a flood pulse that does not exceed the depth of the Mississippi River flood of 1844 at St. Louis, nor extend for more than 14 days in duration. Table 6-4 displays estimates of flood depth during the peak of the 1844 flood event for the seven action areas, and estimated depth and duration of the design flood event at these same areas. The design flood event is the flood event of greatest depth to be directed into an action area. For some action areas, depth and duration of the design event have not been estimated because information is currently lacking.

The three action plans conform to the planning target at nearly all assessed action areas. Table 6-4 shows that the design event at six of seven (89 percent) assessed action areas would not be deeper than the flood of 1844. At all five action areas that were evaluated for duration, the length of design events would be less than 14 days.

Depth of design events are less than the 1844 event at most action areas because of two major constraints imposed by today's environment. First, the amount of water currently available to serve as a flood pulse is considerably less compared to historic conditions. Secondly, the interior flood control system and other floodplain development impose an upper limit to the depth of ponded storm water.

Table 6-4 Depth and duration of design flood events in action areas for the action plans, compared to the 1844 flood at St. Louis (all figures are estimates).

Proposed Action Area and Plan	Peak of 1844 Flood		Peak of Design Event, Three Action Plans			Depth of Design Event < 1844 Flood?	Duration of Design Event < 14 Days?
	Surface elevation, feet NGVD	Range of water depth across site, feet	Surface elevation, feet NGVD	Range of water depth (ponding) across site, feet	Total duration of ponding, hours (days)		
Old Cahokia Creek	428	0-3	431	0-6	140 (5.8)	no	yes
Judy's-Burdicks	426	6-8	424	4-6	15 (0.6)	yes	yes
Dobrey Slough	426	1-15	415	0-5	not estimated	yes	-
Elm Slough	426	10-20	410	0-5	60 (2.5)	yes	yes
Brushy Lake	424	5-20	412	0-7	20 (0.8)	yes	yes
Indian Lake (Spring Lake)	422	15-20	406	1-6	not estimated	yes	-
Cell 1 (Spring Lake)	421	1-10	416.5	6-7	120 (5.0)	yes	yes
Mullens Slough: all 3 plans	419	5-10	not estimated	0-4	not estimated	-	-

Depth of the design event exceeds the 1844 flood at one action area, Old Cahokia Creek. Here the difference is about three feet. This action area is unique because it is located on a natural floodplain terrace, much of which was elevated above the peak of the 1844 flood. Unlike the flood of 1844, the flood pulse of the design event would be detained upstream by an abandoned railroad embankment that crosses the historic channel of Cahokia Creek in the southern portion of the action area. Maximum depth of the design event (about 6 feet) would be similar to that of other action areas. Temporary detention of storm water upstream of the embankment would incidentally protect existing development to the south that lies adjacent to the action area. Under each plan, storm water for the design event would pass downstream of the embankment and remain confined to the restored channel.

Objective No. 3. Restore Habitat Quality. For this objective, the action plans were assessed against the planning target of achieving moderate habitat quality or better for each evaluation species in all restored habitats of the proposed action areas. Moderate habitat quality was considered to be a habitat suitability index of 0.5, based on a scale of 0 to 1, with 0 representing no quality and 1 optimal quality. Each plan's performance is based on the results of the Habitat Assessment described in Appendix A. The reference point in time for comparisons of habitat quality was target year 51, or the end of the 50-year planning period, for which the interagency planning team of biologists projected future habitat conditions.

As shown in Table 6-5, only two of the nine evaluation species achieve at least moderate habitat quality under all three action plans at all action areas with suitable habitat. They are the marsh wren, which uses herbaceous wetlands such as marshes, and the white crappie, typical of lakes and ponds. Two additional species, the black crappie and great blue heron, also exhibit the same degree of achievement of moderate habitat quality for each plan, although not at every action area.

For each of the remaining five species, the three action plans differ in the degree to which they provide moderate-quality habitats. The Incremental Plan ranks below the Biological and Preferred Plans in terms of the proportion of action areas averaged across all species with at least moderately suitable habitats. Compared to the Incremental Plan, the Biological and Preferred Plans achieve a greater percentage of action areas with moderate-quality habitat conditions.

Varying degrees of habitat specificity among the nine evaluation species probably explains why expected future habitat conditions are not reflective of at least moderate quality at all action areas. Some species are habitat specialists while others are habitat generalists. Using other words, a given type of habitat cannot satisfy the requirements of all species. For example, in this study the eastern meadowlark was associated only with prairies because it prefers grasslands, meadows, and pastures. The great blue heron, on the other hand, is a generalist because it uses a wide variety of habitats, including floodplain and upland forests, marshes, ponds and lakes, and streams. Although many of the proposed action areas contain a variety of habitats, habitat types used or preferred by all nine evaluation species are unlikely to be present at each action area.

Therefore, habitat specialists would tend to encounter less favorable habitat conditions than habitat generalists from one action area to the next. Similarly, an action area like Cahokia Mounds, where a 525-acre prairie restoration is proposed, would offer high quality habitat to a specialist like the meadowlark, but none to the great blue heron, which is not associated with prairies.

Table 6-5 Comparison of action plans showing percentage of proposed action areas having at least moderately (0.5) suitable habitat for nine evaluation species at the end of the 50-year planning period.

Evaluation species	**No. of action areas with suitable habitat, depending on plan (at most 9)**	**Percent of action areas with habitat suitability index $\geq$ 0.5 at target year 51**		
		Biological Plan	**Incremental Plan**	**Preferred Plan**
Black crappie	6	83	83	83
Eastern meadowlark	5 or 6	100	83	100
Fox squirrel	5 or 6	100	0	100
Great blue heron	8	63	63	63
Marsh wren	6 or 7	100	100	100
Mink	8	50	63	63
Slider turtle	8	25	13	25
White crappie	1	100	100	100
Wood duck	8	50	38	50
Average across all species		75	60	76

Objective No. 4. Improve Water Quality. The planning target for this objective is improvement of water quality for all surface waters comprising the interior flood control system. These features include stream channels in the tributary watersheds, and ditches, canals, and channels in the bottoms that carry tributary flow and local runoff to the Mississippi River. Water bodies connected to waterways in the bottoms, such as Horseshoe Lake, are also part of the flood control system.

The three action plans attempt to improve water quality by reducing sedimentation, a major source of water quality impairment in the project area. Sediment reduction measures proposed in the tributary watersheds include relatively small in-stream sediment detention basins as well as activities to stabilize channel banks and bottoms, including the creation of riffle and pool complexes. Measures proposed in the bottoms are limited to relatively large sediment detention basins. All plans incorporate measures that have been designed to achieve a minimum 70 percent reduction in sediment transported downstream into restored habitat areas.

As displayed in Table 6-1, the Biological and Preferred Plans meet this objective to a greater degree than the Incremental Plan. About 78 percent of the tributary watershed area that drains into the bottoms would be restored by measures incorporated into the Biological and Preferred Plans. Implementation of stream restoration measures in the tributary watersheds would improve water quality of tributary streams and many surface waters in the bottoms. These plans would address water quality as a structural component of the ecosystem by altering physical habitat. Expected improvement of substrate conditions, in stream cover, and pool and riffle complexes would lead to increased aeration, lower turbidity levels, and lower water temperature. Measures to restore physical habitat would also ensure the protection of restored habitat resources on the floodplain in a more complete and sustainable way.

Under the Incremental Plan, tributary stream restoration measures are lacking in 79 miles of tributary streams that would continue to experience degradation and loss of habitat quality. In the bottoms, only those surface waters downstream of the floodplain sediment detention basins would receive improved water quality and then only by the elimination of sediments. While protecting restored floodplain resources from sediment, the Incremental Plan does not address other important water quality issues that are a component of restoring a more natural hydrologic regime. Sediments would have to be periodically removed from floodplain detention basins, thereby increasing the operation and maintenance efforts for the project.

Objective No. 5. Reduce Erosion. Under this objective, the three action plans were evaluated against the planning target of reducing by 70 percent the total amount of sediment entering the bottoms from the tributary watersheds. In Table 6-1, only the Biological and Preferred Plans are displayed as meeting this objective. The desire to reduce erosion stems from the desire to protect restored habitat areas on the floodplain from the debilitating effects of receiving large sediment loads that have no means of being transported out of these areas once deposited. The three plans perform differently with respect to this planning target. The Biological and Preferred Plans would implement measures that retain sediment in the tributary watersheds, whereas the Incremental Plan would allow sediment to continue to enter the bottoms, where it would be captured in floodplain sediment detention basins in all but one action area.

Although sediment reduction measures incorporated into the three plans are designed to achieve 70 percent efficiency, only the Biological and Preferred Plans would contribute to the achievement of Planning Objective 6, the restoration of stream resources.

Objective No. 6. Restore Tributary Streams. In Table 6-1, the Biological and Preferred Plans are depicted as meeting this objective, and the Incremental Plan as not meeting it. The planning target for this objective is improvement of physical stream habitat and function in as many tributary watersheds as possible. The Incremental Plan incorporates measures to improve tributary streams at only one action area. It is a one-dimensional plan at the remaining 4 action areas with a tributary stream connection and segments these floodplain ecosystems from their tributary watershed. The Biological and Preferred Plans include the same set of various measures to stabilize channel banks and bottoms and include the creation of riffle and pool complexes. About 77 percent of the tributary watershed area, or 178 miles of tributary streams that drain into the bottoms, would be restored by the Biological and Preferred Plans using measures to stabilize channel banks and bottoms and restore pool and riffle complexes.

Objective No. 7. Restore Floodplain Streams. For this objective, the planning target consists of two parts - recreation of four miles of flowing floodplain streams with associated riparian habitat, and establishment of three miles of riparian corridor linkages between existing or proposed habitats. These linkages are to center upon existing floodplain channels, and have a width of 100 meters on each side of the channel.

With regard to the first part of the target, the Biological and Preferred Plans would both achieve 10.4 miles or 260 percent of the restoration target (Table 6-1). The Incremental Plan would attain 9.7 miles or 242 percent of the target. Under all three action plans, a 100-meter wide riparian corridor would be established on both sides of restored stream channels wherever possible. Proposed channel restorations exceed the target under all plans because opportunities to restore channels within the habitat areas of floodplain action areas had not yet been recognized at the beginning of the planning process when targets were established. Once this opportunity became evident at one site, it was recognized at a number of other locations.

Pertaining to the second part of the target, riparian corridors linking habitat areas were included in the early formulation of alternatives at several action areas. Such action areas include Judy's-Burdicks, Brushy Lake, and Spring Lake. At these sites, potential upland-floodplain linkages were identified along existing channels leading away from the bluff, such as Burdick and Schoolhouse Branches and Harding Ditch. In these instances, existing upland forest habitats in the bluffs could be linked with existing or proposed habitats on the floodplain. Potential linkages of habitats within the floodplain were also identified within the Spring Lake action area, including a corridor along Harding Ditch "upstream" of I-255 and between Cell 1 and St. Clair Farms, and one along a new ditch connecting Cell 1 and Indian Lake. Corridor widths of 50, 75, and 100 meters on each side of existing waterways were considered.

In contrast to the ecological benefits of creating linkages in an urban environment where such linkages have largely disappeared due to development, the planning team, including the interagency team of biologists, identified socio-economic concerns associated with the establishment of linkages. For linkages between the bluff and floodplain, concerns include the increased potential for collisions between wildlife and motor vehicles on Illinois Route 157 (the highway along the base of the bluff), and the high potential for the footprint of proposed riparian corridors to impact existing agricultural lands that support production of the specialty crop, horse radish. The proposed widening of Route 157 by the Illinois Department of Transportation from two to four lanes would increase vehicle traffic and the potential for collisions with wildlife. Also, existing development lies within the footprint of all potential corridors, including those within the floodplain. Such development would either have to be relocated, or remain in place with the corridor going around it, which would lessen the corridor's effectiveness to wildlife.

Given these concerns, the concept of riparian corridors was dropped from further consideration at successive stages of evaluation. Corridors along Schoolhouse Branch at Brushy Lake, Harding Ditch at Spring Lake (in the vicinity of Caseyville and near I-255), and the new Fairmont City ditch at Spring Lake. Corridors were carried forward to intermediate stages of evaluation but were eventually deleted. For the three action plans, there is one proposed linkage totaling 0.2 miles, or 7 percent of the 3-mile target.

Objective No. 8a. Reduce Flood Damages. The three action plans do not differ in any substantial manner with regard to the incidental reduction of flood damages. All three plans are designed to restore a flood pulse to habitats in the bottoms using water available from the tributary streams. Under each plan, restored flood pulses would affect up to roughly 3,800 acres of habitats and as a result provide incidental flood damage reduction to surrounding urban and agricultural areas. No plan removes acres from the existing 100-year flood plain.

Objective No. 8b. Enhance Outdoor Recreation. For this objective, the measure of performance is the relative geographic extent of outdoor recreational opportunities that would be created as part of the project. Recreational opportunities include walking/hiking/exercise, outdoor education, nature study, photography, and fishing. All three action plans provide the same recreation opportunity, which is a proposed bike trail along the restored floodplain stream at the Cahokia Creek action area.

Objective No. 8c. Protect Cultural Resources. The measure of performance for this objective is the area of known archaeological sites that occur within the boundaries of all action areas for each plan. A geographical database of identified archaeological sites, maintained by the Illinois State Museum, permitted the determination of area of sites. All three action plans encompass over 1,000 acres of known sites (Table 6-1). The Biological Plan, which affects the most land of the three plans, encompasses the greatest area of sites. The Incremental and Preferred Plans envelop about 10 fewer acres of known archaeological sites.

Details about known archaeological sites at each action area, such as total number and total area are not provided in this report so as to not jeopardize their integrity. The fact that roughly one-quarter of the entire area enveloped by the three plans has been identified as an archaeological site attests to the high concentration of prehistoric cultural resources in the project area.

6.12.2 Evaluation using Cost Analysis.

While the Incremental Plan produces the lowest output of habitat unit, its first cost is significantly less than either the Biological or Preferred Plans (Table 6-6). The Biological Plan has the highest first cost of the plans but produces the highest habitat unit outputs (Table 6-7). The Preferred Plan consists of alternatives chosen by the biological team and study sponsors, as described in Section 6.11 above (Table 6-8). They represent least-cost alternatives, whether the cheapest least-cost alternative or more expensive alternative providing additional benefits. The Preferred Plan has a first cost slightly lower than the Biological Plan with lower habitat unit outputs and significantly higher first cost and habitat unit output as compared to the Incremental Plan. However, this plan includes the restoration of an additional 79 miles of tributary streams that was deemed to be an essential component of watershed level restoration. The linkage of restored floodplain habitat areas to streams produces improved habitat outputs, quality and sustainability. Table 6-9 provides a comparison of the Biological and Preferred Plan to the Incremental Plan for the purposes of displaying the incremental differences in outputs and costs between plans.

Table 6-6 Cost Analysis for Incremental Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2B-1-(0)-X	141	$377,000	$2,671	X		5.65
Brushy: 4C-3-0	782	$459,800	$588	X		6.95
Judy's: 3C-4-(0)	655	$379,500	$579	X		5.68
Cahokia: 8-1-(H)	849	$113,300	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7B-2	730	$234,700	$322	X		3.51
TOTAL	**7093**	**$7,056,975**	**$995**	**8**	2	**$105.68**

*After relative value indexing **Based on planning estimates

Table 6-7 Cost Analysis for Biological Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-X	87	$134,200	$1,539		X	2.0
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3-(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(VH)	915	$141,700	$155		X	2.05
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	**8399**	**$9,124,875**	**$1,086**	**2**	**8**	**$136.57**

* After relative value indexing **Based on planning estimates

Table 6-8 Cost Analysis for Preferred Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(H)	849	$113,200	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	**8332**	**$9,090,275**	**$1,091**	**4**	**4**	**$136.12**

*After relative value indexing **Based on planning estimates

Table 6-9 Summary of Cost Analysis of the Plans

Incremental Plan

Alternative	Total Output (AAHU)	Incremental Output (AAHU)	Total Annulaized Cost ($)	Incremental Annualized Cost ($)	Total Cost per AAHU	Incremental Cost per AAHU	ICA Winner	HEP Winner	Total Cost ($ millions)
Dobrey: 5A-Y	86		$128,100		$1,491		X		1.92
Elm: 6A-2	745		$389,500		$523		X	X	5.84
Cahokia: 2B-1-(0)-X	141		$377,000		$2,671		X		5.65
Brushy: 4C-3-0	782		$459,800		$588		X		6.95
Judy's: 3C-4-(0)	655		$379,500		$579		X		5.68
Cahokia: 8-1-(H)	849		$113,200		$133		X		1.68
Spring: 1B-3-X	3105		$4,975,075		$1,602		X	X	74.51
Mullens: 7B-2	730		$234,700		$322		X		3.15
TOTAL	**7,093**		**$7,056,875**		**$995**		**8**	**2**	**105.74**

Biological Plan as Increment above Incremental Plan

Alternative	Total Output (AAHU)	Incremental Output (AAHU)	Total Annulaized Cost ($)	Incremental Annualized Cost ($)	Total Cost per AAHU	Incremental Cost per AAHU	ICA Winner	HEP Winner	Total Cost ($ millions)	Incremental Increase in Total Cost ($ millions)	% Increase AAHU	% Increase Annualized Cost	% Increase Total Cost
Dobrey: 5A-X	87	1	$134,200	$6,100	$1,539	6100		X	2	0.08	1.16	4.76	4.17
Elm: 6A-2	745	0	$389,500	$0	$523	NA	X	X	5.84	0	0.00	0.00	0.00
Cahokia: 2A-1-(0)-X	238	97	$647,000	$270,000	$2,723	2783.51		X	9.69	4.04	68.79	71.62	71.50
Brushy: 4A-3-(0)	1047	265	$787,300	$327,500	$752	1235.85		X	11.79	4.84	33.89	71.23	69.64
Judy's: 3A-4-(0)	1350	695	$1,255,700	$876,200	$930	1260.72		X	18.8	13.12	106.11	230.88	230.99
Cahokia: 8-1-(VH)	915	66	$141,700	$28,500	$155	431.82		X	2.05	0.37	7.77	25.18	22.02
Spring: 1B-3-X	3105	0	$4,975,075	$0	$1,602	NA	X	X	74.51	0	0.00	0.00	0.00
Mullens: 7B-2	912	182	$794,400	$559,700	$871	3075.27		X	11.89	8.38	24.93	238.47	238.75
TOTAL	**8,399**	**1,306**	**$9,124,875**	**$2,068,000**	**$1,086**	**$1,583**	**2**	**8**	**136.57**	**30.83**	**18.41**	**29.30**	**29.16**

Table 6-9 -Continued

Preferred Plan as increment above the Incremental Plan

Alternative	Total Output (AAHU)	Incremental Output (AAHU)	Total Annulaized Cost ($)	Incremental Annualized Cost ($)	Total Cost per AAHU	Incremental Cost per AAHU	ICA Winner	HEP Winner	Total Cost ($ millions)	Incremental Increase in Total Cost ($ millions)	% Increase AAHU	% Increase Annualized Cost	% Increase Total Cost
Dobrey: 5A-Y	86	0	$128,100	$0	1491	NA	X		1.92	0	0.00	0.00	0.00
Elm: 6A-2	745	0	$389,500	$0	523	NA	X	X	5.84	0	0.00	0.00	0.00
Cahokia: 2A-1-(0)-X	238	97	$647,000	$270,000	2723	2784	X		9.69	4.04	68.79	71.62	71.50
Brushy: 4A-3-0	1047	265	$787,300	$327,500	752	1236	X		11.79	4.84	33.89	71.23	69.64
Judy's: 3A-4-(0)	1350	695	$1,255,700	$876,200	930	1261	X		18.8	13.12	106.11	230.88	230.99
Cahokia: 8-1-(H)	849	0	$113,200	$0	133	NA	X		1.68	0	0.00	0.00	0.00
Spring: 1B-3-X	3105	0	$4,975,075	$0	1602	NA	X	X	74.51	0	0.00	0.00	0.00
Mullens: 7A-2	912	182	$794,400	$559,700	$871	3075			11.89	8.38	24.93	238.47	238.75
TOTAL	**8,332**	**1,239**	**$9,090,275**	**$2,033,400**	**$1,091**	**$1,641**	**8**	**2**	**136.12**	**30.38**	**17.47**	**28.81**	**28.73**

Comparison of the plans shows the preferred plan to be acceptable with the increase in incremental output of 1,239 AAHU at an incremental cost of $1,641per AAHU. This plan includes the restoration of an additional 79 miles of tributary streams that provide a significant improvement in ecosystem outputs over the incremental plan.

6.12.3 Evaluation using Qualitative Criteria

In addition to effectiveness and cost comparisons, the Biological, Incremental, and Preferred Plans have been assessed using other criteria of a qualitative nature. They include acceptability, completeness, efficiency, partnership context, and reasonableness of costs. As stated above in the section on effectiveness, the Biological and Preferred Plans are more effective than the Incremental Plan in achieving the planning objectives.

Acceptability. The Preferred Plan is acceptable to state and federal resource agencies that were partners in this study, including the Illinois Department of Natural Resources, U.S. Fish and Wildlife Service, Natural Resources Conservation Service, and U.S. Environmental Protection Agency. However, the Incremental Plan is not acceptable to these agencies because it does not reflect a watershed approach to ecosystem restoration problems and opportunities. Although the Biological Plan does take a watershed approach, it is less acceptable than the Preferred Plan because several of its constituent alternatives are not the favorites of these agencies.

Completeness. All three plans provide and account for all necessary investments needed to ensure the realization of the planned restoration outputs. The Biological and Preferred Plans involve uncertainty concerning the functioning of one of the measures proposed for tributary stream restoration, whereas the Incremental Plan does not. It is unknown whether the proposed tributary sediment detention basins will attain a sediment trapping efficiency of 70 percent, as estimated by the Natural Resources Conservation Service. The Preferred and Biological Plans include an adaptive management plan to account for this uncertainty. A pilot program would be implemented in one small tributary watershed, and several tributary sediment detention basins would be constructed to monitor their efficiency. As part of this pilot program, the U.S. Geological Survey is currently monitoring baseline conditions of sediment transport through the tributary stream system within the Judy's Branch watershed.

Efficiency. The cost comparison analysis has determined that the Incremental Plan and Preferred Plan both represent cost effective means to address the study area's restoration problems and opportunities. The Biological Plan is not cost effective. The Preferred Plan provides an additional cost-effective increment of restoration output that the Incremental Plan does not, specifically the restoration of about 79 miles of tributary streams. Although the Natural Resources Conservation Service previously addressed small watershed restoration opportunities in the study area, it was unable to recommend a plan. No other agency or institution is able to produce the proposed restoration outputs in a more cost effective manner.

Partnership Context. One state and three federal natural resource agencies have partnered on this project in an effort to formulate and select a plan that was feasible from an implementation standpoint and met a broad spectrum of resource needs in this significant urban area. From the outset the desire to focus on watershed solutions within the context of agency authorities has been a primary goal. The Corps role in aquatic resource restoration along with our engineering capabilities to provide solutions to the underlying hydrologic problems of the project area has been key to plan formulation.

Each resource agency has voiced their desire that problems be addressed from a cause and effect perspective to the greatest extent practicable with the recommended measures being taken as close to the source of the problem as possible. The tributary stream system is a major area of concern for these agencies. To address this concern, the Corps ecosystem restoration approach of focusing on aquatic resources and their hydrologic processes within the watershed led to the solutions embodied in the Preferred and Biological Plan.

Reasonableness of Costs. As stated in ER1105-2-210, "The willingness of a non-Federal sponsor to share study and project costs and the general concurrence of the State and Federal resource agencies and environmental community are strong indicators of the reasonableness and worthiness of the recommended actions." While the planning level cost of the Preferred Plan (about $136 million) is about $30 million more than that of the Incremental Plan (about $105 million), the support from a broad base of experts has provided a strong indication that the Preferred Plan remains to be reasonable and worthy of action.

6.13 PLAN FORMULATION CONCLUSIONS

Of the three plans, the Preferred Plan is more effective in achieving the planning objectives. It is efficient because it consists of only "best buy" alternatives. The Preferred Plan is acceptable to state and federal resource agencies. It provides and accounts for all necessary investments needed to ensure the realization of the planned restoration outputs. Four state and federal agencies that partnered with the Corps during the study have indicated that the Preferred Plan best meets their desires and concerns. The plan is reasonable because non-Federal sponsors are willing to share study and project costs, and state and federal resource agencies support it. The Preferred Plan would provide significant restoration benefits to aquatic resources of national and regional institutional significance.

Based on these conclusions, the Preferred Plan is justified for selection as the Recommended Plan. Environmental consequences of this plan are discussed in Section 7, and details of this plan are further discussed and described in Section 8 - The Recommended Plan.

SECTION 7 – ENVIRONMENTAL CONSEQUENCES

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SECTION 7 ENVIRONMENTAL CONSEQUENCES

7.1 LAND COVER

Within the footprint of the recommended action areas, about 1,900 acres of forests, prairies, marshes and scrub-shrub wetlands, lakes and ponds, and streams would be protected, and approximately 2,800 additional acres created, for a total of about 4,700 acres. The loss of cultural natural communities, chiefly cropland, accounts for most of these gains. Further details concerning changes in cover types of natural communities within the footprint of the action areas are provided in Section 7.11. Figure 7-1 displays the boundaries of the recommended action areas with respect to land cover from the early 1990s.

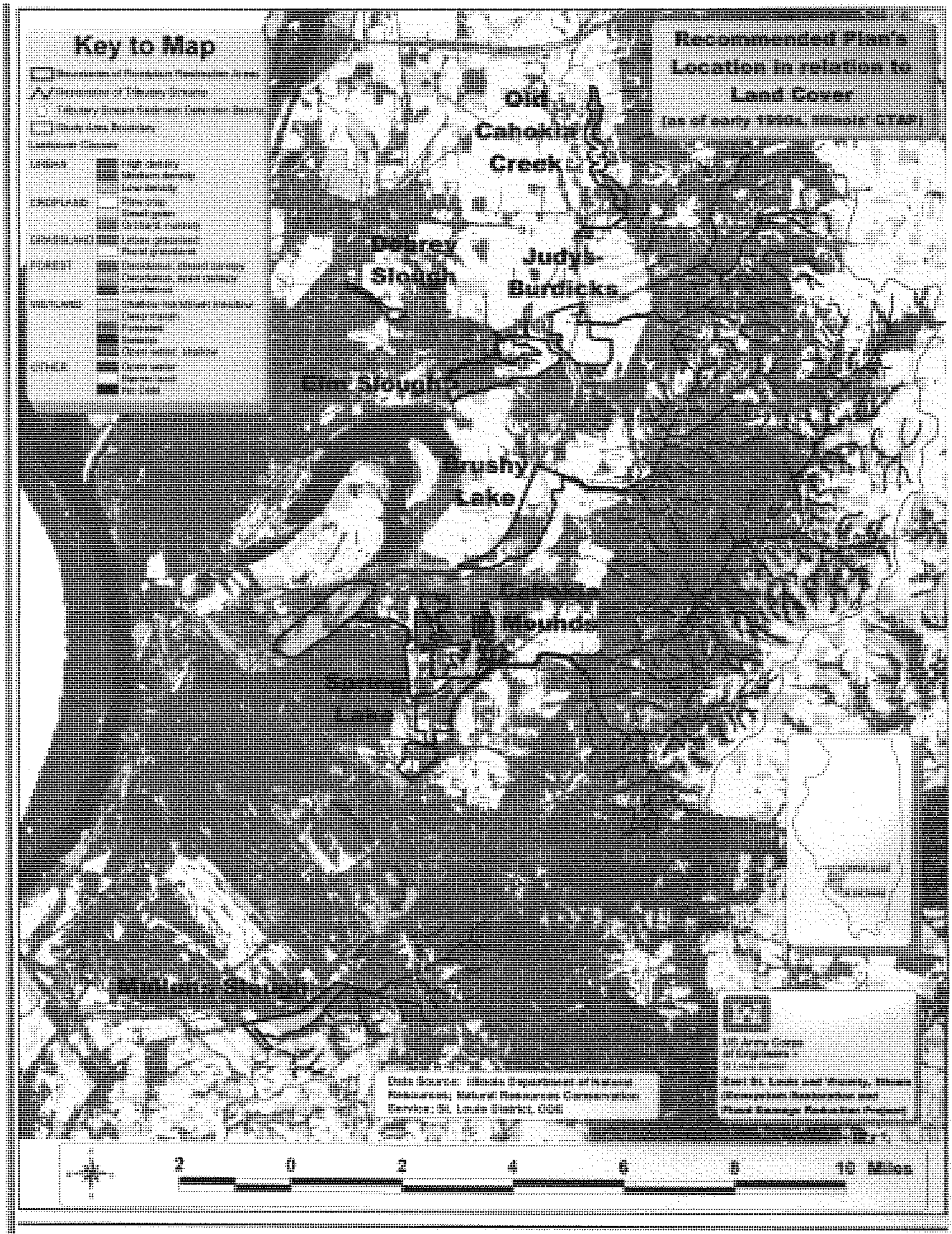

Figure 7-1 Recent Land Cover - Recommended Plan

7.2 LAND USE AND SOCIO-ECONOMIC IMPACTS

7.2.1 Agricultural Use. In this section, expected changes in agricultural use in the study area due to implementation of the recommended plan are described in terms of the amount of cropland affected, direct and indirect conversions of farmland, the suitability of affected soils, and the amount of horseradish lands affected. The results of interagency coordination on farmland impacts are also described.

7.2.1.1 Existing Cropland Affected. Less than one-third of the proposed Project area consists of existing cropland (1,651 acres, or about 31 percent). Proposed features in the tributary streams are not expected to affect farmland. Affected cropland occurs on the floodplain at seven of the eight proposed action areas: Judy's-Burdicks (460 acres), Elm Slough (380 acres), Brushy Lake (357 acres), Spring Lake (187 acres), Old Cahokia Creek (184 acres), Dobrey Slough (52 acres), and Mullens Slough (31 acres). This farmland would be replaced by natural habitats to be created by the proposed plan. In addition to the existing cropland, about 525 acres of lands leased for hay production at Cahokia Mounds State Historic Site would be restored to prairie.

Affected cropland is estimated to represent about 8 percent of all farmland found in the floodplain portion of the study area, or about 10 percent if the hay lease areas are included. This estimate assumes that total farmland in the floodplain portion of the study area is about 37 percent of current land cover, as reflected by the Illinois Land Cover Database (Table 3-3), which represents conditions from the early 1990s.

7.2.1.2 Direct and Indirect Conversions of Farmland. Proposed Federal actions need to be assessed for their potential to convert existing or potential farmland to nonagricultural use. Implementation of the proposed plan would directly convert about 3,874 acres of existing or potential farmland through the act of acquiring private lands for public use. This area of direct conversion was obtained by subtracting known publicly owned lands in the area of the proposed plan (1,373 acres) from the footprint of the proposed plan (4,916 acres). Portions of the Judy's-Burdick, Brushy Lake, Spring Lake, and Mullens Slough action areas include publicly owned lands.

An indirect conversion of about 27 acres has been identified at the Judy's-Burdick action area. Implementation of this action area would create an uneconomical remnant on the floodplain between the west side of the proposed habitat area and I-255. Within the Old Cahokia Creek action area, one or more crossings over the restored creek channel would be constructed to maintain equipment access to existing agricultural areas. No other indirect conversions have been identified, including in the uplands.

The sum of direct and indirect conversions is 3,901 acres. About 42 percent (1,651 acres) of this total consists of existing cropland. The remaining 58 percent (2,250 acres) represents potential cropland, and consists of existing natural habitats, such as wooded areas, marshes, and old fields.

7.2.1.3 Suitability of Affected Soils. With respect to the suitability of soils for the production of crops, about 53 percent of the footprint of the proposed plan would affect undeveloped soils that are not classified as prime by the Natural Resources Conservation Service (Table7-1). These classifications relate to the soils potential to produce crops. About 22 percent of the affected area consists of soils from the three conditionally prime categories. Developed soils and water comprise over 14 percent of the area affected by the proposed plan. Almost 12 percent is comprised of prime soils. About 91 percent of all affected areas are on the floodplain. Figure 7-2 displays boundaries of the recommended action areas in relation to prime farmland status.

Table 7-1 Prime farmland status of soils in the recommended action areas, by landform.

Prime Farmland Status	Floodplain		Upland		Study Area	
	Area (acres)	% Area	Area (acres)	% Area	Area (acres)	% Area
All areas are prime	590.3	12.0	18.7	0.4	609.1	12.4
Only drained areas are prime	396.2	8.1	3.6	0.1	399.9	8.1
Only areas protected from flooding or not frequently flooded during the growing season are prime	152.5	3.1	53.1	1.1	205.5	4.2
Only drained areas that are either protected from flooding or not frequently flooded during the growing season are prime	422.4	8.6	70.6	1.4	493.2	10.0
Not Prime – Undeveloped	2,460.9	50.1	296.9	9.0	2,757.8	56.1
Not Prime – Developed	90.1	1.8	3.7	0.1	93.8	1.9
Not Prime – Water	356.2	7.2	0.8	0.0	357.0	7.3
TOTAL	**4,468.7**	**90.9**	**447.4**	**9.1**	**4,916.1**	**100.0**

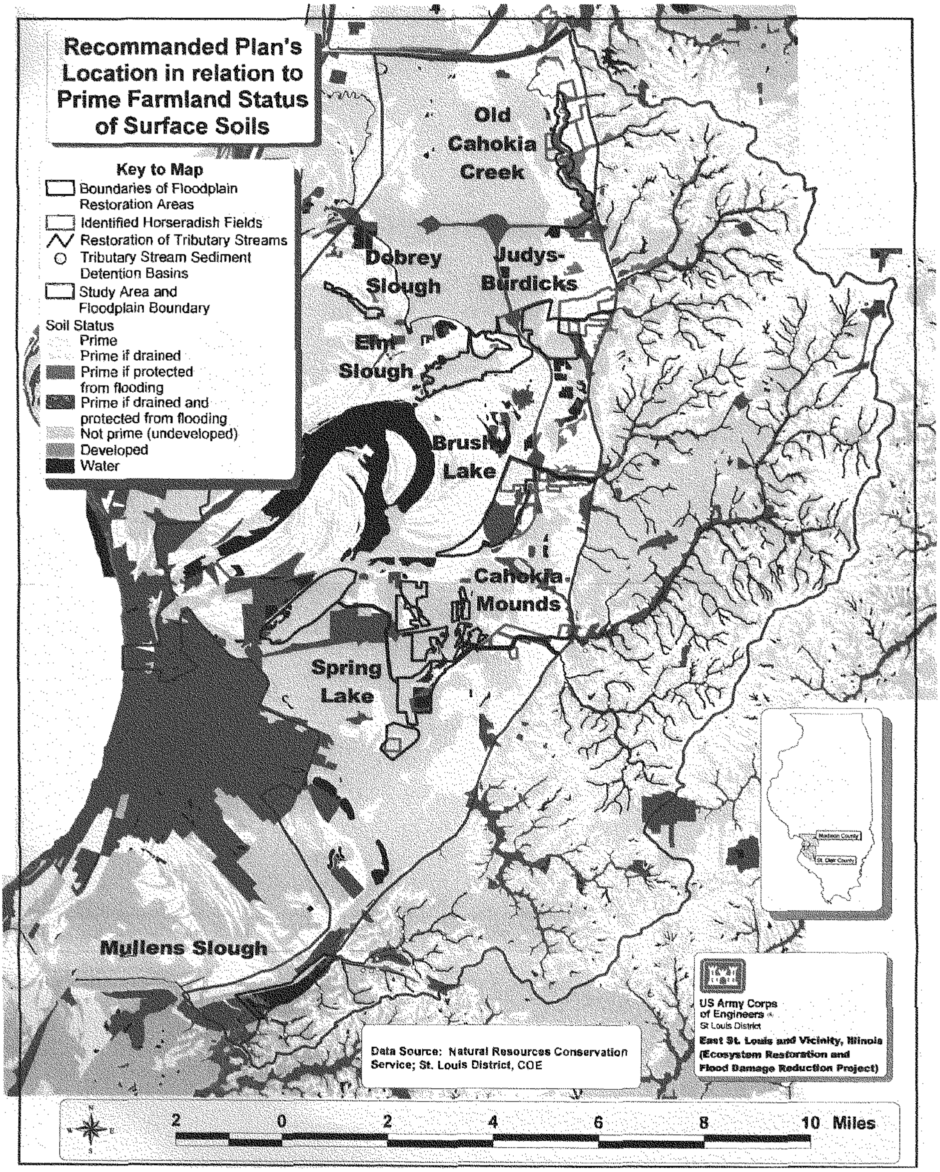

Figure 7-2 Prime Farmland Status of Surface Soils - Recommended Plan

7.2.1.4 Horseradish Affected. The selected plan would result in the loss of 309 acres of horseradish lands. Among proposed action areas, losses would occur at Brushy Lake (176 acres), Old Cahokia Creek (71 acres), Spring Lake (50 acres), and Judy's-Burdick (12 acres). Horseradish producers have examined all proposed action areas to ensure that all horseradish fields have been identified. Figure 7-2 displays boundaries of the recommended action areas in relation to identified horseradish fields.

At Brushy Lake, most of the affected fields are located at the north end of the floodplain environmental area (south of Horseshoe Lake Road and west of I-255), but a small amount occurs along Schoolhouse Branch where the existing channel would be widened.

At Old Cahokia Creek, losses of horseradish fields would occur toward the north end of the floodplain environmental area, where the 100-meter wide forested corridor on each side of the restored historic creek channel would extend into adjacent fields.

At Spring Lake, most of the affected horseradish land lies within the St. Clair Farms component of the floodplain environmental area. The rest of the affected area at Spring Lake consists of fields adjacent to Harding Ditch, which would be widened, and at the site of the proposed bypass channel to carry flows from Canteen Creek to Harding Ditch.

At Judy's-Burdick, most of the losses would occur along the southeast edge of the floodplain environmental area, where existing horseradish fields are found. Smaller losses would occur along Burdick Branch to allow for construction of an earthen berm along the south side of the existing channel.

Like the 1,537 acres of horseradish soils identified within the study area, the soils occurring within these 309 acres are also variable with respect to their prime farmland status as designated by the Natural Resources Conservation Service. In the affected area, 28 percent is considered prime, 48 percent is prime if drained, 3 percent is prime if protected from flooding or not frequently flooded during the growing season, 4 percent is prime if drained and protected from flooding or not frequently flooded during the growing season, and 17 percent is not prime. Compared to the 1,537-acre horseradish base, the affected area would be expected to be less productive on a per acre basis because it contains proportionally fewer prime soils and more soils that are not prime. A listing of the 27 different soils found in the affected area is provided in Table B.4 in Appendix B.

If 5,000 acres of horseradish lands are assumed to exist within the American Bottom, then the estimated loss of 309 acres represents about 6.2 percent of the total. Considering that the actual area of existing horseradish lands is unknown but is estimated to fall between 4,500 to 5,400 acres, then the overall loss resulting from the selected plan lies between 5.7 and 6.9 percent. This extent of loss is somewhat above the planning constraint of 5 percent (Section 6.2.3).

7.2.1.5 Interagency Coordination. To determine potential impacts to agricultural land and initiate compliance with the federal Farmland Preservation Act and Illinois Farmland Preservation Act, the proposed plan was forwarded to the Natural Resources Conservation Service (NRCS) and Illinois Department of Agriculture (IDOA) by the St. Louis District, in a letter dated July 11, 2001. Form AD-1006, Farmland Conversion Impact Rating, and supporting information accompanied this letter. In letter dated December 17, 2001, the Illinois Department of Agriculture responded to the St. Louis District with a farmland conversion impact rating of 121 of 300 possible points. This value was obtained by combining the relative value of the affected farmland (51 of 100 maximum points) with the Illinois Land Evaluation and Site Assessment (70 of 200 maximum points). Alternatives scoring 175 or fewer points have a low rating for farmland protection, those from 176 to 225 points a moderate rating for protection, and those above 225 points should be kept in agricultural use. The responses from NRCS and IDOA are included in the public involvement appendix (Appendix G).

The recommended plan has been assessed to have a low rating for farmland protection. It would not create any significant adverse effect on agricultural lands, including farmland used for horseradish production.

7.2.2 Socio-economic.

7.2.2.1 Political Boundaries of Recommended Plan. With regard to political boundaries, five of the eight recommended action areas are located entirely in Madison County, two lie completely in St. Clair County, and one straddles both counties (Table 7-2). In Madison County, action areas occur in four townships – Edwardsville, Nameoki, Collinsville, and Jarvis. In St. Clair County, there are three affected townships – Canteen, Caseyville, and Stookey. Fourteen municipalities are enveloped, as well as various unincorporated areas. Figure 7-3 displays affected municipalities, and Figure 7-4 shows affected townships.

Table 7-2 Location of all recommended action areas according to landform, county, municipality, and township.

Action Area	Landform	County	Municipality	Township
Old Cahokia Creek	Bottoms	Madison	Edwardsville, Glen Carbon, unincorporated	Edwardsville
	Upland	Madison	Edwardsville, Glen Carbon, unincorporated	Edwardsville
Dobrey Slough	Bottoms	Madison	Granite City, unincorporated	Nameoki
Judy's-Burdick	Bottoms	Madison	Pontoon Beach, unincorporated	Collinsville
	Upland	Madison	Edwardsville, Glen Carbon, Maryville, unincorporated	Edwardsville, Collinsville

Table 7-2 Continued

<table>
<tr><th>Action Area</th><th>Landform</th><th>County</th><th>Municipality</th><th>Township</th></tr>
<tr><td>Elm Slough</td><td>Bottoms</td><td>Madison</td><td>Pontoon Beach, unincorporated</td><td>Nameoki, Collinsville</td></tr>
<tr><td rowspan="2">Brushy Lake</td><td>Bottoms</td><td>Madison</td><td>Pontoon Beach, Collinsville, unincorporated</td><td>Nameoki, Collinsville</td></tr>
<tr><td>Upland</td><td>Madison</td><td>Collinsville, Maryville, unincorporated</td><td>Collinsville</td></tr>
<tr><td>Cahokia Mounds</td><td>Bottoms</td><td>St. Clair</td><td>unincorporated, Caseyville</td><td>Canteen</td></tr>
<tr><td rowspan="2">Spring Lake</td><td>Bottoms</td><td>Madison, St. Clair</td><td>Caseyville, Washington Park, Fairmont City, unincorporated</td><td>Nameoki, Canteen, Caseyville</td></tr>
<tr><td>Upland</td><td>Madison, St. Clair</td><td>Collinsville, Troy, Caseyville, Fairview Heights, unincorporated</td><td>Collinsville, Jarvis, Caseyville</td></tr>
<tr><td rowspan="2">Mullens Slough</td><td>Bottoms</td><td>St. Clair</td><td>Cahokia, unincorporated</td><td>Stookey</td></tr>
<tr><td>Upland</td><td>St. Clair</td><td>unincorporated, Belleville</td><td>Stookey</td></tr>
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Figure 7-3 Recommended Plan's Relation to Municipalities

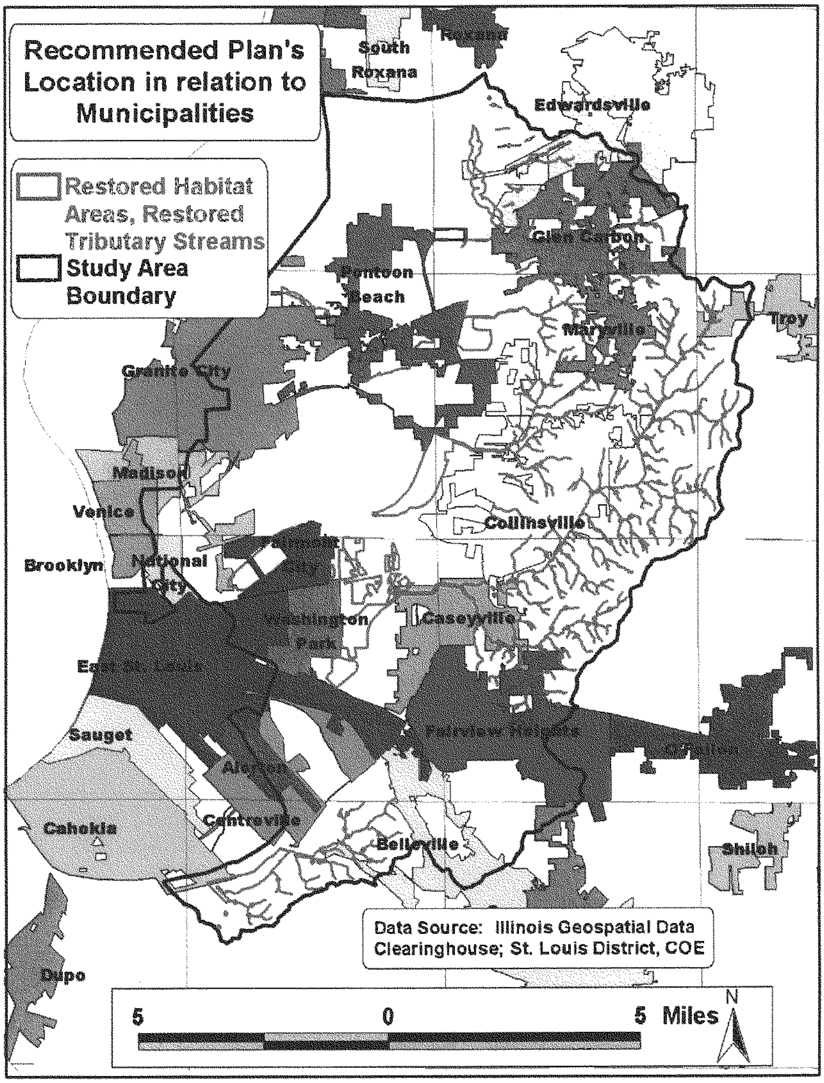
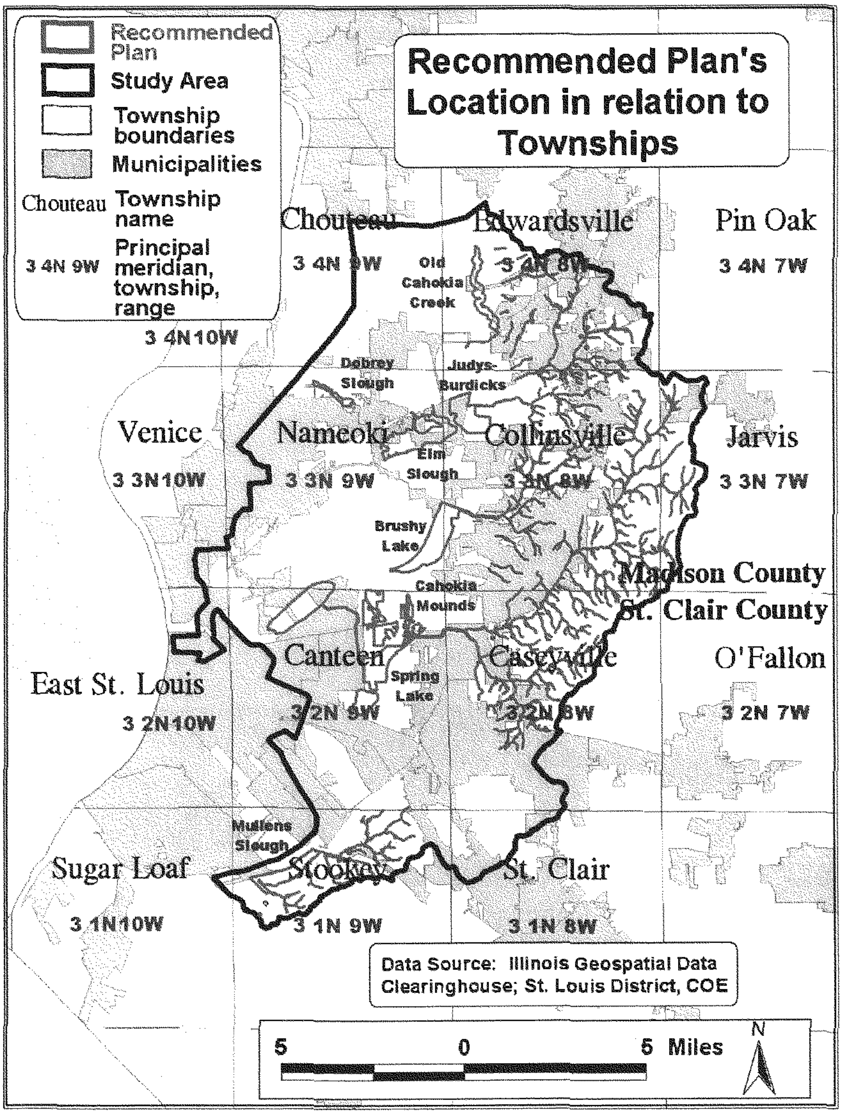


Figure 7-4 Recommended Plan's Relation to Townships



7.2.2.2 Economic Implications. While no areas are removed from the 100-year floodplain, incidental flood damage reduction benefits are realized from implementation of the plans evaluated. In order to quantify these ecosystem services to society a traditional risk based flood damage reduction assessment was completed for the recommended plan. The following details this analysis completed by the Vicksburg District and its results.

7.2.2.2.1 East St. Louis, Missouri, Project Area Flood Damage Analysis Report Introduction. This presents information pertaining to the economic evaluation of proposed water resource improvements in the East St. Louis, Illinois, urban area. The focus of the evaluation was to identify existing flood problems and the potential for implementing local flood protection measures. The discussion includes current flood damage impacts and flood damages prevented with an improvement plan in place.

Information and computations presented describe the methodology used in determining existing flood damages and benefits for with-project conditions. Existing project conditions reflect year 2000 conditions and all values are expressed in October 2000 price levels.

Expected flood damages for existing conditions and with proposed flood control measures in place were estimated utilizing risk and uncertainty guidance in EC 1105-2-205, Risk Analysis Framework for Evaluation of Hydrology/Hydraulics and Economics in Flood Damage Reduction Studies dated 25 February 1994. The specific purpose of this portion of the analysis was to quantify, to the extent possible, any uncertainties inherent in the flood damage evaluation that would aid in making a decision to invest in a flood protection project in the East St. Louis area.

7.2.2.2.2 Flood Damage Analyses. The economic evaluation of flood damages in the East St. Louis Project area included the comparison of the flood damage setting for "without-project" and "with-project" conditions. Without-project conditions, or existing conditions, reflect conditions expected to prevail in the absence of any alternative plan of improvement. With-project conditions reflect conditions in the Project area with a proposed flood control improvement in place.

To quantify the risk and uncertainty with this analysis, risk-based techniques were integrated into the Hydrologic Engineering Center Next Generation Flood Damage Analysis (HEC-FDA) computer program in the calculation of urban flood damages. Results of these analyses were used to identify and evaluate possible flood reduction measures according to the likelihood and variability of their effectiveness, implementability, and feasibility.

7.2.2.2.3 Project Area. This feasibility study is concentrated on identifying the major impacts from flooding in the East St. Louis area from Cahokia Canal and Harding Canal No.1. Based on flood damages incurred in recent years, the Project area was limited to the urban area impacted by flooding from these two channels. It is confined to the area that would be affected by the construction of water resource improvements.

The East St. Louis Project area is located in Madison and St. Clair Counties in the south-central portion of the State of Illinois, approximately 10 miles east of the city of St. Louis. The topography of the Project area is characterized by predominantly level to gently sloping land with over 2,300 structures susceptible to flooding.

7.2.2.2.4 Existing Data Collection. In the initiation of flood damage analyses, field investigations were conducted to determine the extent and character of flooding in the East St. Louis Project area. Comprehensive surveys were used to identify the type, number, elevation, and location of properties impacted by flooding. Land use information was also collected to assess the extent of flood impacts to agricultural production and data was assembled to determine the appropriate hydrologic conditions of the Project area. All of this information was correlated with flood frequency distributions and pertinent depth-damage, stage-area, and stage-damage data to estimate the extent of flood damages in the area. Preliminary evaluations indicated potential impacts to urban structures, automobiles, and agricultural properties within the area and confirmed the need for more detailed flood damage analyses.

Due to the incorporation of the new risk-based HEC-FDA program and unfamiliar applications, data from a similar area was utilized in the evaluation of contents values and depth-damage relationships. Based on the similar socioeconomic characteristics, data used in the risk evaluation of the Morganza to Gulf, Louisiana, Feasibility Study were deemed appropriate for use in the East St. Louis risk evaluation. The final report, dated May 1997, is entitled Depth-Damage Relationships for Structures, Contents, and Vehicles and Content to Structure Value Ratios (CSVRs) in Support of the Lower Atchafalaya Reevaluation and Morganza to the Gulf, Louisiana Feasibility Studies. It also provides risk-based information on expected values and standard deviations for selected residential and non-residential properties in its Project area.

7.2.2.2.5 Structural Surveys. A comprehensive field survey was conducted in June 2000 to identify each urban structure at risk in the affected area. Structure types and elevations were determined by an inventory of the study area, as well as local tax records and information provided by Madison and St. Claire Counties, Illinois.

Information gathered on each structure consisted of structure type, first floor elevation, type of construction and foundation, number of stories, structure dimensions, physical condition of the structure, and the location. Structures were differentiated by three damage categories – commercial, residential and farm. Each damage category was further broken down by occupancy type, however, due to the study area being primarily residential only those occupancy types for the residential damage category are presented in this analysis.

Results of the structural inventory prepared for the East St. Louis Project area are displayed in Table 7-3 by damage category and average structure value. In June 2000, there were 2,380 total structures located within the alignment of the East St. Louis Project area, including 2,325 residential, 36 commercial, and 19 farm properties.

Table 7-3 Average Structure Value by Structure Type, East St. Louis Project Area(October 2000 Price Levels)

DAMAGE CATEGORY	STRUCTURES (#)	AVERAGE STRUCTURE VALUE ($)
Residential	2,325	24,100
One-Story	1490	26,100
Two-Story	30	24,300
Mobile Home	805	16,800
Commercial	36	238,300
Farm	19	12,300
Total	**2,380**	**26,050**

7.2.2.2.6 Structure and Contents Valuation. Structure and contents values are major elements influencing the impact of depth-damage relationships and magnitude of flood damages to urban structures. For the purposes of estimating urban flood damages, a structure is defined as a building and any attached components, such as built-in appliances, shelves, carpeting, etc. The value of land is excluded in the determination of urban structure values. Contents represent furnishings and equipment, or all items within the structure that are not permanently attached.

Structural values for the East St. Louis Project area were estimated utilizing data provided by the tax assessor's offices of Madison and St. Claire Counties, Illinois, in July 2000. These values have been adjusted to reflect depreciated replacement values, which have been determined to be the correct measure of structure values for flood damage analyses. Pertinent structure values, including residential and nonresidential types, were applied to each affected structure within the alignment of the East St. Louis Project area.

In determining flood damages to contents within urban structures, contents are expressed as a percentage the structural value. For this analysis, contents values surveyed for the Morganza to the Gulf Study, New Orleans District, were utilized. New Orleans District personnel conducted on-site interviews for the computation of content-to-structure value ratios (CSVR) for each structure.

Structure Elevation
The first-floor elevation of each structure is utilized to determine the expected flood depths for each structure for each set of hydrologic conditions. Structure elevations for the East St. Louis Project area were derived from 2-foot contour blue-line aerial photography.

Depth-Damage Relationships
In quantifying the extent of flooding that occurs in an area, depth-damage curves are utilized. Depth-damage relationships, provided by the St. Louis District, for the Monarch-Chesterfield Study were used. These curves were deemed appropriate based on the proximity of the two projects and the similarities in the flooding and construction practices between the two areas. The depth-damage curves used in the Monarch-Chesterfield Study are St. Louis District depth-damage curves. They were primarily derived based on area depth-damage surveys from historical area floods. These curves depict a damage factor by flood depth and are differentiated by structure types, structure value, and type of flooding.

Hydrologic Data
Hydrologic data from historic flooding records were collected to develop hydrologic profiles, or water-surface elevations, for predetermined flood event at various points within the impacted area. These data were correlated with each frequency of flood occurrence to develop stage-frequency curves which were aligned with the appropriate structural data in determining susceptibility to flooding. Flooding depth data for each property were then integrated with depth-damage relationships to calculate the flood damages incurred by stage and frequency.

In assessing flood damages to agricultural properties, additional flood characteristics, such as duration, frequency, and time of year of flooding, were utilized in determining acres subjected to flooding. These were then correlated with agricultural land use and crop yield/distribution/ budget data to assess flood damages to agricultural production.

Agricultural Data
Basic land use information was collected for the Project area to identify potential agricultural properties impacted by flooding. The study area is comprised mostly of corn, soybeans and horseradish. However, due to the hydrologic conditions associated with the terrain, the agricultural areas drain very swiftly. The rainwater does not pond, thus stage-area and -duration are not of much consequence in regard to total flood damages. Based on the minimal impacts to cropland in the East St. Louis Project area, it was determined that no substantial damages or benefits would be gained through agricultural damage evaluation. Therefore, this category was dropped from further consideration.

7.2.2.2.7 Damage Categories.

Structures
In determining the number of structures flooded in the East St. Louis Project area, the HEC-FDA program, developed by the Hydrologic Engineering Center (HEC), was utilized. Within the program, eight different types of urban structures were evaluated using hydrologic profile data, structure alignments, first floor elevations, depth-damage relationships, and structure values to compute the depth of flooding, number of structures impacted, and damages by structure type and frequency flood event. Table 7-4 displays the number of structures damaged by flood frequency in the East St. Louis Project area.

Table 7-4 Total Number of Structures Flooded by Frequency a/, for Existing Conditions in the East St. Louis Project area

Flood FrequencyEvent (freq/yr)	Existing Number of Structures Flooded By Frequency By Structure Type			
	Residential	Nonresidential		Total
		Commercial	Farm	
2	71	0	7	78
5	139	1	7	147
10	391	10	7	498
25	496	18	12	526
50	848	19	12	879
100	1,063	20	12	1,095
500	1,482	23	12	1,517

a/ Total numbers are cumulative.

Results of feasibility flood damage analyses estimated that a total of 1,517 structures would experience damage during maximum flooding events and major flooding would begin to occur at the 2-year frequency flood event. Residential structures comprised the majority of the total structures flooded, comprising 98 percent. These results reflect the application of frequency flood events that have occurred in recent storms in an attempt to duplicate the extent of damages known to have occurred in the East St. Louis area.

To address the uncertainties associated with urban flood damage analyses, the existing structural database was integrated into the economic stage-damage section of the HEC-FDA program in developing stage-damage relationships applicable to the East St. Louis Project area. This portion of the program provides results of the flood damage analysis of an area for existing conditions in terms of existing damages by frequency and stage, including their corresponding uncertainties (or standard deviations).

Automobiles

The analysis of automobile damages involved determining the number of automobiles (units) impacted and the application of this data to a damage per unit value. To estimate the number of automobiles that were impacted by each frequency flood event, the average number of automobiles per household in the East St. Louis area was applied to the number of residences flooded by flood frequency. These values were applied to an average damage per automobile to derive overall damages.

The average damage per automobile used in the East St. Louis analysis was based on the average value of a used car. This value was estimated to be $10,750. For the uncertainty analysis done in the HEC-FDA program, the maximum value of an automobile was estimated to be $16,800, based on the average value of a new car before taxes, license, and shipping charges. The minimum value was estimated at $2,000, the average 10-year depreciation value of an automobile in the East St. Louis Project area.

To incorporate risk and uncertainty, the existing automobile database was entered into the economic stage-damage section of the HEC-FDA program to address the uncertainties associated with automobile damages in the East St. Louis Project area. Results included existing automobile damages by frequency and stage, including their corresponding uncertainties.

7.2.2.2.8 Risk And Uncertainty. Even though every attempt is made to ensure accuracy, a degree of uncertainty is implicit in many areas of planning for water resource projects. The uncertainty arises due to error in the data being measured or errors inherent in the methods used to estimate the values of certain critical variables. The potential for error exists throughout the traditional analysis because each of the variables has been assigned a single point value rather than a range of values. In order to compensate for possible error, risk-based analysis can be applied to the planning and design of water resource projects. This approach, which quantifies the extent of systematic risk, provides the decision-maker with a broader range of information. Thus, a decision can be made that reflects the explicit tradeoff between risks and costs.

The Risk-Based Approach

Based on risk and uncertainty procedures outlined in EC 1105-2-205, the HEC-FDA program was utilized in the analysis of urban flood damages in the East St. Louis Project area. The program not only analyzes the reliability and effectiveness of various project improvements, but also accounts for uncertainties associated with various economic and hydrologic parameters, such as structure and content values, structure elevations, depth-damage relationships, and stage-frequency data. The traditional concept of integrating flood depths, frequency, and damage data is still utilized in the determination of flood damages, except, with the risk approach, uncertainty is explicitly quantified.

With the risk-based approach, we can now analytically and mathematically handle the risk and uncertainty which was previously difficult. Sometimes the "true" values of key planning and design variables and parameters are not known with total certainty and are thus assigned a range of potential values. The likelihood of a parameter taking on a particular value can be best described by a probability distribution. Probability distribution may be described by its own parameters, such as mean and variance for a normal distribution, or minimum, maximum, and most likely for a triangular distribution. The risk-based approach to project formulation combines the risk and uncertainty methodology with statistical analysis so that the engineering and economic performance and associated reliability of a project may be expressed in the form of probabilities.

The Risk-Based Damage Analysis

The HEC-FDA program used in the economic evaluation of flood problems in the East St. Louis Project area incorporates two different analyses into one program -- economic stage-damage and hydrologic project analyses. The economic stage-damage portion of the program develops a stage-damage relationship and corresponding uncertainty for the existing hydrologic conditions. The hydrologic portion integrates stage-damage and -frequency relationships for various project improvements and determines average annual expected flood damages for existing and with-project conditions.

7.2.2.2.9 The Stage-Damage Analysis. The HEC-FDA program utilizes a simulation technique to incorporate risk and uncertainty into the calculation of flood damages for specified flood events. Multiple iterations were performed to select or sample from a full range of possible values for each variable identified as a source of uncertainty (e.g., structure values, contents values, first floor elevations, depth-damage relationships, stage-frequency, period of record, etc.). This routine was accomplished simultaneously for each economic and hydrologic variable.

HEC-FDA output results in a mean, or expected damage value, and probability distributions, which reflect a comprehensive picture of all possible outcomes of a flood damage scenario. The resulting stage-damage relationship and corresponding uncertainty are then integrated with the stage-frequency relationship and its corresponding uncertainty to determine the expected without- and with-project flood damages.

The HEC-FDA program involves the following input or output parameters:

Range of Values
The analysis is accomplished by considering the range of possible values (maximum and minimum values for each input variable in the flood damage calculation) and distribution of the likely occurrence of outcomes over a specified range. In the East St. Louis Study, a maximum and minimum value for each economic variable was entered to calculate any uncertainty error associated with elevation- or stage-damage relationships. The program also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-frequency curves.

Probability Distribution
A probability distribution is selected to represent the uncertainty inherent to certain critical variables in the flood damage evaluation. It defines the probability of the occurrence of an event in an infinite number of observations or trials.

Monte Carlo Simulation
The possible occurrences of each variable are derived through the use of Monte Carlo simulation, which uses randomly generated numbers to simulate the values of the selected variables from within the established ranges and distributions.

The Mean
The sum of all sampled values divided by the number of samples yields the expected value, or the mean. In flood damage analyses, the mean value represents the average damage expected to occur from the full range of possible values samples. Its corresponding standard deviation, which represents any uncertainties in key hydrologic or economic input parameters, is a measure of variability that is useful, not only for comparing sets of measurements, but also for describing a single set of measurements.

Standard Deviation
The corresponding uncertainty calculated for each mean is a representation of an estimate of error, or deviation. Error is the difference between the observed value and the most probable value. It is expressed by the standard deviation which best fits the variable. The standard deviation is the average deviation from the mean (i.e., the square root of the mean of the squared deviations).

7.2.2.2.10 Economic Uncertainty. In the East St. Louis Study, risk-based analysis was performed on four key economic variables – property values (structure and automobile), contents-to-structure value ratios, first floor elevations, and depth-damage relationships. The uncertainty associated with each of these variables was analyzed for its impact on the stage-damage curve. Applicable methodology incorporated into the risk and uncertainty analysis for each variable is discussed in the following paragraphs.

Structure Value
In order to determine the uncertainty associated with the structural valuation process, detailed field surveys were conducted to confirm structure values provided by local tax records. These estimates were incorporated into the HEC-FDA program to calculate the stage-damage with uncertainty for the Project area. Uncertainties incorporated into the analysis considered a possible error in value of plus or minus 7.5 percent for residential structures and plus or minus 6.5 percent for nonresidential. Specific input assumptions utilized as follows: a normal probability density function for all structures; the structure value as the mean; a standard deviation of 7.5 percent for residential structures and 6.5 percent for nonresidential structures.

Automobile Value
In analyzing the uncertainty associated with automobile damage, a triangular probability distribution function was used to determine the estimated error surrounding the values assigned to the automobiles in the inventory. The most likely value was assumed to be the average value of a used car ($10,750). The maximum value was assumed to be the average value of a new car before taxes, license, and shipping charges ($16,800). The average 10-year depreciation value of an automobile ($2,000) was used as the minimum value.

Contents Value
In analyzing the uncertainties associated with determining flood damages to contents within structures, the following assumptions were utilized: (1) a CSVR was computed to estimate the contents value (the mean); (2) a normal probability distribution function was used to describe the distribution of the sample observations around the expected mean; (3) a normal probability density function was used for each content category; (4) standard deviations for each applicable category were obtained from the Morganza to the Gulf Study, New Orleans District. Based on research conducted at the Institute of Water Resources, a normal probability density function was determined to best fit the national data on contents-to-structure value ratios

First Floor Structure Elevation
Risk and uncertainty analysis requires the input of a factor to indicate an estimate of error involved in obtaining first-floor structure elevations. More accurate derivation of floor elevations during field surveys would have less error, and less accurate surveys would have more errors. Estimates of error for various survey methods are presented in EC 1105-2-205. Structure elevations for the East St. Louis Project area were derived from 2-foot contour blue-line aerial photography. A standard deviation (estimate of error) of 0.7 feet was calculated for the uncertainty associated with this type survey. A normal probability density function was used to describe the uncertainty associated with this variable.

Depth Damage Relationships
Depth-damage relationships developed for the St. Louis area were used in the East St. Louis Study. These depict a depth-damage factor for residential and nonresidential structure categories. To account for the uncertainty associated with each increment of flooding, a normal probability density function was used.

7.2.2.2.11 The Hydrologic Analysis. The hydrologic analysis portion of the HEC-FDA program calculates the expected damages for existing hydrologic conditions and the type of with-project flood control improvements. This analysis is used to analyze the uncertainties associated with various hydrologic parameters in evaluating project alternatives such as levees, pumps, and channels. In the evaluation of flood control improvements in the East St. Louis Project area, the with-project plan of improvement was evaluated based on stage-frequency analyses. This data was integrated with the stage-damage and stage-frequency relationships and their corresponding uncertainties in determining expected annual damages for without- and with-project conditions. The results of this analysis are displayed in Table 7-5. The difference in total without- and with- project damages results in the total flood damages prevented, and represent the total project benefits for the East St. Louis Project area.

Hydrologic Uncertainty
Uncertainties in hydrologic/hydraulic (H&H) analyses are generally associated with stage and discharge. Some of this exists because of short record lengths, sampling errors, imprecise measurements of data, etc. Stages can also be affected by conveyance roughness, cross-section geometry, debris accumulation, etc. The uncertainties involved in the development of the hydrologic stage-frequency and stage-flow relationships are discussed in more detail in the Hydrology/Hydraulics appendix.

H&H
There were no gauge readings for the East St. Louis Project area, thus rainfall runoff modeling with a record length of 15 years was used for the area. This was indicated to be the maximum record length that could be utilized in this type of modeling. Based on this equivalent record length, the HEC-FDA program calculated the confidence limits surrounding the stage-frequency function.

Hydrologic Analysis Results
The HEC-FDA program integrated the results of the economic uncertainty analysis (elevation-damage curve with error) with the results of the hydrologic/hydraulic uncertainty analysis (stage-frequency curve with error) to produce the without-project and with-project expected annual damages for the alternative plan of improvement. Finally, the program compared the without-project damages to the with-project damages, in order to produce the flood damages prevented from the implementation of the proposed alternative

Table 7-5 Total Expected Annual Flood Damages for Existing and with Project Conditions, East St. Louis Project Area, (October 2000 Price Levels)

Damage Category	Total Expected Annual Flood Damage		Damage Reduction (%)
	Existing Conditions ($000)	With-Project Conditions ($000)	
Structure Damages	1,299	337	74
Automobile Damages	654	250	62
Total Urban Flood Damages	**1,953**	**587**	**70**

7.2.2.2.12 Summary Of Expected Damages. The results of the risk-based flood damage analysis of the East St. Louis Project area are presented in Table 7-6 along with project effectiveness (i.e., percent damage reduction). Risk-based analyses were performed in determining the total existing without- and with-project damages cumulated for both structures and automobiles.

Total existing expected flood damages, which are the total annual damages for expected to occur without flood reduction measures in place, were estimated at $1,953,000 for the total East St. Louis Project area. In comparison, expected annual flood damages for with-project conditions were estimated to be $587,000. Total damages include expected annual flood damages to structures and automobiles. For existing conditions, structure damages account for 67 percent of the total damage.

7.2.2.2.13 Summary Of Inundation Reduction Benefits. The evaluation process of the East St. Louis Feasibility Study involved the formulation and assessment of flood control improvements for one improvement in the determination of without- and with-project flood damages, flood damage prevented, and inundation reduction benefits with the flood control improvement plan in place.

7.2.2.2.14 Total Expected Annual Benefits. The total expected annual benefit from with-project improvements in the East St. Louis area is presented in Table 7-6. Inundation reduction benefits are calculated based on the difference between the expected flood damages for existing without- and with-project conditions as computed within the risk-based framework. Total expected benefits in the East St. Louis Project area were estimated to be $1,366,000.

Table 7-6 Total Expected Annual Benefits With Project Improvements, East St. Louis Project Area, (October 2000 Price Levels)

Benefit Category	Total Expected Annual Benefits ($)
Structure Damages Prevented	962,000
Automobile Damages Prevented	404,000
Total Expected Annual Benefits	1,366,000

The mean benefits are shown in Tables 7-7. The table also shows the mean inundation reduction benefits at the 25, 50, and 75 percentiles. The percentiles reflect the percentage chance that the actual benefits will be greater than or equal to the indicated benefit amount.

Table 7-7 Mean Benefits and Probability Indicators with Project improvements, East St. Louis Project Area, (October 2000 Price Levels)

Mean Benefits	Probability Damaged Reduced Exceeds Indicated Values		
	25%	50%	75%
$1,366,000	$1,767,000	$1,136,000	$731,000

7.3 TOPOGRAPHY/DRAINAGE/FLUVIAL GEOMORPHOLOGY

The topography of the affected area will be impacted slightly by the raising and lowering of ground elevations in localized areas with the construction features of the project. Containment berms that will be used to guide, direct and contain flood pulse flows will produce high points varying at different sites from approximately 2-8 feet above the ground surface. Likewise modifications made to the existing drainage system will lower elevations in localized areas to match existing channel flow lines. These changes do not significantly impact the topography of the overall study area.

Through implementation of the recommended plan, fluvial geomorphology characteristics that were lost by the filling and channelization of the pre-settlement flood plain streams by urbanization will be restored at specific sites through the re-creation of some 10.8 miles of floodplain streams. This restoration of natural stream resources on the floodplain will re-introduce an ecosystem component lost from the floodplain since the early 1900s.

7.4 GEOLOGY AND SOILS

While no systemic changes to the soils or geology of the area will result from implementation of the recommended plan, only localized changes to surficial soils will result. These changes are considered beneficial as they will result from a reduction in the erosional effects experienced by bluff streams. Erosional deposition currently experienced on the floodplain will also be reduced as a result of measures recommended by the plan by retaining soils in the bluffs.

7.5 CLIMATE AND WEATHER

No impacts to climate and weather are anticipated as a result of implementation of the recommended plan.

7.6 AIR QUALITY

Assessment of air quality impacts was conducted by the USEPA, Region 5, as a cooperating agency. A detailed discussion of air quality, including anticipated impacts, is included in Appendix F. The methodology for the general conformity analysis for the recommended plan consists of the following steps: 1) determine pollutants of concern based on attainment status of the Air Quality Control Region (AQCR); 2) define the scope of the recommended plan, including timing and location of emission sources; 3) calculate emissions based on the scope; 4) review net emission changes for threshold levels and regional significance; and 5) determine conformity for applicable criteria pollutants.

7.6.1 Pollutants of Concern. The area affected by the recommended plan is in moderate nonattainment status for ozone (outside an ozone transport region), as described in Section 3.8. Consequently, direct and indirect emissions of Volatile Organic Compounds (VOC) and Nitrous Oxides (NOx) (precursors to ozone) resulting from the recommended plan are subject to the conformity determination. Portions of the recommended plan will take place in the Particulate Matter (PM10) maintenance area. The following analysis focuses only on these three pollutants. The analysis encompasses the year during which the total direct and indirect emissions are anticipated to be the greatest.

7.6.2 Scope of Recommended Plan. The recommended plan will affect the total amount of emissions from two categories of sources. The emissions associated with construction activities and the burning of herbaceous vegetation have been included in the analysis.

With respect to construction activities, off-road mobile construction and demolition vehicles will be involved in six principal activities: clearing and grubbing, floodplain earthwork, tributary stream sediment detention basins, stream bank stabilization, topsoil placement, and environmental plantings and seeding. Although the types and number of construction and demolition equipment are preliminary, the number and types of equipment have been estimated and the emissions analysis assumes the highest number of vehicles to be working at one time and during the one year period that is used for the analysis. A representative year was estimated to have 248 working days, and it accounts for weekends, holidays, and weather days.

Although the General Conformity regulations do not require a worst-case situation to be analyzed, it is appropriate to use this analysis in this situation since the exact equipment requirements have not been specified. Table 7-8 displays these work activities and the anticipated construction equipment, along with expected duration of operation.

Table 7-8 Anticipated work activities, duration, and construction equipment to be used during a representative construction-phase year.

Construction Activity	Time (%)	Days/ Year	Anticipated Construction Equipment
Clearing and Grubbing	10	25	2 Bulldozers, 1 Hydraulic Excavator, 1 Tub Grinder, 2 Chainsaws, and 1 Water Truck
Floodplain Earthwork	50	124	2 Bulldozers, 1 Hydraulic Excavator, 6 Scrapers, and 1 Water Truck
Sediment Detention Dams	25	62	2 Bulldozers, 1 Hydraulic Excavator, 14 Dump Trucks, 1 Vibratory Roller, and 1 Water Truck
Stream Bank Stabilization	10	25	1 Hydraulic Excavator, 1 Bulldozer, 6 Dump Trucks, and 1 Water Truck
Topsoil Placement	3	7	2 Bulldozers, 6 Scrapers, and 1 Water Truck
Environmental Plantings & Seeding	2	5	1 Small Backhoe and 1 No-Till Planter
All Activities	100	248	

With respect to vegetation burning, the principle operations/maintenance activity affecting air quality that will occur once the projects are constructed is periodic prescribed burns within prairies and marshes in floodplain action areas. These burns will be used to maintain the biological integrity of these plant communities. A total of about 1,800 acres of such natural habitats will be managed in this manner. Each year about 600 acres of these habitats will be burned, such that on a rotational cycle every area would be burned once during a 3-year period. Burns will be conducted in the late fall and early spring when plants are dormant.

7.6.3 Expected Emissions. The recommended plan will cause temporary increases in exhaust emissions from machinery and equipment during construction activities. Table 7-9 summarizes the anticipated emissions from these construction activities. Emission factors were obtained from either "A Compilation of Air Pollutant Emissions Factors Fourth Edition (USEPA, AP-42, September 1985, revised July 1993) or "Nonroad Engine and Vehicle Emission Study - Report (USEPA, November 1991) which give emission factors for various types of heavy construction related motorized equipment.

Table 7-9 Summary of anticipated air emissions from proposed construction activities.

Construction Activity	Hours/ Year	Emissions (tons/year)		
		VolitileOrganic Compounds (VOC)	Nitrogen Oxides (NOx)	Particulate Matter PM10)
Clearing and Grubbing	1,400	0.651	1.872	0.256
Floodplain Earthwork	9,920	2.485	18.960	3.798
Tributary Stream Sediment Detention Dams	9,424	1.798	18.832	1.282
Stream Bank Stabilization	1,800	0.386	3.643	0.311
Topsoil Placement	504	0.134	0.976	0.201
Environmental Plantings & Seeding	80	0.020	1.100	0.019
Total Emissions per Year		**5.480**	**45.380**	**5.870**

With regard to prescribed fires, the USEPA issued interim Air Quality Policy on Wildland and Prescribed Fires in May 1998 to address the air quality goals and national air quality standards while improving the quality of ecosystems through the increased use of fire. Under the Policy, Federal prescribed fire projects are considered to conform with the state implementation plan if they are managed under a certified basic smoke management program. The program must require regional coordination (cooperation of all jurisdictions in an airshed) when authorizing fires and real time air quality monitoring at sensitive receptors, when warranted, in addition to the basic program components. If the recommended plan were approved, a smoke management plan would be developed for the action areas where prescribed burning is proposed for vegetation management. Development of such plans would include coordination at the local and regional levels.

7.6.4 Review of Emission Changes. Construction emissions for VOCs, NOx, and PM10 are below the 100 tons per year de minimis level for each pollutant. The area is a moderate ozone nonattainment area and the emissions of VOCs and NOx from the project show conformity by being below the de minimis levels set by the General Conformity regulations. Portions of the area are maintenance for PM10 and the PM10 analysis is below the 100 tons per year de minimis level for a PM10 maintenance area. This also demonstrates conformity. The analysis in Table 7-8 included the entire project, not only the portions that are within the PM10 maintenance area. Thus the emissions in Table 7-9 represent higher emissions than would be expected in the townships that are maintenance for PM10.

With regard to regional significance, the recommended plan must also meet the test of being not regionally significant. Regionally significant is defined in the general conformity regulations as being more than 10% of the total emissions in the nonattainment or maintenance area. The emissions for just the Illinois portion of the St. Louis ozone nonattainment area total 156 tons per day of VOCs and 173 tons per day of NOx. To convert to tons per year, 261 workdays have been used for one year. This conversion to an annual rate is needed because the ozone inventory is based on a ton per summer weekday emission rate. This results in 3,393 tons per year of VOC and 4,515 tons per year of NOx. Ten percent of these figures are 339 tons per year of VOC and 451 tons per year of NOx. Therefore, because the project is less than 10% of the total emissions for the area for both VOCs and NOx, the recommended plan is not regionally significant.

7.6.5 Conformity Determination Results. The recommended plan has minimal air quality impacts. Expected levels of pollutants are below the de minimis levels set for a moderate ozone nonattainment area and for a PM10 maintenance area. Also, the recommended plan is not regionally significant in terms of air quality impacts.

7.7 NOISE

The recommended plan will have a temporary impact on noise in the study area during certain construction activities. However, as the area has an urban characterization with the multiple transportation arteries that transect the Project area, the type of construction required of the project will have a negligible contribution to the overall noise character of the area.

7.8 SURFACE WATER/FLOODPLAIN MANAGEMENT

This plan accomplishes improved management of surface water on the floodplain to the benefit of habitat restoration areas. By restoring floodplain zones that have historically received surface water the plan accomplishes the goal of restoring and improving plant and animal diversity in the ecosystem while providing surrounding areas with relief from the damaging effects of runoff. This plan provides for floodplain management using natural means and taking advantage of environmental opportunities to solve the age-old problem for the bottoms. However, this plan provides benefits beyond the floodplain by managing sediment in the bluff tributaries to improve stream functions while providing infrastructure protection to the surrounding communities. This look to solutions for sediment transport in the bluffs likewise provides benefits to the floodplain by diminishing the adverse effects of sedimentation on ecosystem quality and on the existing flood control system.

The recommended plan will have an incidental impact on the reduction of flooding caused by inadequate channel capacity of the existing flood control system through diversion and temporary detainment of runoff in restored natural areas. The Old Cahokia Creek site will reduce flooding along Sand Road from hillside runoff in the Southern Illinois University-Edwardsville area. The Spring Lake site will reduce flooding in the Collinsville, Caseyville, and state Park Place areas by preventing flows from spilling out of Little Canteen and Canteen Creeks. The Dobrey Slough site will reduce flooding by providing for the temporary storage of runoff until it can be pumped into the existing stormwater system. The Elm Slough site will reduce flooding in the Long Lake area of Pontoon Beach and the Mitchel Ditch agricultural area, both upstream of Illinois Highway 162, by allowing water to more efficiently leave these areas during rainfall events. It is believed that adverse impacts of ponding from rainfall will be reduced in the area draining into County Ditch by the elimination of the backwater effect from the Cahokia Canal system.

7.9 CHANGES TO STORMWATER MANAGEMENT ASSOCIATED WITH EACH ACTION AREA

Old Cahokia Creek Site: Under existing conditions, excess flow from the hillside streams overwhelms the remnants of the Old Cahokia Creek channel and sheet flows to the west, flooding residences along Sand Road. The proposed project as well as fulfilling the main objective of restoring the old creek channel and forested buffer will eliminate flooding along Sand Road.

Judy's/Burdicks Site: Under existing conditions, Judy's and Burdick Branches spill out of their banks onto adjacent farmland. Under the proposed project, the spill out of the two creeks is confined in a bermed area providing environmental benefits on the former farmland.

Brushy Lake Site: Under existing conditions, overflows from Schoolhouse Branch and Snyder Ditch flow into Brushy Lake. Under the proposed condition, the environmental benefits of the Brushy Lake area will be increased by restoring a flood pulse using flows up to the design event from Schoolhouse Branch.

Spring Lake Site: Under existing conditions, the Spring Lake area stores local runoff and Harding Ditch overflows, and this water is unable to drain back into Harding Ditch. Under the proposed project, all flow from Harding Ditch will be temporarily detained in Spring Lake, which will enhance environmental benefits for that area.

Elm Slough Site: Under existing conditions, Elm Slough receives runoff from the Long Lake and Mitchell Ditch areas. Outflow from these areas is limited because of the small culvert sizes that allow flow to enter Elm Slough from the north side of Illinois Highway 162. The proposed project will restore a flood pulse to enhance the environmental quality of Elm Slough by increasing flows from Long Lake and Mitchell Ditch to the area. This will incidentally reduce flooding in the Long Lake and Mitchell Ditch areas.

Dobrey Slough Site: Under existing conditions, a railroad embankment segments Dobrey Slough. The proposed project will reconnect the slough and create an excavated wetland area in the historic slough that will be charged by localized storm water runoff. As a result flood damages experienced during intense rainfall events will incidentally be reduced.

Mullens Slough Site: Mullens Slough will improve environmental benefits to an already wet area. No changes to stormwater management are associated with this project site.

7.10 WATER QUALITY

Implementation of the recommended plan would protect restored floodplain resources from receiving debilitating levels of sediment and provide a means to naturally attenuate some of the water quality impairments identified for the surface water within the study area. Agricultural and urban runoff would be retained in designed ecosystem retention areas. This increased retention time would allow for natural attenuation of portions of nutrient and organic loading from sources of impairment. Loading of known water quality impairments to the current drainage system and lakes within the study area would, therefore, decrease and potentially provide a sufficient reduction such that natural attenuation can further reduce the impairments prior to discharge to downstream receiving waters.

A broader view of the potential benefits of the ecosystem restoration project reveals the potential for reduction in the amount of nutrients and sediments being passed to the Mississippi River and ultimately to the Gulf of Mexico. Currently the Gulf of Mexico west of the Mississippi River Delta is experiencing a severe oxygen deficiency on a seasonal basis. The major contributor to this undesirable water quality condition is wide spread algae blooms which deplete oxygen levels and upset the natural food chain and result in significant loss of fish and other aquatic organisms. This condition is commonly referred to as the "Hypoxia Problem of the Gulf of Mexico". Algae blooms are dependent, among other things, upon the availability of nutrients (i.e., nitrogen and phosphorus compounds), and studies have shown that the Mississippi River delivers about 935,000 metric tons of nutrients to the Gulf of Mexico annually. The proposed ecosystem restoration and flood damage reduction project in East St. Louis and vicinity can potentially decrease the impact on the hypoxia problem within the Gulf of Mexico and the Mississippi Delta area. Decreased sediment loading to the Mississippi River would also be realized by implementing the project. Future monitoring, consisting of sampling and testing, would be required to determine the actual impacts and benefits.

7.11 ECOLOGICAL RESOURCES

This section describes future natural resources and ecological conditions in the study area if the recommended plan were implemented. Like future-without conditions, a 50-year period of analysis has been used in the forecast of future conditions with the recommended plan. In this section, the areas (acres) of communities to be affected by the recommended plan were taken from the habitat assessment in Appendix A.

7.11.1 Communities. The recommended plan's effect on the extent of natural community classes and individual natural communities is described using comparisons from two different points in time. An "early" comparison in the 50-year period of analysis contrasts post-construction conditions with existing conditions. The other comparison represents conditions in 50 years, and contrasts the recommended plan with projected future conditions 50 years in the future without a project. In Appendix A, Habitat Assessment, more detailed comparisons were made using five points in time (target years 0, 1, 11, 21, and 51).

Under the recommended plan, the extent of existing forests, prairies, marshes and scrub-shrub wetlands, lakes and ponds, and streams in the recommended action areas would increase from about 2,300 acres to about 4,700 acres (Table 7-10). The loss of cultural communities, chiefly cropland, accounts for most of these gains. Gains in forest and prairie in the recommended action areas are substantial, and approximate 20 percent for each in comparison to existing conditions. Increases in area of each of the other community classes are more modest.

Table 7-10 Effect on extent of natural community classes in the 4,916-acre action area.

Natural Community Class	Existing Conditions (TY0)		Future Without-Project Conditions (TY51)		Future Conditions with Recommended Plan (TY51)		Net Change, Future With Plan and Future Without		Net Change, Future With Plan (post-construction) and Existing Conditions	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Forest (wetland & nonwetland)	1,139	23.2	820	16.7	2,083	42.4	1,263	25.7	944	19.2
Prairie (wetland and nonwetland)	25	0.5	25	0.5	1,111	22.6	1,086	22.1	1,086	22.1
Marsh & Scrub-Shrub Wetland	669	13.6	510	10.4	843	17.2	334	6.8	174	3.5
Lake & Pond	372	7.6	333	6.8	460	9.4	127	2.6	88	1.8
Stream	77	1.6	68	1.4	161	3.3	93	1.9	84	1.7
Subtotal Natural Communities	*2,281*	*46.4*	*1,756*	*35.7*	*4,659*	*94.8*	*2,903*	*59.0*	*2,377*	*48.3*
Cultural	2,635	53.6	3,160	64.3	258	5.2	-2,902	-59.0	-2,377	-48.3
Total	**4,916**	**100.0**	**4,916**	**100.0**	**4,916**	**100.0**				

Boundaries of all recommended action areas have been displayed on a series of five historic maps of the study area to show their location with respect to local historic environmental conditions. These five historic maps are presented as Figures B.17-B.22 in Appendix B (including 1800 land cover, 1866 Corps topographic feature map, 1904 USGS quadrangle, 1909 MESD topographic map, 1935 USGS quadrangle, and 1940 Corps topographic map).

7.11.1.1 Forest. Within the recommended action areas, the extent of existing forest would increase from about 23 percent to about 42 percent (or by 944 acres, Table 7-10). In the tributary watersheds, the recommended plan would cause a relatively small loss of forest, and in the Mississippi River floodplain, a substantial net gain.

Table 7-11 Effect on extent of forest communities within the recommended action areas.

Forest Community	Cover Type Description	Cover Type Name*	Existing Conditions		Projected Future Without-Project Conditions (in 50 years)		Future Conditions with Recommended Plan (in 50 years)		Difference Between Future With Plan and Future Without (in 50 years)		Difference Between Plan (post-construction) and Existing Conditions	
			Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Upland Forest	Upland forest (existing)	DF	448	9.1	137	2.8	379	7.7	242	4.9	-69	-1.4
	Nonwetland Forest											
	Floodplain forest (existing & proposed)	DFBOTTOMS	40	0.8	14	0.3	36	0.7	22	0.4	-4	-0.1
	Forested corridor along channels (existing)	FCORRIDOR	5	0.1	1	0	1	0	0	0	-4	-0.1
	New forested corridor (proposed)	NEWFCORR	0	0	0	0	47	1.0	47	1.0	47	1.0
	Wetland Forest											
Floodplain Forest	Forested wetland (existing)	PFO	363	7.4	404	8.2	331	6.7	-72	-1.5	-32	-0.6
	New forested wetland (proposed)	NEWPFO	0	0	0	0	505	10.3	511	9.6	511	9.6
	Shrub-scrub wetland naturally succeeding to forest, or planted with trees (proposed)	NEWPFO2	0	0	7	0.1	92	1.9	64	1.2	98	1.8
	Riparian corridor (existing)	RIPARIAN	283	5.8	258	5.2	274	5.6	19	0.4	-22	-0.4
	New riparian corridor (proposed)	NEWRIPAR	0	0	0	0	419	8.5	511	9.6	511	9.6
	Subtotal FloodplainForest		*691*	*14.1*	*683*	*13.9*	*1,705*	*34.7*	*1,101*	*20.7*	*1,105*	*20.7*
All Forest			1,139	23.2	820	16.7	2,083	42.4	1,343	25.6	1,036	19.3

* From Appendix A

7.11.1.1.1 Forest in Tributary Watersheds. The recommended plan includes the acquisition of about 448 acres of upland forest to create 131 tributary stream sediment detention basins scattered across tributary watersheds in the study area. Each basin would include a dam (average footprint about 0.5 acre) and a sediment detention area behind the dam (average footprint about 2.6 acres). Existing trees would be removed from the dam site, but the detention area would remain forested. To increase local tree species diversity, mast tree species, such as oaks and hickories, would be planted in each basin. Outside the action areas, and within the larger Project area, upland forests are expected to continue to be lost due to anticipated development, as described in the section on future-without project conditions.

7.11.1.1.1.1 Affected Action Areas. Five of the eight proposed action areas would include construction of sediment detention basins and planting of tree seedlings in tributary watersheds: Old Cahokia Creek, Judy's-Burdicks, Brushy Lake, Spring Lake, and Mullens Slough.

7.11.1.1.1.2 Forest Plantings. Trees planted in the ponding areas of detention basins would consist of two-gallon containerized seedlings. Each seedling would be planted in a 20-foot diameter clearing, at a density of about 25 per acre. These shade-intolerant seedlings would be revisited once about every ten years during the project life to release them from any over shading growth. Further details about these plantings are described in Section 8, Recommended Plan.

7.11.1.1.1.3 Project-Induced Forest Losses. Of the approximately 448 acres of upland forest needed for constructing all detention basins, a total of about 69 acres of trees would be permanently lost to build a dam at each of the 131 sites. The level of forest fragmentation associated with the permanent loss of about 0.5 acres of trees at each site would be minor. At each site, the accumulation of sediment or periodic detention of water during storms is not expected to cause adverse impacts to forest within detention areas. Periodic sediment removal is not anticipated over the project life because the basins have been sized to accommodate sediment detention for 50 years. Natural tree regeneration is expected to continue. Storm water detained temporarily by the dam would pass downstream after several hours. Small natural depressions may develop in each basin that could trap water for longer periods, leading to a slight overall shift in vegetation towards plant species more tolerant of wet conditions.

Most of the estimated 69 acres of project-induced losses of upland forest would be avoided if tributary stream sediment detention basins to be constructed in a pilot program do not perform as expected. Collectively, the 131 basins are expected to reduce sediment transfer from tributary watersheds to floodplain action areas by 70 percent. To determine the actual efficiency of these proposed structures, a pilot project will be constructed and monitored on Judy's Branch if this project were approved. If monitoring of these pilot detention basins were to show that they did not perform as expected, alterations to the design could reduce impacted acres. Follow-up NEPA compliance documents to this report will present the findings of the sediment basin pilot program, and whether project-related upland forest losses as described here are still anticipated.

7.11.1.1.1.4 Wildlife Habitat of Forest in Tributary Watersheds. Like existing and future-without project conditions, the interagency biology team assessed future quality of forest within the proposed tributary stream sediment detention basins as wildlife habitat for three vertebrate species. This forest envelops a total of 379 acres at 131 scattered sites. The HEP analyses described in Appendix A demonstrate that under the recommended plan, the quality of forest as wildlife habitat within the proposed tributary stream sediment detention basins is expected to improve for two species (Table 7-12). Average HSI scores for the fox squirrel and mink exceed the moderate level (0.5) at target year 51 (TY51). For these two species, the future-with-recommended-plan condition also represents an improvement compared to existing and anticipated future-without-project conditions. For the squirrel, the planting of mast tree species in the detention basins is the major factor contributing to habitat quality improvement, and the temporary detention of stormwater in the basins is the main reason for improvement for the mink.

The third species, the wood duck, is not expected to benefit from the recommended plan, as forest affected by the project is essentially not suitable for the species. Evaluation procedures for these species are discussed in depth in Appendix A. Outside the proposed detention basins, forest habitat conditions for these species are expected to be those of future-without project conditions.

Table 7-12 Existing and projected habitat quality of forest within recommended detention basins of tributary watersheds, expressed as habitat suitability indices (average and range) for three evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)			Future With Recommended Plan (TY51)			Net Change, Without Project versus With Plan
	Average	Range	Average	Range	Net Change, TY51-TY0	Average	Range	Net Change, TY51-TY0	
Fox squirrel	**0.54**	0 - 0.62	0.33	0 - 0.38	-0.21	**0.62**	0 - 0.67	0.08	0.29
Mink	0.40	0 - 1	0.40	0 - 1	0.00	**0.96**	0 - 1	0.56	0.56
Wood duck	0.04	0 - 0.17	0.03	0 - 0.09	-0.01	0.02	0 - 0.03	-0.02	-0.01

7.11.1.1.2 Forest in the Bottoms. Under the recommended plan, the extent of existing floodplain forest in the action areas would increase from about 14 percent to 35 percent, or by about 1,105 acres (Table 7-11). Areas to be reforested would consist of sites that were historically forested for the most part. Planting would consist of historically occurring tree species. Some existing forest in the action areas would be improved by planting under-represented tree species. The plan would also introduce periodic flooding as an ecological attribute to most floodplain forests in the action areas, thereby restoring the existing floodplain ecosystem to a more natural condition. Storm water from tributaries would serve as the source of this flooding. The recommended series of tributary stream sediment detention basins to be created would substantially reduce the rate of sediment transfer to the floodplain, and ensure that flooding introduced into floodplain forests would not carry excessive levels of sediment.

Outside the action areas, and within the larger Project area, floodplain forests are expected to continue to be lost due to anticipated development, as described in the section on future-without project conditions.

7.11.1.1.2.1 Affected Action Areas. Five of the eight proposed floodplain action areas would include reforestation. These action areas are, in order of decreasing area of total future forest (along with area of current forest), Brushy Lake (579 future, 250 existing acres), Elm Slough (451 future, 135 existing acres), Spring Lake (360 future, 182 existing acres), Old Cahokia Creek (238 future, 72 existing acres), and Dobrey Slough (36 future, 3 existing acres). The plan would not expand forest resources at the three remaining proposed action areas (Judy's-Burdicks, Cahokia Mounds Prairie, Mullens Slough).

7.11.1.1.2.2 Forest Plantings. Most of the 1,063 acres of recommended forest plantings would develop into forested wetlands or riparian corridors established along restored floodplain streams. Wet-mesic floodplain forest and wet floodplain forest would represent the desired condition for most reforestation efforts. Mesic floodplain forest would also be represented to a lesser degree.

Tree species to be planted for reforestation and for improvement of existing forest remnants would consist of primarily heavily seeded species, such as natural oaks and hickories, which were present historically. A list of these tree species is presented in Table 8-3 in Section 8, Recommended Plan. Light-seeded species, such as cottonwood, willow, green ash, silver maple, and elm, would not be actively planted. Such species would likely become established in areas recommended for reforestation through natural means of colonization.

7.11.1.1.2.2.1 New Forest. Four of the seven action areas receiving forest plantings - Brushy Lake, Elm Slough, Spring Lake, and Old Cahokia Creek – would contain most of the new forest. Establishment of a riparian corridor along a restored portion of historic Cahokia Creek would occur at these proposed action areas, except for Elm Slough. About 95 acres of the 1,063 acres of recommended forest would be located at sites that are not expected to develop into wetlands or be subjected to overbank flows from restored streams. Instead, these plantings would occur on relatively dry sites that either never were historic wetlands, or are immediately landside of berms along floodplain channels, such as Harding Ditch.

Reforestation would consist of the planting of tree seedlings. The type of seedling would be matched with maximum anticipated depth of proposed flooding in each reforestation area. In areas proposed to be influenced by periodic "flood pulses" consisting of overbank flows from adjacent streams, 2-gallon containerized seedlings (4 to 6 feet tall) would be used, at a density of 48 seedlings per acre (30 by 30 foot spacing). Action areas where this type of tree seedling would be used include Brushy Lake, Spring Lake, Elm Slough, and Old Cahokia Creek. In areas without plans for overbank flooding, bare-root seedlings (1 to 3 feet tall) would be employed at a density of 350 per acre (11 by 11 foot spacing). These seedlings would be planted at the Dobrey Slough action area, as well as at topographically high sites within action areas to receive overbank flooding, where maximum water depths are expected to be less than one foot.

7.11.1.1.2.2.2 Improvements to Existing Forest. In the action areas, existing forest remnants with low tree species diversity relative to historic conditions would be improved by the addition of underrepresented species, such as oaks and hickories. In these areas, small forest clearings (20 foot diameter) would be created at a density of 25 per acre, and one two-gallon containerized seedling would be planted in each clearing. These shade-intolerant seedlings would be revisited once about every ten years during the project life to release them from any over shading growth. Such plantings would occur at the Elm Slough and Mullens Slough action areas. Similar plantings would be implemented in about 90 acres of existing scrub-shrub wetlands to make them into forested wetlands ("NEWPFO2" in Table 7-11). This would occur at the Dobrey Slough and Spring Lake action areas, where either early successional forest would be augmented with underrepresented species, or areas of drowned trees now vegetated by shrubs such as buttonbush would be improved by removing standing water and reforested.

7.11.1.1.2.3 Conversion of Bottomland Forest to Other Habitat Types. To implement the recommended plan, various types of nonforested habitat would replace a total of about 58 acres of floodplain forest. The loss of these 58 acres is considered short-term because the recommended plan includes the creation of over 1,000 acres of new floodplain forest. The interagency team of biologists that formulated alternative habitat plans at each of the action areas was aware of these project-induced forest losses when the recommended plan at each action area was chosen. Short-term forest losses would occur at four of the proposed action areas, and most would occur at Spring Lake and Mullens Slough.

About 25 of the 58 total acres of losses would occur at the Spring Lake action area. Forested areas proposed to be lost at this action area currently consist of second growth reflecting relatively recent disturbances. They occur within former residential areas bought out by FEMA in the 1990s, such as within the St. Clair Farms component. This forest consists of few old trees and mostly saplings and relatively young trees. About 25 acres of forested wetland and riparian forest would be lost, mainly to create new marsh (23 acres) across all of St. Clair Farms, and to restore historic Cahokia Creek (2 acres, by widening) in Indian Lake. Also at Spring Lake, about 5 acres of nonwetland forest would be lost to widen Harding Ditch between I-255 and Forest Boulevard. In addition to bottomland forest, scattered trees in "urban old fields", a cultural community comprised by FEMA buyout areas, would also be lost at Spring Lake (in the St. Clair Farms and Cell 1 components).

At the Mullens Slough action area, about 10 acres of forested wetland would be lost to create a floodplain sediment detention basin to be planted with marsh vegetation. Restoration of a portion of historic Cahokia Creek at the Brushy Lake action area would cause the loss of about 5 acres of these two forest types, and about two additional acres for grassy features. Lastly, at Old Cahokia Creek, about 3 acres of existing riparian forest are expected to be lost, mainly to restore the historic creek channel, and also to construct a grassy earthen berm along the west side of the action area.

7.11.1.1.2.4 Wildlife Habitat of Forest in the Bottoms. Like existing and future-without project conditions, the interagency biology team assessed future quality of bottomland forest within the proposed action areas as wildlife habitat for five vertebrate species. Nonwetland bottomland forest was treated separately from wetland bottomland forest. The HEP analyses described in Appendix A demonstrate that under the recommended plan, the quality of bottomland forests as wildlife habitat within the proposed action areas is expected to improve for all species (Table 7-13). Average HSI scores for all species but the wood duck exceed the moderate level (0.5) at target year 51 (TY51). For all species, the future-with-recommended-plan condition also represents an improvement compared to existing and anticipated future-without-project conditions. Some factors associated with habitat improvements include the planting of mast tree species, a somewhat wetter hydrologic regime due to the introduction of flood pulses, and improved water quality caused by restoration of tributary stream resources. Outside the proposed action areas, bottomland forest habitat conditions for these species are expected to be those of future-without project conditions.

Table 7-13 Existing and projected habitat quality of bottomland forests within recommended action areas, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)			Future With Recommended Plan (TY51)			Net Change, Without Project versus With Plan
	Average	Range	Average	Range	Net Change, TY51-TY0	Average	Range	Net Change, TY51-TY0	
Nonwetland bottomland forest									
Great blue heron	**0.52**	0 - 0.52	0.10	0 - 0.1	-0.43	**0.57**	0 - 0.57	0.05	0.47
Fox squirrel	0.33	0 - 0.33	0.42	0 - 0.42	0.09	**0.63**	0 - 0.63	0.30	0.21
Mink	0.00	0 - 0	0.00	0 - 0	0.00	**1.00**	0 - 1	1.00	1.00
Wood duck	0.01	0 - 0.01	0.03	0 - 0.03	0.02	0.22	0 - 0.22	0.21	0.19
Wetland bottomland forest									
Great blue heron	0.45	0 - 0.62	0.24	0 - 0.46	-0.21	**0.54**	0 - 0.94	0.09	0.30
Mink	0.29	0 - 1	0.20	0 - 0.55	-0.09	**0.65**	0 - 0.9	0.36	0.45
Slider turtle	0.23	0 - 0.46	0.12	0 - 0.24	-0.11	**0.50**	0 - 0.55	0.27	0.38
Wood duck	0.02	0 - 0.04	0.03	0 - 0.06	0.01	0.24	0 - 0.32	0.22	0.21

7.11.1.2 Prairie. Under the recommended plan, over 1,050 acres of prairie would be created on the Mississippi River floodplain at sites that historically were mainly prairie. As a proportion of the action areas, prairie communities would increase from about 0.5 percent under existing conditions to about 22 percent (Table 7-14). Two proposed action areas – Judy's-Burdicks and Cahokia Mounds - would support nearly all this prairie. The plan would also introduce periodic flooding as an ecological feature to the Judy's-Burdicks action area, thereby restoring the existing ecosystem to a more natural condition. Storm water from two tributaries, Judy's and Burdick Branches, would serve as the source of this flooding. The recommended series of tributary stream sediment detention basins to be created in these tributary watersheds would substantially reduce the rate of sediment transfer to the floodplain, and ensure that flooding introduced into prairie of the Judy's-Burdicks action area would not carry excessive levels of sediment.

Table7-14 Effect on extent of prairie communities within the recommended action areas.

Cover Type Description	Cover Type Name*	Existing Conditions		Projected Future Without-Project Conditions (in 50 years)		Future Conditions with Recommended Plan (in 50 years)		Difference Between Future With Plan and Future Without (in 50 years)		Difference Between Plan (post-construction) and Existing Conditions	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Prairie, existing and proposed)	PRAIRIE	25	0.5	25	0.5	1,065	21.7	1,040	21.2	1,040	21.2
Prairie plantings for filtering sediment (proposed)	PBUFFER	0	0	0	0	46	0.9	46	0.9	46	0.9
Total Prairie		25	0.5	25	0.5	1,111	22.6	1,086	22.1	1,086	22.1

* From Appendix A

7.11.1.2.1 Affected Action Areas. Four proposed action areas would support new prairie - Cahokia Mounds (525 acres), Judy's-Burdicks (461 acres), Mullens Slough (53 acres), and Elm Slough (46 acres).

At Cahokia Mounds action area, mesic prairie would be planted in eight separate fields currently leased for hay production. These fields total 525 acres, and vary in size from 161 acres to 7 acres (average, 65 acres). Existing marshes and wooded areas adjacent to these hay fields would be left intact.

At Judy's-Burdicks action area, about 350 acres of wet-mesic prairie would be established. This wetland community would periodically receive a flood pulse consisting of overbank flows from the tributary watersheds drained by Judy's and Burdick Branches. About 115 acres of mesic prairie would be planted on the proposed earthen berm encircling the wet-mesic prairie, around the exterior of this berm at a width of 328 feet (100 meters), and in the interior on a small area of nonwetland soils. The extent of prairie proposed by the Corps at this action area would be reduced by about 100 acres if the proposed "Stallings Site" or "I-255/Rt. 162 wetland replication area" for the New Mississippi River Crossing and Relocated I-70 and I-62 Connector project (USDOT 2000) is implemented. Most of this wetland mitigation area would be planted with trees to create forested floodplain forest, but wet prairie would be established under existing power lines. At Elm Slough action area, two separate 23-acre tracts of prairie would be established in the north half of the reforestation area. Mesic and wet-mesic prairie would comprise roughly half of each prairie area. These prairies would serve as vegetative buffers to filter out sediment carried by stormwater from the realigned Long Lake and Mitchell Ditch before it enters the reforestation area as sheet flow. At Mullens Slough action area, about 33 acres of mesic and wet-mesic prairie would be restored to the south of the lake, and about 20 acres of mesic prairie would be established on islands created within the lake. Brushy Lake, the only action area with existing prairie (about 25 acres), would remain unchanged with regard to prairie acreage, but periodic flooding would be introduced to that area.

7.11.1.2.2 Prairie Plantings. Prairie would be established in cropland areas as well as grassy fields and old fields. Plant species to be used would consist of grasses (about a half dozen types), forbs (about 40 to 50 types), and a few sedges and shrubs. Representative prairie species are included in Table 8-2 of Section 8, Recommended Plan. Species would be selected according to local soil moisture conditions. Further planting details are described in Section 8.

7.11.1.2.3 Wildlife Habitat of Prairie. Like existing and future-without project conditions, the interagency biology team assessed future quality of prairie within the proposed action areas as wildlife habitat for one vertebrate species. The HEP analyses described in Appendix A demonstrate that under the recommended plan, the quality of newly created prairie within the proposed action areas as wildlife habitat for the eastern meadowlark is expected to be high, but slightly less than that of existing prairie (Table 7-15). The average HSI score for this bird exceeds the moderate level (0.5) at target year 51 (TY51). A factor associated with this slight reduction in quality is a higher proportion of forb plant species to be used in prairie restorations. Outside the proposed action areas, prairie habitat conditions for the eastern meadowlark are expected to be those of future-without project conditions.

Table 7-15 Existing and projected habitat quality of prairie within recommended action areas, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)			Future With Recommended Plan (TY51)			Net Change, Without Project versus With Plan
	Average	Range	Average	Range	Net Change, TY51-TY0	Average	Range	Net Change, TY51-TY0	
Eastern meadowlark	**0.94**	0 - 0.94	**0.94**	0 - 0.94	0.00	**0.82**	0 - 0.94	-0.12	-0.12

7.11.1.3 Wetland. Under the recommended plan, wetlands of various kinds would be the principle type of habitat to be restored and recreated. These wetlands would consist of marshes as well as wet types of forests and prairies, such as wet-mesic floodplain forest, wet floodplain forest, and wet-mesic prairie. The plan would create about 1,340 acres of new wetlands on the Mississippi River floodplain, thereby increasing the area of wetlands in the action areas from about 1,320 existing acres to about 2,650 proposed acres.

Figure 7-5 displays the boundaries of the recommended action areas with respect to historic changes in spatial extent of wetlands and lakes and ponds. In this figure, areas in green represent existing wetlands, and areas in gray within action area boundaries represent proposed wetland restoration areas. The plan would also introduce periodic flooding as an ecological feature to most wetlands enveloped by the action areas, thereby restoring the existing ecosystem to a more natural historic-like condition. Storm water from tributary streams would serve as the source of this flooding. The recommended series of tributary stream sediment detention basins to be created would substantially reduce the rate of sediment transfer to the floodplain, and ensure that flooding introduced into floodplain wetlands would not carry excessive levels of sediment.

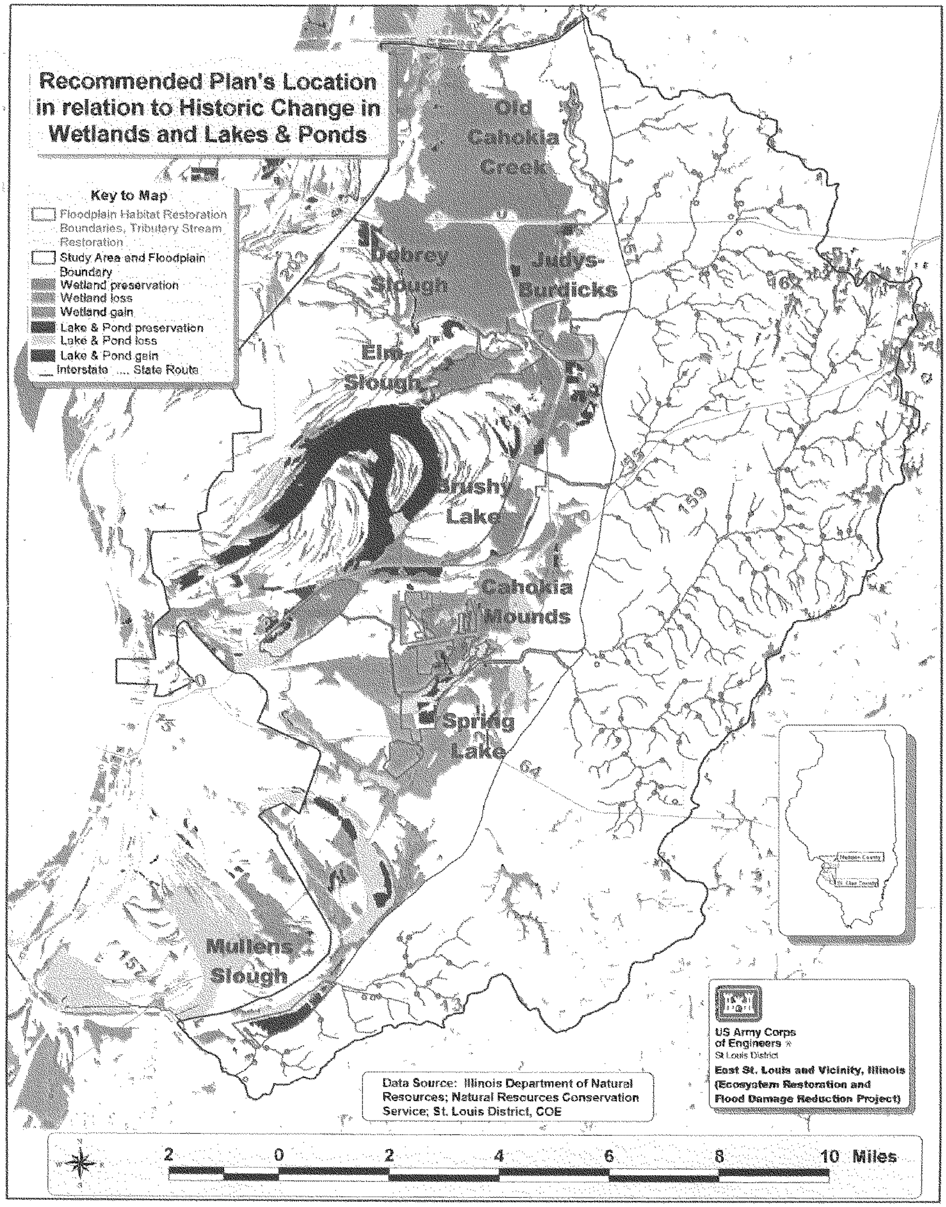


Figure 7-5 Historic Changes
Wetlands and Lakes & Ponds –
Recommended Plan

The plan's expected effects on marsh and scrub-shrub vegetation are displayed in Table 7-16, and are discussed below. Effects on wetlands consisting of forest and prairie vegetation are discussed separately in the forest and prairie portions of Section 7.11.

Table 7-16 Effect on extent of marsh and scrub-shrub wetlands within the recommended action areas.

Cover Type Description	Cover Type Name*	Existing Conditions		Projected Future Without-Project Conditions (in 50 years)		Future Conditions with Recommended Plan (in 50 years)		Difference Between Future With Plan and Future Without (in 50 years)		Difference Between Plan (post-construction) and Existing Conditions	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Marsh (existing)	MARSH	441	9.0	335	6.8	376	7.6	41	0.8	-65	-1.3
New marsh (proposed)	NEWMARSH	0	0	0	0	303	6.2	303	6.2	303	6.2
Detention basin with marsh plantings (proposed)	DETENTION	0	0	0	0	17	0.3	17	0.3	17	0.3
Scrub-shrub wetland (existing)	PSS	228	4.6	174	3.5	148	3.0	-27	-0.5	-81	-1.6
Total		669	13.6	510	10.4	843	17.2	334	6.8	174	3.5

* From Appendix A

7.11.1.3.1 Affected Action Areas. The plan would establish about 320 acres of new marsh in three action areas. Most new marsh would be created in the Spring Lake action area (272 acres). In this action area, all of the St. Clair Farms component would become new marsh, and portions of the Cell 1 and Indian Lake components would also be planted with vegetation to create new marsh and complement existing marsh in these areas. At Dobrey Slough action area, about 31 acres of new marsh would be created. Another kind of new marsh, consisting of marsh plantings inside floodplain sediment detention basins, would be created at Mullens Slough action area (17 acres). At this site, marsh plantings in two detention basins would filter out remaining sediment carried by overflows from Powdermill Creek before entering the large lake.

7.11.1.3.2 Wetland Plantings. Marsh would be established in areas receiving flooding from stormwater. Plant species to be used would consist of a few shrubs, a number of grasses, numerous sedges, and many forbs, for a total of about 45 to 50 species. Representative marsh plant species are presented in Table 8-4 of Section 8, Recommended Plan. Further details concerning marsh plantings are described in Section 8.

7.11.1.3.3 Conversion of Wetland to Other Habitat Types. To implement the recommended plan, other habitat types would replace about 146 acres of marshes and scrub-shrub wetlands (Table 7-11). The interagency team of biologists that formulated alternative habitat plans at each of the action areas was aware of these habitat conversions when the recommended plan at each action area was chosen.

Under the recommended plan, about 65 acres of existing marsh would be converted into other types of habitat. The loss of this marsh is considered short-term because the recommended plan includes the creation of about 320 acres of new marsh. About 60 acres consist of the conversion of existing marsh at Indian Lake of the Spring Lake action area into new riparian forest (328 feet or 100 meters wide on each side) along the restored portion of historic Cahokia Creek. About five additional acres of marsh would be needed to create the new channel.

Table 7-16 also displays a reduction in area of existing scrub-shrub wetlands by about 81 acres. Most of these scrub-shrub wetlands would be converted at the Spring Lake and Dobrey Slough action areas into new forested wetland or new riparian forest by tree planting. At Spring Lake action area, about 71 acres of scrub-shrub wetlands would be planted with trees. Most of this conversion would occur at the Indian Lake component in conjunction with the removal of permanent standing water to reforest an area of drowned trees. Within the same action area, a smaller area of drowned trees in Cahokia Mounds State Historic Site would be similarly treated. At Dobrey Slough action area, about 10 acres of scrub-shrub wetlands consisting of early successional forest would be augmented with underrepresented tree species.

7.11.1.3.4 Restored Flooding. In general, the recommended plan would use storm water from tributary watersheds to mimic the "flood pulse" of historic conditions on the Mississippi River floodplain. Storm water would substitute for historic riverine overflow from the Mississippi River. (Given the urban constraints of today's environment, the plan does not propose to restore overflows from the Mississippi River.)

The introduction of periodic "flood pulses" of storm water into the forests, prairies, and marshes of the proposed floodplain action areas would return the existing ecosystem to a more natural condition. A major source of surface hydrology would be restored to affected floodplain wetlands and aquatic areas. Periodic flood pulses similar to those of historic conditions would be expected to sweep slowly across portions of the landscape. By receiving "flood pulses", habitats in action areas would once again be under the influence of a fundamental type of natural disturbance typical of floodplains. The capacity of wetlands to temporarily store floodwater as they did historically would be restored. Storm water would then be released from these areas back into the interior flood control system and eventually to the Mississippi River. Restoring flooding to floodplain habitats and linking these areas to the interior flood control system would reintegrate the landscape and create a more naturally functioning ecosystem.

7.11.1.3.4.1 Design Flood Events. A maximum of about 3,650 acres of various wetland and aquatic habitats in eight action areas would be flooded by design flood events. The design flood event would be the maximum flood event to be directed into an action area.

Lesser storms in tributary watersheds would produce a smaller "flood pulse", which in turn would inundate lesser areas of habitat, in terms of depth or extent. Table 7-17 displays characteristics of design flood events proposed to be introduced into action areas. In general, the maximum "flood pulse" would be much less, in terms of water depth and duration, than the flood of 1844. As described in Section 5, this event was selected as the upper limit for flood pulse restoration. These proposed maximum events are intended to provide various ecological benefits without causing excessive mortality to plant communities due to drowning.

Stormwater would be used to restore riverine overflow conditions where riverine overflow historically was a major source of wetland hydrology. This includes all eight action areas where flooding would be introduced, except for Dobrey Slough. At Dobrey Slough, which had no historic channel discharging into it but instead received local runoff as the dominant source of wetland hydrology, local storm water from the surrounding watershed would continue to serve as the "flood pulse". At most action areas, the surface elevation of the design flood event would be appreciably less than that of the 1844 flood, and consequently maximum flood depths would also be less than this historic event (Table 7-17). This reflects two major constraints imposed by today's environment – the considerably smaller amount of water currently available to serve as a flood pulse compared to historic conditions, and limits to potential flood water surface elevations imposed by the interior flood control system and other floodplain development.

Table 7-17 Characteristics of design flood events to be introduced into action areas of the recommended plan, compared to the 1844 flood at St. Louis (all figures are estimates).

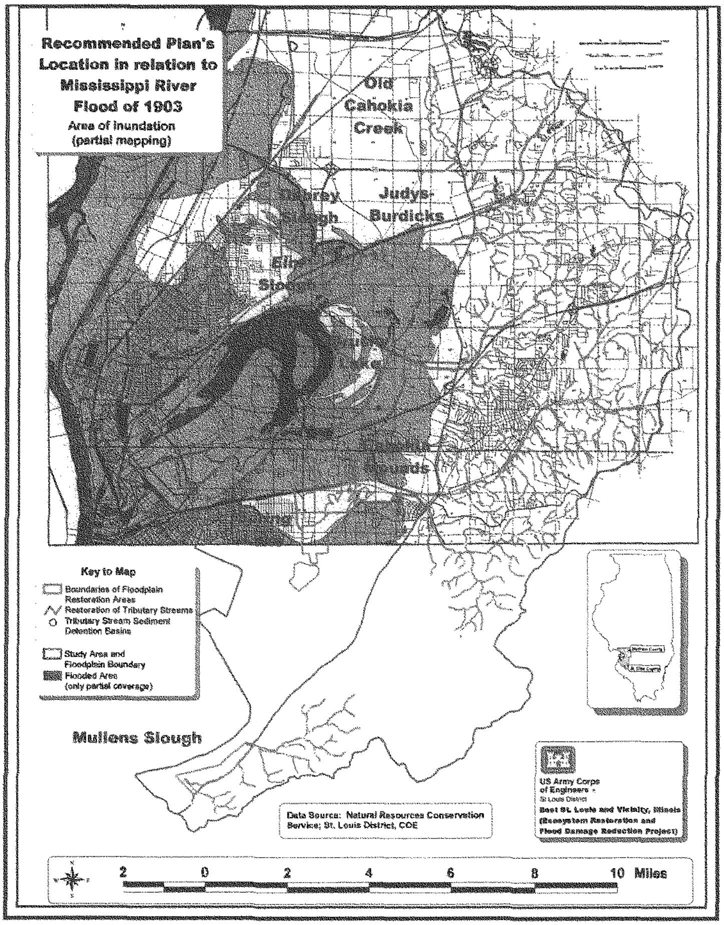
	Maximum Stage, 1844 Flood		Maximum Stage, Recommended Plan						
Proposed Action Area	Surface elevation, feet NGVD	Range of water depth across site, feet	Surface elevation, feet NGVD	Range of water depth (ponding) across site, feet	Total duration of ponding, hours (days)	Area of ponding, acres	Volume of ponded water, acre-feet	% of habitat area flooded by ponded water	Dominant habitat type
Old Cahokia Creek	428	0-3	431	0-6	140 (5.8)	410	1,237	79	forest
Judy's-Burdicks	426	6-8	424	4-6	15 (0.6)	356	1,787	81	prairie
Dobrey Slough	426	1-15	415	0-5	not estimated	53	158	66	marsh
Elm Slough	426	10-20	410	0-5	60 (2.5)	548	1,272	85	forest
Brushy Lake	424	5-20	412	0-7	20 (0.8)	600	1,920	86	forest

Table 7-17 Continued

Proposed Action Area	Maximum Stage, 1844 Flood		Maximum Stage, Recommended Plan						
	Surface elevation, feet NGVD	Range of water depth across site, feet	Surface elevation, feet NGVD	Range of water depth (ponding) across site, feet	Total duration of ponding, hours (days)	Area of ponding, acres	Volume of ponded water, acre-feet	% of habitat area flooded by ponded water	Dominant habitat type
Spring Lake, Indian Lake	422	15-20	406	1-6	not estimated	619	2,355	100	forest, marsh
Spring Lake, Cell 1	421	1-10	416.5	6-7	120 (5.0)	374	2,624	100	marsh
Spring Lake, St. Clair Farms	421	1-10	415.5	4-5	300 (12.5)	172	769	100	marsh
Mullens Slough	419	5-10	not estimated	0-4	not estimated	285	1,163	80	lake

7.11.1.3.4.2 Flooding at Affected Action Areas. To demonstrate that flooding introduced into the proposed action areas would mimic historic events of riverine overflow, Figure 7-6 displays the boundaries of all action areas with respect to the area inundated in 1903 by the Mississippi River. Although this flood event was not the greatest on record, it was the last major occurrence to inundate the American Bottom prior to the establishment of major levees along the Mississippi River. It should be noted that mapping available for the 1903 event did not cover the entire project area. Figure 7-6 depicts available information.

Figure 7-6 Recommended Plan's Relation to Mississippi River Flood of 1903



At Old Cahokia Creek, proposed flooding would mimic historic conditions consisting of frequent overflow from historic Cahokia Creek. All flood events would pond in the northern two-thirds of the floodplain action area, to the north of the old railroad embankment, which is now a bike trail. Above the trail, nearly all of the forested corridor on both sides of the restored creek (about 225 acres) would pond water during the design flood event, as would about 185 acres of agricultural land to the east. South of the trail, floodwater from the design flood and lesser events would be confined to the creek channel.

At Judy's-Burdicks action area in the floodplain, proposed flooding would mimic historic conditions consisting of overflow from Cahokia Creek, Judy's and Burdick Branches, and the Mississippi River. All of the prairie inside of the earthen ring levee would be inundated by the design flood event. However, prairie planted on the levee as well as outside its perimeter at a width of 328 feet (100 meters) would remain "dry".

At Dobrey Slough, proposed flooding would mimic historic conditions consisting of frequent runoff from the surrounding watershed, as well as occasional flooding from the Mississippi River. Most of the action area would be inundated by the design flood event, but the portion not inundated would consist of forested corridor on relatively high ground along the north side of the action area, to the west of the railroad tracks. Duration of flooding for the design flood or any lesser events would depend on when the local pump station serving Dobrey Slough can be activated based on down-channel conditions.

At Elm Slough, proposed flooding would mimic historic conditions consisting of frequent sheet-flow flooding from Long Lake, as well as backwater flooding from the Mississippi River. About 85 percent of the action area would be ponded by the design flood event. During lesser events, storm water would sheet flow across the habitat area from the realigned Mitchell Ditch and Long Lake.

At Brushy Lake, proposed flooding would mimic historic conditions consisting of frequent flooding from historic Cahokia Creek, Schoolhouse Branch, and the Mississippi River. The design flood event would inundate all but about 15 percent of the floodplain action area, which consists of forest on relatively high ground to the northeast.

At Spring Lake action area, proposed flooding would mimic historic conditions consisting of frequent flooding from historic Cahokia Creek, as well as Little Canteen and Schoenberger Creeks and the Mississippi River. The design flood event would inundate all of Indian Lake, Cell 1, and St. Clair Farms. Flood duration has not been estimated at Indian Lake because systemic modeling of Cahokia Canal and all action areas linked to it would be required; this effort would be accomplished if the recommended plan were approved.

At Mullens Slough, proposed flooding would mimic historic conditions consisting of frequent flooding from Powdermill Creek and occasional flooding from the Mississippi River. The design flood event would inundate about 80 percent of the floodplain action area. Surface elevation and duration have not been estimated because detailed mapping of ground elevations in this floodplain area is currently lacking; ground elevation data and flood surface and duration estimates would be developed if the recommended plan were approved.

7.11.1.3.5 Wildlife Habitat of Wetlands. Like existing and future-without project conditions, the interagency biology team assessed future quality of marsh and scrub-shrub wetlands within the proposed action areas as wildlife habitat for five vertebrate species. The HEP analyses described in Appendix A demonstrate that under the recommended plan, the quality of marshes and scrub-shrub wetlands as wildlife habitat within the proposed action areas is expected to improve for all of these species but the mink (Table 7-18).

Average HSI scores for all species but the wood duck exceed the moderate level (0.5) at target year 51 (TY51). For all species but the mink, the future-with-recommended-plan condition also represents an improvement compared to existing and anticipated future-without-project conditions. Some factors associated with habitat improvements are a somewhat wetter hydrologic regime due to the introduction of flood pulses, and improved water quality caused by restoration of tributary stream resources. Outside the proposed action areas, marsh and scrub-shrub wetland habitat conditions for these species are expected to be those of future-without project conditions. Appendix A provides greater detail on these results.

Table 7-18 Existing and projected habitat quality of marsh and scrub-shrub wetlands within recommended action areas, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)			Future With Recommended Plan (TY51)			Net Change, Without Project versus With Plan
	Average	Range	Average	Range	Net Change, TY51-TY0	Average	Range	Net Change, TY51-TY0	
Great blue heron	**0.66**	0 - 1	0.30	0 - 0.87	-0.36	**0.80**	0 - 1	0.14	0.50
Marsh wren	**0.62**	0 - 0.7	**0.59**	0 - 0.71	-0.03	**0.89**	0 - 0.98	0.27	0.30
Mink	**1.00**	0 - 1	**1.00**	0 - 1	0.00	**0.87**	0 - 0.91	-0.13	-0.13
Slider turtle	0.29	0 - 0.55	0.18	0 - 0.31	-0.11	**0.82**	0 - 1	0.53	0.64
Wood duck	0.00	0 - 0.02	0.01	0 - 0.02	0.01	0.35	0 - 0.4	0.35	0.34

7.11.1.3.6 Functional Capacity of Wetlands. The interagency biology team assessed future functional capacity of three separate wetlands to perform various functions. The same procedures that were used to assess existing and future without-project capacity – the Expert HydroGeoMorphic Approach and draft functional capacity index (FCI) models - were employed to assess conditions under the recommended plan. Evaluation procedures for these wetlands and functions are discussed in depth in Appendix A.

Unlike the wildlife habitat quality assessments based on HEP, these wetland functional capacity assessments were used only to compare plans, and did not form the basis for evaluating alternative restoration plans for purposes of incremental cost analysis and plan selection. Moreover, these wetland functional capacity assessments are incomplete because not all models applicable to the study area's wetlands were developed and employed. In addition, these assessments represent the first application of these draft HGM models within the St. Louis District, and therefore there are no other results to compare them with.

As shown in Table 7-19, the recommended plan would increase the capacity of wetlands at Dobrey Slough to perform three of four functions. At Elm Slough and Brushy Lake, where partial wetland areas were evaluated, five of six functions would increase in capacity. The functions pertaining to storage of water – detain floodwater or store surface water – increased at all three sites with the recommended plan. The assessments also show that the plant and animal habitat functions - maintain characteristic plant community and wildlife habitat – also increased. Instances of either no change or a decrease in functional capacity were limited to biogeochemical functions.

Table 7-19 Existing and projected functional capacity of wetlands within three recommended action areas, expressed as functional capacity indices for seven wetland functions. Indices potentially range from 0 (no capacity) to 1 (optimum capacity); indices > 0.5 shown in bold, negative changes in red, positive changes in blue. NA indicates not applicable.

Wetland Functions	Existing (TY0)	Future Without Project (TY51)	Net Change, TY51-TY0	Future With Recommended Plan (TY51)	Net Change, TY51-TY0	Net Change, Without Project versus With Plan
Isolated depressional wetland - Dobrey Slough (disturbed marsh, forested and scrub-shrub wetland)						
Detain floodwater	NA	NA	NA	NA	NA	NA
Store surface water	**0.86**	**0.76**	-0.10	**0.97**	0.11	0.21
Cycle nutrients	**0.58**	**0.83**	0.25	**0.83**	0.25	0.00
Export organic carbon	NA	NA	NA	NA	NA	NA
Remove & sequester elements as compounds	NA	NA	NA	NA	NA	NA
Maintain characteristic plant community	**0.55**	**0.60**	0.05	**0.89**	0.34	0.29
Maintain wildlife habitat	0.27	0.31	0.04	**0.83**	0.56	0.52
Connected depressional wetland - Elm Slough (only deep marsh and scrub-shrub wetland)						
Detain floodwater	**0.58**	**0.62**	0.04	**0.87**	0.29	0.25
Store surface water	NA	NA	NA	NA	NA	NA
Cycle nutrients	**0.73**	**0.74**	0.01	**0.90**	0.17	0.16
Export organic carbon	0.48	**0.57**	0.09	**0.87**	0.39	0.30
Remove & sequester elements as compounds	**0.73**	**0.78**	0.05	**0.69**	-0.04	-0.09
Maintain characteristic plant community	**0.66**	**0.68**	0.02	**0.86**	0.20	0.18
Maintain wildlife habitat	**0.62**	**0.64**	0.02	**0.91**	0.29	0.27
Connected depressional wetland - Brushy Lake (only shallow marsh within Levee Lake INAI site)						
Detain floodwater	**0.53**	0.35	-0.18	**0.74**	0.21	0.39
Store surface water	NA	NA	NA	NA	NA	NA
Cycle nutrients	**0.68**	**0.68**	0.00	**0.53**	-0.15	-0.15
Export organic carbon	**0.58**	0.38	-0.20	**0.76**	0.18	0.38
Remove & sequester elements as compounds	**0.56**	0.38	-0.18	**0.84**	0.28	0.46
Maintain characteristic plant community	**0.66**	**0.66**	0.00	**0.87**	0.21	0.21
Maintain wildlife habitat	**0.75**	**0.59**	-0.16	**0.93**	0.18	0.34

7.11.1.4 Lake and Pond. Under the recommended plan, the extent of existing lakes and ponds in the action areas would increase slightly from about 8 to 9 percent, or by about 90 acres (Table 7-20). The plan would also introduce periodic flooding as an ecological feature to most of the lakes and ponds enveloped by the action areas, thereby restoring the existing ecosystem to a more natural condition. Storm water from tributary streams would serve as the source of this flooding. The recommended series of tributary stream sediment detention basins to be created would substantially reduce the rate of sediment transfer to the floodplain, and ensure that flooding introduced into floodplain lakes and ponds would not carry excessive levels of sediment. The plan would also improve biological aspects of most lakes and ponds in the action areas by establishing a band of emergent shallow-water vegetation along the shore, creating areas of deepwater habitat for over wintering fishes where needed, and adding submerged woody material or structure to increase aquatic habitat diversity.

Table 7-20 Effect on lake and pond communities within the recommended action areas.

Cover Type Description	Cover Type Name*	Existing Conditions		Projected Future Without-Project Conditions (in 50 years)		Future Conditions with Recommended Plan (in 50 years)		Difference Between Future With Plan and Future Without (in 50 years)		Difference Between Plan (post-construction) and Existing Conditions	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Lake and borrow pit (existing & proposed)	LACUST	372	7.6	333	6.8	460	9.4	127	2.6	88	1.8

* From Appendix A

7.11.1.4.1 Affected Action Areas. Most acreage of lake and pond communities to be affected by the plan is located in the Spring Lake and Mullens Slough action areas. Conversion of an existing sand plant at Cell 1 in the Spring Lake action area from an urban or developed area into a lacustrine or lake-like area represents the increase in acreage of this community type. Borrow pits at the sand plant that are currently filled with water (72 acres) and disturbed ground surrounding them (55 acres) would be made into one large lake immediately adjacent to Harding Ditch. Emergent vegetation would be established along the lake's margins, and woody material would be placed in the water as structure. Other existing water bodies in the Spring Lake action area, including natural ponds in Cell 1 and man-made borrow pits in Indian Lake, would remain as they are. Periodic flooding of lake communities in Cell 1 would come from flows from Harding Ditch; upon entering Cell 1, Harding Ditch would discharge first into the new lake created from the sand plant, where sediments would drop out. Periodic flooding in the Indian Lake component would also originate from Harding Ditch, via the proposed Fairmont City ditch leaving Cell 1.

At Mullens Slough action area, deepwater areas for over wintering of fish would be created in the existing 200-acre lake. Earthen materials excavated to create deep water areas would be used to build about five islands in the lake, which would reduce its surface area by about 20 acres. Shoreline vegetation and woody material would also be added. Also at Mullens Slough, an existing 5-acre man-made fishing lake would be converted into a floodplain detention basin to capture sediment carried by Powdermill Creek; high flows from the creek would be rerouted from Canal No. 1 into the large lake.

At four other action areas, existing lake communities consisting of man-made borrow pits would be retained, including, Judy's-Burdicks (19 acres), Elm Slough (16 acres), Brushy Lake (14 acres), and Dobrey Slough (about 2 acres). Emergent vegetation and woody structure would be added to the water bodies at the Judy's-Burdicks and Dobrey Slough action areas. Sources of periodic flooding of the lake communities at these other action areas would include various surface tributaries: Judy's and Burdick Branches (Judy's-Burdick), and Long Lake and Mitchell Ditch (Elm Slough).

7.11.1.4.2 Lake and Pond Plantings. Vegetative plantings in lakes and ponds would be restricted to shallow water areas along the shoreline of these waterbodies. Plant species to be used would consist of those selected for marsh plantings. These species are displayed in Table 8-3 of Section 8, Recommended Plan.

7.11.1.4.3 Wildlife Habitat of Lake and Pond. Like existing and future-without project conditions, the interagency biology team assessed future quality of lakes and ponds within the proposed action areas as wildlife habitat for four vertebrate species. The HEP analyses described in Appendix A demonstrate that under the recommended plan, the quality of lakes and ponds as wildlife habitat within the proposed action areas is expected to improve for three of these species (Table 7-21). Average HSI scores for all species but the white crappie exceed the moderate level (0.5) at target year 51 (TY51). For all species but the mink, the future-with-recommended-plan condition also represents an improvement compared to existing and anticipated future-without-project conditions. Some factors associated with habitat improvements are the planting of emergent herbaceous vegetation to increase shore cover, the creation of deepwater to provide overwintering habitat, and improved water quality caused by restoration of tributary stream resources. Outside the proposed action areas, lake and pond habitat conditions for these species are expected to be those of future-without project conditions.

Table 7-21 Existing and projected habitat quality of lakes and ponds within recommended action areas, expressed as habitat suitability indices (average and range) for four evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)			Future With Recommended Plan (TY51)			Net Change, Without Project versus With Plan
	Average	Range	Average	Range	Net Change, TY51-TY0	Average	Range	Net Change, TY51-TY0	
Great blue heron	**0.61**	0 - 0.71	0.41	0 - 0.58	-0.20	**0.66**	0 - 0.87	0.05	0.25
Mink	**0.74**	0 - 1	**0.84**	0 - 1	0.10	**0.82**	0 - 1	0.08	-0.02
Slider turtle	0.44	0 - 0.78	0.40	0 - 0.69	-0.04	**0.76**	0 - 0.96	0.32	0.36
White crappie	0.00	0 - 0	0.00	0 - 0	0.00	0.36	0 - 0.82	0.36	0.36

7.11.1.5 Stream. Total length of stream restoration under the recommended plan is about 11 miles in the proposed habitat restoration areas, and about 178 miles in the tributary watersheds that drain into the habitat restoration areas. In the bottoms, stream restoration would occur at four action areas, and in the tributary watersheds at five action areas.

In the bottoms, the plan would establish areas of natural habitats adjacent to these stream restorations. It would also introduce flooding as an ecological attribute to the streams and adjacent habitats, thereby restoring the existing floodplain ecosystem to a more natural condition. Storm water coming from tributary streams or floodplain channels would serve as the source of flooding in these floodplain areas. Table 7-22 reflects the area of proposed restored floodplain streams in the existing and proposed natural channel cover types. The plan would slightly increase the percentage of the action areas comprised by existing streams (natural or restored channels and man-made ditches), from about 2 percent to about 3 percent, or by about 85 acres.

Table 7-22 Effect on floodplain stream communities within the recommended action areas.

Cover Type Description	Cover Type Name*	Existing Conditions		Projected Future Without-Project Conditions (in 50 years)		Future Conditions with Recommended Plan (in 50 years)		Difference Between Future With Plan and Future Without (in 50 years)		Difference Between Plan (post-constructiou) and Existing Conditions	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Natural channel (existing)	CHANNEL	58	1.2	48	1.0	39	0.8	-9	-0.2	-19	-0.4
New natural channel (proposed)	NEWCHANNEL	0	0	0	0	66	1.3	66	1.3	66	1.3
Man-made ditch (existing)	DITCH	19	0.4	19	0.4	16	0.3	-3	-0.1	-3	-0.1
New man-made ditch (proposed)	NEWDITCH	0	0	0	0	40	0.8	40	0.8	40	0.8
Total		77	1.6	68	1.4	161	3.3	93	1.9	84	1.7

* From Appendix A

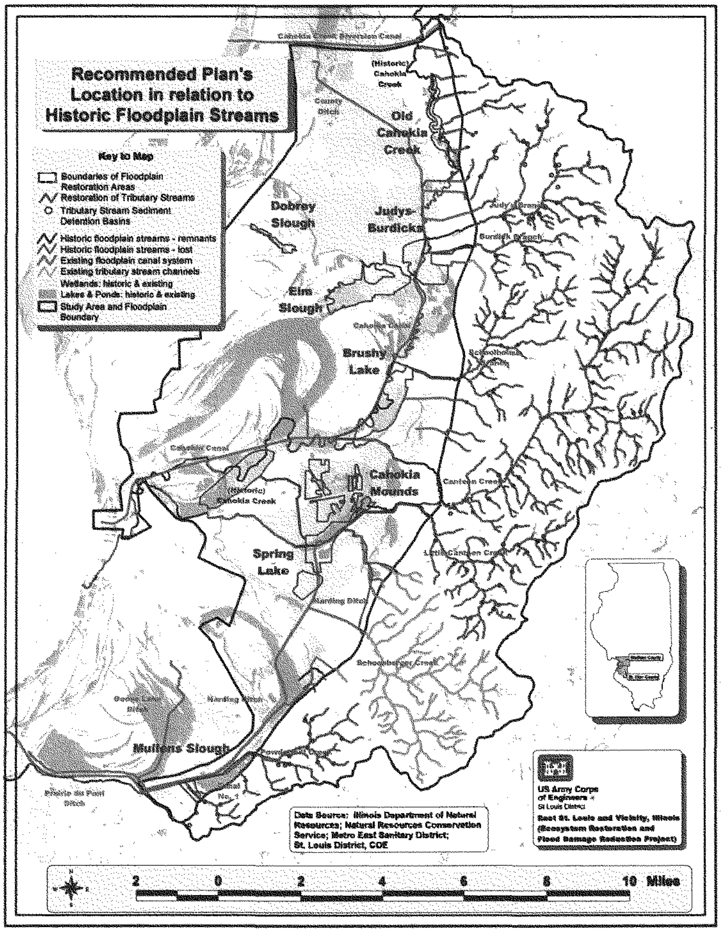
7.11.1.5.1 Affected Action Areas. The four action areas where floodplain stream restorations are recommended are Old Cahokia Creek, Judy's-Burdicks, Brushy Lake, and Spring Lake. The length of proposed stream restoration for each action area is shown in Table 7-23. Historic Cahokia Creek would be restored to its original location at these action areas wherever possible. Dimensions of the restored channel would approximate those of the historic channel, but future analyses may determine that they would need to be smaller to accommodate lesser flows under present-day compared to historic conditions.

Table 7-23 Proposed stream restoration in recommended plan.

Proposed Action Area	Length of Stream Restoration (miles)	
	Floodplain Habitat Area (bottoms)	Tributary Watershed (uplands)
Old Cahokia Creek	3.4	6.6
Judy's-Burdicks	0.8	32.1
Brushy Lake	3.5	25.2
Spring Lake	3.1	98.6
Mullens Slough	0.0	15.8
Total	**10.8**	**178.3**

Figure 7-7 displays the boundaries of the recommended action areas with respect to historic changes in spatial extent of floodplain streams. In this figure, areas in dark blue represent existing stream remnants, and areas in light blue within the boundaries of the Old Cahokia Creek, Judy's-Burdicks, and Brushy Lake action areas (in Table 7-18) represent proposed stream restoration areas. In Figure 7-7, the dark blue remnant within the Indian Lake portion of the Spring Lake action area represents the area of stream restoration [near the label "(Historic) Cahokia Creek"].

Figure 7-7 Recommended Plan's Relation to Historic Floodplain Streams-



7.11.1.5.2 Wildlife Habitat of Streams. Like existing and future-without project conditions, the interagency biology team assessed future quality of floodplain streams and ditches within the proposed action areas as wildlife habitat for five vertebrate species. The HEP analyses described in Appendix A demonstrate that under the recommended plan, the quality of floodplain streams and ditches as wildlife habitat within the proposed action areas is expected to improve for black crappie, great blue heron, and slider turtle, and remain about the same for the mink (Table 7-24). The wood duck is not expected to benefit from the recommended plan, as streams and ditches are not suitable for the species. Average HSI scores for the black crappie, great blue heron, and mink exceed the moderate level (0.5) at target year 51 (TY51). For the black crappie and great blue heron, the future-with-recommended-plan condition also represents an improvement compared to existing and anticipated future-without-project conditions. Some factors associated with habitat improvements are the restoration of flowing conditions to remnant channels, the creation of a riparian corridor adjacent to channels, and improved water quality caused by the restoration of tributary stream resources. Outside the proposed action areas, floodplain stream and ditch habitat conditions for these species are expected to be those of future-without project conditions, except that water quality should be improved due to the restoration of tributary stream resources.

The recommended plan, with proposed restoration of floodplain streams at four separate action areas, is expected to create conditions attractive to the beaver, which occurs within the study area. This mammal sometimes builds dams in channels of the interior flood control system that carry flowing water. By ponding water, these dams can interfere with the flood control function of the channels, and their presence represents a maintenance responsibility. Beaver activity within proposed action areas and the adjacent interior flood control system would be monitored. If dams were to be built that hinde the flood control or ecological function of the system, then a management program to remove beavers from such areas would need to be implemented.

Proposed restoration of tributary streams is expected to improve habitat conditions for a variety of aquatic life. To assess habitat improvements, the Qualitative Habitat Evaluation Index procedure was applied to evaluate existing and projected future conditions for fish and aquatic invertebrate communities. Using this method, the habitat suitability index for existing conditions was 0.64 on a scale from 0 to 1. For future conditions in 50 years, the value dropped to 0.55 under no action, and increased to 0.85 under the recommended plan. The proposed restoration would improve various physical characteristics of stream habitat that are currently degraded and forecast to worsen in the future with no action. Stabilization of eroding banks and unstable channel bottoms is expected to reduce the amount of silt in channel substrates from elevated to normal levels. The proposed 131 tributary stream sediment detention basins scattered across the affected watersheds are expected to reduce sediment loads that are currently excessive. Coarse natural till materials such as gravels and cobbles would become more prevalent in substrates. The proposed addition of boulders to restore riffle/run complexes would add further substrate diversity. Bank stabilization measures would improve in-stream cover and riparian zone width over the future no-action condition by restoring bank stability that would otherwise lead to channel widening and toppling of bank line trees. Restoration of pool/riffle complexes at successive reaches along streams is expected to increase stream gradients to some extent and raise current velocities to more desirable levels.

Within pools and riffles, water depths that are generally too shallow to support much aquatic life are expected to increase substantially. Improved physical conditions of streams are expected to lead to water quality improvements, and greater levels of productivity of organisms such as aquatic invertebrates. In turn, higher trophic levels, such as forest birds specializing on aquatic invertebrates, would benefit from increased feeding opportunities.

Table 7-24 Existing and projected habitat quality of floodplain streams and ditches within recommended action areas, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)			Future With Recommended Plan (TY51)			Net Change, Without Project versus With Plan
	Average	Range	Average	Range	Net Change, TY51-TY0	Average	Range	Net Change, TY51-TY0	
Black crappie	**0.55**	0 – 0.79	**0.58**	0 - 0.79	0.03	**0.80**	0 - 0.84	0.25	0.22
Great blue heron	**0.54**	0 – 0.79	0.44	0 - 0.66	-0.10	**0.59**	0 - 0.92	0.05	0.15
Mink	**0.72**	0 – 0.87	**0.57**	0 - 0.88	-0.15	**0.59**	0 - 1	-0.13	0.02
Slider turtle	0.27	0 – 0.45	0.25	0 - 0.37	-0.02	0.48	0 - 0.58	0.21	0.23
Wood duck	0.01	0 – 0.16	0.01	0 - 0.16	0.00	0.03	0 - 0.39	0.02	0.02

7.11.1.6 Cultural. Under the recommended plan, the expansion of existing natural areas and creation of new ones would require the conversion of existing cultural habitats, such as cropland, hay production areas, and abandoned fields. Within the action areas, the plan would reduce the area of existing cultural communities from about 2,640 acres to 260 acres, or from about 54 percent to 5 percent. Table 7-25 displays these changes in cultural communities for five different cover types.

Table 7-25 Effect on cultural communities within the recommended action areas.

Cover Type Description	Cover Type Name*	Existing Conditions		Projected Future Without-Project Conditions (in 50 years)		Future Conditions with Recommended Plan (in 50 years)		Difference Between Future With Plan and Future Without (in 50 years)		Difference Between Plan (post-construction) and Existing Conditions	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Abandoned fields and haylands (existing)	FIELD	538	10.9	525	10.7	11	0.2	-514	-10.5	-527	-10.7
Urban old fields (existing)	URBFIELD	92	1.9	3	0.1	0	0	-3	-0.1	- 92	-1.9
Urban development (existing)	URBAN	236	4.8	1,971	40.1	110	2.2	-1,862	-37.9	-127	-2.6
Cropland (existing)	AGCROP	1,651	33.6	545	11.1	0	0	-545	-11.1	-1,651	-33.6
Grassy areas (existing & proposed)	GRASS	118	2.4	116	2.4	137	2.8	21	0.4	19	0.4
Total		2,635	53.6	3,160	64.3	258	5.2	-2,902	-59.0	-2,377	-48.3

*From Appendix A

7.11.1.6.1 Wildlife Habitat of Cultural Areas. Like existing and future-without project conditions, the interagency biology team assessed future quality of cultural cover types that were considered to be suitable as wildlife habitat. The only cover type to fit this description is field, and about 11 acres is proposed at the Elm Slough action area only (to act as a sediment screen for sheet flow from Long Lake and Mitchell Ditch). The HEP analysis described in Appendix A demonstrates that under the recommended plan, the quality of newly created field at Elm Slough as wildlife habitat for the eastern meadowlark is expected to be slightly less than existing field at other sites (Table 7-26).

Table 7-26 Existing and projected habitat quality of old fields within recommended action areas, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)			Future With Recommended Plan (TY51)			Net Change, Without Project versus With Plan
	Average	Range	Average	Range	Net Change, TY51-TY0	Average	Range	Net Change, TY51-TY0	
Eastern meadowlark	0.34	0 - 0.34	0.38	0 - 0.39	0.04	0.28	0 - 0.28	-0.06	-0.10

7.11.2 Natural Areas, Nature Preserves, and Endangered Species Sites. The recommended plan would envelop one designated natural area (Levee Lake) and two endangered species sites (Illinois chorus frog, decurrent false aster) that are included in the natural heritage database maintained by the Illinois Department of Natural Resources. The plan would not affect the Bohm Woods or Poag Railroad Prairie Natural Areas, nor the William & Emma Bohm Memorial Nature Preserve, which are within the study area. It also would not affect the Chouteau Catchfly, Poag Railroad Prairie, Eagle Park Marsh, and East St. Louis (Alorton) Heron Colony endangered species sites.

The Levee Lake Natural Area lies within the floodplain portion of the Brushy Lake action area. Main features of the proposed plan for Brushy Lake includes expansion of forested floodplain habitats and introduction of periodic flood pulses using stormwater from Schoolhouse Branch and Snyder Ditch. The Natural Area would serve as a core area for habitat expansion. Native trees species would be planted in existing cropland to create new forest. About 3.5 miles of historic Cahokia Creek would be restored to a flowing condition within the habitat area from north to south (Table 7-23). Agricultural ditches in existing cropland at the site would be plugged to restore water levels in pond and shrub-swamp plant communities that were drained about 20 years ago. Implementation of these features would return the Levee Lake Natural Area and surrounding new habitats to a more historic condition.

At Brushy Lake, the addition of about 330 acres of new floodplain forest to about 240 acres of existing forest would establish a wooded area exceeding 500 acres in size, the recommended minimum area in Illinois for successful breeding by populations of forest interior nesting birds. New forest established adjacent to the restored stream channel would create a 3.5-mile long riparian corridor within the habitat area, which is expected to benefit a wide variety of wildlife species.

The design flood, or maximum flood event to be introduced into the Brushy Lake habitat area, is estimated to vary in depth from zero to seven feet, depending on local topography (Table 7-17). The design event is also expected to inundate most of the proposed habitat area for a duration of less than one day (Table 7-17). A variety of wetland functions are expected to improve at Brushy Lake with the proposed reintroduction of flood pulses (Table 7-19), however this analysis did not include all wetlands at the site, but only those with the lowest topography. A gradual but slight shift in composition of plant communities toward wetter species is expected over time after reintroduction of periodic flood pulses (Section 7.11.3.1.2). Stormwater introduced into Levee Lake Natural Area is expected to be relatively free of sediment and a number of pollutants after implementation of the proposed system of tributary stream sediment detention basins and in-stream channel improvements in the study area's tributary watersheds (Section 7.11.3.1.3).

For the state-threatened Illinois chorus frog (*Pseudacris streckeri illinoensis*), two of four tracts of precision habitat for this species overlap with the floodplain portion of the Old Cahokia Creek action area. At this site, about 3.4 miles of historic Cahokia Creek would be restored to a flowing condition, from north to south (Table 7-18), and a 328-foot (100-meter) wide forested corridor would be established on both sides of the creek channel. Stormwater from Bluff 1 tributaries would be used to reintroduce a periodic flood pulse into the forested corridor habitat area. An earthen berm would be constructed along the west edge of the action area to contain stormwater in the corridor, and prevent it from flooding developed areas to the west.

The largest of the four tracts of precision habitat lies at the north end of the stream restoration area, and the smallest occurs toward the south end. For these two tracts, the area of overlap with the action area is about 105 acres, which represents about 22 percent of the total area of precision habitat (about 475 acres). Existing cropland areas adjacent to the historic creek channel would be forested with native tree species to establish a continuous riparian corridor along the restored stream channel. This reforestation is expected to benefit the species. The earthen berm is also expected to benefit the frog by preventing fish (a natural predator) from reaching the two other tracts of precision habitat located to the west of the action area. During the design flood event, most of the northern and southern tracts of precision habitat overlapping with the action area would be inundated by water, which would vary in depth from zero to about three feet depending on local topography (Table 7-12). If the recommended plan is approved, further refinement of features at this action area would be coordinated with pertinent federal and state natural resource agencies to avoid potential adverse impacts to the Illinois chorus frog. Additional details concerning this species are found in Appendix B in the biological assessment for state-listed species (Annex B.14).

For the state- and federally-threatened decurrent false aster (*Boltonia decurrens*), the Fairmont City Site for this species lies within the Indian Lake component of the Spring Lake action area. Indian Lake lies south of I-55/70 between IL Routes 203 and 111. A number of colonies of decurrent false aster have been reported by USDOT (2000) from marsh and other habitats at Indian Lake. Here, the proposed restoration of Cahokia Creek, and establishment of a 328-foot (100-meter) wide forested riparian zone on both sides of the creek restoration, may overlap with colonies previously identified. These proposed features might also overlap with a wetlands compensation site to be used for decurrent false aster mitigation by USDOT (2000) for the new Mississippi River bridge and relocated I-70 and I-64 connector. If the plan recommended in this document is approved, the location and extent of existing decurrent false aster colonies (and USDOT mitigation site) will be defined and compared with proposed features. Proposed features found to be overlapping with individual plants or colonies will be modified to avoid any overlap. A main goal of these efforts will be to restore and maintain existing habitat used by the species in a state of high-light levels with open, nonwoody vegetation. The reintroduction of periodic "flood pulses" into Indian Lake is expected to benefit the decurrent false aster because flood waters can promote seed dispersal, and this type of ecosystem disturbance can retard the encroachment of woody vegetation into open areas. Effects on the Fairmont City Site are also discussed in Appendix B in the biological assessment for federally listed species.

7.11.3 Plant and Animal Species. Given that ecosystem restoration is the fundamental objective of the recommended plan, many native species of floodplain-adapted plants and animals are expected to benefit from features designed to expand existing habitats, restore underrepresented habitats, and restore historic ecosystem processes, such as wild fire and riverine flooding.

7.11.3.1 Plants. Plants to be used to create and restore natural communities, such as forests, prairies, and marshes, would consist of native species only. Specific species to be planted and general planting methods to be employed are described in Section 8 – Recommended Plan. Recreated natural communities would consist of a diverse number of plant species known to occur in those communities, as available commercially. The plan would not attempt to include all species known to occur in a particular natural community.

7.11.3.1.1 Effects of Prescribed Fire on Native Plant Communities. After the establishment of vegetative plantings, prescribed fire would be used as a management tool to maintain the natural integrity of about 1,800 acres of prairie and marsh plant communities, since wild fire performed this function during predevelopment times. Periodic use of prescribed fire in these plant communities would remove accumulations of dead plant material and allow for growth of new vegetation, increase flowering, improve seed germination, and allow for the earlier emergence of new growth in the spring. Fire would also suppress the encroachment of trees, and eliminate non-native plant species. Because wild fire apparently was not an important historic ecological factor in floodplain forests of the American Bottom or adjacent tributary streams, forested communities within the proposed action areas would not be burned.

Affected action areas would include Judy's-Burdicks (new prairie), Dobrey Slough (new marsh), Elm Slough (new prairie), Brushy Lake (existing prairie), Cahokia Mounds (new prairie), Spring Lake, including Cell 1, St. Clair Farms, and Indian Lake (existing and new marsh), and Mullens Slough (new prairie). Burning would be conducted on a 3-year rotational cycle such that about one-third of all areas prescribed for fire would be burned every year. Under this management schedule, about 600 acres of prairies and marshes would be burned annually. Burns would be conducted in the late fall and/or early spring when plants are dormant. Burn management plans would be developed for each action area if the recommended plan were approved. Development of these plans would be coordinated with applicable agencies and the public.

7.11.3.1.2 Effects of Introduced Flooding on Native Plant Communities. Stormwater introduced into habitats to mimic historic flooding is expected to cause a gradual shift in composition of plant communities toward wetter species. This shift in species composition would be slight because duration of flood events, including the design flood event, would last from about one day to two weeks, depending on location. Flood durations capable of killing woody vegetation by drowning would be avoided by design.

7.11.3.1.3 Effects of Stormwater Pollutants on Native Plant Communities. Because wetlands improve water quality by acting as filters, exposure of natural wetlands over extended periods of time to pollutants contained in rural and urban stormwater can adversely affect native wetland plant communities. Excessive levels of nutrients, such as nitrogen and phosphorus, and the presence of heavy metals, oil and grease, and other contaminants, can reduce plant species diversity, replace sensitive species with those tolerant of disturbed conditions, and alter species distributions (Mitsch and Gosselink 1993, USEPA 1996). Native species such as common reed (*Phragmites australis*), river bulrush (*Scirpus fluviatilis*), and common cattail (*Typha latifolia*) can become aggressive in marshes subject to sedimentation and fertilizer runoff from agricultural fields, as well as increased flooding (IDNR 1998e).

Sensitivity of existing plant communities to pollutants varies among the nine action areas into which stormwater would be introduced for ecological purposes. This variation in community sensitivity is due to differences among the sites in plant species composition, or the proportion of species that are considered to be typical of degraded versus "pristine" conditions (as assessed during baseline vegetation inventories conducted in the spring of 1999 and 2000).

The flora at Brushy Lake apparently is the most sensitive. Brushy Lake is the only action area containing a state-designated natural area (Levee Lake Natural Area). The high natural integrity of local pond and shrub-swamp plant communities noted in the mid-1970s formed the basis for this designation. Lake cress (*Armoracia aquatica*) is an example of a locally occurring plant that is considered to be restricted to "pristine" areas (Taft et al. 1997). Encountered within the Natural Area in May 2000, this species is a perennial aquatic herb found in "swamps and quiet streams" of Illinois (Mohlenbrock 1975:252). It is considered to be sensitive to agricultural and industrial runoff (Gabel and Les 2001). Action areas with the least sensitive plant communities include Judy's-Burdicks (nearly all cropland), and Dobrey Slough (disturbed marsh in residential area). Plant communities at the remaining five action areas – Old Cahokia Creek, Elm Slough, Spring Lake, Mullens Slough – would be intermediate in sensitivity.

Much of the non-point source pollution carried by stormwater coming from tributary streams would be greatly reduced by the recommended plan's proposed series of tributary stream sediment detention basins. These structures, along with in-stream riffle and pool components, are collectively designed to reduce the rate of sediment transfer from tributary streams to floodplain by 70 percent. By capturing and detaining sediment, these features would also substantially reduce levels of other pollutants in stormwater, such as phosphorus and heavy metals. Phosphorus and heavy metals are often bound to sediment particles, whereas nitrogen is often dissolved (USEPA 1996). At the two action areas receiving stormwater from floodplain rather than upland tributaries (Elm Slough and Dobrey Slough), proposed plantings of either grassy species (Elm Slough) or tree species with groundcover (Dobrey Slough) would create vegetative sediment filters to reduce levels of pollutants in stormwater sheet-flowing into these areas. Therefore, stormwater introduced as a "flood pulse" into habitats of proposed floodplain action areas would be relatively free of sediment and a number of other pollutants.

If the pilot program to construct several tributary stream sediment detention basins and in-stream riffle and pool complexes on Judy's Branch were to show that these features do not function as effectively in capturing sediment as planned, then some augmentation with sediment detention basins within the floodplain action areas may be required. Whether upland sediment detention features alone would be sufficient to reduce all non-point source pollutants of concern to a level that existing and created wetland habitats could sustain to maintain plant community integrity, is unknown at this time. The need to incorporate wetlands created to specifically treat stormwater in combination with sedimentation basins, in a "treatment train approach", would be examined during the design phase, if the recommended plan were approved.

7.11.3.2 Invertebrates. Invertebrate species typical of natural floodplain habitats, especially wetland and aquatic areas, are expected to benefit from the recommended plan. Arthropods or insects, the most diverse group of invertebrates, would be expected to live in the forest, prairie, marsh, lake and pond, and stream habitats included in the recommended action areas. Invertebrates inhabiting these areas would constitute a food source for coexisting insectivorous animals, including other invertebrates as well as many birds, amphibians and reptiles, fish, and some mammals.

Concerning mosquitoes, the recommended plan would prevent stormwater (up to the design flood event) from occasionally overtopping the interior flood control system and temporarily flooding adjacent developed areas, where standing water in proximity to people could function as larval habitat. Instead, stormwater would be beneficially utilized to create a flood pulse in proposed action areas and thereby kept out of developed areas.

Within the proposed action areas, habitats such as marshes and forests with temporary pools of water probably would serve as larval habitat for some mosquito species. However, population levels of mosquitoes are not expected to become a nuisance in adjacent developed areas because these habitats are anticipated to support insectivorous birds, fish, insects, and other animals that feed on larval and adult mosquitoes. Because of the proposed tributary stream sediment detention basins and other structures, stormwater entering the proposed action areas would be relatively free of sediment and many other pollutants, and capable of supporting aquatic animal populations that eat mosquitoes. Periodic flooding in these habitats would allow for turnover of standing water and reduce stagnant conditions favorable for mosquito breeding.

7.11.3.3 Fishes. The recommended plan is expected to benefit fishes by restoring aquatic habitat and improving conditions for spawning, rearing, and feeding. The restoration of about 10.8 miles of historic Cahokia Creek at four separate action areas would provide floodplain stream habitat for numerous fish species. Natural habitats surrounding these stream restoration areas would be periodically accessible to fishes for feeding or spawning during events of overbank flooding.

The addition of emergent shoreline vegetation and woody materials to the lake habitats at Mullens Slough, Spring Lake, and Judy's-Burdicks action areas would improve feeding, spawning, and rearing opportunities for local fishes. Overwintering habitat at Mullens Slough would be improved by the creation of areas over eight feet deep. Because the proposed tributary stream sediment detention basins would capture much of the sediment currently reaching the floodplain, stream habitats in the uplands and floodplain would experience substantially less levels of sedimentation and smothering of substrates by sediment particles. Reduced levels of suspended sediments would improve water quality in these aquatic areas and benefit sight-feeding fishes.

An indirect adverse impact of constructing 131 detention basins in the tributary watersheds is that the dam at each basin would act as a partial barrier to fish movement. Fish could be carried downstream when storm water would overtop the dam's spillway, and probably also during normal conditions when low flows would pass through each structure's concrete gravity flow system. However, fish would not be able to move upstream past these structures during either low or high water conditions. As barriers to upstream dispersal, these structures could contribute to local population reductions and possible extirpation of some of the 5 to 7 fish species known from these watersheds. This potential adverse impact of basins on fish movements would be largely avoided if a pilot program consisting of several detention basins and other in-stream structures to be constructed on Judy's Branch were not successful at reducing sediment transfer to the floodplain. Then basins would not be built in streams of the other upland watersheds per the recommended plan. Follow-up NEPA compliance documents to this report will present the findings of the pilot program.

7.11.3.4 Reptiles and Amphibians. The recommended plan would benefit reptiles and amphibians by providing about 4,700 acres of diverse natural habitats. Proposed forests, prairies, marshes, and restored floodplain streams and lakes, including riparian zones along stream channels, would support a diversity of species. The establishment of a zone of emergent vegetation along lakeshores at some action areas would provide habitat for a number of species. Temporary ponding of stormwater in the proposed series of tributary stream sediment detention basins to be constructed in the tributary watersheds would be expected to benefit some of these animals. Improvement of water quality in streams and lakes in the bottoms, due to a reduction of sediment and other pollutants transferred from tributary watersheds to the floodplain, would especially benefit reptiles and amphibians.

Some reptiles and amphibians would be expected to avoid flooding of action areas by stormwater by moving laterally toward higher ground, ahead of rising water levels. Others, such as most turtles, would adapt to flooding. Since floodplain action areas receiving stormwater would be completely inundated during large storm events, the creation of buffer or escape zones around the perimeter of flooded areas was desirable. At the floodplain portion of the Judy's-Burdicks action area, the 328-foot (100-meter) wide zone of prairie surrounding the earthen ring berm to contain flood pulses is intended to serve this purpose. Incorporation of such a feature at other action areas proved to be difficult, most often because of the close proximity of adjacent development. Similarly, establishment of corridors linking floodplain and upland areas, such as along stream channels, also proved difficult because of existing development (principally Route 157).

7.11.3.5 Birds. The recommended plan would benefit many bird species by providing about 4,700 acres of diverse habitats for foraging and nesting, including forests, prairies, marshes, and restored floodplain streams and lakes. Wooded areas exceeding 500 acres in size, the recommended minimum area in Illinois for successful breeding by populations of forest interior nesting birds, would be established at one action area, and nearly so at a second. At Brushy Lake action area, the addition of about 330 additional acres of new forest to about 240 acres of existing forest would create a wooded area of about 550 acres. At Elm Slough and vicinity, an area approaching 500 acres would be created. At this action area, about 450 acres of forested habitats would be established, which would be contiguous with about 50 acres of existing forest outside the action area to the southeast. Foraging opportunities for birds would also be improved at lake habitats located at Spring Lake, Mullens Slough, and Judy's-Burdicks action areas because of expected increases in aquatic invertebrates and fishes, due to the establishment of emergent shoreline vegetation.

Prairie areas large enough to benefit area-sensitive grassland breeding bird species, which are recommended to exceed 125 acres and preferably 250 acres, would be established at the Judy's-Burdicks and Cahokia Mounds actions areas. At the former, about 350 to 450 acres of prairie would be recreated, depending on whether a forested wetland mitigation site is implemented there (USDOT 2000). At Cahokia Mounds, one prairie restoration site is about 160 acres, whereas the remaining sites are each less than 125 acres.

An indirect adverse impact of the recommended plan would be the potential for occasional large stormwater events introduced into action areas as flood pulses to inundate active nests of bird species that usually nest near the ground, and either destroy eggs or drown young nestlings.

This potential for flood-induced mortality, a natural phenomenon of historic floodplains, would exist at all eight action areas to receive flood pulses. Maximum flood depths would vary from 4 to 7 feet (Table 7-17). The likelihood that local populations of bird species that nest near the ground would decline over the long term due to mortality from flood pulses is expected to be low, for several reasons. First, during most years, depth of flood events introduced into action areas would be much less than the estimated maximum depth, and these lesser events would likely cause no to little mortality. Second, once flooding from large storm events would recede (maximum duration estimated to vary from one to 13 days), adults of most affected bird species probably would re-nest. Lastly, many existing wetlands and other habitats in the study area that are or could be used by birds for nesting are not incorporated into the recommended plan, and flood pulses would not affect them.

7.11.3.6 Mammals. Many mammals would benefit from the preservation and creation of about 4,700 acres of various habitats, including floodplain forests, prairies, marshes, streams, and lakes. Mammals of the study area that are adapted to wetlands, streams, or lakes, such as opossum, mink, muskrat, beaver, bats, and all carnivores, would especially benefit. Improvement of water quality of stormwater and of streams and lakes in the bottoms, due to a reduction of sediment and other pollutants transferred from tributary watersheds to the floodplain, would especially benefit these species. Some non-flying mammals would be expected to avoid flooding of action areas by stormwater by moving laterally toward higher ground, ahead of rising water levels. Others, such muskrats and beavers, would adapt to flooding. Since floodplain action areas receiving stormwater would be completely inundated during large storm events, the creation of buffer or escape zones around the perimeter of flooded areas was desirable. At the floodplain portion of the Judy's-Burdicks action area, the 328-foot (100-meter) wide zone of prairie surrounding the earthen ring berm to contain flood pulses is intended to serve this purpose.

There are some species, such as small rodents and insectivores, which could drown from flooding introduced into the action areas. This indirect adverse impact of the recommended plan, a natural phenomenon of historic floodplains, is not expected to lead to a long-term reduction of population levels of such affected species, for several reasons. Once flooding recedes, recolonization of habitats would be expected as times passes. Also, species inhabiting floodplain habitats not incorporated into the recommended plan would not be affected.

7.11.4 Endangered and Threatened Species. This section presents a summary of the recommended plan's effect on federally- and state-listed species that may occur within the study area. A detailed description of potential effects on each of these species is presented in Appendix B in a biological assessment of listed species. This assessment also includes a detailed discussion of the potential presence of federally- and state-listed species in the study area under existing conditions.

If the recommended plan is approved, this assessment of the plan's effect on listed species would be revised and updated as necessary, and would appear again in future NEPA compliance documents prepared for each of the action areas once detailed plans are finalized.

7.11.4.1 Summary of Potential Effects on Federally-Listed Species. It is the St. Louis District's opinion that the recommended plan would not adversely impact any of the federally threatened or endangered species, or species of concern, that may occur in the study area, provided that 1) tree felling is restricted to the time of the year (October 1 through March 31) when Indiana bat maternity colonies are not present, and 2) any potential overlap of proposed features with existing decurrent false aster populations, or USDOT decurrent false aster mitigation areas, is avoided. The U.S. Fish and Wildlife Service will be given an opportunity to review this report, including the biological assessment in Appendix B (Annex B.14).

7.11.4.2 Summary of Potential Effects on State-Listed Species. Excluding the federally-listed species (including the massasauga), state-listed species in general are expected to benefit from the recommended plan. Adverse effects potentially could occur to eight bird species. Conversion of pasture-like grassy areas and shrubby areas to prairie restoration would remove potential habitat for the upland sandpiper and loggerhead shrike. Larger flood pulses introduced into a number of proposed action areas could occasionally inundate nests of the American bittern, northern harrier, king rail, pied-billed grebe, least bittern, or common moorhen, if these species were to nest in these areas.

7.12 CULTURAL RESOURCES

Three proposed floodplain habitat restoration areas overlap with Cahokia Mounds National Historic Landmark (Figure 7-8). They include part of Brushy Lake, all of Cahokia Mounds Prairie, and part of Spring Lake.

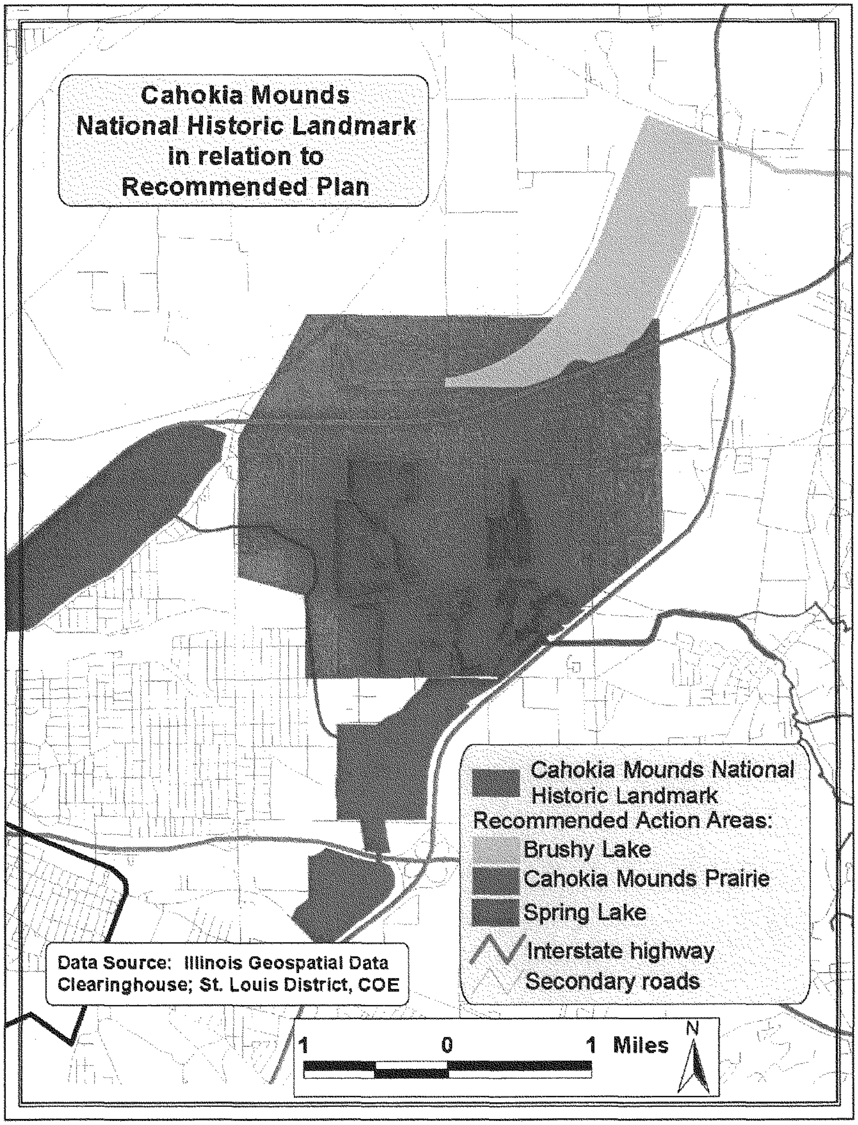
The prehistoric site of Cahokia Mounds, the largest prehistoric complex in North America, is situated near the center of the Project area. Hundreds of additional archaeological sites, related to this United Nations World Heritage landmark, surround the site of Cahokia. The majority of these archaeological properties are located on floodplain ridges and in bluff edge contexts. Prior to the completion of the interior drainage network (constructed throughout the American Bottom during the early twentieth century), these archaeological sites were once in close proximity to numerous wetlands, sloughs, and shallow lake - features critical to the restoration study goals.

Given the unique, internationally significant, character of these archaeological remains, this study has recommended structuring individual project features in such a manner as to minimize damage to potentially significant archaeological remains. This goal can be achieved by purposefully integrating (to the extent practical) the boundaries of individual components of this prehistoric archaeological complex into individual project features. In many cases, the floodplain ridges upon which these archaeological sites are located will comprise the borders of the ecological units, natural detention areas, or other recommended project features.

Archaeological sites within these contexts will then be afforded long-term protection consistent with the Illinois State Historic Preservation Officer's preservation covenants, as administered by the Illinois Historic Preservation Agency (IHPA). All historic properties investigations shall be closely coordinated with, and reviewed by, the IHPA, the National Parks Service, and the Advisory Council on Historic Preservation.

The cultural value of this effort becomes clear when measured against demographic predications which state that as much as 90 percent of the land surfaces within the study area upon which these archaeological remains are located will be lost to future residential or commercial development. Growth projections reveal that virtually all unprotected archaeological sites within the project study area will be destroyed within the next three decades.

Figure 7-8 Recommended Plan in Relation to Cahokia Mounds National Historic Landmark



7.13 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTES

Eight hazardous waste sites are within 0.5 mile of the recommended plan. These sites are displayed in Figure 7-8. Table 7-26 presents information about these sites and the plan's nearest feature.

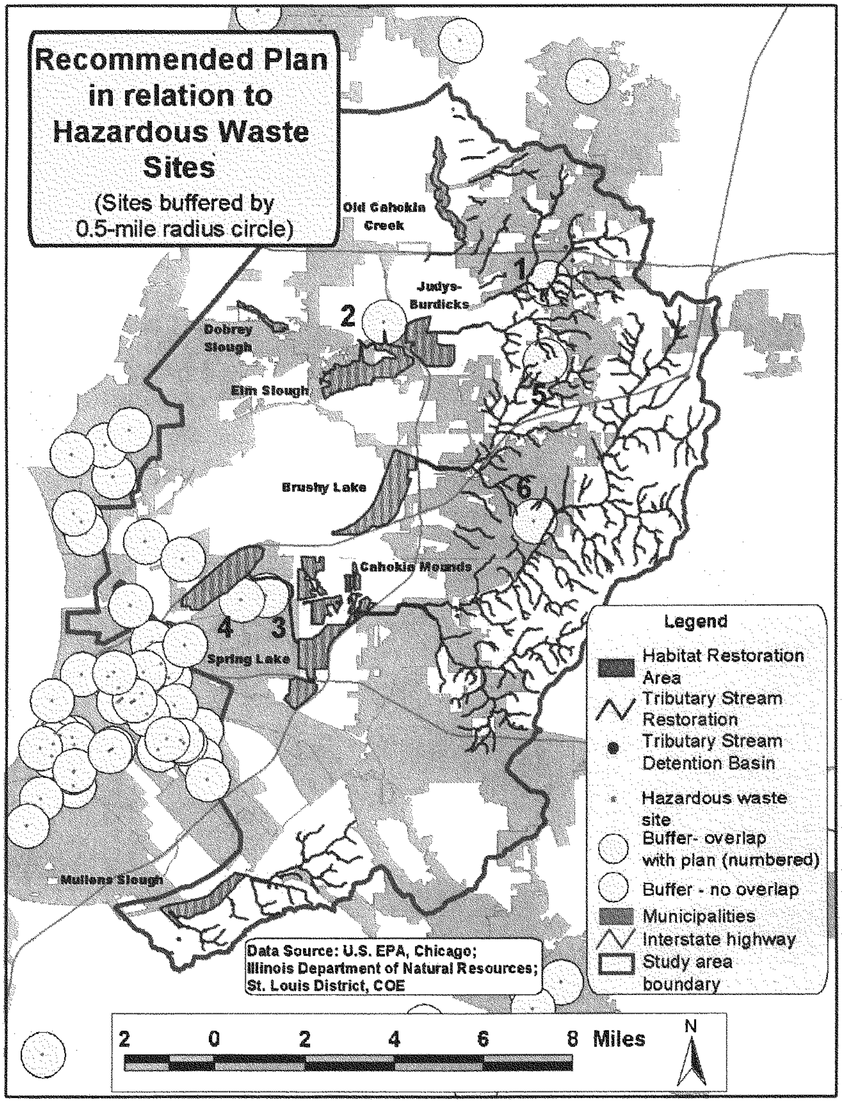
At site number 1 in Figure 7-8, three proposed tributary stream sediment detention basins are located from 800 to 1,300 feet away and on the opposite side of Judy's Branch from the hazardous waste site. The channel of Judy's Branch is as close as about 300 feet from this site. Site number 2, which is archived, is about 1,000 feet north of the junction of Route 162 and Mitchell Ditch at the Elm Slough action area. Site number 3 is about 2,000 feet south of the proposed Fairmont City ditch at the Spring Lake action area. Site number 4 is about 2,800 feet from the same proposed ditch, and about 1,800 feet southeast of Indian Lake. Site number 5, which is also archived, is about 400 from the nearest tributary stream channel of Burdicks Branch of the Judy's-Burdicks action area, and about 1,000 feet from the nearest channel of Schoolhouse Branch of the Brushy Lake project area. Because of their close proximity, three hazardous waste sites represent site number 6 in Figure 7-8. These sites are from 1,300 to 1,700 feet from the nearest tributary stream channel of Canteen Creek, and 2,200 feet from the nearest channel of Little Canteen Creek of the Spring Lake action area.

Given the distance between these sites and the nearest proposed features, the recommended plan is not expected to affect any known hazardous waste sites.

Table 7-27 Hazardous waste sites within 0.5 mile of the recommended plan.

Site Number	Waste Site and Location	Site Status	Nearest Action Area	Closest Proposed Feature
1	Kettle River Creosole Works, Glen Carbon	Cerclis	Judy's-Burdicks	3 tributary stream sediment detention basins; tributary stream restoration (pool-riffle)
2	Illinois Power Co Stallings Gas Turbine, Stallings	Archived	Elm Slough	Mitchell Ditch modification
3	Swift Ag Chem Fairmont City Plant, Fairmont City	Cerclis	Spring Lake	Fairmont City ditch
4	Old American Zinc Plant, Fairmont City	Cerclis	Spring Lake	Indian Lake component
5	Kosyak Horse Arena	Archived	Judy's-Burdicks, Brushy Lake	Tributary stream restoration (pool-riffle)
6	St. Louis Smelting & Refining Co.	Cerclis	Spring Lake	Tributary stream restoration (pool-riffle)
6	Collinsville/Keel	Cerclis	Spring Lake	Tributary stream restoration (pool-riffle)
6	Central States Battery	Cerclis	Spring Lake	Tributary stream restoration (pool-riffle)

Figure 7-9 Recommended Plan in Relation to Hazardous Waste Sites



7.14 CUMULATIVE IMPACTS

The cumulative effects of the recommended plan in the context of other activities and development in the affected area are the focus of this section. The Council on Environmental Quality defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time" (40 Code of Federal Regulations, Section 1508.7).

Topics addressed in this section include past and present actions, reasonably foreseeable future actions, and impact analysis. Actions that have been considered include those that have a similar or related purpose to that of the recommended plan (ecosystem restoration), and those that have effects on the same resource, ecosystem, or human community (such as flood control). Such resources would include forests, prairies, wetlands, lakes and ponds, and streams, as well as farmland and water quality; affected communities would include the farming community.

7.14.1 Past and Present Actions. Past and present actions are discussed in this section as either projects with similar purposes, or as projects with effects on similar resources, resource conditions, and human communities.

7.14.1.1 Projects with Similar Purposes. With regard to ecosystem restoration projects, no past or present projects of this nature have been implemented in the American Bottom. However, the American Bottom Ecosystem Partnership, one of a number of watershed-based initiatives in Illinois stemming from the Ecosystems Program of Conservation 2000 (which is administered by the Illinois Department of Natural Resources), has recently formed and is beginning a process of identifying and assessing conditions of environmental resources in an area overlapping the study area.

7.14.1.2 Projects with Effects on Similar Resources, Resource Conditions, and Communities.

Adverse effects of past to present development on similar resources, such as forests, prairies, marshes, streams, and lakes and ponds, have been described for the study area in Section 3, Existing Conditions. The description does not relate these effects to specific projects, but to development as a whole. Effects on each class of natural community are described in terms of decreased quantity and quality, based on historic conditions (Section 2, Predevelopment Conditions).

Flood control or flood damage reduction activities in the American Bottom began soon after European settlement. Initial attempts to keep Mississippi River floodwaters out of the area were unsuccessful because early levees were relatively low and constructed in a piece-meal fashion. Earthen embankments constructed to bear a system of railroad tracks that converged on East St. Louis from different directions proved more effective. The existing urban river front levee built about 50 years ago has protected the bottoms from Mississippi River overflows. Flood control activities in the area between the river and bluff, interior to riverside levees, began with minor ditch systems to drain low areas of ponded water.

About 90 years ago, Cahokia Creek was diverted from its historic course to the Mississippi River using a shorter man-made route, and a system of drainage canals was established to carry hillside stormwater across the bottoms to the Mississippi.

The ongoing East St. Louis Levee Rehabilitation Project, administered by the Corps, is intended to rehabilitate the riverfront and interior systems that have protected the area for many years. Completed actions include replacement of mechanical and electrical components at pump stations, improvements to gravity drains and closure structures, restoration of drainage canals, and rehabilitation of relief wells. The Natural Resources Conservation Service (NRCS) repaired damaged berms along interior drainage canals after flooding in the mid-1990s, and also removed accumulated sediments from a number of these canals to restore them to their original design capacity. The NRCS also initiated an effort in the recent past to identify solutions to flooding along Sand Road, in the northeast part of the study area. The Federal Emergency Management Agency, acting through local counties, bought out some flood-damaged properties after flooding in the mid-1990s.

The Office of Water Resources of the Illinois Department of Natural Resources has been studying water resource problems in the American Bottom or Metro East area for some time, and is seeking or implementing flood damage reduction or stream stabilization solutions at various sites, including Centreville, Dobrey Slough, Fairmount City Ditch, Judy's Branch, and Powdermill Creek. Finally, the Metro East Regional Storm Water Committee issued in 2000 a framework for coordinated storm water work in the Metro East. In that same year, Madison County passed a 100-year stormwater control ordinance requiring new development to incorporate post-construction measures to temporarily detain runoff onsite, up to and including the 100-year storm, with release of stormwater to the local watershed at a rate no greater than that of preconstruction conditions.

As a resource condition, water quality has also been affected by many different activities from past to present. Non-point and point source pollution have adversely affected water quality. Existing water quality conditions are described in Section 3, Existing Conditions. Since settlement, agricultural land has historically been the dominant land use in the study area. Occupying about one-third the study area today, farming continues to be the dominant land use, but since settlement, various residential, commercial, and industrial developments have replaced much farmland. The decline in farmland has been accompanied by a shrinking role that agriculture plays in the local economy, and by a decline in the number of farms and farming businesses comprising the local agricultural community. Local production of horseradish has accounted for about two-thirds of the world's supply of this commodity, but ongoing development is eroding the roughly 5,000 acres of land used for this crop.

7.14.2 Reasonably Foreseeable Future Actions. Probable future flood damage reduction projects in the study area are not expected to be large in scale like some past features, such as the urban riverside levee or the interior flood control system. Rather, future projects most likely would consist of maintaining the existing flood protection system, and building new smaller projects affecting more localized areas. Future ecosystem restoration projects are probable, but most likely would involve small-scale habitat restoration projects. Such projects most likely would not make any large-scale changes to the interior flood control system for environmental purposes.

Future development affecting forests, wetlands, and other natural resources in the study area will occur. The rate and location of future development is not certain, but assumptions concerning future growth have been presented in Section 4, Future "Without Project" Conditions. Wetland mitigation banking is a reasonable foreseeable activity in the American Bottom, but whether a bank could be established taking advantage of storm water as a major source of hydrology is uncertain. Wetland mitigation associated with individual projects is a virtual certainty, given the juxtaposition of existing wetlands and expanding development. The combined area of newly created wetlands stemming from a future mitigation bank and mitigation for future individual projects is not likely to exceed a tenth of the area of existing wetlands in the study area (about 750 acres).

St. Clair County is expected to approve a storm water control ordinance similar to that already implemented by Madison County. Unified ordinances in the two counties would assist in implementing the Phase II storm water regulations of the U.S. Environmental Protection Agency, which require control measures to be implemented at development sites both during and after construction. With regard to farmland and horseradish, the creation of a special agricultural district by farmers in the American Bottom to protect and maintain an agricultural land base is not expected, given the potential for conversion of private farmland to development and high land values created by the local market.

7.14.3 Impact Analysis. Because the recommended plan proposes to establish areas of natural habitat consisting of existing and/or newly created forests, prairies, wetlands, streams, and lakes and ponds, its overall effects are countervailing to those of most development, which typically adversely affects these kinds of communities. The plan would establish scattered "islands" of natural habitats on the Mississippi River floodplain, within a landscape undergoing increasing development.

In the uplands, the loss of about 83 acres of upland forest due to construction of 155 tributary stream sediment detention basins would be additive to future expected losses of upland forest due to development. Upland forest losses due to the project are expected to be minor in comparison to future losses in the study area due to development, which have been roughly estimated to range from about 150 to 300 acres per year (Section 4, Future "Without Project" Conditions). Additional forest fragmentation caused by construction of the detention basins is also expected to be minor, since about 0.5 acre of forest would be lost per site. Loss of forest in the uplands due to the project would not reduce large, contiguous tracts of upland forest below the ecological threshold of 500 acres, the minimum area believed necessary to sustain local populations of forest interior breeding bird species, because there are none in the study area.

Water quality in the study area is expected to improve with implementation of the recommended plan. Levels of sediment and other pollutants carried in storm water are expected to be reduced by the restoration of tributary stream resources. Storm water control measures implemented by the counties under their storm water ordinances would be expected to be additive, and produce similar improvements in water quality.

The loss of about 1,650 acres (or about 8 percent) of existing cropland in the floodplain portion of the study area to create seven of the proposed floodplain action areas would be additive with losses of cropland due to development. Similarly, of this cropland, the project-induced loss of about 310 acres (or about 6 percent) of existing horseradish land to create four of the floodplain action areas would also be additive with horseradish land losses due to development.

7.15 MITIGATION SUMMARY

The recommended plan would not require compensatory mitigation for adverse impacts to wetlands or other aquatic resources protected under Section 404 of the Clean Water Act. Because of the plan's purpose, which is ecosystem restoration, and its anticipated effect on aquatic and terrestrial communities, which is beneficial over the 50-year project life rather than adverse, the need to mitigate for adverse impacts is not warranted. This determination is based on recent Corps guidance for the regulatory program (Regulatory Guidance Letter No. 01-1, dated October 31, 2001).

This regulatory guidance letter adopts the use of an accounting system in the regulatory program better able to meet the national no-overall-net-loss policy pertaining to wetlands. In the accounting system, "debits" are used to denote adverse impacts to wetlands, and "credits" represent benefits accruing from compensatory wetland mitigation plans. Methods to be used to assess debits and assign credits are to be compatible, and can include acre-for-acre ratios, the HydroGeomorphic Approach (HGM), or other procedures developed to measure various functional components of affected resources.

Ecosystem restoration features of the plan would create about 1,340 acres of new wetlands on the Mississippi River floodplain, and increase wetlands in the action areas from about 1,320 existing acres to about 2,650 proposed acres. Development of new wetlands would involve restoration of areas that were historically but are not currently wetlands. Restored wetlands would consist of marshes as well as wet types of forests and prairies. The plan would also introduce periodic flooding as an ecological feature to most wetlands enveloped by the action areas, thereby restoring the existing ecosystem to a more natural historic-like condition. Other measures, such as planting of underrepresented native tree species, would be implemented to improve quality of existing habitats.

The recommended plan's expected effect on habitat value of terrestrial, wetland, and aquatic resources was assessed using the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP). Applying habitat suitability models for nine vertebrate species and quantifying areas of suitable habitat for these species assessed changes in habitat value. The evaluation species included the black crappie, fox squirrel, marsh wren, slider turtle, wood duck, eastern meadowlark, great blue heron, mink, and white crappie. Similarly, HGM was used to assess the plan's effect on seven wetland functions. However, because of time and budget constraints, HGM was applied to only a subset of all wetlands to be affected by the plan. Assessed functions included floodwater detention, surface water storage, nutrient cycling, organic carbon export, removal and sequestration of elements and compounds, plant characteristic maintenance, and wildlife habitat maintenance.

The HEP assessment showed overall improvement in habitat value for all evaluation species over the 50-year project life, and the HGM evaluation portrayed increases in functional capacity for nearly all wetland functions. These assessments are presented in Appendix A. The assessments accounted for adverse impacts associated with the recommended plan. Under the plan, an estimated 15 acres of wetlands would be permanently filled to convert existing wetlands into non-habitat features, such as grassy earthen berms. Another 64 acres of wetlands would be excavated to convert existing habitats from one type into another, such as forest into new marsh, or marsh into restored stream channel. For example, excavation of 34 acres of existing wetlands in the Spring Lake action area to a lower elevation, followed by vegetative plantings to create new marsh, would allow for more frequent flooding from Harding Ditch. Despite short-term wetland losses, this plan was the preferred alternative of the interagency team of biologists.

The recommended plan would require authorization under Sections 404 of the Clean Water Act, as well as Sections 401 and 402. The amount of filled and excavated wetlands is likely to be an overestimate, especially for forested wetlands and scrub-shrub wetlands consisting of successional forest. Wooded areas on the Mississippi River floodplain that appeared to be wetland during 1999 baseline field surveys carried out for this study were assumed to be wetland. Jurisdictional delineations of wetlands were generally not conducted, except for a small portion of the area of the recommended plan. It is expected that future jurisdictional delineations conducted during the design phase would show that some supposed woody wetlands are actually nonwetland bottomland forest.

Mitigation requirements for adverse impacts to bottomland hardwood forest are included in the Corps "Planning Guidance Notebook" (Engineering Regulation 1105-2-100). Bottomland hardwood forest can be either wetland floodplain forest or nonwetland floodplain forest. Of the nonwetland floodplain forest, about 10 acres are expected to be lost at the Judy's-Burdicks and Spring Lake action areas, and about 80 acres are to be planted at various locations within the action areas. For wetland forest, about 54 acres are expected to be lost (and are included in the discussion above) to convert one habitat type to another, and they would be replaced with about 940 acres of new wetland forest.

7.16 ENVIRONMENTAL JUSTICE SUMMARY

This document, the Final Environmental Impact Statement (DPEIS) for the East St. Louis and Vicinity, Illinois, Ecosystem Restoration and Flood Damage Reduction Project, conforms to the U.S. government's policy of insuring that federal projects do not disproportionately impact a community's right to a safe and clean environment. The project poses no significant risks to the health of nearby residents or the surrounding environment. Rather, the project is expected to improve long-term environmental conditions in the American Bottom area by improved flood protection, restoration of pre-settlement hydrology, improving water quality, restoring stream resources, reducing sediment loads, increasing biodiversity, and preserving open space. Results of a complete analysis of the project, prepared by the USEPA, Region 5, as a cooperating agency, are contained in Appendix L.

7.17 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Implementation of the recommended plan would result in adverse environmental impacts that cannot be avoided. The gain in about 2,400 acres of new natural habitats consisting of forest, prairie, marsh, stream, and lake communities would occur as a result of the loss of various types of cultural habitats, including 1,650 acres of cropland, 525 acres of hay production areas, 125 acres of urban development, and 90 acres of urban old fields. Losses of about 275 acres of natural habitats would occur in the tributary watersheds and on the Mississippi River's floodplain. In the tributary watersheds, there would be a loss of about 70 acres of forest to construct 131 tributary stream sediment detention basins. In the bottoms, about 60 acres of forested areas, 65 acres of marsh, and 80 acres of scrub-shrub wetlands would be converted into other natural habitat types to implement the recommended plan. The losses of these environmental resources are not considered to be significant. The creation of new habitats in conjunction with existing ones, along with the introduction of storm water as a "flood pulse" into the proposed action areas, would restore the floodplain ecosystem to a more natural and sustainable condition.

7.18 RELATIONSHIP BETWEEN SHORT TERM USES AND LONG TERM PRODUCTIVITY

Continuing development in the American Bottom, especially of undeveloped land, gradually eliminates environmental options to solve the interior flooding problems beset by this area since European settlement. If the recommended plan were not implemented, additional development in the American Bottom would continue, and over the long-term, flood damages to development on the floodplain from storm water would be expected to increase. At the same time, areas of natural habitat would continue to disappear and diminish in quality, reflecting a decline in the structure and function of the ecosystem. Implementation of the recommended plan and its ecosystem-restoration features would lead to some short-term "losses" of potential economic activity, and long-term "gains" in the reduction of future flood damages. Restoration of a diversity of floodplain habitats and reintroduction of flooding as an ecological component of those habitats would return the ecosystem to a more historic condition.

7.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible and irretrievable resource commitments would include the loss of the funds, labor, energy, and construction materials used to plan, design, build, and monitor the project. The acquisition of land, in itself, would not represent an irreversible or irretrievable commitment of a resource because the land could be returned to cultivation or other use in the future if the project were to be decommissioned.

SECTION 8 – RECOMMENDED PLAN

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SECTION 8 - RECOMMENDED PLAN

8.1 OVERVIEW

Ecosystem degradation, recurring flooding and the adverse impacts of erosion and sedimentation within the study area were identified as significant water and land resource problems that needed to be addressed. The Recommended Plan has been formulated to address these concerns within an ecosystem restoration project.

The Recommended Plan consists of the alternative selected from each of the 8 Project action areas as identified in Section 6. To recap, these Project action areas are Old Cahokia Creek, Judy's and Burdick Branch, Brushy Lake Spring Lake, Mullens Slough, Dobrey Slough, Elm Slough, and Cahokia Mounds Prairie. The alternative selected to be a part of the Recommended Plan from each of these areas was the one that best addressed study objectives and planning targets within each respective Project action area. Section 6 of this report details the development, evaluation and selection process. Section 8.4 contains a detailed breakdown of the construction features and their quantities (when applicable) within each of the 8 Project action areas.

In general, the Recommended Plan consists of the following measures: the restoration of bottomland forest habitat (1,705 acres), prairie habitat (1,111 acres), marsh and shrub swamp habitat (843 acres), lake habitat (460 acres), upland riparian forest (379 acres), floodplain stream restoration (10.4 miles or 161 acres), placement of wood duck boxes (651 boxes) and prairie bird perches (870 perches), creation of over wintering holes and shoreline plantings (20 acres), and construction of tributary stream detention basins (131), riffle and pool complexes in 178 miles of streams, earthen embankments (15.5 miles), and hydraulic control devices (culverts, flap gates, and new channels).

Currently a total of 4,916 acres are included in the Project footprint, of which 4,468 acres are in the Mississippi River's floodplain and 448 acres are along streams in the tributary watersheds. The 178 miles of tributary stream restoration are not reflected in this Project area footprint. Specific sites, at which stream restoration measures would be implemented, other than the tributary sediment detention basins, have yet to be determined.

8.2 ENVIRONMENTAL FEATURES

Based on existing soils, hydrology, planning objectives and using presettlement conditions as a guide, different restoration scenarios were competed through an incremental cost analysis. This process is described in more detail in Section 6 and Appendix A. The result was the selection of a preferred plan that best fulfilled restoration objectives and planning targets as determined through the iterative evaluation and selection process. The following details the environmental restoration features and outputs for each of the sites comprising the recommended plan.

Table 8-1 provides a summary of cover types and acres by action area of the Recommended Plan.

Table 8-1 Area of vegetation cover types to be established in the eight recommended action areas*

Community Type	Cover Type Description	**Cover Type Name	OCC	JB	DS	ES	BL	CM	SL	MS	TOTAL
Upland Forest	Upland forest (existing)	DF	12.3	76.1			22.3		216.4	51.5	378.6
Floodplain Forest - nonwetland	Floodplain forest (existing & proposed)	DFBOTTOMS		1.5					34.3		35.8
	Forested corridor along channels (existing)	FCORRIDOR		1.0							1.0
	New forested corridor along channels (proposed)	NEWFCORR			28.7				18.1		46.8
Floodplain Forest - wetland	Forested wetland (existing)	PFO		2.5	2.8	134.8	96.3		59.6	35.4	331.4
	New forested wetland (proposed)	NEWPFO				286.7	208.5		9.5		504.7
	Shrub-scrub wetland naturally succeeding to forest or planted with trees (proposed)	NEWPFO2			4.7				87.3		92.0
	Riparian corridor (existing)	RIPARIAN	69.2				147.0		58.0		274.2
	New riparian corridor (proposed)	NEWRIPAR	168.8			29.5	127.2		93.3		418.8
Prairie	Prairie (wetland & nonwetland, existing & proposed)	PRAIRIE		461.3			25.1	525.4		53.0	1,064.8
	Prairie plantings for filtering sediment (proposed)	PBUFFER				46.0					46.0
Marsh & Scrub-Shrub Wetland	Marsh (existing)	MARSH			5.4		35.6		334.9		375.9
	New marsh (proposed)	NEWMARSH			31.2				272.1		303.3
	Detention basin with marsh plantings (proposed)	DETENTION								16.6	16.6
	Scrub-shrub wetland (existing)	PSS				138.0			9.6		147.6
Lake & Pond	Lake and borrow pit (existing & proposed)	LACUST		18.8	1.7	15.7	14.4		210.0	199.6	460.2
Stream	Natural channel (existing)	CHANNEL		2.9		1.4	12.6		19.3	3.0	39.2
	New channel (proposed)	NEWCHANNEL	29.1	3.9			26.6		6.1	0.4	66.1
	Man-made ditch (existing)	DITCH	3.9				4.4		7.8		16.1
	New man-made ditch (proposed)	NEWDITCH				0.1	1.2		38.3		39.6

Table 8-1 Continued

Community Type	Cover Type Description	**Cover Type Name	OCC	JB	DS	ES	BL	CM	SL	MS	TOTAL
Cultural	Abandoned fields and haylands (existing)	FIELD				11.4					11.4
	Urban old fields (existing)	URBFIELD									0.0
	Urban development (existing)	URBAN	14.4	16.7	0.4	1.3	6.0		63.1	7.6	109.5
	Cropland (existing)	AGCROP									0.0
	Grassy areas (existing & proposed)	GRASS	16.8	15.3		5.4	18.1		77.3	4.2	137.1
TOTAL		(acres)	314.4	599.9	74.9	670.3	745.1	525.4	1,614.7	371.4	4,916
		(percent)	6.4	12	1.5	13.6	14.2	10.6	32.8	7.5	100.0

*OCC=Old Cahokia Creek, JB=Judy's-Burdicks, DS=Dobrey Slough, ES=Elm Slough, BL=Brushy Lake, CM=Cahokia Mounds, SL=Spring Lake, MS=Mullens Slough **from Appendix A

8.2.1 Old Cahokia Creek (Plan 2A-1-0-X).

Overview. The Old Cahokia Creek action area consists of features to restore aquatic and terrestrial habitat in the floodplain and tributary stream watersheds. In the floodplain, about 3.4 miles of historic Cahokia Creek are to be restored to a flowing condition, and a 328-foot (100-meter) wide forested corridor is to be established along both sides of the restored creek channel. Together the restored creek and adjacent forest form a habitat area. About 6.6 miles of tributary streams in the Bluff 1 watershed are to be restored by constructing a series of riffle and pool complexes and building ten tributary stream sediment detention basins at scattered locations. The total footprint of all features is 314 acres, excluding restoration of tributary streams.

Figure 8-1 displays boundaries of floodplain and tributary stream features, and Figure 8-1a shows the floodplain habitat area and its constituent cover types. Area of these cover types is displayed in Table 8-1. Details about floodplain and tributary stream features are provided below.

Floodplain. Features in the bottoms encompass about 298 acres, and extend north to south from a point about 0.5 mile south of New Poag Road to the south side of I-270. The habitat area extends north of Chain of Rocks Road. Its establishment consists of restoring 18,200 feet of historic Cahokia Creek to a flowing condition, creating a continuous forested corridor along the restored channel, reintroducing flooding into the habitat area, and building a berm along the west side of the habitat area. The stream is to be restored to its approximate historic location. Bare-root tree seedlings consisting of native species (Table 8-3) are to be planted at 350 per acre to establish the forested corridor. Wood duck nest boxes are to be placed in the corridor on poles at one per acre of forest. Storm water from the Bluff 1 watershed is to be used to mimic the flood regime of historic Cahokia Creek. The channel is designed to allow for periodic overbank flooding of the forested corridor north of the bike trail embankment. Flood depth and duration would vary with the severity of local storm events.

Along the west side of the habitat area, a grassy earthen berm with an average height of about four feet is to be constructed to retain overbank flooding in the forested corridor. A pedestrian trail for biking and hiking is to be established on top of the earthen berm. One or more creek crossings are to be established within the habitat area, if needed, to provide access to private property outside the action area for agricultural purposes. A ditch extending south of Chain of Rocks Road to the south side of I-270 is to be improved to carry storm water from the Bluff 1 watershed to County Ditch.

Tributary streams. The series of riffle and pool complexes are to be constructed within the streams at locations yet to be determined. Construction of the ten sediment detention basins requires a total of about 17 acres of land. Each basin is to be located in a stream valley, and is to consist of a concrete dam with spillway, and a sediment detention area that is to remain forested. In the forested areas of these basins, which total about 12 acres, tree species diversity is to be improved by creating small forest clearings (20-foot diameter, 25 per acre), and planting a two-gallon containerized seedling of a native tree species (Table 8-3) in each clearing.

Figure 8-1 Old Cahokia Creek Action Area

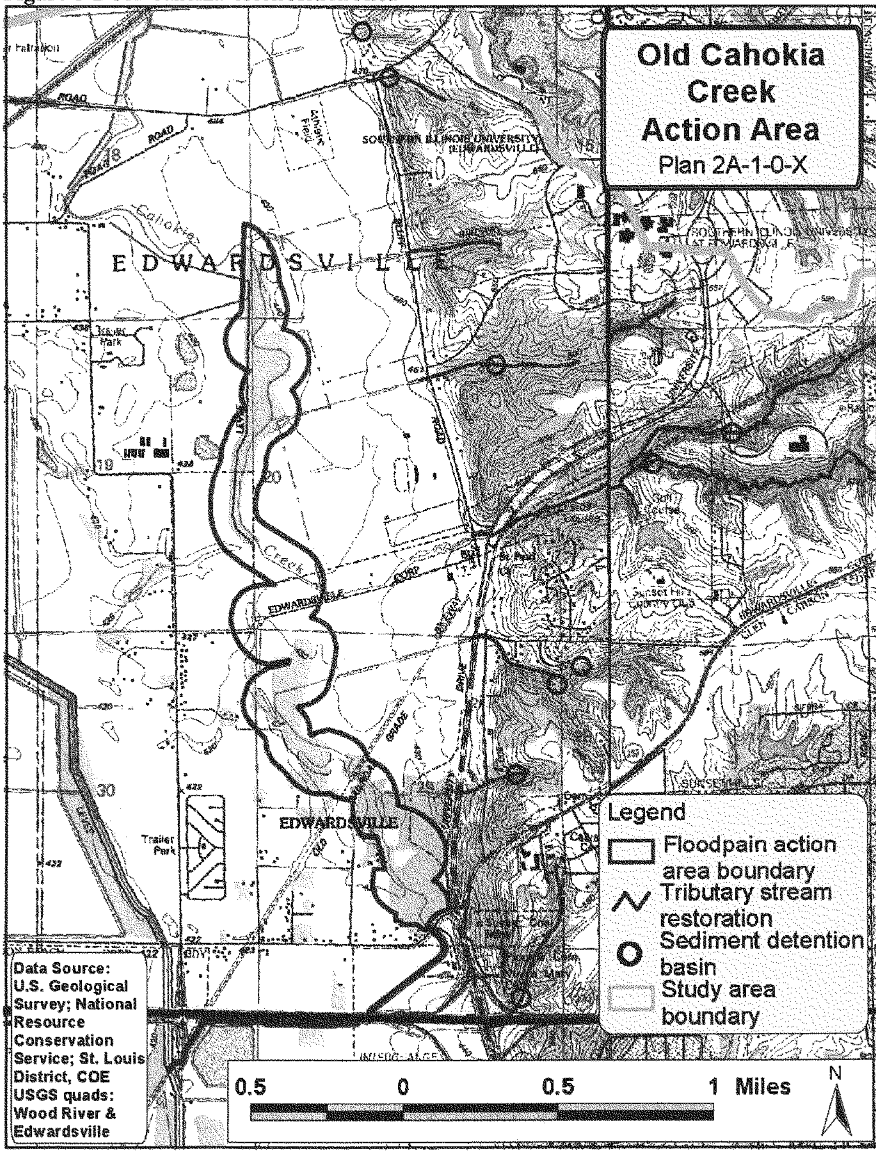
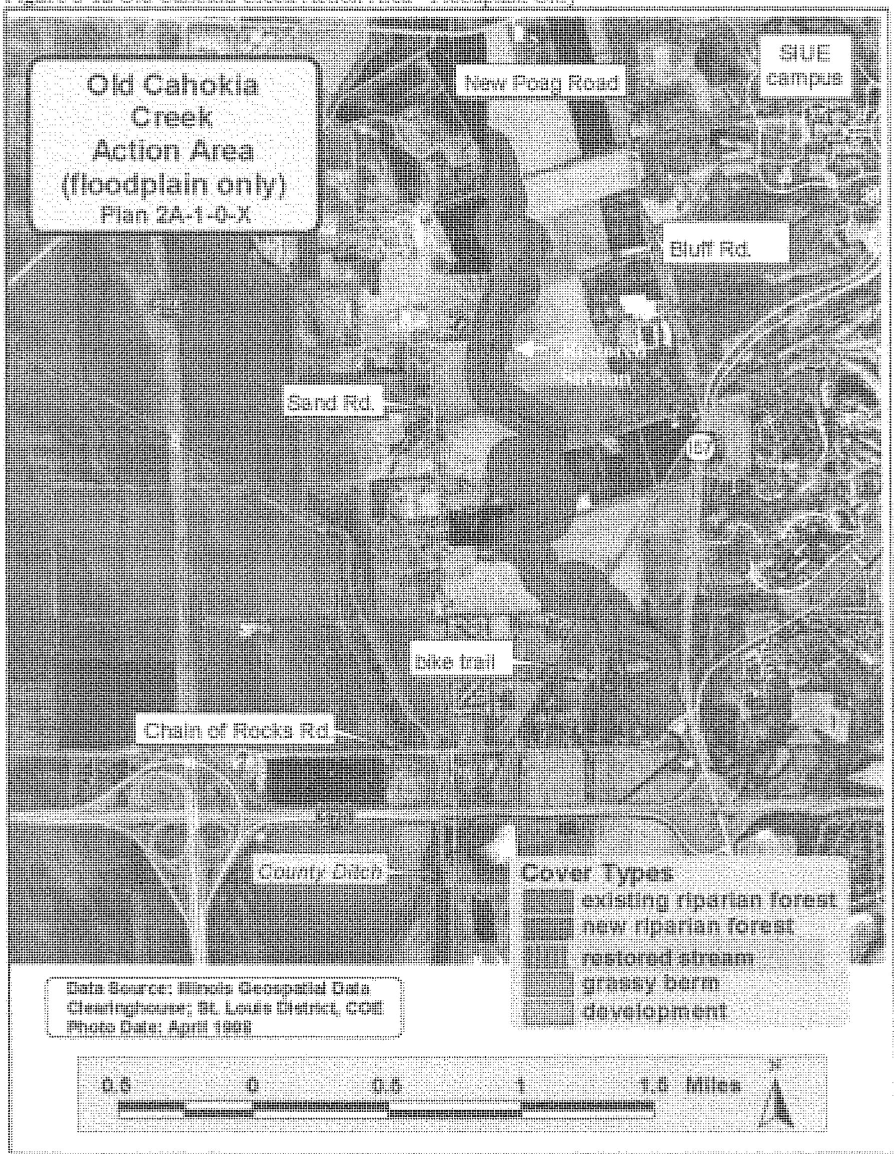


Figure 8-1a Old Cahokia Creek Action Area - Floodplain Only



8.2.2 Judy's-Burdick Branch (Plan 3A-4-0).

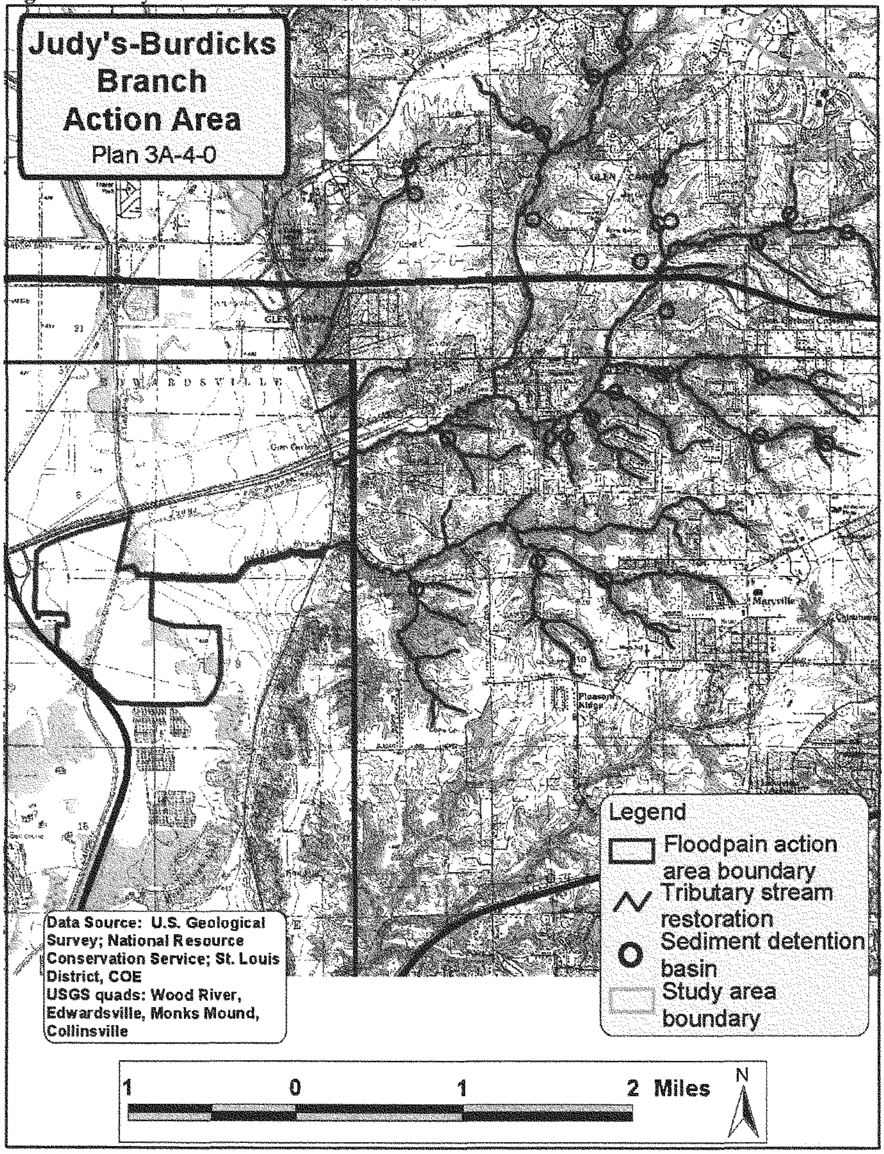
Overview. The Judy's-Burdick action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary steams. A 507-acre floodplain habitat area of prairie is to be established at the confluence of Cahokia Canal, Judy's Branch, and Burdick Branch. About 32 miles of tributary streams in the Judy's, Burdick, and Bluff 1 watersheds are to be restored by constructing a series of riffle and pool complexes and building 28 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 600 acres, excluding restoration of tributary streams. Figure 8-2 displays boundaries of floodplain and upland features, and Figure 8-2a shows the floodplain habitat area and its constituent cover types. Area of these cover types is displayed in Table 8-1. Details about floodplain and upland features are provided below.

Floodplain. Features in the bottoms encompass about 507 acres, and they lie south of Il Route 162, west of Il Route 157, and east of I-270. The habitat area consists of prairie plantings, a creek restoration, reintroduction of flooding into the habitat area, and an earthen ring berm. The ring berm has an average height of about six feet. Prairie plant species (Table 8-2) are to be established inside the ring berm, on the berm side slopes, and also in a 328-foot (100-meter) wide buffer around its perimeter, where compatible with existing development. Wooden stakes placed in the prairie at two per acre are to temporarily serve as bird perches until plantings of perennial robust forbs become established. About 0.8 miles of Cahokia Creek are to be restored inside the berm to the stream's approximate historic location. Storm water from the Judy's, Burdick and Bluff 1 watersheds is to enter the habitat area to mimic the historic flood regime. The restored creek channel is designed to allow for periodic overbank flooding of the prairie inside the ring berm. Flood depth and duration would vary with the severity of local storm events. Plantings of emergent vegetation (Table 8-4) are to be placed along the margins of the restored stream channel. A series of rock riffles is to be established in the channel bottom. Vegetation and riffles are also to be placed in that portion of Cahokia Canal within the habitat area, which is to be retained. Existing borrow pits located inside the ring berm are to be enhanced by shaping the shoreline to create a gradual transition to deep water, placing submerged woody debris, and planting emergent (Table 8-4) and woody (Table 8-3) vegetation around the shoreline.

The existing levee along the south side of Burdick Branch is to be modified to ensure that storm water from the Judy's and Burdick tributaries is directed into the floodplain habitat area. A pedestrian trail for biking and hiking is to be established on top of the ring berm.

Tributary Streams. The series of riffle and pool complexes are to be constructed within the streams at locations yet to be determined. Construction of 21 sediment detention basins in Judy's Branch watershed, 4 in Burdick Branch watershed, and 3 in the southern portion of the Bluff 1 watershed requires a total of about 93 acres of land. Each basin is to be located in a stream valley, and is to consist of a concrete dam with spillway, and a sediment detention area that is to remain forested. In the forested areas of these basins, which total about 76 acres, tree species diversity is to be improved by creating small forest clearings (20-foot diameter, 25 per acre), and planting a two-gallon containerized seedling of a native tree species (Table 8-3) in each clearing.

Figure 8-2 Judy's-Burdicks Branch Action Area



8.2.4 Elm Slough (Plan 6A-2).

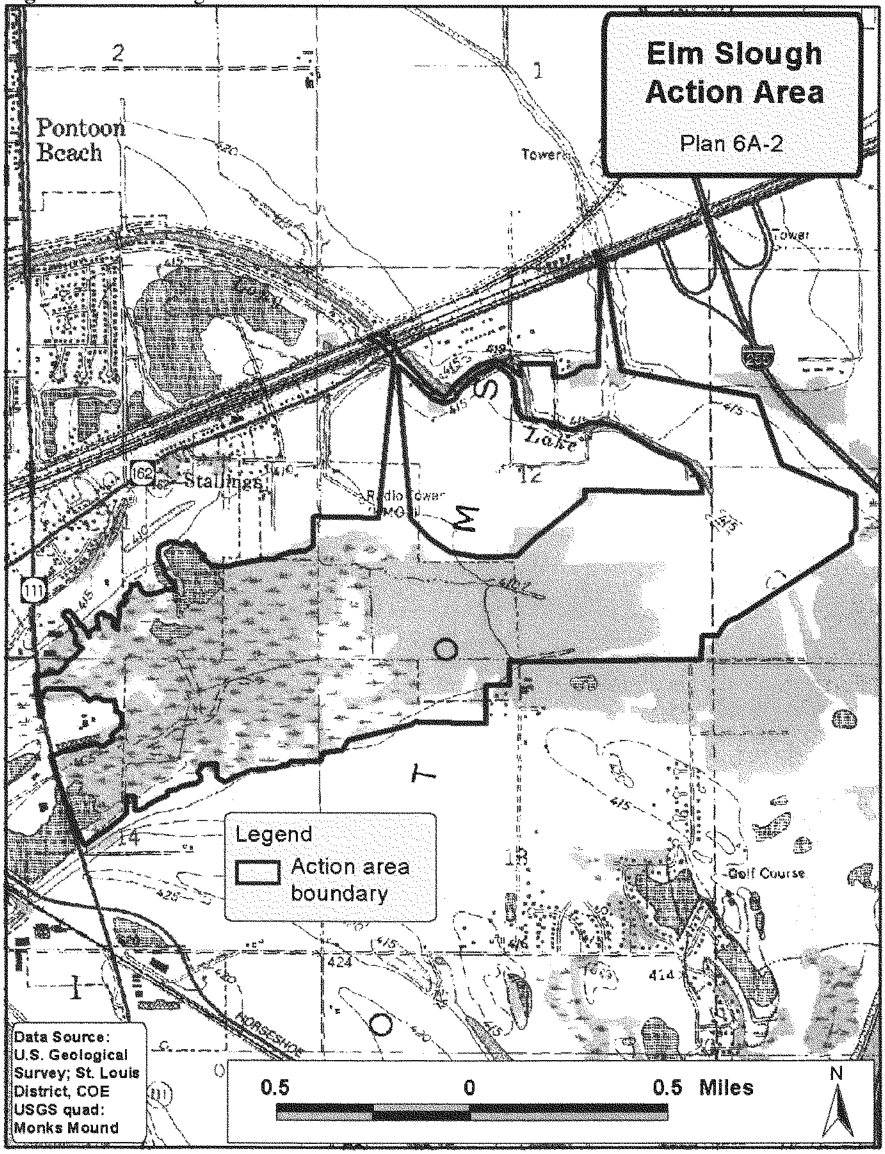
Overview. The Elm Slough action area consists of features to restore and enhance aquatic, wetland and terrestrial habitats in the floodplain. A 670-acre habitat area consisting principally of forested and scrub-shrub wetland is to be established. Il Route 111 bounds the habitat area on the west, Il Route 162 on the north, and I-255 on the east. Figure 8-4 displays the action area's boundaries, and Figure 8-4a shows the habitat area and its constituent cover types. Area of these cover types is displayed in Table 8-1. Details about these floodplain features are provided below.

Floodplain. Establishment of the habitat area involves expansion of existing forested wetlands by creating new forested wetlands, enhancement of existing wetlands, modification of existing patterns of drainage into Elm Slough to approximate historic flooding conditions, creation of vegetative buffers within the modified drainage ways to intercept sediment carried by flows from Long Lake and Mitchell Ditch, and construction of earthen berms to keep storm water within the habitat area. New forested wetlands are to be created to the east of a complex of existing scrub-shrub and forested wetlands. Two-gallon containerized RPM tree seedlings consisting of native species (Table 8-3) are to be planted at 48 per acre to establish new forested wetlands. Tree species diversity in existing forested wetlands is to be increased by selective thinning and planting of mast tree species. Small forest clearings (20-foot diameter, 25 per acre) are to be planted with two-gallon containerized RPM seedlings of native species (Table 8-3), one per clearing. Wood duck nest boxes mounted on poles are to be placed in existing scrub-shrub wetland at a density of one per acre.

The existing drainage pattern of Long Lake and Mitchell Ditch on the south side of Il Route 162 is to be modified, and two new "funnel"-shaped waterways, one for Long Lake, the other for Mitchell Ditch, are to be established to carry storm water from these floodplain tributaries south into Elm Slough in a sheet-flow manner. Storm water entering the habitat area is to be used to mimic the historic flood regime. Flood depth and duration would vary with the severity of local storm events. Earthen berms with an average height of about six feet are to be constructed along the edges of these modified waterways to ensure that storm water is directed into the main habitat area. Culverts under Route 162 and the adjacent railroad embankments are to be modified to accommodate greater flows from Long Lake and Mitchell Ditch. An earthen berm with an average height of about two feet is to be constructed along the southern perimeter of the habitat area to keep storm water in Elm Slough's forested and scrub-shrub wetlands.

Grassy vegetation is to be planted inside the "funnel"-shaped areas to act as a filter and intercept sediment carried by storm water. A second vegetative buffer consisting of prairie plant species (Table 8-2) is to be established before the main forested habitat area to intercept additional sediment. Wooden stakes placed in the prairie at two per acre are to temporarily serve as bird perches until plantings of perennial robust forbs become established. In the northeastern portion of the action area, bare-root tree seedlings consisting of native species (Table 8-3) are to be planted at 350 per acre to establish a riparian corridor along a portion of Mitchell Ditch and Long Lake. To make hydrologic conditions in a large area of the newly planted wetland forest similar to those of the existing wetland forest, a cropland area of about 175 acres is to be excavated an average of about two feet to temporarily pond water.

Figure 8-4 Elm Slough Action Area



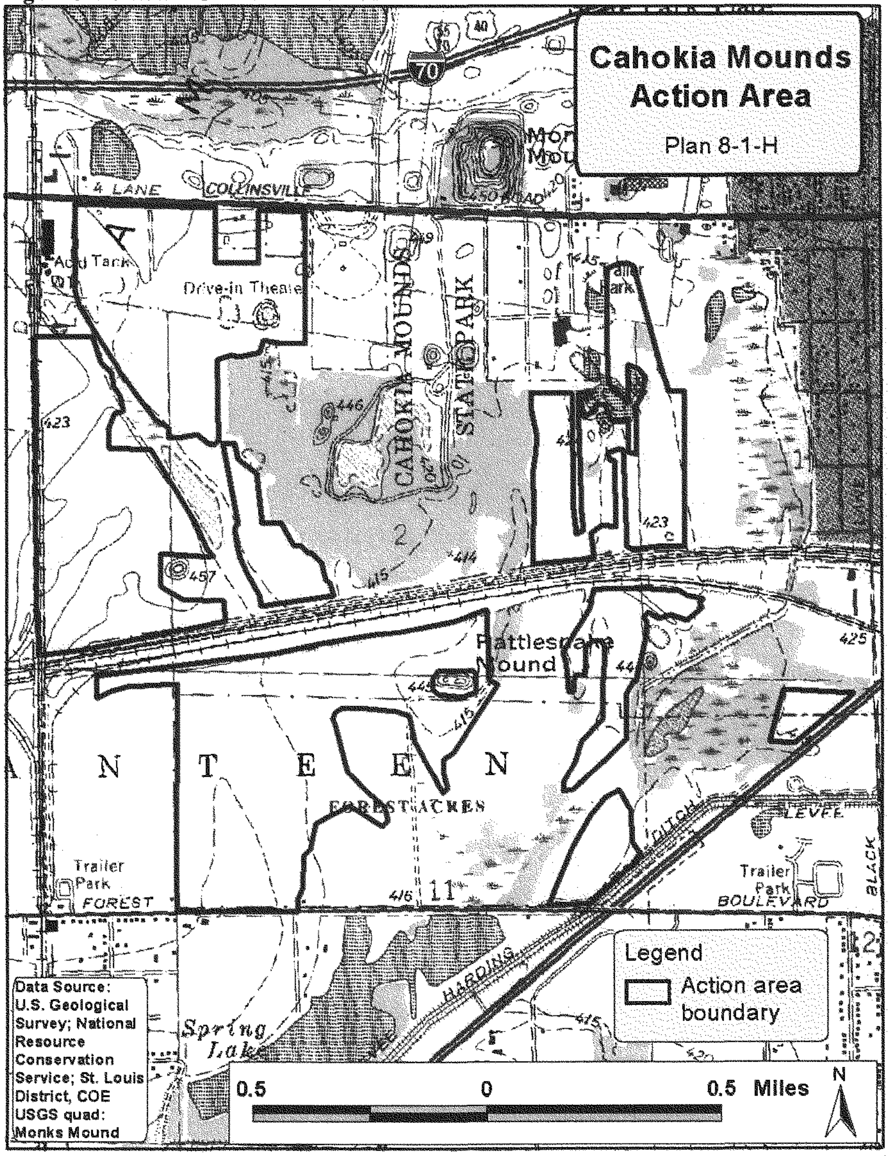
8.2.6 Cahokia Mounds Prairie (Plan 8-1-H).

The Cahokia Mounds action area consists of the restoration of 525 acres of floodplain prairie within the Cahokia Mounds State Historic Site. The action area is bounded by Collinsville Road on the north, Black Lane on the east, Forest Boulevard on the south, and railroad tracks on the west. Prairie plantings are to be established in eight separate tracts currently used as hay lease areas. Native plant species consisting of a variety of grasses and herbs and some sedges and shrubs are to be used (Table 8-2). Wooden stakes placed in the prairie at two per acre are to temporarily serve as bird perches until plantings of perennial robust forbs become established. Figure 8-6 displays the action area's boundaries, and Figure 8-6a shows the habitat area and its constituent cover types. Area of these cover types is displayed in Table 8-1.

As described in Section 6.7.6, historic prairie at this site most likely was wetland prairie. The principal source of historic wetland hydrology probably consisted of rainfall and local run off, and was occasionally supplemented by the Mississippi River, as was the case in 1844.

Current soil mapping for the restoration area shows the presence of hydric or wetland soils, but their presence apparently reflects a relict condition since current vegetation supporting a hay lease program does not consist of wetland plant species. Under the recommended plan, no additional water is being proposed to be brought onto this site. Additional investigation will be undertaken during preparation of follow-on reports, such as the installation of piezometers at the site, to ensure that current hydrology is sufficient to support the recommended prairie complex.

Figure 8-6 Cahokia Mounds Action Area



A new Canteen Creek relief channel is to be constructed just west of Il Route 157 to ensure that storm water from the Canteen Creek watershed enters the Harding Ditch system, and eventually the habitat areas. This new channel is to have concrete sides and bottom, and an earthen levee along both sides.

A new Fairmont City Ditch is to be constructed from Cell 1 to Indian Lake to provide the hydraulic connection from Canteen Creek back to Cahokia Canal. This channel is to have grassy sides and an earthen bottom, and an earthen levee along both sides where necessary in topographically low areas. The restored Cahokia Creek channel is to be connected to Lansdowne Ditch at the southwest corner of Indian Lake to allow temporarily ponded storm water to return to Cahokia Canal. In addition to these two new ditches, Harding Ditch is to be modified from Route 157 to Cell 1, and from Cell 1 to St. Clair Farms, to ensure that storm water events from Canteen and Little Canteen Creeks reach the habitat areas. The modified channels are to have grassy sides and an earthen bottom, and an earthen levee along both sides.

A forested riparian zone is to be established along both sides of Harding Ditch (outside its levees) between Cell 1 and St. Clair Farms. This zone is to be 328 feet (100 meters) wide, and planted with bare-root tree seedlings consisting of native species (Table 8-3) at 350 per acre.

Aquatic habitat in Cell 1 is to be enhanced by planting various aquatic plant species around its perimeter along the shoreline (Table 8-4). This aquatic area consists of the borrow pit created by the existing sand plant; the borrow pit, over 50 feet deep, is to be the disposal site for earthen material excavated from Cell 1 and St. Clair Farms. To reestablish forest in dead timber north of Forest Boulevard within the Cahokia Mounds State Historic Site, a 35-acre tract of dead (drowned) timber would be partially drained and appropriate native tree species planted.

Tributary streams. The series of riffle and pool complexes are to be constructed within the streams at locations yet to be determined. Construction of 37 tributary stream sediment detention basins in the Canteen Creek watershed and 21 in the Little Canteen Creek watershed requires a total of about 251 acres of land. Each basin is to be located in a stream valley, and is to consist of a concrete dam with spillway, and a sediment detention area that is to remain forested. In the forested areas of these basins, which total about 216 acres, tree species diversity is to be improved by creating small forest clearings (20-foot diameter, 25 per acre), and planting a two-gallon containerized seedling of a native tree species (Table 8-3) in each clearing.

Figure 8-7 Spring Lake Action Area

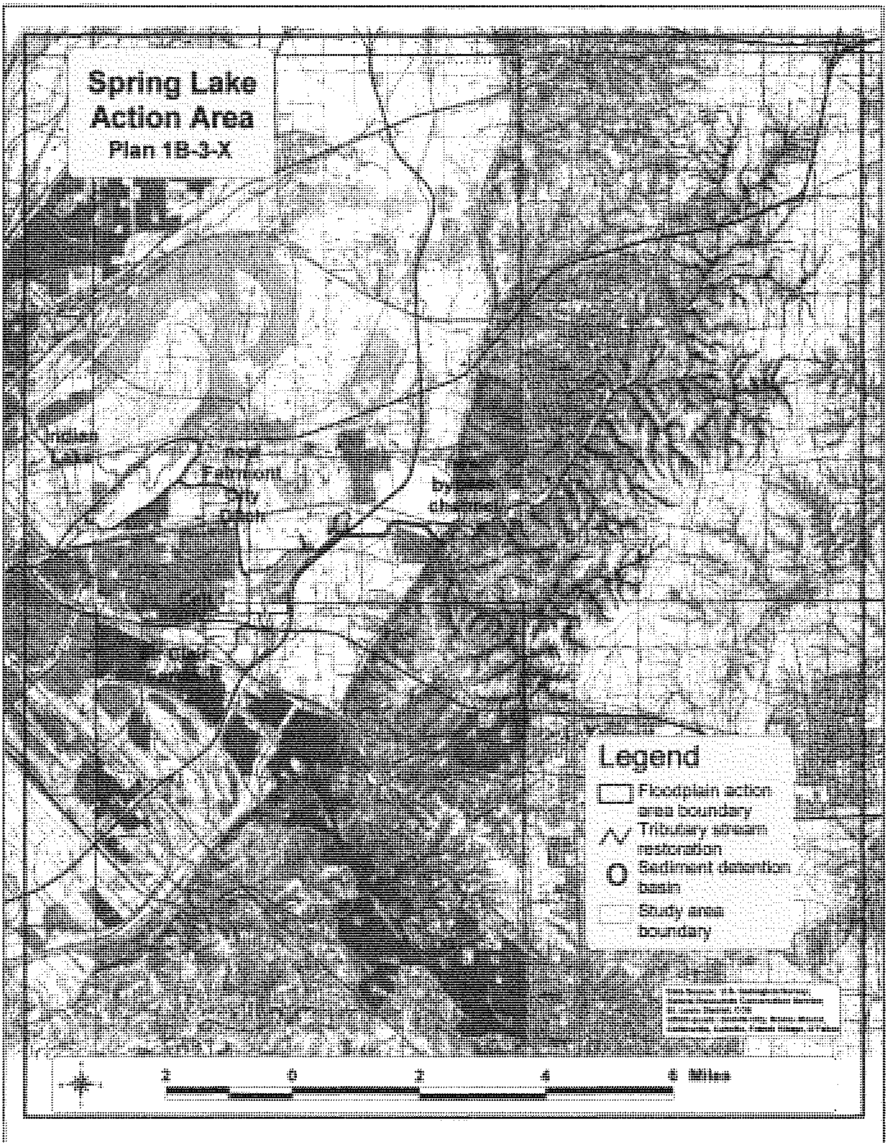
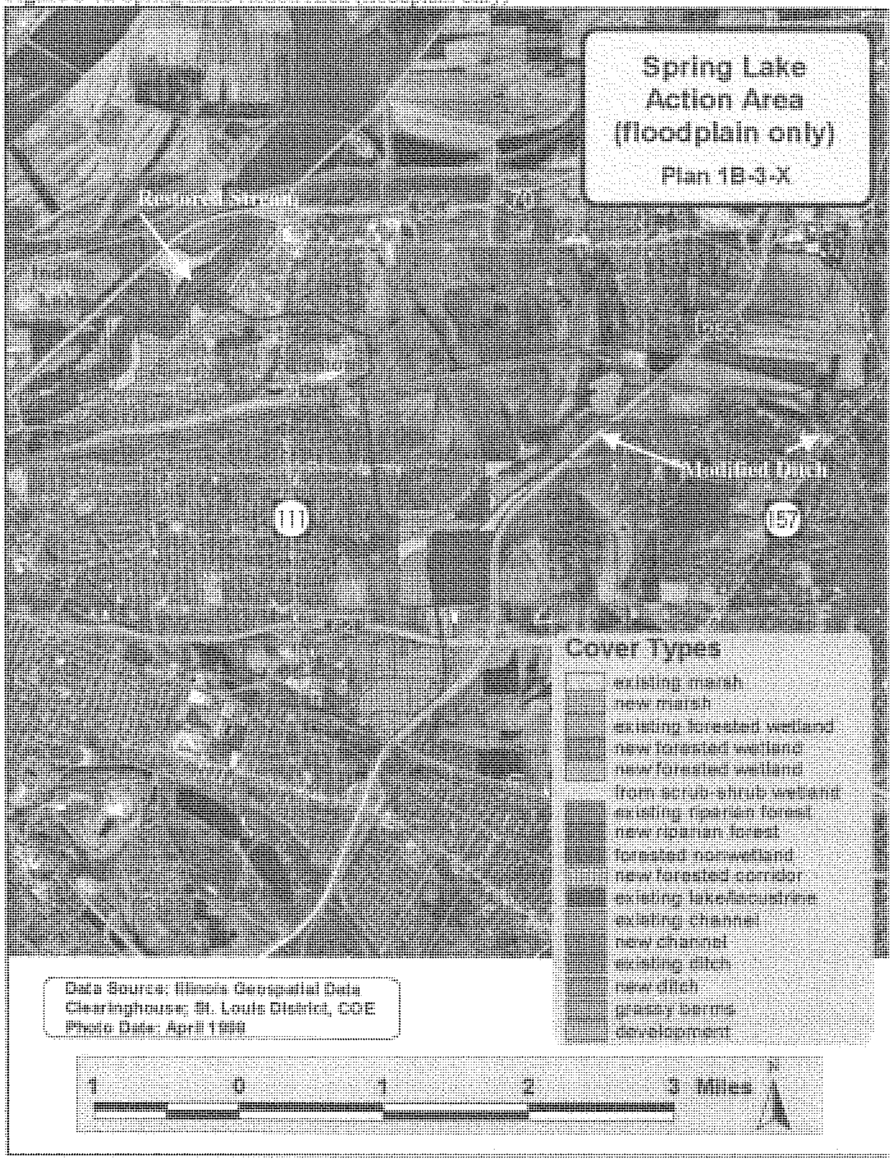


Figure 8-7a Spring Lake Action Area (floodplain only)



8.2.8 Mullens Slough.

Overview. The Mullens Slough action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary streams. A 312-acre floodplain habitat area consisting predominantly of a lake (known as Mullens Slough) is to be established adjacent to the confluence of Powdermill Creek and Canal No. 1. About 16 miles of tributary streams in the Powdermill Creek and Bluff 6 watersheds are to be restored by constructing a series of riffle and pool complexes and building 20 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 371 acres, excluding restoration of tributary streams. Figure 8-9 displays boundaries of floodplain and tributary stream features, and Figure 8-9a shows the floodplain habitat area and its constituent cover types. Area of these cover types is displayed in Table 8-1. Details about floodplain and tributary stream features are provided below.

Floodplain. Features in the bottoms encompass about 312 acres, and are bounded on the north by Powdermill Creek, on the west by Canal No. 1 and Harding Ditch, and on the east by the bluff. Establishment of this habitat area involves enhancement of the lake and other habitats, creation of floodplain prairie, reintroduction of flooding into the habitat area, construction of a floodplain sediment detention basin, and creation of an earthen berm along the southwest boundary of Mullens Slough. Enhancement of aquatic habitat in Mullens Slough is to consist of the creation of overwintering habitat for fish, and the addition of habitat structure. A series of deep pools (water depth greater than 8 feet) is to be created parallel to Canal No. 1 by excavation to provide suitable conditions for winter survival of fish; excavation is to be performed after draw down of the lake. To improve habitat structure, woody debris is to be placed in the lake, and various aquatic plant species are to be planted around its perimeter along the shoreline (Table 8-4). Tree species diversity in existing forested wetlands along Canal No. 1 and Mullens Slough is to be increased by selective thinning and planting of mast tree species. Small forest clearings (20-foot diameter, 25 per acre) are to be planted with two-gallon containerized RPM seedlings of native species (Table 8-3), one per clearing. Earthen material excavated to create overwintering habitat is to be placed in the lake to make about five islands, and these islands are to be planted to prairie (Table 8-2). In addition to prairie plantings on the islands, new prairie is to be established on about 30 acres southwest of the lake. Wooden stakes placed in the prairie at two per acre are to temporarily serve as bird perches until plantings of perennial robust forbs become established.

Storm water from the Powdermill Creek watershed is to be introduced into the habitat area to approximate historic hydrological conditions. Flood depth and duration would vary with the severity of local storm events. A floodplain sediment detention basin of about 17 acres is to be established between Powdermill Creek and Il Route 163. This basin is to capture sediment carried by the creek before flows enter Mullens Slough, and the basin would be planted with marsh species (Table 8-4). Wood duck nest boxes mounted on poles are to be placed in the detention basin's marsh and also along the channel of Canal No. 1, at a density of one per every four acres. Between Mullens Slough and the 30-acre prairie to its southwest, an earthen berm is to be constructed along an existing drainage way to temporarily retain storm water within the habitat area. At the southwest corner of the habitat area, a new drainage structure is to be constructed in the levee along Canal No. 1 to allow storm water to reenter the interior flood control system.

Tributary streams. The series of riffle and pool complexes are to be constructed within the streams at locations yet to be determined. Construction of 14 tributary stream sediment detention basins in the Powdermill Creek watershed and six in the Bluff 6 watershed requires a total of about 59 acres of land. Each basin is to be located in a stream valley, and is to consist of a concrete dam with spillway, and a sediment detention area that is to remain forested. In the forested areas of these basins, which total about 52 acres, tree species diversity is to be improved by creating small forest clearings (20-foot diameter, 25 per acre), and planting a two-gallon containerized seedling of a native tree species (Table 8-3) in each clearing.

Figure 8-8 Mullens Slough Action Area

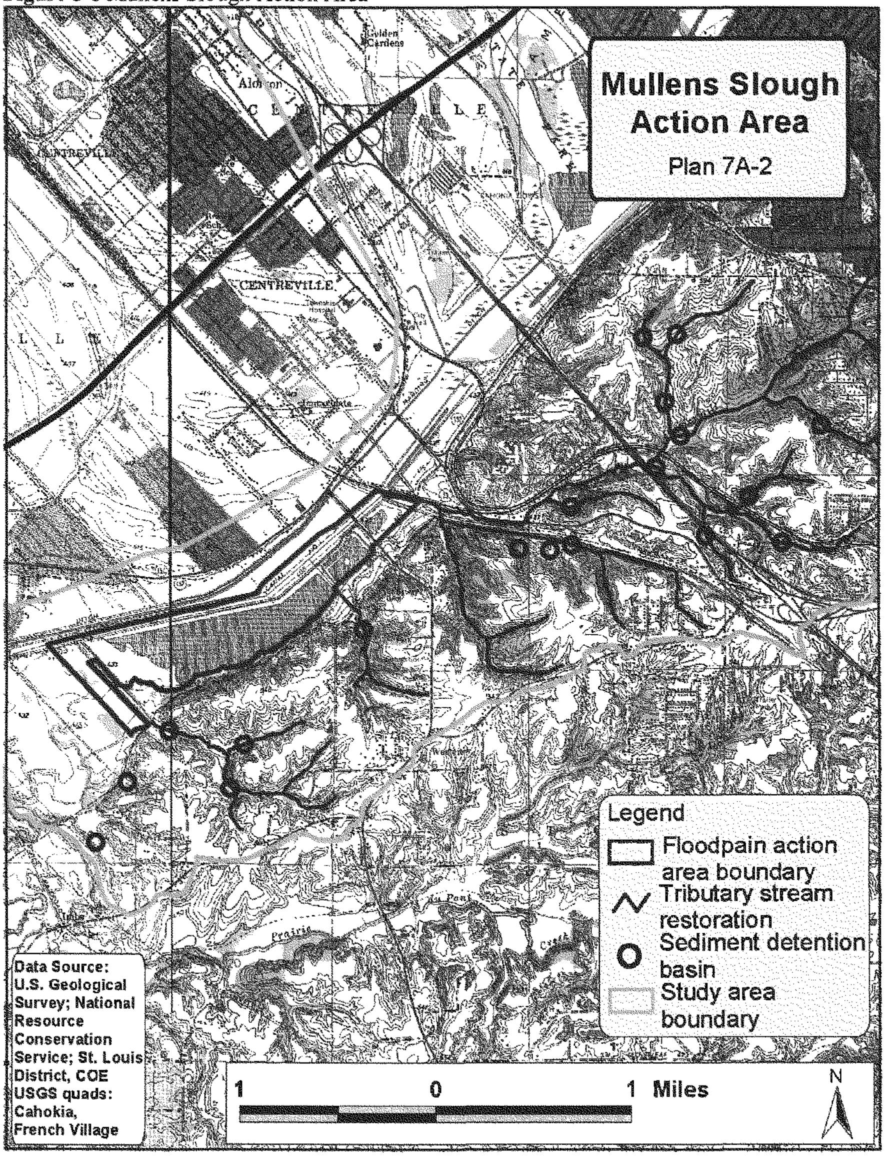
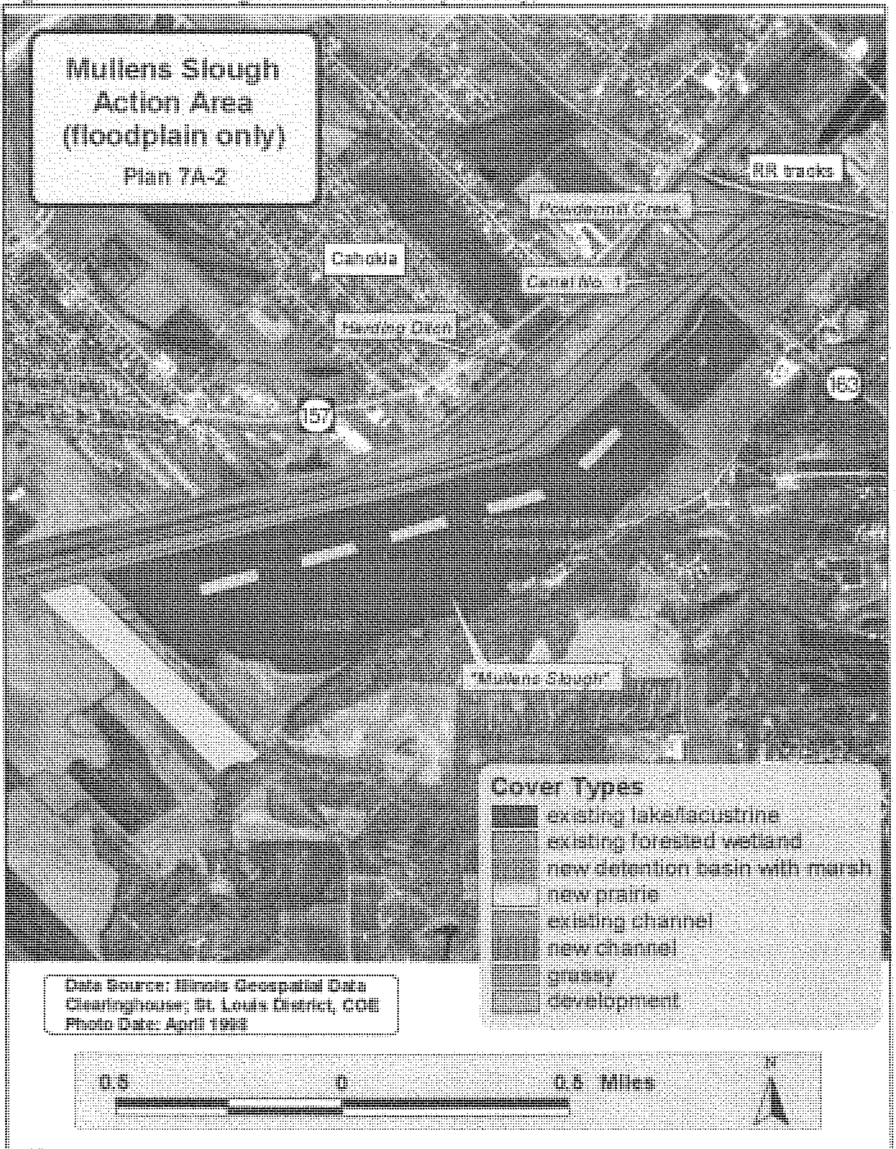


Figure 8-8a Mullens Slough Action Area (floodplain only)



8.3 SIGNIFICANCE OF RESOURCES RESTORED

The Study area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area will contribute greatly to national, regional and local systems.

North American Waterfowl Management Plan

Resource Significance: Because the study area's aquatic resources are within a waterfowl habitat area of major concern designated under the North American Waterfowl Management Plan, and within a joint venture area approved under the Plan, their institutional significance is recognized from both a national and international perspective. Additionally, the study area's aquatic resources exist within a priority or focus area designated in the Upper Mississippi River/Great Lakes Region Joint Venture Implementation Plan, which recognizes their institutional significance from a regional perspective. Based on technical recognition, Horseshoe Lake and surrounding wetlands are significant from a state perspective because they are important resources for migratory waterfowl in terms of connectivity. At the landscape level, the lake and its surrounding wetlands serve as an important link in a chain of habitats used by migratory waterfowl along the Mississippi flyway. Based on public recognition, Horseshoe Lake is locally significant because of the hunting opportunities it offers to the public, and because the Illinois Chapter of Ducks Unlimited, Inc., supports wetland enhancement opportunities at the lake.

Recommended Plan: The recommended plan will contribute to the North American Waterfowl Management Plan's goals for conservation and management of waterfowl species and habitat by protecting and restoring mid-migrational and breeding habitat along the Mississippi River flyway. The proposed habitat restoration on the Mississippi River's floodplain will occur within one of the Plan's waterfowl habitat areas of major concern on the North American continent, and within a migratory focus area designated at the regional scale under the Upper Mississippi River/Great Lakes Region Joint Venture's Implementation Plan. This habitat restoration will contribute to the Joint Venture Implementation Plan's goal of increasing wetland habitats by about 36,000 acres in migratory focus areas along the Mississippi River in Illinois. The plan will contribute significantly by providing about 1,350 acres of new wetlands through reestablishment of historic vegetation and functions to former wetlands. It will also restore about 1,325 acres of existing wetlands by improving natural conditions and returning historic functions to degraded wetlands. About 30 species of migratory swans, geese, and ducks should benefit from the restoration of these 2,700 acres of affected wetlands.

The recommended plan will also provide additional benefits to migratory and resident waterfowl species at lake and pond habitats. Within the proposed habitat restoration areas, improving natural conditions and replacing historic functions will restore about 460 acres of lake and pond habitat, which is expected to provide more feeding opportunities for waterfowl by increasing production of aquatic organisms. In addition, indirect benefits to lake and pond habitat are expected outside the proposed restoration areas at the 2,000-acre Horseshoe Lake at Horseshoe Lake State Park. The proposed restoration of 178 miles of tributary streams is expected to reduce excessive sediment loads carried from the bluffs into Horseshoe Lake by the study area's interior drainage system during storm events, and similarly improve feeding opportunities for migratory and resident waterfowl.

Upper Mississippi River System

Resource Significance: Because the study area's aquatic resources on the Mississippi River's floodplain are located within the floodplain of the Upper Mississippi River System, they can be recognized as part of a nationally significant ecosystem. Also, because these resources are within an area of the UMRS targeted for habitat restoration under the Upper Mississippi River Environmental Management Program, its natural resources can be recognized as institutionally significant from a regional perspective. In addition, floodplain prairies, hardwood forests, marshes, and deep backwaters within the study area can be recognized as technically significant from a regional perspective based on status and trends as described in the Habitat Needs Assessment.

Recommended Plan: The recommended plan will contribute to the goal of the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program of increasing by about 100,000 acres the amount of prairie, marsh, and forest on the Mississippi River's floodplain within the river reach extending from St. Louis to Cairo. The plan will significantly increase the area of prairie, marsh, and forest in this river reach by about 2,365 acres. The plan is also expected to meet the need for three specific habitat improvements identified in the Habitat Needs Assessment. First, the plan is expected to restore existing degraded habitats by improving natural habitat conditions, thereby improving habitat quality. Second, the plan will restore a flood pulse to floodplain habitats, thereby returning the current hydrological regime to a closer approximation of pre-development conditions. Lastly, the plan will restore historically typical floodplain habitats that are now uncommon, such as floodplain prairies and streams, thereby increasing floodplain habitat diversity.

Clean Water Action Plan

Resource Significance: Because the watersheds in the study area are designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan, they can be recognized as institutionally significant from a national perspective.

Recommended Plan: The recommended plan will contribute toward the goals of the Clean Water Action Plan by restoring 178 miles of streams in five small watersheds identified as priority watersheds for restoration in Illinois. The plan's proposed restoration of tributary streams in these five watersheds is expected to correct silt and sedimentation problems that have degraded in-stream habitat. Improving the quality of in-stream habitat should restore conditions that can support a diverse food web of animals by improving substrate quality, restoring channels and pool and riffle complexes, and encouraging recolonization by benthic invertebrates. Restoration of riparian forest along tributary streams at the 131 proposed sediment detention basins is expected to improve degraded habitat conditions by reintroducing uncommon native tree species such as oaks. Under the plan, storm water carried by the tributary streams proposed for restoration is to serve as the source of the flood pulse to be reintroduced into the proposed habitat restoration areas on the Mississippi River's floodplain. An expected secondary effect of tributary stream restoration is improvement of conditions in the floodplain habitats, by reducing excessive sediment loads currently reaching the floodplain.

Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force

Resource Significance: Because the study area is located on the floodplain of the Mississippi River north of the Ohio River, it occurs in an area highlighted by the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force as potentially important to contributing to the Action Plan's goals of reducing nitrogen loads to the Gulf of Mexico and improving waters within the river's basin. As such, the study area and its aquatic resources can be recognized as institutionally significant from a regional perspective. Given the potential to implement one of the Action Plan's recommended actions in the study area, namely the restoration of floodplain wetlands, further significance is associated with study area and its aquatic resources.

Recommended Plan: The plan's proposed restoration of wetlands on the Mississippi River's floodplain in Illinois supports the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The proposed restoration of about 2,700 acres of floodplain wetlands is expected to promote nitrogen retention within the study area's watersheds, reduce nitrogen loads of inflow from the interior drainage system to the Mississippi River, and contribute to the eventual improvement of the hypoxic condition in the northern Gulf of Mexico.

Species of Concern

Resource Significance: The listing of certain migratory birds as species of concern by the U.S. Fish and Wildlife Service demonstrates that the Federal government recognizes them as highly significant. Their institutional significance is further supported by various international agreements the Federal government has entered into with Canada, Mexico, and other countries to foster continental and regional bird conservation strategies. Additional institutional significance is supported because aquatic habitats in the study area and along the Mississippi River also serve as habitat for these 34 bird species of concern as well as and two federally threatened species.

Recommended Plan: The recommended plan is expected to benefit 34 priority species of birds and two federally threatened species (one plant and one bird) through the restoration of about 4,300 acres of aquatic habitats on the Mississippi River's floodplain, 178 miles of tributary streams, and about 380 acres of riparian forest along the tributary streams. Migratory and breeding habitat for 10 priority species of ducks is expected to be provided by the proposed restoration of 2,700 acres of wetlands and 460 acres of lake habitat within eight proposed floodplain habitat restoration areas. The proposed plan will support the North American Waterbird Conservation Plan by providing migratory and breeding habitat for four heron and rail species of concern through the proposed wetland restoration, along with the proposed restoration of about 11 miles of floodplain streams. Feeding opportunities for two of these heron species are also expected to improve from the proposed restoration of 178 miles of tributary streams. The recommended plan will contribute to the U.S. Shorebird Conservation Plan by providing migratory habitat to eight sandpiper species of concern through the proposed floodplain wetland restoration. Horseshoe Lake at Horseshoe Lake State Park, recognized under the Shorebird Plan as an important stopover in Illinois for migratory shorebird species, is expected to indirectly benefit from the proposed plan through reduced levels of sedimentation, which is expected to provide improved feeding opportunities to shorebirds. The Neotropical Migratory Bird Conservation Program (Partners in Flight) and 11 landbird species of concern are expected to benefit from the recommended plan through the proposed restoration of forested wetlands, marshes, wet prairies, and floodplain and tributary streams, and restoration of riparian forest along tributary streams. Restoration of forested wetland habitat at the proposed Brushy Lake action area is expected to meet the size requirements for breeding habitat of some area-sensitive landbird species of concern, such as the Acadian flycatcher and Louisiana waterthrush. Similarly, area-sensitive grassland breeding species of concern like the grasshopper sparrow and sedge wren are expected to benefit from restoration of floodplain prairie at the Judy's-Burdick and Cahokia Prairie action areas. The federally threatened bald eagle is expected to benefit from improved feeding opportunities through proposed restoration of 460 acres of lake habitats. The proposed plan will contribute to the recovery plan of the federally threatened decurrent false aster through restoration of about 1,500 acres of marsh and wet prairie habitats where it can be introduced.

8.4 CONSTRUCTION FEATURES

Each of the Project action areas has their own individual combination of construction features (measures). Of these measures, several are common to each Project action area throughout the Recommended Plan. These common measures consist of tributary stream detention basins, channel improvements (from bluff tributaries to habitat areas), earthen embankments (to direct and contain the desired hydraulic flow/pulse and provide definition/protection to the habitat areas), and the connection and control of hydraulic components by means of elevation changes, culverts, flap gates and new channels.

These measures were designed at various levels of detail based upon information available during the plan formulation and evaluation phase. Many of the design assumptions were based on the output from a hydraulic computer model (HEC-2) used to develop the 1985 plan updated for today's conditions. For this reason, the first component of the next phase of work will be the development of a new unsteady flow model to validate assumptions drawn from the one dimensional HEC 2 model. The information provided by the unsteady flow model will be used to validate or change the optimum size of connections into and out of habitat areas during design of the action areas to achieve desired goals of disturbance depth and duration. The following are generic descriptions of the measures that make up the construction features of the recommended plans. Evaluation of the Judy's Branch Pilot project will further refine model information and assist in follow-on design efforts.

8.4.1 Prairie Planting. Prairie will be established in cropland areas as well as grassy fields and old fields. Plant species to be used will consist of grasses (about a half dozen), forbs (about 40 to 50), and a few sedges and shrubs. Representative prairie species are included in Table 8-2. All of these species are native to Illinois. Local ecotypes will be used, and species will be selected according to local soil moisture conditions. Procedures for establishing prairie in cropland areas are as follows. Sites will be prepared prior to planting by disking or harrowing in the spring. Then a fine-textured soil or firm seedbed will be created in the tilled ground with a cultipacker, coil, or roller packer. Planting of prairie seed will be conducted during the April 1 – June 15 time frame using a no-till warm-season grass seed drill. Seeds will be placed at a soil depth of 0.25-1.0 inch. A cover crop of winter wheat, oats, or millet will then be planted to control the germination and growth of weeds. By late summer or early fall, the planted area will be mowed with a rotary mower, not shorter than 8 inches, for further weed control. Temporary bird perches consisting of 2 six-foot tall wooden stakes per acre will be placed the following spring. Action areas at which these steps would be taken include Judy's-Burdick, Elm Slough, and Mullens Slough.

Procedures for establishing prairie at grassy or old field sites include some additional steps. During the fall prior to planting, existing vegetation will be mowed. After mowing, an herbicide (Roundup) will be applied to "burn down" the existing vegetation. If fescue is present, Plateau with Roundup will be used. About two weeks after the chemical "burn down", nutrient levels (phosphorus and potassium) at the site will be tested and adjusted if necessary. The following spring, the entire field will be burned two weeks prior to planting with prairie seed. Successive planting methods and weed control measures would follow those to be used at cropland sites. If fescue is still present, spot control will consist of the application of Plateau with Roundup. Cahokia Mounds is the action area where these steps would be used.

Table 8-2 Representative prairie plant species to be used in prairie restorations of the recommended plan

Plant Form/Common Name	**Scientific Name** ([1])
Shrubs	
NEW JERSEY TEA	*Ceanothus americanus*
AMERICAN FILBERT	*Corylus americana*
GRAY DOGWOOD	*Cornus racemosa*
Grasses	
BIG BLUESTEM	*Andropogon gerardii*
SIDE-OATS GRAMA	*Bouteloua curtipendula*
PRAIRIE SWITCHGRASS	*Panicum virgatum*
LITTLE BLUESTEM	*Schizachyrium scoparium*
INDIAN GRASS	*Sorghastrum nutans*
PRAIRIE DROPSEED	*Sporobolus heterolepis*
GAMA GRASS	*Tripsacum dactyloides*
Sedges	
FOX SEDGE	*Carex vulpinoidea*
GRASS BEAK RUSH	*Rhynchospora globularis*
Forbs	
SWAMP MILKWEED	*Asclepias incarnata*
BUTTERFLY WEED	*Asclepias tuberosa ssp. interior*
SKY-BLUE ASTER	*Aster azureus*
SMOOTH BLUE ASTER	*Aster laevis*
NEW ENGLAND ASTER	*Aster novae-angliae*
CREAM WILD INDIGO	*Baptisia leucophaea*
PRAIRIE COREOPSIS	*Coreopsis palmata*
WHITE PRAIRIE CLOVER	*Dalea candida*
PURPLE PRAIRIE CLOVER	*Dalea purpurea*
SHOWY TICK TREFOIL	*Desmodium canadense*
ILLINOIS TICK TREFOIL	*Desmodium illinoense*
PALE PURPLE CONEFLOWER	*Echinacea pallida*

Table 8-2 - Continued

Plant Form/Common Name	Scientific Name ([1])
Forbs - Continued	
PURPLE CONEFLOWER	*Echinacea purpurea*
RATTLESNAKE MASTER	*Eryngium yuccifolium*
FLOWERING SPURGE	*Euphorbia corollata*
CLOSED GENTIAN	*Gentiana andrewsii*
SNEEZEWEED	*Helenium autumnale*
FALSE SUNFLOWER	*Heliopsis helianthoides*
SOUTHERN BLUE FLAG	*Iris shrevei*
SOFT RUSH	*Juncus effusus*
ROUND-HEADED BUSH CLOVER	*Lespedeza capitata*
PRAIRIE BLAZINE STAR	*Liatris pycnostachya*
MARSH BLAZING STAR	*Liatris spicata*
BLUE LOBELIA	*Lobelia siphilitica*
WILD BERGAMOT	*Monarda fistulosa*
WILD QUININE	*Parthenium integrifolium*
FOXGLOVE BEARD TONGUE	*Penstemon digitalis*
OBEDIENT PLANT	*Physostegia virginiana*
PRAIRIE CINQUEFOIL	*Potentilla arguta*
COMMON MOUNTAIN MINT	*Pycnanthemum virginianum*
YELLOW CONEFLOWER	*Ratibida pinnata*
ORANGE CONEFLOWER	*Rudbeckia fulgida*
BLACK-EYED SUSAN	*Rudbeckia hirta*
FRAGRANT CONEFLOWER	*Rudbeckia subtomentosa*
ROSIN WEED	*Silphium integrifolium*
COMPASS PLANT	*Silphium laciniatum*
CUP PLANT	*Silphium perfoliatum*
PRAIRIE DOCK	*Silphium terebinthinaceum*
PRAIRIE BLUE-EYED GRASS	*Sisyrinchium campestre*
OHIO GOLDENROD	*Solidago ohioensis*
RIGID GOLDENROD	*Solidago rigida*
PURPLE MEADOW RUE	*Thalictrum dasycarpum*
OHIO SPIDERWORT	*Tradescantia ohiensis*
BLUE VERVAIN	*Verbena hastata*
COMMON IRONWEED	*Vernonia fasciculata*
CULVER'S ROOT	*Veronicastrum virginicum*
GOLDEN ALEXANDERS	*Zizia aurea*
([1]) All species are perennial	

8.4.2 Tree planting. All tree species to be used will consist of species native to Illinois. Local ecotypes will also be used. Additionally, source plant materials to be planted in wetland areas will come from wetland genetic stocks.

8.4.2.1 Tree planting to create forest. Two methods will be used to reforest cropland areas. For sites that will receive flooding consisting from tributary streams, tree seedlings consisting of 2-gallon RPM (root pruning method) containerized stock will be used. These seedlings are about 5 to 7 feet tall. Before planting of seedlings, a ground cover consisting of winter wheat (*Triticum aestivum*) and redtop (*Agrostis alba*) will be established. Seedlings will be placed on a 30 foot by 30 foot spacing (48/acre). A survival rate of 75% for seedlings planted in this manner has been assumed. Tree species to be planted will be selected from those included in Table 8-2. Species selection will be based upon local soil moisture conditions, and will approximate historical tree species diversity.

Species such as box elder (*Acer negundo*), silver maple (*Acer saccharinum*), sweet gum (*Liquidambar styraciflua*), red mulberry (*Morus rubra*), sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*), and various willows (*Salix* spp.) will not be planted. Instead, it is expected that colonization of planted sites by these species will occur naturally. This type of reforestation will occur at the Elm Slough (in part), Brushy Lake, and Spring Lake Action Areas.

For sites not receiving a flood pulse (or shallow flooding consisting of sheet flow), bare-root seedlings will be used. These seedlings can vary in height from one to three feet. At these sites, a ground cover consisting of winter wheat and redtop will also be established. Seedlings will be placed on an 11 foot by 11 foot spacing (350/acre), with no tree shelters. A 50% survival rate has been assumed for bare-root seedlings. Species selection for bare-root seedlings will follow the same rationale used for RPM seedlings. This type of reforestation will occur at the Old Cahokia Creek, Dobrey Slough, Elm Slough (in part), and Spring Lake Action Areas.

8.4.2.2 Tree Planting to Improve Existing Forest. Tree stand improvements will be implemented within some areas of existing forest to add tree species that once occurred but are currently lacking. These improvements will consist of the creation of 25 small forest clearings (20 foot diameter) per acre, and the planting of 25 two-gallon containerized seedlings (RPMs) per acre. Species to be planted will be selected from those included in Table 8-3, and will reflect local soil moisture conditions. These improvements will occur at both floodplain and tributary stream sites. Floodplain sites include the Elm Slough and Mullens Slough Action Areas. Tributary stream sites include each of the 131 tributary stream sediment detention basins. Each site is expected to include an area of forest acquired to build the tributary stream detention basins.

Table 8-3 Representative tree species to be used in forest restorations of the recommended plan, according to landform (floodplain and uplands) and soil moisture class. ([1])

		Floodplain			**Upland**
Common Name	**Scientific Name**	**mesic**	**wet-mesic**	**wet**	**mesic**
Ohio buckeye	*Aesculus glabra*	x	x		x
Pawpaw	*Asimina triloba*	x	x		X
River birch	*Betula nigra*	X	x	x	
Bitternut hickory	*Carya cordiformis*	x			x
Pignut hickory	*Carya glabra*				x
Pecan	*Carya illinoensis*	x	x	X	
Big shellbark	*Carya laciniosa*		X	x	x
Shagbark hickory	*Carya ovata*				X

Table 8-3 Continued

		Floodplain			Upland
Common Name	**Scientific Name**	**mesic**	**wet-mesic**	**wet**	**mesic**
Mockernut hickory	*Carya tomentosa*				x
Sugarberry	*Celtis laevigata*		x	**X**	
Hackberry	*Celtis occidentalis*	x	**X**	x	**X**
Eastern redbud	*Cercis canadensis*	x	x		x
Cock-spur thorn	*Crataegus crus-galli*		x		
Red haw	*Crataegus mollis*	x	x		
Green thorn	*Crataegus viridis*			x	
Persimmon	*Diospyros virginiana*	x	x		
White ash	*Fraxinus americana*				**X**
Green ash	*Fraxinus pennsylvanica*	**X**	**X**	**X**	x
Blue ash	*Fraxinus quadrangulata*	x			x
Honey locust	*Gleditsia triacanthos*	x	**X**	x	
Kentucky coffeetree	*Gymnocladus dioicus*	x			
Black walnut	*Juglans nigra*	**X**			x
Black gum	*Nyssa sylvatica*	x			x
Hop hornbeam	*Ostrya virginiana*	x			x
Wild black cherry	*Prunus serotina*	**X**	x		x
White oak	*Quercus alba*	**X**			**X**
Swamp white oak	*Quercus bicolor*		x	x	x
Jack oak	*Quercus imbricaria*	x	x		x
Burr oak	*Quercus macrocarpa*	x	**X**		x
Chinkapin oak	*Quercus muhlenbergii*				x
Pin oak	*Quercus palustris*	**X**	**X**		
Northern red oak	*Quercus rubra*	**X**			**X**
Post oak	*Quercus stellata*				x
Black oak	*Quercus velutina*				**X**
Sassafras	*Sassafras albidum*	x			x
American linden	*Tilia americana*	x	x		**X**
American elm	*Ulmus americana*	x	**X**	**X**	**X**
Slippery elm	*Ulmus rubra*	x	x		**X**
([1]) The information in this table is taken from Appendix B.					
Bold "X" indicates those tree species that are normally dominant in their forest community.					

8.4.3 Marsh Planting. Marsh will be established in areas receiving adequate hydrology from stormwater. Plant species to be used will consist of a few shrubs, a number of grasses, numerous sedges, and many forbs, for a total of about 45 to 50 species. Representative marsh plant species are presented in Table 8-4. All of these species are native to Illinois. Local ecotypes will be used. A number of locally common species are expected to become introduced naturally, and will not be planted. Examples of such species include cattails (*Typha* spp.), smartweeds (*Polygonum* spp.), beggars ticks (*Bidens* spp.), and a few willows (*Salix* spp.). Action Areas at which marsh will be planted include Dobrey Slough and Spring Lake. Vegetative plantings to be established along the shoreline of lakes and other water bodies will consist of these marsh species. Shoreline plantings will occur at the Judy's-Burdicks, Dobrey Slough, Spring Lake, and Mullens Slough Action Areas.

Table 8-4 Representative marsh plant species to be used in marsh restorations of the recommended plan

Plant Form/Common Name	Scientific Name
Shrubs	
False indigo bush	*Amorpha fruticosa*
Pale dogwood	*Cornus obliqua*
Grasses	
Canada brome grass	*Bromus ciliatus*
Blue joint grass	*Calamagrostis canadensis*
Fowl manna grass	*Glyceria striata*
Rice cutgrass	*Leersia oryzoides*
Prairie cord grass	*Spartina pectinata*
Sedges	
Broom sedge	*Carex scoparia*
Sedge	*Carex cristatella*
Sedge	*Carex crus-corvi*
Sedge	*Carex frankii*
Common lake sedge	*Carex lacustris*
Hop sedge	*Carex lupulina*
Prickly sedge	*Carex stipata*
Common tussock sedge	*Carex stricta*
Fox sedge	*Carex vulpinoidea*
Common spikerush	*Eleocharis palustris*
American bulrush	*Scirpus americanus*
Dark green rush	*Scirpus atrovirens*
River bulrush	*Scirpus fluviatilis*
Red bulrush	*Scirpus pendulus*
Forbs	
Common water plantain	*Alisma subcordatum*
Swamp milkweed	*Asclepias incarnata*
Nodding beggar-ticks	*Bidens cernua*
False aster	*Boltonia asteroides*
Water hemlock	*Cicuta maculata*
Green-stemmed joe-pye weed	*Eupatorium purpureum*
Autumn sneezeweed	*Helenium autumnale*
Sawtooth sunflower	*Helianthus grosseserratus*
Jewelweed	*Impatiens capensis*
Southern blue flag	*Iris shrevei*
Cardinal-flower	*Lobelia cardinalis*

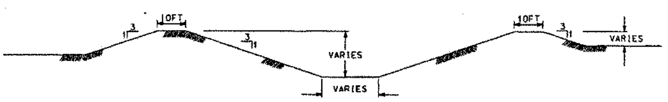
Table 8-4 Continued

Plant Form/Common Name	Scientific Name
Blue cardinal-flower	*Lobelia siphilitica*
Seedbox	*Ludwigia alternifolia*
Pinkweed	*Polygonum pensylvanicum*
Swamp dock	*Rumex verticillatus*
Marsh pink	*Sabatia angularis*
Common arrowhead	*Sagittaria latifolia*
Common bur reed	*Sparganium eurycarpum*
American germander	*Teucrium canadense var. virginicum*
Purple meadow rue	*Thalictrum dasycarpum*
Blue vervain	*Verbena hastata*
Common ironweed	*Vernonia fasciculata*
Missouri ironweed	*Vernonia missurica*

8.4.4 Channel Improvements. The existing channels that are to be improved currently have inadequate cross-sectional areas to pass desired flows. New channel improvements have been designed to provide adequate conveyance/drainage ways with minimal adverse impact on the environment.

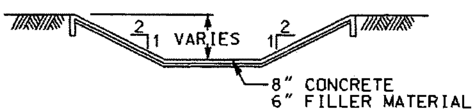
8.4.4.1 Grass-lined Trapezoidal Channel Improvements. The grass-lined channel slopes will be graded to 1 vertical on 3 horizontal with channel bottom widths ranging from 10 feet to110 feet. The excavated channel materials will be placed properly and compacted along the channel alignment with 10-foot crown widths. The back slopes of the channel embankments will be graded to 1 vertical on 3 horizontal to maintain stability. Moisture control and compaction of the material will be required to maintain stability, support vehicle loads and maintenance equipment, and resist erosion and channel scour. Crushed stone aggregate (IDOT CA-6 gradation) surfacing, 6-inch compacted thickness, will be constructed on the crown to provide reliable vehicular access along the earthen embankments. On some earthen embankments where a bicycle trail will be located on the embankment crown, the crushed stone aggregate surfacing will use material to provide a smoother riding surface instead of the IDOT CA-6 gradation. Well-rooted turf will be established to prevent scour and erosion on the side slopes. The proposed grass-lined trapezoidal channel section is shown in Figure 8-9.

Figure 8-9 Grass-lined Trapezoidal Channel



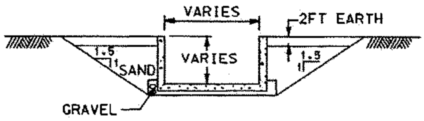
8.4.4.2 Concrete-paved Trapezoidal Channel Improvements. There are some channels that require their slopes and channel bottoms to be protected and paved with concrete due to the high velocity flows that will otherwise erode grass-lined earthen slopes. The channel slopes will be graded to 1 vertical on 3 horizontal with channel bottom widths ranging from 10 feet to 75 feet. The concrete pavement will be 8 inches thick and underlain by 6-inch thick sand drainage layers. Drainage weep holes will be constructed on 10-foot centers and located 2 feet above the channel bottom. The proposed concrete-paved trapezoidal channel section is shown in Figure 8-13.

Figure 8-10 Concrete-paved Trapezoidal Channel



8.4.4.3 Concrete Rectangular Channel Improvements. The channel improvements located under some bridges require concrete channels to avoid bridge relocations. Trapezoidal channels will be transitioned into concrete rectangular channel sections. The rectangular channel sections will be designed as "U"-frame monoliths to optimize the concrete reinforcement and reduce concrete quantities. The rectangular channel bottom widths range from 10-foot to 55-foot. Gravel drainage filters will be constructed below the concrete base slab and extend up the outer wall surface to provide drainage for the structures. The structural backfills will consist of compacted sand capped with 2-foot thick clay/topsoil to establish a well-rooted turf. The proposed concrete rectangular channel section is shown in Figure 8-11.

Figure 8-11 Concrete Rectangular Channel



8.4.5 Tributary Stream Detention Basins. Tributary stream detention basins, so-called because they are intended to slow flows to release them at a substantially lower rate than would have occurred without the basin. Most of the sediments entering the tributary stream sediment detention basins will be allowed to settle out of the temporarily ponded water.

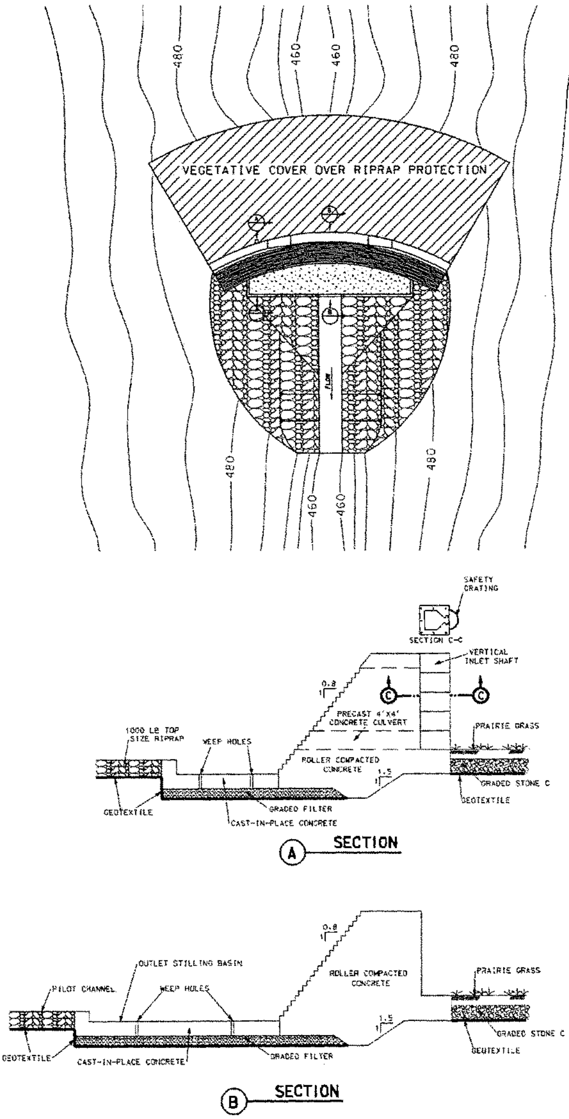
These structures are to be constructed in the stream valleys within the watershed. Roller-compacted concrete was selected for the design to minimize the detention dam structures' thereby reducing their footprints and impact on existing environmental quality in the bluffs. The detention dams will have an upstream arched alignment to improve overall stability against sliding and overturning and to better control the overtopping events that will occur during the life of the structure.

Dam overflow spillways sections will be constructed and ramped 3-feet lower than the adjacent top crown elevations. The spillway lengths typically will vary from 100 feet to 200 feet. Low upstream flows will be allowed to pass through the dam by flowing through a precast concrete gravity flow system that uses a 4-foot square vertical inlet shaft located on the upstream face of the dam. The upstream flows will enter through a one-foot wide vertical opening in the vertical inlet shaft protected with semicircle grating protruding outside from the opening for safety purposes. The opening in the concrete wall will be slotted on both sides of the opening. As sediment aggrades at the base of the dam, 2-foot square precast reinforced concrete panels will be dropped into the slotted opening to retain the sediment loads. The upstream flows will drop down the vertical shaft into a 4-foot square horizontal box culvert that discharges into a plunge pool. Plunge pools will be designed to varying depths immediately downstream of the detention dams and armored with roller-compacted concrete.

Graded riprap protection will be placed on the channel slopes and the channel bottom between the plunge pool and a point approximately 200 feet downstream to further dissipate the hydraulic energy of the released flows and to protect against scour and erosion. Graded riprap will be placed between the upstream face of the dam and 150 feet upstream. This riprap protection is designed to protect the dam's foundation against scour and undercutting forces produced by turbulent eddies immediately upstream of the dam during overtopping events. The upstream riprap will be covered with a minimum two feet of clay and 6-inches of topsoil from the on-site excavations.

Prairie grasses and wild flowers will be planted within 150 feet of the dam. The grasses and clay cover will provide additional scour protection while enhancing the ecosystem. The detention basins will be left in their natural state. Man-made waste in the vicinity such as vehicles, tires, refrigerators, water heaters, and the like will be removed and disposed of properly. Several different views of a typical proposed tributary stream detention dam are shown on Figure 8-12 below.

'igure 8-12 Tributary Stream Sediment Detention Basin



8.4.6 Earthen Embankments. The earthen embankments will be constructed of clay materials taken from the channel excavations. The embankment will have a 10-foot crown width with 1 vertical on 3 horizontal side slopes as shown on Figure 8-13. These embankments are designed to retain water and support vehicle and maintenance equipment. The excavated clay materials will be placed with moisture control and compacted. A well rooted turf will be established on the side slopes. Crushed stone aggregate surfacing (IDOT CA-6 gradation) with 6-inch compacted thickness, will be constructed on the crown to provide reliable vehicular access along the earthen embankments. On some earthen embankments where a bicycle trail will be located on the embankment crown, crushed stone aggregate surfacing will be used to provide a smoother riding surface instead of the IDOT CA-6 gradation. The proposed earthen embankment section is shown in Figure 8-6.

Figure 8-13 Earthen Embankments

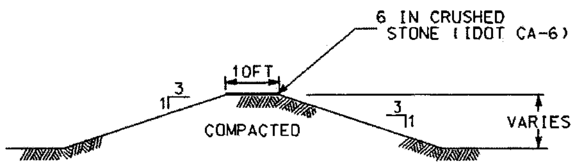
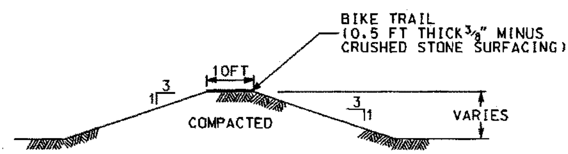
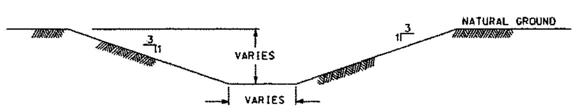


Figure 8-14 Bike Trail



8.4.7 New Channels. The new grass-lined channel slopes will be graded to 1 vertical on 3 horizontal with varying channel bottom widths. Well-rooted turf will be established to prevent scour and erosion on the side slopes. The proposed grass-lined trapezoidal channel section is shown in Figure 8-18.

Figure 8-15 New Grass-Lined Channels



8.4.8 Stream Bank and Bottom Stability Control. There are several factors that initiate stream bank instability and stream bottom instability. Urbanization of the uplands has increased runoff from the additional impervious surfaces. This has caused runoff to be the major contributor to stream bank and bottom instabilities since the stream flows have more volume and higher velocities. Sustained high velocity flows cause more frequent scouring and undercutting of the channel toes, which means that the upper portions of the stream banks can no longer be supported after the channel toe is undercut and scoured away. This leads to total bank instability. Soil slab failures occur, falling into the stream, and are then carried away as sediment.

In the stream channel bottom, grade controls and channel toe protection are key components to stabilizing the streams. Placement of low height stone protection across the stream will create riffle pools, which provide good aquatic species habitat and also serve as a plunge pool and channel grade control. The riffle pools will be constructed as a series, in increments, dependent upon channel slope and flow velocities. Channel slope toe protection will be required where the soils are susceptible to erosion and scour. Stone armoring has been successful over the long term.

8.4.9 Culverts and Flap Gates. Culverts will be used to convey water through embankments for roadways, railroads, and water retention structures. There will be two basic types utilized: concrete box culverts; and, reinforced concrete pipe. Their use will depend upon maintenance requirements as well as highway and railroad loading values at each location. All culvert joints will be wrapped in geotextile to keep fine soils from migrating through the joints. Flowable fill, called pipe haunch, will be placed around the lower pipe sections. The lower pipe sections are the hardest to compact adequately without proper compaction tools and a conscientious workforce. These areas also are the most critical. Without proper placement and compaction, seepage and erosion around and under the pipe haunches will occur. Flap gates will be designed to handle heavy-duty service and infrequent maintenance.

8.5 DETAILED CONSTRUCTION FEATURES

8.5.1 Old Cahokia Creek. Construction components within this Project action plan include: ten tributary stream detention basins; a series of riffle and pool complexes; restoration by excavation of the historic channel to re-establish the historic bottom width (approximately 40 feet) of the channel; extension and improvement of an existing earthen berm to the west side of the creek designed to provide for the creation of a riverine overflow environment along the restored creek without inducing flooding on the adjacent urban area to the west; improvement to culverts at the southern end of the creek for the reconnection to the existing interior drainage system; improvement by excavation of an existing interior drainage channel to allow the restored creek hydraulics to reconnect to the existing interior drainage system; planting of native hardwood species within the footprint of the Project site; and, a bike path constructed on top of the earthen berm (berm) to form a connection to the existing Southern Illinois University Edwardsville's trail to provide an interpretive opportunity for the public. A detailed list of the specific measures and quantities are presented in Table 8-5.

Table 8-5 Old Cahokia Creek Construction Items.

ITEM	QUANTITY	UNIT
Excavate and Dispose of Offsite (channel excavation)	336,000	CY
West Side Berm - north (4')	138	CLF
West Side Berm - south (1')	32	CLF
Concrete Box Culverts (2ea - 2' x 2')	1.4	CLF
72" x 44" CMP Arch (1ea)	0.7	CLF
24" Dia. CMP (3ea)	1.1	CLF
Concrete Trapezoidal Channel (25' bot.width x 6' deep)	19	CLF
Clearing & Grubbing	29	ACR
Upland Forest, Tree Stand Improvement (simple)	12	ACR
Plant New Forest w/BRS's -		
Plant Bare Root Seedlings (350/acr)	169	ACR
Plant Ground Cover	169	ACR
Establishment of Turf	13	ACR
Wood Duck Boxes (1-pole w/2-boxes)	85	EA
Tributary Stream Detention Structures	10	EA

8.5.2 Judy's-Burdicks Branch. Construction components for this action plan include: 28 tributary stream detention basins; a series of riffle and pool complexes; restoration by excavation of the historic Cahokia Creek; degradation by excavation of the existing Cahokia Canal drainage channel within this reach to allow the required hydraulic re-connection to the restored creek and new habitat area; construction of a perimeter earthen berm to provide definition for, and protection of, the habitat area while promoting the desired disturbance hydrology for the area and preventing induced flooding to surrounding agricultural and urban areas; and, planting native prairie species within the footprint of the Project site. A detailed list of the specific measures and quantities are presented in Table 8-6.

Table 8-6 Judy's-Burdicks Construction Items

ITEM	QUANTITY	UNIT
Excavate and Dispose of Offsite	118,300	CY
Perimeter Berm (6')	130	CLF
Containment Berm (6')	48	CLF
Concrete Box Culverts (2ea - 9' x 9')	2.3	CLF
Creek/Ditch Restoration -		
Channel Excavation	44,000	CY
Stone for Rock Riffles (18ea)	4,860	TON
Plantings (incl. new & exist. channel)	7	ACR
Clearing & Grubbing	22	ACR
Disc/Till Topsoil (prairie land)	389	ACR
Grade Tilled Soil	389	ACR
Plant Prairie	389	ACR
Prairie Bird Perches (2ea/acre)	778	EA

Table 8-6 – Continued

ITEM	QUANTITY	UNIT
Material -		
Prairie Seed	389	ACR
Miscellaneous	389	ACR
Upland Forest Tree Stand Improvement	76	ACR
Plant Bare Root Seedlings (350/acre)	71	ACR
Establish Ground Cover	71	ACR
Shore Cover (25' strip)	4	ACR
Seasonal Mowing (2-times)	778	ACR
Tributary Stream Sediment Detention Structures	28	EA

8.5.3 Brushy Lake. Construction components for this action plan include: 15 tributary stream detention basins; a series of riffle and pool complexes; improvement of the hydraulic conveyance through the School House Branch drainage canal; restoration by excavation of the historic Cahokia Creek through the habitat area; degradation by excavation of the existing Cahokia Canal drainage channel in this reach to allow for the required hydraulic re-connection to the new habitat area; construction of a perimeter earthen berm that ties into existing elevations to provide definition for, and protection of, the habitat area on the one hand while promoting the desired disturbance hydrology for the area as well as preventing induced flooding to surrounding agricultural and urban areas on the other; and, planting of native hardwood tree species within the footprint of the Project site. A detailed list of the specific measures and quantities are presented in Table 8-7.

Table 8-7 Brushy Lake Construction Items

ITEM	QUANTITY	UNIT
Excavate and Dispose of Offsite (channel excavation)	436,000	CY
Concrete Rectangular Channel through I-255 (30' bottom width x 12' deep)	3	CLF
Grass Lined Trapezoidal Channel w/Earthen Bottom (10' bot.width x 12' deep)	63	CLF
Concrete Trapezoidal Channel (Black Ln. bridge) (10' bot.width x 12' deep)	0.24	CLF
Clearing & Grubbing	26	ACR
Plant New Forest w/RPM's -		
Plant RPM's (48/acr)	336	ACR
Plant Ground Cover	336	ACR
Wood Duck Boxes (1-pole w/2-boxes)	64	EA
Upland Forest, Tree Stand Improvement (simple)	23	ACR
Tributary Stream Sediment Detention Structures	15	EA

8.5.4 Spring Lake. Construction components for this action plan include: 58 tributary stream detention basins; a series of riffle and pool complexes; connection of Canteen Creek to the Harding system through a new concrete channel; improvement of the existing Harding Canal at Caseyville, so as to permit the desired hydraulic re-connection to the Spring Lake area; removal of the west side berm of the Harding Canal adjacent to Spring Lake; excavation of the habitat areas to achieve a flow line that allows the desired flood pulse disturbance to the Spring Lake and St Clair Farms habitat area; reconnection of Indian Lake to the hydraulic system by excavation of a connection canal through Fairmont City; re-creation by excavation of the historic Cahokia Creek through the Indian Lake habitat area; hydraulic reconnection of the Indian Lake habitat area to the existing Lansdowne Canal; and, planting of marsh and native hardwood trees within the footprint of the Project site. A detailed list of the specific measures and quantities are presented in Table 8-8.

Table 8-8 Spring Lake Construction Items

ITEM	QUANTITY	UNIT
Excavate and Dispose of Offsite	3,501,000	CY
Perimeter Berm Spring Lake 1 (7.5')	144	CLF
Perimeter Berm St. Clair Farms (5')	66	CLF
Concrete Box Culverts (1ea - 10' x 10')	0.9	CLF
Concrete Box Culverts (8ea - 11' x 7')	4.7	CLF
Tunnel Under Railroad Embank. (7' opening)	300	LF
Concrete Rectangular Channel (52' bot.width x 13' deep)	40	CLF
Grass Lined Trapezoidal Channels -		
Fairmont City - New (61' bot. width x 8' deep)	129	CLF
Harding Ditch Reach 1 (20'/78' bot.width x 8' deep)	16	CLF
Harding Ditch Reach 2 (15'/106' bot.width x 8' deep)	70	CLF
Harding Ditch Reach 3A (15'/48' bot.width x 8' deep)	20	CLF
Harding Ditch Reach 3B (15'/70' bot.width x 8' deep)	30	CLF
Bridge Replacement -		
Highway 157	3,800	SF
CSX Railroad	3,000	SF
Black Lane	8,900	SF
Channel Improvement for Bridge Replacement -		
Concrete Trapezoidal (assume 10' bot. width)	1.24	CLF
New Bridges -		
Forest Blvd.	2,200	SF
Maryland Ave.	2,200	SF
Highway 111	2,200	SF
North 51st Street	2,200	SF
Collinsville Road	2,200	SF
Penn. Central Railroad	2,100	SF
Channel Improvement for New Bridges -		
Concrete Trapezoidal (assume 10' bot. width)	3.30	CLF
Channel Improvement Only -		
Long Street - Concrete Rectangular	0.39	CLF

Table 8-8 – Continued

ITEM	QUANTITY	UNIT
I-255 Northbound - Conc.Trapez.w/Earth Bot.(bw=74')	1.34	CLF
I-255 Southbound - Conc.Trapez.w/Earth Bot.(bw=74')	1.34	CLF
Forest Blvd.- Conc.Trapez.w/Earth Bot.(bw=74')	1.34	CLF
Bunkum Road - Conc. Trapez.(bw=10')	0.70	CLF
I-64 Eastbound - Conc.Trapez.w/Earth Bot.(bw=32')	0.92	CLF
I-64 Westbound - Conc.Trapez.w/Earth Bot.(bw=32')	0.92	CLF
Clearing & Grubbing	70	ACR
Cleanout Sediment From Old Creek Channel	62,700	CY
Excavate New Creek Channel	39,900	CY
Plant New Forest w/RPM's -		
Plant RPM's (48/acr)	142	ACR
Plant Ground Cover	142	ACR
Plant New Forest w/BRS's -		
Plant Bare Root Seedlings(350/acr)	18	ACR
Plant Ground Cover	18	ACR
Plant High Quality Marsh	272	ACR
Shoreline Plantings	9	ACR
Wood Duck Boxes (1-pole w/2-boxes)	304	EA
Upland Forest, Tree Stand Improvement (simple)	216	ACR
Establishment of Turf	11	ACR
Mowing	172	ACR
Tributary Stream Sediment Detention Structures	58	EA

8.5.5 Mullens Slough. Construction components for this action plan include: 20 tributary stream detention basins; a series of riffle and pool complexes; improvement through excavation of hydraulic connection to existing culverts under highway 163; excavation between existing ponds to Mullens Slough in order to achieve the desired hydraulic reconnection, deepening by excavation of the Slough; addition of a low flow weir at the western end of the slough to provide the hydraulic re-connection to the existing Canal No. 1; re-created prairie through the construction of a perimeter earthen berm that ties into existing elevations to provide definition for, and protection of, the prairie habitat area while promoting the desired disturbance hydrology for the area and preventing induced flooding to surrounding agricultural areas; and provide woody debris and shoreline plantings for fish habitat and construction of duck islands in the slough. A detailed list of the specific measures and quantities are presented in Table 8-9.

Table 8-9 Mullens Slough Construction Items

ITEM	QUANTITY	UNIT
New Channel - Grass Lined Trapezoidal	10	CLF
Overflow/Wier Structure -		
Excavate and Dispose of Offsite	10,000	CY
Stone Fill	7,500	TN

Table 8-9 - Continued

ITEM	QUANTITY	UNIT
Canal 1 Stoplog Structure -		
Fabricate Stoplog Structure	1	EA
Install Stoplog Structure	1	EA
Lumber for Stoplogs (2xs')	1	LS
36" Dia CMP Outlet	1	CLF
Clearing and Grubbing	8	ACR
Disc/Till Topsoil (prairie land)	6	ACR
Grade Tilled Soil	6	ACR
Plant Prairie	6	ACR
Prairie Bird Perches (2ea/acre)	12	EA
Material -		
Prairie Seed	6	ACR
Miscellaneous	6	ACR
Existing Forest, Tree Stand Improvement (simple)	35	ACR
Create Overwintering Holes -		
Drain Lake (221.6 acres)	1	LS
Excavate and Dispose of Offsite	287,000	CY
Dam Lake	1	LS
Fish Cover (woody debris piles)	15	EA
Shoreline Plantings	7	ACR
Wood Duck Boxes (1-pole w/2-boxes)	3	EA
Tributary Stream Sediment Detention Structures	20	EA

8.5.6 Elm Slough. Construction components for this action plan include: improved hydraulic connection to the historic slough from both Long Lake and the Mitchell drainage system by placement of improved culverts under the railroad embankment and Horseshoe Lake Road; excavation of portions of the re-created slough to achieve a flow line that allows the desired flood pulse disturbance to the area; construction of a perimeter earthen berm that ties into existing elevations to provide definition for, and protection of, the habitat area while promoting the desired disturbance hydrology for the area and preventing induced flooding to surrounding urban areas; and, planting native hardwood tree species within the footprint of the Project site. A detailed list of the specific measures and quantities are presented in Table 8-10.

Table 8-10 Elm Slough Construction Items

ITEM	QUANTITY	UNIT
Excavate and Dispose of Offsite	400,500	CY
Directional Berm (4')	42	CLF
Perimeter Berm (6')	29	CLF
Perimeter Berm (2')	48	CLF
Concrete Box Culverts -		
10' x 4' Conc. Box Culvert (3ea @ 45')	1.35	CLF
10' x 4' Conc. Box Culvert (6ea @ 50')	3.00	CLF
10' x 4' Conc. Box Culvert (3ea @ 178')	5.34	CLF

Table 8-10 - Continued

ITEM	QUANTITY	UNIT
10' x 4' Conc. Box Culvert (3ea @ 55')	1.65	CLF
10' x 4' Conc. Box Culvert (3ea @ 53')	1.59	CLF
Ditch Cleanout Between Culverts (185')	740	CY
Riprap for Ditch Between Culverts	720	TN
Disc/Till Topsoil (prairie land)	46	ACR
Grade Tilled Soil	46	ACR
Plant Prairie	46	ACR
Prairie Bird Perches (2ea/acre)	92	EA
Material -		
Prairie Seed	46	ACR
Miscellaneous	46	ACR
Existing Forest, Tree Stand Improvement (simple)	135	ACR
Plant New Forest w/BRS's -		
Plant Bare Root Seedlings(350/acr)	316	ACR
Plant Ground Cover	316	ACR
Plant New Forest w/RPM's -		
Disc/Till Topsoil	16	ACR
Plant RPM's (48/acr)	16	ACR
Plant Ground Cover	16	ACR
Plant Field	12	ACR
Establish Turf	7	ACR
Seasonal Mowing of Prairie (2-times)	92	ACR
Wood Duck Boxes (1-pole w/2-boxes per acre)	138	EA

8.5.7 Dobrey Slough. Construction components for this action plan include: connection of the historic slough by placement of a two culverts under the railroad embankment; excavation of the re-created slough to achieve a flow line that allows the desired flood pulse disturbance to the area; construction of a perimeter earthen berm to provide definition for, and protection of, the habitat area while promoting the desired disturbance hydrology for the area and preventing induced flooding to surrounding urban areas; planting of native hardwood tree species and marsh within the footprint of the Project site. A detailed list of the specific measures and quantities are presented in Table 8-11.

Table 8-11 Dobrey Slough Construction Items

ITEM	QUANTITY	UNIT
Excavate and Dispose of Offsite	205,100	CY
Berm for Overflow Protection (2')	12.5	CLF
42 Inch Dia. RCP (1ea)	0.28	CLF
10' x 4' Conc. Box Culvert (2ea @ ')	0.50	CLF
Plant High Quality Marsh	34	ACR
Shore Cover (25' strip)	2	ACR

Table 8-11 - Continued

ITEM	QUANTITY	UNIT
Plant New Forest w/BRS's -		
Plant Bare Root Seedlings(350/acr)	29	ACR
Plant Ground Cover	29	ACR
Wood Duck Boxes (1-pole w/2-boxes per 8 acres)	4	EA

8.5.8 Cahokia Mounds. There are no construction components to this action plan except the preparation for, and planting of native prairie. A detailed list of the specific measures and quantities are presented in Table 8-13. As indicated in Section 8.2.6, additional information on the hydrology of the site will be obtained during design and prior to initiation of construction.

Table 8-12 Cahokia Mounds Construction Items

ITEM	QUANTITY	UNIT
Initial Mowing (light density)	193	ACR
Initial Burn	525	ACR
Apply Herbicide & Chemical Mixture	525	ACR
Planting	525	ACR
Materials -		
Herbicide & Chemicals	525	ACR
Prairie Seed	525	ACR
Miscellaneous	525	ACR

8.6 OPERATIONAL FEATURES

Each of the action areas will operate independently. None of the features of the Recommended Plan have any manual or automated operational components (such as slide gate and stop log closures or pumping stations except the tributary stream sediment basins). Also, no changes in the operation of the remaining flood control features such as canals and pumping plants will be necessary. Features of the Recommended Plan will require periodic inspection and maintenance to include: the removal of collected vegetative and woody debris at all control structures and tributary stream detention basins; installation of sediment panels in tributary stream detention basins; periodic erosion repair; periodic inspection to maintain smooth operation of all flap gates; and, and the mowing or burning, as necessary, of berms and prairie areas.

8.7 REAL ESTATE

8.7.1 Overview. The Project will require the acquisition of approximately 5,569 acres of land. It will affect approximately 1725 land parcels and 744 landowners. Nine areas in the floodplain and 131 sites in tributary streams are a part of this Project. Fee title is required on most of the land in the floodplain to allow the Sponsors, Madison and St. Clair Counties, Illinois, to control the environmental restoration, habitat development and operation maintenance of the land as per Engineering Regulation (ER) 1165-2-502 (17)(b), ER 1105-2-100 (F-8) (a)(1), and ER 1165-2-501 (17). Permanent easement will be required to construct, to access, and to operate and maintain the 131 tributary stream sediment detention basins. Flowage easement will be required for a ponding area at both Old Cahokia Creek and Judy's-Burdick Branch.

Flowage easement will also be required for the 131 tributary stream detention basins to allow water to temporarily pond during storm events. In summary, 4,593 acres in fee, 78 acres in permanent easement, and 898 acres in flowage easement will be acquired. Temporary Easements for access and construction are required and will be determined when the Engineering Design Reports are prepared for each Project action area. The temporary construction easements for this type of project are not considered out of the ordinary. A more detailed discussion of all the real estate requirements discussed here and below, including a cost estimate, are presented in Appendix H.

8.7.2 Land Acquisition. As mentioned earlier in this report, Madison and St. Clair Counties will be the Local Sponsors for the Project and will therefore have responsibility for land acquisition. The Metro East Sanitary District (MESD) owns 455 acres and the State of Illinois owns 1491 acres of property required for the Project. The State and the MESD will not be involved in the land acquisition program but they will allow their lands to be used for Project purposes. The State of Illinois is providing funding for construction of the Project but will not participate in the acquisition of necessary Project lands.

8.7.3 Relocation Assistance (Public Law 91-646). The property will be acquired in accordance with Public Law 91-646, "Uniform Relocation Assistance and Real Property Acquisition Policies Act", as amended. Project-wide, relocation assistance will be required for landowners located in St. Clair Farms area in addition to a business owner in Spring Lake. In the St. Clair Farms area, three homeowners and a mobile homeowner are expected to require assistance under the Public Law. In the Spring Lake area, the one business expected to require relocation assistance is a truck repair facility. It is important to note that the number of relocations is an estimate and that the number could change during Pre-construction Engineering and Design (PED).

8.8 ADAPTIVE ASSESSMENT AND MONITORING PROGRAM

The Recommended Plan includes post-construction monitoring to determine if predicted environmental outputs will be achieved following construction, and to provide feedback for future ecosystem restoration projects. During the study's formulation process, it was uncertain whether specific proposed measures would achieve their restoration objectives. Consequently, the monitoring program reflects the incorporation of adaptive management. Adaptive management is a technique for addressing uncertainty in restoration projects. Under this approach, restoration measures are implemented and monitored, feedback is provided based on new insights gained from the response of the system and its resources, and adjustments are made to the Project as necessary and feasible.

8.8.1 Adaptive Management Program. With regard to achieving restoration planning targets, the major uncertainty identified during the planning process has been whether the current rate of sediment transported from tributary watersheds to the Mississippi River's floodplain will be reduced by the target of 70 percent. Under the Recommended Plan, it is assumed that the aggregation of 131 tributary stream sediment detention basins constructed in conjunction with other in-stream restoration measures will achieve this goal while restoring quality and function to these scarce resources. Consequently, the habitat areas recommended in the floodplain that would receive storm water to mimic the predevelopment flood regime would not have any accommodations for sediment detention.

To test whether tributary stream sediment detention basins and in-stream restoration measures will perform as expected, a demonstration project has been established on Judy's Branch, one of the tributary watersheds. Work began on this pilot project in early 2000 with the implementation of sediment monitoring by the U.S. Geological Survey on Judy's Branch. This pilot project is described in greater detail in Appendix E. With the information gained from this monitoring process, preliminary plans for stream sediment detention and in-stream restoration measures will be developed and implemented in this tributary first. The performance of these measures will be analyzed over an approximate 3-year period to determine their effectiveness in restoring stream quality, stabilizing stream banks, and slowing the transfer of sediment to the floodplain. Results from this pilot project will be used to make the adaptive changes required to achieve anticipated Project outputs.

8.9 FISH AND WILDLFE MITIGATION

Since the purpose of ecosystem restoration is to provide environmental benefits, this Project was formulated and designed to avoid and/or minimize adverse effects to environmental resources. Multi-agency participation on the study team was critical in maintaining this focus during the processes of alternative plan formulation, assessment, and selection. To achieve study planning targets and constraints, modifications of alternatives were made during the conceptual design of plan components. One notable modification of a plan component was the Corps and NRCS engineering team's tributary stream detention basin design purposely having a minimum construction footprint. These designs ensured that construction of 131 of these structures, as proposed under the Recommended Plan, would result in the loss of less than 100 acres of upland forest, and meet the study target for this resource. The use of traditional sediment detention basin designs would have resulted in the loss of hundreds of acres of upland forest resources. This type of iterative analysis process was used whenever possible for all alternative designs in order to minimize adverse effects.

During subsequent phases of this Project, the construction features of the Recommended Plan will be designed to avoid and/or minimize any impacts to wetlands or other aquatic sites. Creation and enhancement that results from the overall restoration achieved by the Recommended Plan are expected to offset unavoidable temporary impacts to existing wetlands or other aquatic sites. Accordingly, separate mitigation features are not included in the Recommended Plan for these impacts.

8.10 CULTURAL RESOURCES MITIGATION

Prior to the discussion of any potential Project feature locations, the State of Illinois Historic Preservation Officer (SHPO) provided the design team with the locations of all previously recorded archaeological sites within the study area. The Re-study team used this information throughout the plan formulation phase so as to avoid impacts to any known archaeological sites. The information provided by the SHPO allowed the Re-study team to best address one of the planning objectives; the protection of potentially significant historic properties. Where feasible, Project action area footprints were defined such that significant cultural sites were included within the footprint in order to provide the opportunity to protect them. Conversely, in other areas where protection was impractical, these sites were left outside of Project action area footprints. The process of locating currently unknown archaeological sites within the Project action areas will be conducted during the next design phase of this study.

These investigations will include surface surveys, geomorphologic investigations, and limited subsurface test excavations. Cost estimates for this phase of the study include substantial funding for such investigations. The guiding principle regarding archaeological remains will be to avoid and/or minimize the impact to potentially significant historic properties, a specific planning objective of the formulation effort. The precise manner by which these historic properties activities will be undertaken shall be clearly and concisely defined in a formal Memorandum of Agreement between the U.S. Army Engineering District St. Louis, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation. This document will be prepared at the beginning of the next phase of design work, which is Pre-construction Engineering and Design (PED).

8.11 OUTDOOR RECREATION

During the latter study stages, local interests made formal requests to the Restudy Team to investigate water and related land resources outdoor recreation opportunities, especially as they tie in with the existing infrastructure and the potential to be derived from the Recommended Plan. The Recommended Plan contains a bike trail at the Old Cahokia Creek action area. This bike trail extends an existing trail and was justified using the Facility Capacity Method having an annualized cost of $16,084. At the current interest rate this trail has a benefit to cost ratio of 1.7 to 1. The recreation benefit analysis of the Cahokia Creek Bike Trail can be found in Appendix K. However, it is clear that there are many other opportunities as can be seen in Table 8-13. The opportunities are due, in part, to the scenic views of natural areas with interpretive potential and in their proximity for easy connection to the regional trail network that is being developed by local organizations and agencies. Trails also could be planned not only in the levied areas, but also along the streams and greenways. Ecosystem restoration measures of the Recommended Plan such as wetlands, would also lend themselves to outdoor recreational pursuits. The development of boardwalks at the wetlands would provide a close up view of wildlife. These boardwalks also would be useful for rest stops along the trail. Any recreation or interpretive opportunities will have to be consistent with the intent of the project and not interfere with the achievement of restoration objectives. As noted, Table 8-13 identifies the potential outdoor recreation features that could be pursued under separate action after authorization of this project.

Table 8-13 Potential Outdoor Recreation Features For Separate Action

Name/Description	County	Possible connections	Features
Judy's-Burdicks Branch	Madison	28 tributary stream basins SIUE Glen Carbon Trail Cahokia Canal	Prairie restoration, earthen levee surrounding area, riverine restoration of portion of old channel
Brushy Lake	Madison	15 tributary stream basins Cahokia Canal	Earthen levee as elevations dictate, riverine restoration of the old channel, improvements to Schoolhouse Branch, forested wetland restoration

Table 8-13 - Continued

Name/Description	County	Possible connections	Features
Spring Lake	St. Clair	58 tributary stream basins Harding Ditch, Fairmont Ditch Cahokia Canal	Improvement to Harding Channel, riverine restoration, reconnect Indian Lake to hydraulic system
Mullen Slough	St. Clair	20 tributary stream basins Harding Ditch	Connect hydraulic system, improve fish habitat, creation of prairie
Dobrey Slough	Madison	SIUE Bike Trail Glen Carbon Trail	Recreate wetland marsh, reconnect hydraulic system, 75 meter forested corridor along both sides of the slough, earthen levee on east side
Elm Slough	Madison	Cahokia Canal Horseshoe Lake	Earthen levee on west side to contain flow.

8.12 PRECONSTRUCTION ENGINEERING AND DESIGN (PED)

8.12.1 Overview. Activities for PED are scheduled to begin in FY 2003 and are expected to proceed through FY 2004. The first item of construction will be ready for implementation beginning in FY 2005. This is expected to provide time for Project approval and authorization as well as the negotiation and execution of the Project Cooperation Agreement. The PED schedule has been coordinated with the Sponsors and meets their expectations.

8.12.2 Hydrology and Hydraulics. During the initial PED phase, detailed hydrology and hydraulic analyses will be required to finalize unsteady flow model relationships between the Project action areas and the existing interior drainage system. This will enable the fine-tuning of hydraulic events staging in and out of the habitat systems so as to achieve the desired flood pulse disturbance. This is necessary to obtain the desired disturbance duration, achieve the desired flood damage reduction and to validate assumptions made during the plan formulation and evaluation process. This information must precede the final design of any of the selected plans for the Project action areas. The Judy's Branch demonstration project will provide additional information to be used in hydraulic modeling and calculations.

8.12.3 Sediment. Final modeling and assessment of recommended sediment control and stream bank stability assumptions would be validated during the initial PED process as well. The Judy's Branch demonstration project will be the first test of these models.

During PED, this demonstration project will be included in the Project design activities. A sediment and stream restoration analysis will be conducted in concert with these efforts during the initial PED activities. The results of this analysis will be used for an initial construction project with its output becoming an integral part of the input to the monitoring and adaptive management process. This process will be used to validate the assumptions and results for input to establishing the follow-on design requirements.

As described in Appendix E, studies already underway will provide information necessary to design in-stream components that will work in concert with tributary stream detention basins in the tributary streams. These components will be essential to achieving stream related objectives. Initial PED studies include the development of sediment transport models required to guide these design efforts.

8.12.4 Potential Improvements to the Recommended Plan. During the course of PED, a number of additional restoration activities that would provide additional benefits for little or no cost would continue to be identified for action by others, or to be further investigated under new studies. As an example, the reconnection of several segmented wetlands along the canal systems, particularly at the lower end of the Cahokia Canal, may be able to be accomplished with little cost. Additionally, study of plans for the Borrow Pit and Stockyards areas will be encouraged.

The Project also has the potential to provide an expanded outdoor recreation component that would create an outstanding trail and ecosystem education center. The Project's location adjacent to the confluence of the Mississippi and Missouri Rivers, the Cahokia Mounds, the trail head of the Lewis and Clark exploration, Highway 101 and the Katie Trail, make it a natural recreation center. The earthen berm features associated with the Project, and its connection to the existing interior drainage system and main line levee, easily affords the opportunity for the connection of an extensive hiking, biking or riding trail system.

While only one small outdoor recreation opportunity is addressed in this plan due to funding and time constraints, these opportunities can be further explored in a separate study once this project becomes authorized. As the Sponsors and interested public groups have requested, Table 8-13 identifies the potential outdoor recreation features that could be explored as a separate action following authorization of this project.

8.13 COST ESTIMATE

The Project cost estimate was developed using the Micro-computer Aided Cost Estimating System (MCACES). A level of detail was used to determine a baseline cost with reasonable contingency factors. Appendix K contains the MCACES estimate. All summary, detail and backup reports are included in the cost estimate. Notes related to specific items are in the detail section of the estimate. Any pertinent backup data can be obtained from the St. Louis District's Cost Engineering Branch. The bases of the costs used for the MCACES estimate were preliminary cost estimates developed during the plan formulation process. Due to the large number of alternatives and the many variables that had to be considered for differing site conditions, cost curves were developed for some of the engineered items. These cost curves were utilized for the development of costs for specific construction items and are noted in the MCACES for the items to which they pertain. Cost data used for the development of biologically related items were based upon previous estimates and information obtained from other agencies with experience in ecosystem restoration. The estimate developed for this study should ensure that the Recommended Plan could be designed and constructed as formulated. Table 8-14 provides a summary of the baseline estimate.

Table 8-14 MCACES Summary

Feature Accounts	Costs	Contingency	Total Costs
01 Lands and Damages	23,568,400	4,444,000	28,012,400
02 Relocations	4,956,000	1,239,000	6,195,000
06 Fish and Wildlife Facilities	95,852,400	22,277,900	118,130,300
14 Recreation Facilities	206,600	51,600	258,000
30 Planning, Engineering & Design	22,363,300	2,235,100	24,598,400
31 Construction Management	10,976,500	1,095,500	12,072,000
Total*	**157,923,000**	**31,343,100**	**189,266,100**

**Total does not include PED costs*

8.14 PROJECT OUTPUTS

In accordance with the Corps of Engineers' guidance contained in Engineering Regulation 1105-2-100, the evaluation process for ecosystem restoration projects focuses on quantitative and qualitative restoration outputs. In the case of this study, habitat units were chosen as the measure of outputs. These were analyzed using an incremental cost analysis methodology in order to determine the cost effectiveness of comparative plans.

8.14.1 Annualized Project Outputs and Costs. Project outputs have been captured by means of identifying habitat units and the dollar value of producing these units. Qualitative factors such as Habitat Suitability Index were utilized during plan assessment and evaluation to ensure that quantitative measures were maintaining qualitative standards. Cost data gathered after the selection of the Recommended Plan, which included the gross appraisal and other pertinent real estate and engineering information, was used to develop the baseline Project cost estimate. Average annual Project costs were computed to be approximately $11,798,851 using the current interest rate of 5.875% over the 50-year Project life. Annualized outputs for the Recommended Plan total some 8,332 habitat units. The Recommended Plan therefore produces these habitat units for an average annualized cost of approximately $1,416 per unit.

8.14.2 Other Project Benefits. While this Project was formulated as a single purpose Ecosystem Restoration project, in accordance with ER1105-2-100 (3-5c. (1), "Monetary gains (e.g. incidental recreation or flood damage reduction) and losses (e.g., flood damage reduction or hydropower) associated with the project shall also be identified." As discussed in Section 5 and 6, the reintroduction of a floodplain flood pulse to the Project area and the restoration of thousands of acres of floodplain wetland habitat was anticipated to provide incidental flood damage reduction benefits. In an attempt to quantify these benefits a risk based analysis, which is contained in Section 7, was performed. This analysis determined that $1,366,000 in average annual flood damage reduction is incidental to each of the plans considered. The Old Cahokia Creek bike trail has an annualized cost of $16,084. At the current interest rate this trail has a benefit to cost ratio of 1.7 to 1.

8.14.3 Cost Estimate Uncertainties. As with any study of comparable size and complexity, there are unknown future conditions that create cost estimate uncertainties. The approach used in this study was to analyze costs conservatively using historic information to guide the process. Contingencies were included in all plan features based upon professional judgment and historic data to account for unexpected situations that can occur over the course of Project implementation. Based upon the procedures used, the Project estimate is considered to be reasonable.

8.15 COST SHARING

The Corps of Engineers, on behalf of the Federal government and the non-Federal Sponsors, the Counties of Madison and St. Clair, will share in the responsibilities for implementing the Recommended Plan. The Counties will participate in a third party agreement with the State of Illinois who will provide monetary support to the Counties for the implementation of the Project.

The Corps will be responsible for designing the Project and administering all government construction contracts to implement it. The Counties and the State will share in the design and construction costs. The Counties will furnish the necessary lands, easements, rights of way, relocation, and disposal areas (collectively referred to as the LERRD's) as well as operate and maintain the completed Project. Rules that determine how project responsibilities are shared are established in Federal law and related Administration implementing policies.

8.15.1 Cost Sharing Principles. Section 103(c)(4) and (7) of the Water Resources Development Act (WRDA) of 1986, as amended, 33 U.S.C. 2213(c)(4) and (7) established the cost sharing rules for this Project. Additional discussion can be found in U.S. Army Engineering Pamphlet 1165-2-502, paragraph 5.a.1. (b.). In general, the total first cost of the Project, including the value of LERRD's, pre-construction engineering and design costs, and all project coordination activities conducted under the Design Agreement and the Project Cooperation Agreement (PCA), shall be cost shared 65 percent Federal and 35 percent non-Federal, with the exception of recreation features which will be cost shared 50 percent Federal and 50 percent non-Federal. The cost of the LERRD's is a 100 percent non-Federal Sponsor responsibility. If the value of the LERRD's allocated to ecosystem restoration exceeds the 35 percent non-Federal cost sharing requirement, then the Federal government shall reimburse the non-Federal Sponsor for the value of the LERRD's in excess of the 35 percent requirement. If the value of the LERRD's allocated to recreation features exceeds the 0 percent non-Federal cost sharing requirement, there will be no reimbursement of the non-Federal Sponsor by the Federal government for the value of the LERRD's in excess of the 50 percent requirement. If the value of the LERRD's and the required non-Federal Sponsor project coordination activities conducted under the terms of the Design Agreement and the PCA is less than the 35 percent requirement, then the non-Federal Sponsor shall provide the balance in cash.

8.15.2 Cost Sharing of Operation and Maintenance. Section 103(j)(1) of the WRDA of 1986, 33 U.S.C. 2213(j)(1) requires that the non-Federal Sponsor bear 100 percent of all operation, maintenance, repair, replacement and rehabilitation (OMRR&R) costs. For this Project, the OMRR&R will become the responsibility of Madison County and St. Clair County. The Counties will be responsible for the Project OMRR&R requirements within their respective geographic boundaries. These costs are currently estimated to be $93,000 annually.

As a result of the State's involvement, separate operation and maintenance (OMRR&R) agreements will be developed to support the third party partnership between the State and the two Counties. In this situation, the State will also be required under their existing policies to inspect the finished Project and by State law, will have the authority to withhold gas tax revenues from the Counties until necessary Project corrections are made. As a result of this arrangement, the Corps of Engineers has a high degree of confidence that the Project will be operated and maintained in the future in accordance with the requirements to be stipulated in the OMRR&R support manuals which will be prepared and provided to the Local Sponsors.

8.16 REQUIREMENTS FOR NON-FEDERAL SPONSORSHIP

The requirements for non-Federal sponsorship of this project will be fully delineated in a separate signed agreement. Some of the major non-Federal sponsorship requirements are as follows. The non-Federal sponsorship requirements will apply jointly and severally to all non-Federal Sponsors signing the agreement.

a. Provide 35 percent of the separable project costs allocated to ecosystem restoration and 50 percent of the separate project costs allocated to recreation, as further specified below:

(1) Enter into an agreement which provides, prior to execution of a project cooperation agreement for the project, 25 percent of design costs;

(2) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(5) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to ecosystem restoration and 50 percent of the separable project costs allocated to recreation.

b. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, including mitigation features, at no cost to the Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and any specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

c. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

d. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

e. Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

f. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

g. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

h. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

i. To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project and otherwise perform its obligations in a manner that will not cause liability to arise under CERCLA.

j. Prevent future encroachments on project lands, easements, and rights-of-way which might interfere with the proper functioning of the project.

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

l. Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

m. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with cost sharing provisions of the agreement;

n. Not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

o. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

SECTION 9 – IMPLEMENTATION PLAN

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SECTION 9 - IMPLEMENTATION PLAN

9.1 INTRODUCTION

This Project originally was authorized to address flood damage reduction. As a result of the Water Resources Development Act of 2000, ecosystem restoration was added as a Project purpose, thus permitting the formulation of alternatives for this Project using the Administration Policy Guidelines for an incrementally justified National Environmental Restoration Project. In accordance with the National Environmental Policy Act (NEPA) requirements, this report has been, and will continue to be coordinated with the public and appropriate resource agencies to seek their input. Once the Project Team receives public and review agency comments to the Draft Report, the Team will prepare a final report and submit it to the Corps of Engineers' Mississippi Valley Division Headquarters for review and processing. After follow-on review at the Corps of Engineers' main headquarters in Washington D.C., the Chief of Engineers will release this report through the Assistant Secretary of the Army for Civil Works, who in-turn will refer it to Congress for authorization. Congressional authorization will permit a construction new start for the Project.

9.2 GUIDELINES FOR IMPLEMENTING THE RECOMMENDED PLAN

The level of detail utilized in the formulation and evaluation of the recommended plan has recognized that the project area is large and complex and constantly changing and the period of implementation is likely to be lengthy. Therefore the actual implementation of each of the action area plans will require the development of an Engineering Documentation Report (EDR) prior to the initiation of design or construction activities. Each EDR will include: detailed engineering documentation; an environmental assessment or supplemental environmental impact statement; a real estate plan; a Phase 1 hazardous, toxic and radioactive waste assessment; an analysis of environmental benefits (if the plan has been altered); and, a cost estimate. The environmental assessment will follow the NEPA requirements of having a public comment period and agency review. It is during this process that full documentation will be provided to support either a Finding of No Significant Impact or requirements for mitigation that are unanticipated at this time. Specific permit requirements will also be determined during this process. The building block approach to construction components will allow for some standardization of design elements between sites. This will produce efficiencies in specification development and contract preparation across the Project.

The eight action areas of the recommended plan have been formulated and evaluated in a manner that makes the overall implementation of the Project as flexible as possible for the non-Federal (Sponsor), Madison and Saint Clair Counties, Illinois. Because the Project represents a large ecosystem restoration effort that is land intensive, the Project Team determined that flexibility was a necessity in order to ensure the best chance of successful Project implementation. To this end, any one of the recommended action alternatives can be implemented as a total unit in any sequence. Since each alternative site was incrementally justified on its own merits, this flexibility of implementation does not adversely impact ecosystem outputs.

In other words, once an alternative site is completed, the anticipated environmental outputs that incrementally justified that site can be realized immediately without waiting for the implementation of any other alternative. Additionally, because of the flexibility built into the Recommended Plan, construction can be ongoing simultaneously at multiple alternative sites.

Total Project benefits will be realized when all eight action areas are completed and functioning. This does not mean that individual action alternatives are not complex within themselves. Each will require the sequencing of their building block components to ensure a sustainable ecosystem restoration benefit at each site. For example, habitat areas with an upland connection will have to be protected from the adverse effects of sediment. This means that upland measures will have to be in place and functioning prior to the hydraulic connection of components. As a result, temporary floodplain sediment detention areas may be required to provide advance protection until upland measures are tested and proven. These same type considerations must be taken into account with the placement of all connective components.

9.2.1 Utilize Interdisciplinary and Interagency Teams. From the outset, the Project Team has included technical representatives from a variety of federal, state and local governments as well as the private professional community as part of the study process. The follow-on implementation process will continue this approach. The complex nature of this Project requires participation from experts in many fields and disciplines in order to draw on the best talent with the widest base of experience available for the work at hand. Every technical input source will be considered for the implementation effort. It is fully intended that the interagency team approach will continue throughout the implementation period to review, evaluate, and adaptively manage the design, construction, and monitoring of the Recommended Plan.

9.2.2 Incorporate Outreach and Public Involvement. The outreach and public involvement efforts described in Section 10 and documented in Appendix G, have been an important component of the process used to develop the Recommended Plan and will continue to play a central role throughout the design, construction, implementation and monitoring of the Project. The guidelines for implementing the Project that require follow-on environmental analysis in accordance with the NEPA requirements for each of the action areas prior to their design will provide a natural forum for the continuation of broad-based public involvement. The potential to add additional recreational features to the Project will bring a new dimension to the public involvement conducted to date. Meetings held with the various community park districts, and the newly formed Metro East Park and Recreation District, have indicated a significant amount of interest in participating in the development of future plans related to recreational and educational opportunities that the Project could provide.

9.2.3 Maintaining Regional System Focus. The Recommended Plan was developed using a broad base of local, state and regional expertise. The complexity of this plan and the implementation period will require the continued input from this type of focus group. The re-creation of approximately 5,000 acres of habitat that make up the Recommended Plan will need to be accomplished with an understanding of the larger regional ecosystem. The Illinois' Conservation 2000 Ecosystems Program promotes the formation of partnerships across the state that will focus on developing long-term approaches to protecting and managing regional natural resources.

These partnerships typically consists of broad-based coalition of local stakeholders from a given region - private landowners, businesses, scientists, environmental organizations, recreational enthusiasts, and policy makers. The American Bottom Partnership, formed under this program in southwestern Illinois is focusing on the larger region that envelops the Project area and will be the type of resource group best equipped to provide regional input to Project activities. Continued Project outreach efforts and use of interdisciplinary multi-agency teams for this Project will promote a continuing regional systems focus.

9.2.4 Integration with Ongoing and Future Projects and Programs. The recommended plan involves making alterations to portions of the Project area's existing interior drainage system. None of the current action alternatives overlap with the ongoing East St. Louis Rehabilitation Project. Canal work initiated under the East St. Louis Rehabilitation Project was accomplished in the lower reaches of the drainage system and was designed only to return the channels to their original capacity. All but one and a half miles of this rehabilitation work is already complete and the remaining work will be completed before initiation of construction for this Project in fiscal year 2005. As a result of the public involvement and outreach efforts of the Project Team, the local communities, appropriate state and federal agencies, in addition to planning groups, are aware of this Project. This situation also has created a productive coordination environment for other planning activities such as permit reviews. It is anticipated that these coordination efforts will continue and the good will that has been built to-date will foster more collaborative efforts in the future across the region.

9.2.5 Plan Evaluation Through Adaptive Assessment. The size and complexity of the Project's upland components designed to address sedimentation and stream bank stability will require the implementation and assessment of a demonstration area to ensure that they perform as anticipated. This process is currently underway with the pilot Project at Judy's Branch. The analytical data being gathered there will be used to assess and adapt as required, assumptions and future design recommendations for sediment removal and stream bank stability across the bluff watersheds.

9.2.6 Uncertainties. The engineering analysis scheduled during the first year of preconstruction engineering and design (PED) is designed to explore in detail, the assumptions that were drawn from previous studies of the area. These include hydraulic modeling that will expand existing information to include: the implications of unsteady flow in the system; period of record analysis of hydrologic conditions to compare to urbanized flow rates utilized; geo-technical investigations of the stability of upland areas; and, hydrogeomorphic investigations on process of sediment transport in the system. These PED activities will provide a broad base of analytical data upon which to initiate with confidence the first EDR and design for construction. As with any large water resource project that will be executed over an extended period, changes to the existing conditions could impact the validity of alternative plans. It is for this reason that this Project will utilize the tiered approach to environmental review in order to provide the greatest flexibility in ensuring that uncertainties can be addressed while maintaining overall Project integrity.

9.2.7 Development and Refinement of Models and Tools. In response to Project uncertainties, several analytical models will be used to verify assumptions made during the PED phase. The State of Illinois' Department of Natural Resources has already undertaken a demonstration project in Judy's Branch in cooperation with the U.S. Geological Survey, the U.S. Environmental

Protection Agency, the Natural Resource Conservation Service and the Corps to analyze the effects of adding series and grade control and pool and riffle structures in the bluff tributaries. Funding and time constraints did not permit this type of investigation or modeling during the reevaluation of the East St. Louis Illinois and Vicinity Project. However, all parties believe that these type features are integral to reducing the transfer of sediment to the bottomland and improving the quality of the upland streams. The State has timed their efforts to ensure technical data is available in time for the design of upland components for the restoration Project. Performing this analysis now will provide information that will preclude delay in future Project execution.

During upcoming PED activities, the Corps will be developing an unsteady flow model and period of record hydrologic analysis for the Project area in order to validate depth, duration, urbanized flow rate and back water flow assumptions developed during original hydraulic modeling from earlier studies. Additional geo-technical and structural analyses will be made along with an analysis in conjunction with the demonstration project to validate sediment transport assumptions.

9.3 PROJECT IMPLEMENTATION PROCESS

The first set of plans and specifications will be undertaken as a part of the existing scope of the PED agreement. Based on consultation with the Sponsors, the first alternative to be undertaken outside the demonstration project will be the restoration of an area that does not have an upland component. In this manner, the analysis of sedimentation and stream stabilization can be completed on an alternative having those components prior to the completion of the design. Prior to the acquisition of Project lands and the subsequent initiation of the first item of construction, a Project Cooperation Agreement (PCA) will be executed for the entire Project effectively bringing the PED phase to a conclusion. Work under the PCA will begin with the Sponsors' acquisition of lands, easements, rights-of-way, relocations and necessary disposal areas (LERRD's) in advance of the advertisement and award of the first construction contract. The PCA will detail items of analysis, design and construction that may be undertaken by the Sponsors. This information will be documented further during the preparation and execution of the PCA.

9.4 PROJECT IMPLEMENTATION REPORTS

As previously stated, an EDR will be prepared to validate each recommended action plan. These reports will develop the detail for each alternative that was not accomplished during the restudy effort. Each EDR will detail the full spectrum of technical analyses required to support engineering considerations as well as assessing the validity of assumptions made during the ecosystem restoration evaluation. These EDRs will include comparisons to the original Habitat Evaluation Procedure outputs. If differences in the alternative design are required as a result of significant changes in the existing conditions that impact acreage, basic restoration concepts, or hydrology, the incremental cost analysis of outputs will be re-validated. Each EDR also will include a real estate report that verifies costs and estates required for the Project and an overall detailed cost estimate referred to as an "MCACES" estimate. Based upon these findings, an environmental assessment or supplemental environmental impact statement will be completed in accordance with NEPA requirements.

Following public review and comment, the EDR, will be forwarded as appropriate for approval within the Corps' chain of command. The design of alternative features will not begin until it is determined that the proposed action plan still supports original Project objectives and thus, continued action. Designs will be packaged in units appropriate to support efficient contract work on a specific alternative and sequenced as required to maintain Project progress in a logical manner.

As a result of these actions, the integrity of the Project objectives will be maintained. It will be unlikely that any of the restoration focus will be lost or diluted over time. The institution of this rigorous process as a part of Project implementation is deemed appropriate based on the uniqueness of this Project and its underlying concepts.

9.5 RESTORATION, COORDINATION, AND VERIFICATION PROCESS

It is anticipated that the multi-agency team that was involved with the Project during its re-evaluation will continue its partnership during the Project's implementation phase. This integrated agency partnership ensured that a regional focus was maintained during the study phase. This same partnership will be essential during the implementation phase. Additionally, this team of biological and engineering experts that were responsible for creating the assumptions and rules that governed the restoration projections will continue their assessment and evaluation during Project execution. The preparation of the EDR that will precede the design of each action plan will validate restoration outputs. As previously noted, should conditions change or assumptions prove flawed, an update to the original incremental cost analysis will be required.

Preparation of an EDR will ensure that, at a minimum, an Environmental Assessment is produced and coordinated in accordance with NEPA requirements. In this manner, not only the core team and the Sponsors will be knowledgeable of outputs in advance of the design for an alternative, but so will all of the stakeholders and the public.

Verification requirements will be detailed in each action plan's monitoring program. In this way its performance with respect to all anticipated outputs can be analyzed and measured.

9.6 PROJECT MANAGEMENT

The Project will be managed in accordance with all applicable laws, regulations, and policies. Information that outlines the philosophy of project management within the Corps of Engineers is contained in Engineering Regulation 5-7-1. There will be a lead Corps of Engineers person designated to manage the Project during its life cycle. This person will be responsible for managing the programmatic and the technical aspects of the Project as well as coordinating all issues related to the Project between the Sponsors, the stakeholders, and the public.

9.7 SCHEDULE DEVELOPMENT

A Project schedule has been developed based upon the assumption that a positive Chief of Engineers' report will be forwarded to the Assistant Secretary of the Army for Civil Works during calendar year 2003 and that Congressional authorization will occur in time to program construction new start funds for FY 2005. The Project schedule sequences the reporting, design, and construction activities as they move from the simple to the complex. In this manner, there will be ample time to complete sediment analyses and to review demonstration project results so that analytical data and practical lessons learned can be incorporated into action plan execution. Additionally, the schedule has been prepared in a manner to have new EDR's prepared simultaneously, with the designing and/or constructing of action areas covered in approved EDR's. This helps to ensure that project momentum is maintained and that the necessary experts remain engaged throughout the process. The development of this schedule assumes funding is available in the years required and that the real estate and relocations actions are completed on schedule.

As mentioned, initiation and completion of EDRs are independent of one another for the various action plans. However, design and construction activities are dependent upon their respective EDR's approval. A copy of the proposed schedule is included in Appendix K. The Project schedule will be evaluated and updated continuously, based upon future funding levels and the results of the EDR studies.

9.8 IMPLEMENTATION SCHEDULE

The recommended schedule reflects the information currently available and the current departmental policies governing execution of projects. It does not reflect program and budgeting priorities inherent in either the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the schedule recommended in Appendix K may be modified before it is transmitted to higher authority for authorization and/or implementation funding.

Under current plans, this schedule begins with PED activities in FY 2003 and concludes in FY 2005 with the advertisement and award of the first item of construction.

9.9 FUNDING STREAM

In order to support the planning and budget development process for the Project, a table depicting the necessary funding stream required to support the Project schedule is presented below. This table identifies the resource requirements by year and details non-Federal requirements for Project implementation. Table 9-1 identifies both cash requirements and the requirements estimated by year for LERRD's for the Restoration Project. The recreation portion of the project is projected to occur in FY 08 and is estimated to cost $258,200. This cost will be shared 50-50 and is not reflected in Table 9-1. However these costs are included in paragraph 9.13 below.

Table 9-1 Funding Stream Restoration Project.

		2	3	4	5	7	9
FY	**Phase**	**Total Project Implementation Cost**	**LERRDs**	**PED or Construction**	**%**	**Additional Non-Fed Cash**	**Federal Cash Schedule**
Prior FY's	PED	2407.00	0.00	2407.00		601.75	1805.25
FY03	PED	800.00	0.00	800.00		200.00	600.00
FY04	PED	793.00	0.00	793.00		198.25	594.75
FY05	Constr	4865.43	3343.89	1521.54	0.01	371.99	1149.55
FY06	Constr	1348.91	130.47	1218.44	0.01	308.35	910.09
FY07	Constr	5018.77	2074.02	2944.75	0.02	670.84	2273.91
FY08	Constr	11589.60	4182.30	7407.30	0.05	1607.91	5799.39
FY09	Constr	12626.80	6880.12	5746.68	0.04	1259.20	4487.48
FY10	Constr	12242.21	6881.97	5360.24	0.04	1178.06	4182.18
FY11	Constr	18987.80	6230.54	12757.26	0.08	2731.31	10025.95
FY12	Constr	16344.35	1620.66	14723.69	0.09	3144.23	11579.46
FY13	Constr	18853.90	633.87	18220.03	0.12	3878.40	14341.63
FY14	Constr	22284.47	968.57	21315.90	0.14	4528.48	16787.42
FY15	Constr	16491.59	791.19	15700.40	0.10	3349.32	12351.08
FY16	Constr	14666.30	469.70	14196.60	0.09	3033.55	11163.05
FY17	Constr	13120.50	0.00	13120.50	0.08	2807.58	10312.92
FY18	Constr	11529.21	0.00	11529.21	0.07	2473.44	9055.77
FY19	Constr	8845.00	0.00	8845.00	0.06	1909.80	6935.20
FY20	Constr	193.26	0.00	193.26	0.00	93.08	100.18
Total		**193008.10**	**34207.30**	**158800.80**	**1.000**	**33345.54**	**124455.27**

*Displayed in $1,000s

9.10 RECOMMENDED FEATURES FOR AUTHORIZATION

The Project construction items have been categorized as Fish and Wildlife Facilities based on their contribution to project objectives. Additionally, the standard features of Lands and Damages, Relocations, Planning, Engineering and Design, and Construction Management are applicable to this Project. All estimated costs have been allocated among these feature accounts and will be managed in this manner. The Project Cost Estimate contained in Appendix K reflects the feature account breakout. Table 9-2 is a summary of costs by account.

Table 9-2 Summary of Cost by Accounts

Feature Accounts	Costs	Contingency	Total Costs
01 Lands and Damages	23,568,400	4,444,000	28,012,400
02 Relocations	4,956,000	1,239,000	6,195,000
06 Fish and Wildlife Facilities	95,852,400	22,277,900	118,130,300
14 Recreation Facilities	206,600	51,[illegible]00	258,[illegible]00
30 Planning, Engineering & Design	22,363,300	2,235,100	24,598,400
31 Construction Management	10,976,500	1,095,500	12,072,000
Total*	**157,923,000**	**31,343,100**	**189,266,[illegible]00**

**Total does not include PED costs*

9.11 ADAPATIVE ASSESSMENT AND CONSTRUCTION MONTORING PROGRAM

There are several different Project components, such as tributary stream sediment detention basins and pool and riffle complexes that will require construction monitoring and assessment to determine whether possible construction adaptations are necessary. Assumptions related to sediment reduction and restoration of tributary stream resources are key to the success of the overall restoration Project and as such, will require monitoring to ensure that they perform as desired. The Judy's Branch pilot project is the first in a series of plans for construction monitoring programs. This pilot project is being structured in order to serve as a modeling tool to analyze results of in-stream bank stabilization methods and the performance of upland dry detention basins. One adaptive measure that may be required temporarily is the use of lowland sediment detention basins in advance of habitat areas.

In this manner areas created in the bottoms area will be protected should their development preceed the completion of the upland components. Monitoring of periodic flooding in the floodplain habitat areas will also be conducted to determine that flood depths do not exceed expected depths, and that the existing flood control system still functions effectively. In this manner, required adaptations can be determined and assessed prior to the initiation of construction in follow-on bluff streams. Likewise, more routine monitoring programs will be required to assess the success of habitat creation plans. Each habitat area will need to be monitored after construction to ensure outputs are achieved as anticipated. Where results are inconsistent with assumptions, adaptive measures will be required. The preparation of each action site's EDR will detail the methods to be used in instituting an appropriate construction monitoring program. The program will be based upon the site's characteristics and it will illuminate applicable adaptive assessment procedures. The goal of the Project execution plan is to achieve all of the beneficial outputs (both habitat and flood damage reduction related) which the Re-evaluation Report indicates are feasible.

9.12 PROJECT IMPLEMENTATION SUMMARY

The EDR's will be utilized to develop the technical analyses required to move the Project into plans and specifications for each of the eight action area sites. The EDR's will validate original assumptions under existing conditions and make adjustments required to achieve originally documented habitat outputs. They also will document compliance with NEPA requirements, ensuring a continuing public involvement process and completion of an environmental assessment or environmental impact statement.

The continued use of an interdisciplinary and interagency team will be a goal of Project implementation. In this manner, the regional focus necessary to effectively execute a project of this magnitude will be maintained, as will its integration with ongoing and future projects and programs. Uncertainties and assumptions will be reviewed and addressed during follow-on engineering analyses involving the final development and refinement of the technical models. Separate EDRs will be used to focus on each of the eight action plans.

Project implementation is projected to occur over approximately 15 years once construction authorization is received. Project momentum will be maintained through a sequencing of products that will require on-going coordination with the interdisciplinary and interagency team throughout the Project execution period. Monitoring and adaptive management programs will be a necessity based upon the nature of this Project in order to ensure the Project meets its projected benefit outputs. The first program designed to validate assumptions and monitor results is the Judy's Branch demonstration pilot.

9.13 FINANCIAL ANALYSIS

The schedule of Federal and non-Federal expenditures by year is shown in paragraph 9.9. As previously addressed, Madison and St. Clair County, Illinois are expected to serve as Sponsors and thus, share in the non-Federal costs of this Project. They are being joined in a separate third party agreement with the Illinois Department of Natural Resources, who is committing to provide minimum cash contribution of $10,000,000.

The Sponsors' share of the Project cost is estimated to be $67,681,840 of which $1,000,000 has already been contributed during PED. The Illinois Department of Natural Resources has committed to providing funds totaling approximately $10,000,000. The estimated $34,207,400 in LERRD's costs will be borne by Madison and St. Clair Counties. The remainder of the Sponsors' share estimated to be $22,474,440 will be a divided among the State and the two counties. These figures include the restoration project costs that are shared at a 35% -65% rate and recreation features that are shared at a 50%-50% rate. Madison and St. Clair Counties and the State of Illinois have the capability of performing some of the required work themselves. During the development and negotiation of the Project Cooperation Agreement (PCA) these possibilities will be further examined.

The Sponsors have the capability to finance this Project. Additionally, they have the financial resources to accomplish future OMRR&R requirements currently estimated to be $93,000 a year. They each have taxing authority and an annual budget that supports their estimated individual share of estimated Project costs. The Commander's Assessment of the Financing Plan is in Appendix L along with the Sponsors' Letters of Intent.

SECTION 10 – PUBLIC INVOLVEMENT AND COORDINATION

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SECTION 10 - PUBLIC INVOLVEMENT AND COORDINATION

As a result of the many unsuccessful attempts by numerous Federal, State and local agencies to address the flooding problems of the area, the direction by congress for the Corps to investigate these issues for a third time drew much public and political interest. There was an increased level of distrust and skepticism initially regarding this Project because of past experiences. The public has been asked many times to participate in various study activities over the past fifty years, each of which has failed to provide them with the help they feel is desperately needed and justified. The public involvement process, which is a critical component to any study process, had increased importance to this Project effort because of the long history of failed studies for the area.

10.1 PUBLIC INVOLVEMENT PROGRAM

Public involvement, by definition, is a process by which interested and affected individuals, organizations, agencies and governmental entities are consulted with and participate in a decision-making process. Public involvement in this Project had several functions: generate input to develop and validate statements of problems and opportunities; maintain open lines of communication in order to facilitate frank discussion that enhanced efforts aimed at developing trust and understanding; and develop alternatives that could meet Project goals and objectives and gain a broad base of public support and buy in.

A variety of methods were utilized during the study to ensure public involvement throughout the process. These included public workshops, focus group meetings, technical briefings and presentations to interested parties. The composition of the Project team was expanded for this Project to include technical team members from the U.S. Fish and Wildlife Service, the Natural Resource Conservation Service, the Illinois Department of Natural Resources and the U.S. Environmental Protection Agency. Additionally, the team participated in studies initiated by other agencies during this period that were designed to address related issues and concerns through public involvement. These included such planning efforts as the Sand Road Study conducted by the Madison Soil and Water Conservation District and the Gateway Initiative, Brownfield Program and Lead Collaborative of the USEPA Region 5. Each of these public based studies provided an additional forum for discussion of ongoing Corps study activities and an even broader base of information exchange and collaboration.

The public outreach and public participation was designed to 1) inform the public, 2) gather information, 3) identify public concerns, 4) develop consensus and 5) develop and maintain credibility.

10.2 SCOPING

A Notice of Intent to prepare a Programmatic Environmental Impact Statement for the Project was published in the Federal Register, Volume 64, No. 14 on January22, 1999. The Notice of Intent outlined in summary form the Project purpose and objective; described the Project area, features and scope; and laid out the scoping process utilized to involve Federal, state and local agencies, and interested private organizations and parties. A copy of this notice is contained in Appendix G.

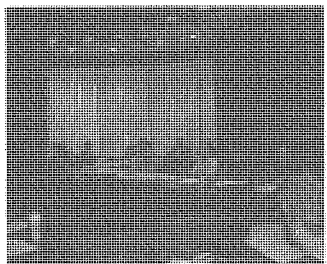
A Scoping Letter, dated January 13, 1999, was sent out by the Corps to over 250 recipients including Federal, state, and local agencies, and private organizations and parties. This letter, contained in Appendix G, announced an open workshop to be conducted on February 1 soliciting views, comments and information about resources, Project objectives, alternatives and important features within the Project area. 87 individuals registered at the workshop and it was estimated that approximately 150 individuals attended the event. The record was held open for 43 -day comment period. Over 24 written responses were received within the comment period. The issues and comments were compiled and infused into the Project plan formulation process over the subsequent year. A compilation of comments is contained in Appendix G.

Additionally, as a part of the initial scoping process the Project team wanted to ensure the incorporation of the problems and opportunities identified over the previous four years by the NRCS Resource Planning efforts of the Project area. After a review and comparison of these 9 plans, the Metro East Regional Stormwater Committee compiled and endorsed a list that they felt represented the essence of these previous planning efforts. This list was provided to the restudy team on 7 May 1999 and incorporated into the analysis process. A copy of this information is contained in Appendix G.

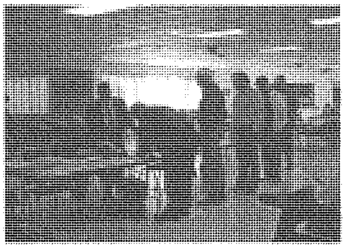
10.3 COORDINATION

A three-phase coordination process, in addition to the public workshops, was initiated for this Project. There was a recognized need to keep the Project sponsors, potential Project sponsors, resource agencies and the public informed and in the Project development process from its inception. Initially, the monthly Metro East Regional Storm Water Committee meetings served as a way to ensure involvement of all four categories of interested parties. As the study progressed, being available for all requests and seeking forums to provide Project information to Interest Groups further broadened the coordination and information exchange process for the Project. Finally, the need to keep the Corps of Engineers (Mississippi Valley Division and Headquarters), internally informed was deemed a necessity and pursued at every opportunity.

The Project Team was fortunate to be able to take advantage of the already existing Metro East Regional Storm Water Committee and the Metro East Resource Coordinating Committee as a forum for the coordination and evaluation of the planning process as it proceeded from 1998 to the present. Appendix G contains a sample attendance roster with meeting minutes. At the Regional Committee meetings a monthly report on the Project progress provided a forum for the public and State, County and Municipal leaders to keep abreast of ongoing Project activities, ask questions and provide comments. This forum allowed for an open exchange of information throughout the process. The Resource Coordinating Committee was a sub committee of technical members representing Federal, State, and County personnel who not only reviewed Project



progress but participated in the development of technical information for Project documentation. These groups merged in early 2000 to form the Joint Committee, which continued to provide a monthly forum that maintained both political and public input as well as providing technical support.



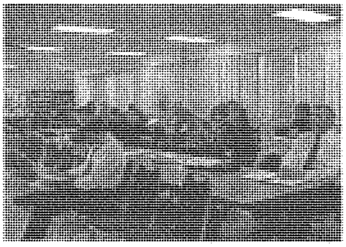


Table 10-1 indicates dates and locations of meetings, which included a presentation of the Project progress or work on Project documentation and focus.

Table 10-1 Project Meetings and Presentations

DATE	LOCATION	PARTICIPATION
GROUP MEETINGS Metro East Regional Stormwater Committee	*Illinois Department of Transportation (IDOT) Bldg Collinsville, IL*	*Regional Stormwater Committee Members, Political and Public Participants*
4 December 1998	IDOT Bldg Collinsville	"
8 January 1999	IDOT Bldg Collinsville	
11 March 1999	IDOT Bldg Collinsville	"
6 August 1999	IDOT Bldg Collinsville	"
3 September 1999	IDOT Bldg Collinsville	"
8 October 1999	IDOT Bldg Collinsville	"
7 January 2000	IDOT Bldg Collinsville	"
4 February 2000	IDOT Bldg Collinsville	"
Metro East Resource Coordinating Committee		*Regional Stormwater Committee Technical Members, (state, county and local)*
4 November 1998	IDOT Bldg Collinsville	"
6 January 1999	IDOT Bldg Collinsville	"
3 March 1999	IDOT Bldg Collinsville	"
7 April 1999	Madison County Farm Bureau Office	"
1 September 1999	IDOT Bldg Collinsville	"
6 October 1999	IDOT Bldg Collinsville	"
3 November 1999	IDOT Bldg Collinsville	"
1 December 1999	IDOT Bldg Collinsville	"
5 January 2000	IDOT Bldg Collinsville	"
2 February 2000	IDOT Bldg Collinsville	"

Table 10-1 Continued

DATE	LOCATION	PARTICIPATION
Metro East Regional Stormwater Joint Committee		*Regional Stormwater Committee Technical, Political and Public Participants*
4 February 2000	IDOT Bldg Collinsville	"
2 March 2000	IDOT Bldg Collinsville	"
6 April 2000	IDOT Bldg Collinsville	"
11 May 2000	IDOT Bldg Collinsville	"
3 August 2000	IDOT Bldg Collinsville	"
7 September 2000	IDOT Bldg Collinsville	"
2 November 2000	IDOT Bldg Collinsville	"
4 January 2001	IDOT Bldg Collinsville	"
1 February 2001	IDOT Bldg Collinsville	"
1 March 2001	IDOT Bldg Collinsville	"
5 April 2001	IDOT Bldg Collinsville	"
7 June 2001	IDOT Bldg Collinsville	"
2 August 2001	Collinsville Senior Center	"
6 September 2001	Collinsville Senior Center	"
October 2001	Collinsville Senior Center	"
December 2001	Collinsville Senior Center	"

Requests to investigate possible opportunities at Wedgewood, St. Clair Farms, Centerville, Arlington and the Legacy Golf Course were a result of these meetings. This group received a formulation strategy briefing for input and comment and later was briefed as formulation progressed on the development of potential alternatives. A final alternative selection briefing was also provided to this forum for reaction and comment. In this manner this Project process was enhanced as well as pertinent information being made available to many other Projects that were contemplated or underway in the Project area. Technical members on this Project became support participants to related activities such as IDOT mitigation efforts, EPA Urban Sprawl, Gateway Initiatives, the East St. Louis Lead Collaborative, and the NRCS Sand Road Resource Planning Study. The Stormwater Committee provided a powerful means for strengthening the collaborative process and initiated the effort in both counties to develop and pass comprehensive stormwater management strategies.

10.3.1 Interest Group Involvement and Agency Coordination. After the initial scoping meeting was conducted in February of 1999 there were several news articles, which further created interest in the regional area regarding the Project goals and formulation process. Over the course of the next two years more than 25 presentations on the Project were requested and made to a wide variety of interest groups. These presentations ranged from groups of a dozen to forums of a hundred or more. Each of these presentations provided the opportunity to receive input on methods, strategies being used in the Project process, and on alternatives under consideration. Table 10-2 table provides information on these presentations.

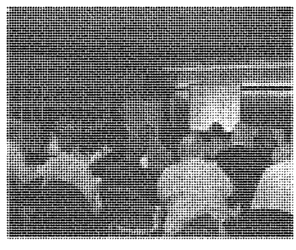


Table 10-2 Project Presentations to Interest Groups

INTEREST GROUPS	LOCATION	ATTENDEES
American Rivers 16 February 1999	Park Service/Confluence Greenway Offices St. Louis, MO	Park Service, Confluence Greenway and American Heritage Rivers personnel
Sponsor Briefing 29 March 1999	IDOT Collinsville	Madison and St. Clair County, State of Illinois and MESD representatives
Congressional Bus Tour 6 April 1999	Project Area	Congressmen Costello and Shimkus, State, County and Municipal leaders and interested citizens
Tri-Cities Chamber of Commerce February 1999	Legacy Golf Course	Municipal and business leaders
St. Louis Regional Commerce and Growth Association 13th Annual Environmental Conference - 27 October 1999		Business leaders, Environmental Groups, Developers/Construction Mgmt, AE Community, Political Leaders
Fairview Heights City Council 28 June 1999	Fairview Heights Government Bldg	City Council and interested citizens
St. Clair County Health Department	St. Clair County Building Belleville, IL	Agency personnel
Southwest Illinois Leadership Council - 4 February 2000	Holiday Inn Collinsville, IL	Leadership Council Members and County and Municipal leaders and business leaders
Confluence Greenway 16 February 2000	Confluence Greenway Offices	Interested members of the Confluence Greenway
Polish American Veterans of Foreign Wars - 22 February 2000	Veterans Lodge, Caseyville	Local interested citizens
East St. Louis Community Action Network 17 March 2000	Casino Queen	Interested citizens
Collinsville Women's Club 4 April 2000	Public Library on Main Collinsville, IL	Local interested citizens
Illinois Association of Flood Plain Managers Annual Conference - 5 May 2000	Holiday Inn City Center Peoria, Illinois	IEMA and FEMA coordinators across the state of Illinois
St. Clair County Briefing 17 July 2000	St. Clair County Offices Belleville, IL	County Board Chairman, and invited staff, IDNR-OWR representatives
Coastal America Foundation 30 August 2000	Fish and Wildlife Services Regional Office Minneapolis, MN	Organization members, and US Fish and Wildlife personnel
Home Builders Association 27 September 2000	Holiday Inn Collinsville, IL	Developers and interested parties
County Storm Water Managers State of Illinois Conference 27 September 2000	Lake Shelbyville, IL	County engineers, community leaders and state effected agencies.
Upland Sediment Detention Presentation to Municipalities and Counties 13 October 2000	Maryville Senior Center	Community leaders, municipal engineers and interested parties.
State Federal Emergency Management Agency Conference 24 October 2000	Cahokia Mounds, IL	Agency personnel from 6 State Offices
McKnight Foundation 11 January 2001	St. Louis Corps of Engineers Offices	McKnight staff
Upland Detention Briefing Park District 27 February 2001	Collinsville Area Recreation District Office, Collinsville, IL	Park and Recreation District Personnel from Madison and St. Clair Counties
Water Symposium 27 April 2001	Missouri Botanical Garden	Environmentalist, engineering community, community leaders, interested public

Table 10-2 Continued

INTEREST GROUPS	LOCATION	ATTENDEES
Cahokia Mounds Briefing 23 July 2001	Cahokia Mounds	Local/Regional members of the Sierra Club and American Bottoms Conservancy
Madison County Transit – Trails 11 June 2001	Madison County Transit Building	Regional Parks District members, and interested rails to trails public group
Wedgewood Association 19 September 2001	5300 State Street, East St. Louis, IL	Members of the Wedgewood citizen group

During this same time period, coordination continued on both an informal and formal level with State and Federal agencies participating in the Project effort. As indicated in Table 10-3, numerous presentations were made to keep these agencies engaged during the Project process.

Table 10-3 Project Presentations to Other Agencies

AGENCY COORDINATION	LOCATION	ATTENDEES
USEPA, Region 5 19 March 1999	USEPA Offices, Chicago, IL	Critical Ecosystem Team, Upper Mississippi River Team, Gateway Team, and OSEA
Illinois State Historic Preservation Office- 9 Jun 1999	Cahokia Mounds, IL	Agency personnel
Illinois Emergency Management Agency - 12 January 2000	Springfield, IL	Agency personnel
USEPA, Region 5 23 February 2000	USEPA Offices, Chicago, IL	Critical Ecosystem Team, NPDES, Upper Miss Team, Brownfields and Gateway Team, and OSEA
Illinois Transportation Archeological Research Program - 24 May 2001	IDOT Bldg, Collinsville, IL	Staff archeologist
Illinois Department of Natural Resources - 9 November 2000	IDNR Offices, Springfield, IL	Staff from OWR and OREP Divisions

As a result of the 12 January 2000 presentation to IEMA this Project was nominated for an award and recognized at the 5 May 2000 Annual Conference of the Illinois Association of Flood Plain Managers. A presentation at this forum was also made. Each of these groups had a different focus to bring to the Project that resulted in a better exchange of information during the formulation process. The presentation provided to this group also fostered a collaboration with the USGS on sediment transport and stream geomorphology. The presentations provided on upland detention created an interest in the Project from recreation department directors as well as drawing the upland communities into a dialogue regarding sediment transport and its effects on infrastructure and stream quality. The extent of collaboration on this Project is perhaps the greatest ever experienced by the St. Louis District.

10.3.2 Internal to the Corps of Engineers. The change in focus of this re-evaluation Project from those done previously made internal coordination a key component to the Project development process. Meetings with Division Staff began with the re-initiation of the Project and continued with a formulation strategy meeting and an alternative development meeting. Each of these meetings provided valuable insight into methods and considerations that should be used during the re-Project process. Additionally, opportunities occurred to provide the Chief of Planning, HQUSACE and the ASA (CW) with presentations on the Project goals, objectives and potential results. Each was well received.

A schedule of these internal meetings and briefings that were a part of the Project process and guided its development is shown in Table 10-4.

Table 10-4 Project Presentations within the Corps of Engineers

CORPS OF ENGINEERS PRESENTATIONS	LOCATION	ATTENDEES
Mississippi Valley Division Project Strategy Briefing 22 October+ 1998	Mississippi Valley Division Office	Division staff including PM, Policy, Economics, Environmental, and Regulatory
Briefing Chief, Program Execution Division - 7 December 1999	St. Louis District Office St. Louis, MO	Chief, Program Execution Division
Chief Planning Division HQUSACE – 27 October 1999	St. Louis District Office St. Louis, MO	Chief Planning Division
Mississippi Valley Division Formulation Briefing 21 January 2000	Mississippi Valley Division Office, Vicksburg, MS	Division staff including PM, Policy, Economics and Environmental
Briefing Assistant Secretary of the Army for Civil Works 28 September 2000	St. Louis District Office St. Louis, MO	Assistant Secretary of the Army for Civil Works
Briefing Chief, Program Execution Division -	St. Louis District Office St. Louis, MO	Steve Cobb etc.

10.4 OTHER REQUIRED COORDINATION

10.4.1 U.S. Fish and Wildlife Service. Under the requirements of the Fish and Wildlife Coordination Act, the Service was consulted with on the Project. Their response is contained in Appendix G. The conclusions drawn by the Service are noteworthy –

> **Conclusions**
>
> The proposed project represents an ambitious effort by various agencies to address resource concerns in the American Bottoms. As proposed this project will result in significant habitat gains for a variety of species. Restoration of wetlands will not only provide valuable wildlife habitat, but it will improve flood storage, groundwater recharge, sediment control/erosion reduction, and pollution control. The Service fully supports measures to reduce upland stream erosion and degradation. The benefits of these measures to fish and wildlife resources is difficult to measure with existing evaluation techniques. Overall, project features in the upland areas will improve water quality and ensure protection of the riparian corridor. The Service applauds the Corps and project sponsors for selecting alternatives that truly reflect an ecosystem restoration initiative.

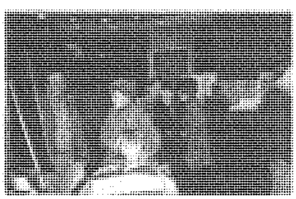
10.4.2 Illinois Department of Agriculture. In accordance with the requirements of the Farmland Protection Policy Act, IDOA consultation results are contained in Appendix G.

10.5 COOPERATING STATE AND FEDERAL AGENCIES

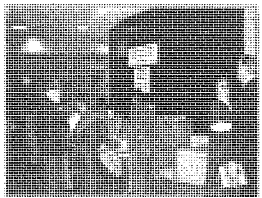
Regulations for implementing the National Environmental Policy Act state that any Federal agency which has special expertise with respect to any environmental issue which should be addressed in the statement, may be a cooperating agency when requested by the lead agency (40CFR, Parts 1500-1508, - 1501.6). In December 1998, the Corps, through official correspondence, invited the USEPA and NRCS to assist in preparation of the Environmental Impact Statement for the restudy. The scope and range of issues involved and work already underway in the Project area by these agencies made this cooperation desirable. Both the USEPA Region 5 and the NRCS, State of Illinois, agreed to participate on the Environmental Impact Statement as cooperating agencies. The NRCS accepted responsibility to produce several specific technical reports on upland erosion, provide a biologist to the restudy team and participate in all decision making meetings throughout the Project process. The USEPA Region 5 agreed to cooperate by providing a biologist to the restudy team and providing technical assistance to several sections of the Project report including the Environmental Justice, Hazardous and Toxic Waste, and Air Quality sections. These associations strengthened the process, broadened the focus of the restudy team and enhanced the quality of the final product. Documentation regarding this status is contained in Appendix G.

10.6 PUBLIC MEETINGS

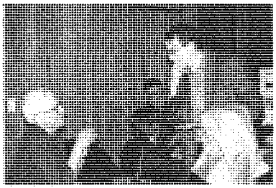
The Corps sent out a letter, dated January 14, 2000, to over 350 recipients including Federal, state, and local agencies, private organizations and all attendees registering at the 1999 workshop. A copy of this letter is contained in Appendix G. This letter announced an open workshop to be conducted on February 2. The purpose of this workshop was to display Project alternatives currently under investigation. The public was invited to review these plans to ensure that all problems, needs, concerns, issues, resources, and potential solutions were being considered in the Project's alternative development process. 256 individuals registered at the workshop. The record was held open for a 43 - day comment period. Some 46 written responses were received within the comment period. These issues were compiled and infused into the restudy plan formulation process over the next year and a half.



A compilation of comments received in response to the workshop, which was conducted on 2 February 2000 in Collinsville, Illinois, was made. These comments were categorized for consolidation of similar issues and concerns expressed by the public. This feedback was provided in writing to all individuals providing written comments in response to the workshop. A compilation of these comments and additional individual letters, which responded to specific issues are contained in Appendix G.



As a result of input received from this process an alternative was added for the Judy's/Burdick action area for evaluation, which ultimately became the recommended plan.



Information presented and mapping used at the 2 February was placed on the District's Web site so that interested parties could review material presented at any time.

10.7 IMPLEMENTATION PLAN COORDINATION

10.7.1 Metro East Regional Stormwater Joint Committee. During the summer of 2001, presentations were provided to, and comment received from, the Joint Committee concerning the recommended plan, cost sharing requirements, Project Cooperation Agreement requirements, and Project implementation strategy. Formal comments were received during the coordination of the Draft Report in the spring of 2003.

10.7.2 Interested Parties. The review and comment period for the Draft report occurred between 28 February and 7 June 2003. Appendix M includes a complete list of all parties who received direct information from the Corps of Engineers regarding the report review period and/or a copy of the report compact disk (CD). At the request of several interested public parties, the comment period was extended 30 days from the original Federal Register closing date of 7 May 2003. Additionally, the draft report was placed on the St. Louis District's web site at the beginning of the comment period to ensure the widest dissemination of information possible. A public meeting was held on 8 April 2003 at the Gateway Center in Collinsville Illinois, which included an informal workshop followed by a formal comment period. Appendix G contains the list of those attending the public meeting and a copy of all comments received during the comment period. Responses to comments received during the draft report review also are contained in Appendix G.

10.7.3 Public. As this Project continues during the preparation of Engineering Design Reports described in Section 9, follow-on public involvement will continue. The goal of this process is to ensure that the intended benefits of the recommended plan are achieved as the Project is implemented. It is anticipated that all parties who are interested in this Project will be kept informed through public meetings and web based information.

10.8 AREAS OF PUBLIC CONCERN

Three areas of concern have consistently been mentioned in public meetings, at several interest group presentations, and as part of the comments received during the Draft report review period. The first involves the taking of private land for the Project. Many of the affected landowners voiced their opposition to any plan that would affect their property. Several of the recommended action areas encompass all or parts of family farms that have been held for several generations. The second involves a general fear that the creation of additional wetlands on the floodplain will exacerbate the mosquito problems within the area. With the out break of the West Nile virus in this regional area in 2002, a vigorous information campaign will be necessary to educate the public on the facts regarding wetlands and the mosquito.

During coordination of the Draft report, it was clear that the Wedgewood Action Area, if implemented, would have a negative effect on the adjacent neighborhood and local residents due to the closing of Summit Road. As a result of the input received, this action area has been removed from the recommended plan. Additional information regarding this action is contained in Appendix G.

During the Draft report review process, a third area of concern was noted. A fear was expressed that future Federal action will destroy areas addressed in the recommended plan that are believed to be of high environmental and ecological quality. In a number of comments, the Indian Lake portion of the Spring Lake Action Area was specifically addressed. As described in Section 9 of this report, the tiered approach to the NEPA process and the future documentation of action areas in follow-on Engineering Design Reports will be used to ensure that the greatest implementation flexibility is maintained. In this manner, it is believed that the uncertainties and concerns identified above will be addressed and overall Project integrity maintained.

10.9 PUBLIC INVOLVEMENT CONCLUSIONS

The purpose of the public outreach and public participation for this re-study effort was designed to: 1) inform the public; 2) gather information; 3) identify public concerns; 4) develop consensus; and, 5) develop and maintain credibility. The public involvement process, which was conducted using a three-phase approach (public workshops, focus group meetings, and interest group presentations), achieved this purpose. By using this combination of public involvement and agency participation, trust in the process was established and a broad base of support and concurrence was achieved. The public involvement program guided the Project development process from scoping to the selection of the recommended plan.

This process will continue to provide valuable input and guidance to the Study Team as the Project goes through the design and implementation phases.

SECTION 11 – ENVIRONMENTAL STATUTES AND REQUIREMENTS

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SECTION 11 – ENVIRONMENTAL STATUTES AND REQUIREMENTS

11.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

The National Environmental Policy Act (NEPA) is the basic national charter for protection of the environment. The Act declares it a national policy to "encourage productive and enjoyable harmony between man and the environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; and to enrich the understanding of the ecological systems and natural resources important to the Nation". The profound impacts of man's activities "on the interrelations of all components of the natural environment" are recognized (e.g., urbanization, population growth, industrial expansion, resource exploitation) (42 USC 4331).

The Act specifically declares a "continuing policy of the Federal Government, in cooperation with State and local governments, and other public and private organizations to use all practicable means and measures to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans" (42 USC 4331). The Act also states that it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of National policy, to improve and coordinate Federal plans, functions, programs, and resources to, among other things: assure safe, healthful, productive and esthetically and culturally pleasing surroundings for all Americans; attain the widest beneficial use of the environment without degradation, risk to health or safety; preserve important historic, cultural and natural aspects of our national heritage; achieve balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and, enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Agencies are required to "utilize a systematic, interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and decision making...". They are also to insure that "unquantified environmental amenities and values may be give appropriate consideration in decision making along with economic and technical considerations".

NEPA requires that every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, include a statement on: the environmental impacts of the proposed action; any adverse environmental effects which cannot be avoided should the proposal be implemented; alternatives to the proposed action; the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and, any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. Agencies responsible for the action shall consult with and obtain comments from other agencies with jurisdiction by law or special expertise, with response to any environmental impact.

NEPA also establishes the Council on Environmental Quality (CEQ), in the Executive Office of the President (42 USC 4341). The Council advises and assists the President in providing leadership in protecting and enhancing the quality of the Nation's environment. It develops and evaluates Federal policies and activities on environmental quality. One of CEQ's primary functions in relation to water resources is the preparation of regulations concerning the development of environmental impact statements developed by the Corps and other agencies.

11.2 FISH AND WILDLIFE COORDINATION ACT OF 1958

This Act declares that fish and wildlife are of ecological, educational, esthetic, cultural, recreational, economic and scientific value to the Nation. The Act acknowledges that historically, fish and wildlife conservation programs have focused on more recreationally and commercially important species within any particular ecosystem, with out provisions for the conservation and management of non-game fish and wildlife. The purposes of this Act are to encourage Federal agencies to utilize their statutory and administrative authority, to the maximum extent practicable and consistent with each agency's statutory responsibilities, to conserve and to promote conservation of non-game fish and wildlife and their habitats, in furtherance of the provisions of this chapter, and to provide financial and technical assistance to States to conduct inventories and conservation plans for conservation of non-game wildlife (16 U.S.C. 2901(b)). The Act defines "fish and wildlife" as "wild vertebrate animals in an unconfined state, including, but not limited to, non-game fish and wildlife," and "non-game fish and wildlife" as wild vertebrate animals in an unconfined state, that are not ordinarily taken for sport, fur or food, not listed as endangered or threatened species.

11.3 ENDANGERED SPECIES ACT OF 1973

Under the Endangered Species Act (ESA), federal agencies are required to conserve biological and wildlife species that have been federally listed as endangered or threatened. All federal agencies must consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that any actions authorized, funded, or carried out by the agencies are not likely to jeopardize the continued existence of any endangered or threatened species or to result in the destruction of or substantial damage to its critical habitat. This consultation, deriving from Section 7 of the act, is often referred to as the Section 7 consultation process, and may include either *formal* or *informal* consultations. Section 7(a) of the ESA requires *formal* consultation with the US Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) whenever an action may affect (beneficially or adversely) a listed species or critical habitat. *Informal* consultation with the USFWS or NMFS is always appropriate to clarify if an action is likely to affect a listed species or critical habitat, and should be initiated to proactively and positively address potential issues. While this consultation is in progress, an agency must not make an irretrievable commitment of resources to its project.

The ESA prohibits the taking of endangered fish and wildlife species. Under the ESA, *take* is defined as "...to harass, harm, pursue, hunt, shoot, wound, kill, track, capture, or collect (or attempt to engage in any such conduct) a species." The definition of *take* has been expanded to include effects to the species resulting from impacts to their habitat. With respect to the *taking* of endangered plants, it is prohibited to remove or seize any listed species. Amendments to the ESA in 1982 allow the Secretary of the Interior to approve "incidental" taking of listed species if, after notice and comment, the Secretary finds that the taking will be incidental, the applicant will exert maximum effort to minimize and mitigate the effects of taking, the applicant will ensure adequate funding for the plan, and the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.

11.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966

The National Historic Preservation Act of 1966 (NHPA) protects buildings, sites, districts, structures, and objects that have significant scientific, historic, or cultural value. The act establishes affirmative responsibilities of federal agencies to preserve historic and prehistoric resources. Effects on properties that are on, or eligible for, the National Register of Historic Places (NRHP) must be taken into account in planning and operations. Any property that may qualify for inclusion on the National Register of Historic Places must not be inadvertently transferred, sold, demolished, substantially altered, or allowed to deteriorate. National Register of Historic Places criteria are those qualities of significance in American history, architecture, engineering, archaeology, and culture present in districts, sites, buildings, structures, and objects of state, local, regional, or national importance. These properties possess integrity of location, design, setting, materials, workmanship, feeling, and association.

Fulfillment of the purposes of the NHPA is assisted through consultation with the Advisory Council on Historic Preservation (ACHP) and with each State Historic Preservation Officer (SHPO). Prior to final disposal action, the Army must ensure that National Historic Preservation Act Section 106 consultations are complete and that appropriate considerations have been afforded Fort Chaffee properties which are on or eligible for the National Register.

11.5 CLEAN WATER ACT OF 1972

Since major improvements in 1977, the Federal Water Pollution Control Act has been known as the Clean Water Act (CWA). This statute, which seeks to restore and maintain the chemical, physical, and biological integrity of the Nation's waters, identifies certain pollutants and sets required treatment levels for those pollutants. The CWA addresses both point source and nonpoint source discharges. Point sources are distinct entities that discharge wastewater into rivers or lakes through distinct conveyances such as pipes, ditches, or canals. Nonpoint sources are those which do not discharge wastewater from a discrete conveyance (e.g., agricultural lands, construction sites, parking lots, streets).

Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) program. NPDES permits are required for all point source discharges to waters of the United States, including discharges of stormwater associated with industrial activities. CWA provisions apply to Fort Chaffee with respect to operations at the installation's wastewater treatment facility and industrial facilities, which are subject to the NPDES permitting provisions.

Sections 401 and 404 of the CWA contain provisions for the protection of wetlands. The CWA establishes a permitting and water quality certification process for both Federal and private activities having potential effects on wetland areas.

11.6 CLEAN AIR ACT OF 1972

The Clean Air Act (CAA) controls the emission of pollutants into the atmosphere. Under the CAA, USEPA has established national air standards. These standards, which express concentrations of designated pollutants, are called the National Ambient Air Quality Standards (NAAQS). The NAAQS, uniformly applied throughout the Nation, are time-averaged concentrations of the specified pollutants that cannot be exceeded in the ambient air more than a specified number of times. Standards have been established for the pollutants sulfur dioxide, carbon monoxide, ozone, nitrogen oxides, lead, and inhalable particulate matter. The NAAQS are to be achieved by the states through State Implementation Plans, which provide for limitations, schedules, and timetables for compliance with NAAQS by stationary sources and transportation control plans for mobile sources.

Amendments to the CAA in 1990 introduced, at Section 1.76(c) of the Act, a requirement that "No department, agency, or instrumentality of the Federal Government shall engage in, support in any way, or provide financial assistance for, license or permit, or approve any activity which does not conform to an implementation plan approved or promulgated. The assurance of conformity shall be an affirmative responsibility of the head of such department, agency, or instrumentality." Conformity to an implementation plan means conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards. It further refers to conducting activities so that they will not cause or contribute to any new violation of any standard in any area, increase the frequency or severity of any existing violation of any standards in any area, or delay timely attainment of any standard of any required interim emission reductions or other milestone in any area. Regulations regarding determining conformity of general federal actions to implementation plans appear at 40 CFR Parts 51 and 93.

11.7 FARMLAND PROTECTION POLICY ACT OF 1981

Prime farmland soils are protected under the Farmland Protection Policy Act of 1981 (FPPA). The intent of the act is to minimize the extent to which federal programs contribute to the unnecessary or irreversible conversion of farmland soils to nonagricultural uses. The act also ensures that federal programs are administered in a manner that, to the extent practicable, will be compatible with private, state, and local government programs and policies to protect farmland. The Natural Resources Conservation Service (NRCS) is responsible for overseeing compliance with the FPPA and has developed rules and regulations for implementation of the act (7 CFR Part 658, U.S. Department of Agriculture [USDA] Final Rule, Farmland Protection Policy, July 5, 1984).

The FPPA's and NRCS's implementing procedures require federal agencies to evaluate the adverse effects of their activities on prime and unique farmland, as well as farmland of statewide and local importance, and to consider alternative actions that could avoid adverse effects.

11.8 WILD AND SCENIC RIVER ACT OF 1968

The Act establishes the policy that certain rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The Act both identifies specific river reaches for designation as wild or scenic, and provides criteria to be used for classifying additional river reaches (16 U.S.C. 1272). "Wild river areas" are those rivers or sections of rivers that are free from impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent the vestiges of primitive America. "Scenic river areas" are those rivers or sections of rivers that are free from impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads. "Recreational river areas" are those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

The National Wild and Scenic River System was established to protect the environmental values of free-flowing streams from degradation by impacting activities, including water resources projects. The system is administered jointly by the U.S. Forest Service, Department of Agriculture, and the National Park Service, Department of the Interior. Corps activities on the streams included in the system are subject to review by whichever of these agencies is responsible for the specific stream. In all planning for the use and development of water and related land resources, consideration shall be given to potential national wild, scenic and recreational river areas, and all river basin and project plan reports submitted to the Congress shall consider and discuss and such potentials (16 U.S.C. 1276(d).

11.9 FEDERAL WATER PROJECT RECREATION ACT Of 1965

The Act establishes the policy that consideration be given to the opportunities for outdoor recreation and fish and wildlife enhancement in the investigating and planning of any Federal navigation, flood control, reclamation, hydroelectric or multi-purpose water resource project, whenever any such project can reasonably serve either or both purposes consistently. Recreational use of projects will be coordinated with other existing and planned Federal, State, or local recreational developments. The Act does not apply to local flood control, beach erosion control, small boat harbors, or hurricane protection projects. Non-Federal bodies will be encouraged to operate and maintain project recreational and fish and wildlife enhancement facilities. If non-Federal bodies agree in writing to administer the facilities at their expense and to pay one-half the separable first cost, the recreation and fish and wildlife benefits shall be included in project benefits and project costs allocated to recreation and fish and wildlife. Fees may be charged by the non-Federal interests to repay their costs. If non-Federal bodies do not so agree, no facilities for recreation and fish and wildlife may be provided except those justified to serve other purposes or as needed for public health and safety. However, project land may be acquired to preserve the recreational potential. If within 10 years after initial project operation there is no local agreement the land may be used for other purposes or sold.

Benefits for recreation should be included in the economics of a contemplated project, provided that non-Federal public entities agree (letter of intent) to participate in the recreation development. Recent Corps policy resulting from the Water Resources Development Act of 1986 is that a non-Federal public body must cost share recreation (50% of separable costs), and bear all costs of operation, maintenance, repair, and rehabilitation (OMRR). The Corps is authorized to construct minimum health, safety, and access facilities without cost sharing. The Act also contains a provision that non-Federal public bodies may elect to lease recreation facilities and lands as long as they agree to bear OMRR responsibilities and costs.
The Secretary of Interior is authorized to enter into agreements with Federal agencies to promote development and operation of lands or facilities for recreation and fish and wildlife enhancement purposes.

11.10 RESOURCE CONSERVATION AND RECOVERY ACT OF 1976

Under the Resource Conservation and Recovery Act (RCRA), USEPA defines those wastes that are hazardous and regulates their generation, treatment, storage, transportation, and disposal. USEPA also establishes technical and performance requirements for hazardous waste management units and exercises responsibility over a permit system for hazardous waste management facilities. RCRA is also the source for regulations pertaining to solid waste management and underground storage tank management.

11.11 TOXIC SUBSTANCES CONTROL ACT OF 1976

This Act, as last amended in 1986, is the federal legislation, which deals with the control of toxic substances. The Act consists of three subchapters, one of which regulates the control of toxic substances (such as polychlorinated biphenyls (PCBs)), another governs asbestos hazard emergency response, and another subchapter regulates indoor radon abatement. TSCA was designed to establish a system in which all chemicals would be evaluated before they are used to ensure they pose no unnecessary risk to human health, other living organisms and the environment. The risks and benefits of the chemicals "use" are to be balanced. The Administrator can waive compliance with any provision of this Act upon a request and determination by the President that the requested waiver is necessary in the interest of National Defense (15 U.S.C. 2621).

TSCA was also designed to mitigate the hazards of certain chemicals already in use. Because environmental contamination caused by stable PCB compounds and ozone layer destruction caused by chlorofluorocarbons could not be controlled under existing environmental legislation, Congress specifically included bans on the manufacture of PCBs and bans on the use of chloroflourocarbon propellants under TSCA. By regulating these substances, Congress intended to control these problems at the source rather than legislating corrective actions once the materials were released to the environment.

11.12 E.O. 11988, FLOODPLAIN MANAGEMENT

Issued on May 24,1977, EO 11988 requires federal agencies to take action to reduce the risk of flood loss, to minimize the impacts of floods on human safety, health, and welfare, and to restore and preserve the national and beneficial values served by floodplains in carrying out their responsibilities for managing and disposing of federal lands. Before taking action, an agency must determine whether the proposed action will occur in a floodplain; if so, consideration must be made of alternatives to avoid adverse effects and incompatible development in floodplains.

11.13 E.O. 11990, PROTECTION OF WETLANDS

Issued on May 24, 1977, EO 11990 requires federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for managing and disposing of federal lands and facilities. For any proposal for lease, easement, right-of-way, or disposal to nonfederal public or private parties, the federal agency is to reference in the conveyance document those uses which are restricted under federal, state, or local wetland regulations and to attach other appropriate restrictions to the uses of properties by the grantee or purchaser and any successor, except where prohibited by law, or withhold such properties from disposal.

11.14 E.O. 12898, ENVIRONMENTAL JUSTICE

Issued on February 11, 1994, EO 12898 requires that federal agencies conduct their programs, policies, and activities that substantially affect human health or the environment in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under such programs, policies, and activities because of their race, color, or national origin. On February 11, 1994, the President also issued a memorandum for heads of all departments and agencies, directing that USEPA, whenever reviewing environmental effects of proposed actions pursuant to its authority under Section 309 of the CAA, ensure that the involved agency has fully analyzed environmental effects on minority communities and low-income communities, including human health, social, and economic effects.

The essential purpose of the EO is to ensure the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no groups of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

SECTION 12 - COMMANDER'S RECOMMENDATION

COMMANDER'S RECOMMENDATION

The Project area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area will contribute greatly to national, regional and local systems. The Study area's ecosystem significance relates directly to contributions towards the: North American Waterfowl Management Plan; Upper Mississippi River System Environmental Management Program; Clean Water Action Plan; Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; and, federal government's list of "Species of Concern".

I have carefully considered the significant factors related to the problems and associated opportunities identified within the Project Area, as well as the numerous alternative plans that were developed to address these problems and opportunities. These factors include: the severity of the environmental, social and economic consequences of ecosystem degradation and its related land and water resources problems within this significant, internationally known and valued environmental/cultural resource area; the probability of more severe conditions in the future; the ability of each alternative plan to address the ecosystem restoration and related problems and opportunities; the costs of the plans and the relationship of the costs to their associated outputs; and the acceptability of the plans to the non-Federal interests and partner Resource agencies. In consideration of these important factors, I have determined that the following recommendation is in the public's interest.

I recommend that East St. Louis and Vicinity, Illinois project authorized by the Section 204 of the Flood Control Act of 1965 and amended by Section 310 of the Water Resources Development Act of 2000 be modified to implement the National Environmental Restoration Plan identified in this Report as the Recommended Plan, as a Federal project with further modifications as necessary, in the discretion of the Commander, USACE, that may be advisable in accordance with the cost sharing and financing arrangements satisfactory to the President and the Congress. Based on October 2003 price levels, the total cost of the recommended plan is currently estimated to be $193,266,100 including PED activities. The Federal and non-Federal shares are estimated at $125,584,260 and $67,681,840, respectively. These costs reflect a 65-35% cost share of the environmental features and a 50-50 cost share for the recreation features. The non-Federal operation, maintenance, repair, rehabilitation and replacement costs are estimated at $93,000 annually. This recommendation is made with the provision that prior to Project implementation, the non-Federal interests must:

a. Provide a minimum of 35 percent of project costs allocated to ecosystem restoration and 50 percent of the project costs allocated to recreation, as further specified below:

(1) Enter into an agreement to provide, prior to execution of the project cooperation agreement, 25 percent of design costs;

(2) Provide during construction, any additional funds needed to cover the non-Federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the Project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the Project;

(5) Provide during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of total project costs allocated to ecosystem restoration and 50 percent of the total project costs allocated to recreation.

b. Provide 35 percent of the cost for that portion of total cultural resource preservation mitigation and data recovery costs attributable to ecosystem restoration that are in excess of one percent of the total amount authorized to be appropriated for the Project;

c. Provide 50 percent of the cost for that portion of total cultural resource preservation mitigation and data recovery costs attributable to recreation that are in excess of one percent of the total amount authorized to be appropriated for the Project;

d. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

e. Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

f. Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence construction of any water resources project or separable element thereof until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

g. Hold and save the Government free from all damages arising for the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

h. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extend and in such detail as will properly reflect total project costs;

i. Perform, or cause to be performed, any investigations for hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government;

j. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

k. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA;

l. Prevent future encroachments on project lands, easements, and rights-of-way, which might interfere with the proper functioning of the Project;

m. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), as amended by Public Law 102-240, Section 1055 (re: rural electrification), as amended by Public Law 105-117, Section 104 (re: Alien not lawfully present in United States), and the Uniform Regulation contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

n. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable federal labor standards requirements, including, but not limited to, the Davis-Bacon Act (40 U.S.C. 276a et. seq.), the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et. seq.) and the Copeland Anti-Kickback Act (40 U.S.C. 276c).

o. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. Consequently, this recommendation may be modified before it is transmitted to Congress as proposals for authorization and implementation funding. However, prior to transmittal to Congress, the State of Illinois, Madison and St. Clair Counties, Illinois, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

C. Kevin Williams
Colonel, Corps of Engineers
District Commander

SECTION 13 – STUDY TEAM MEMBERS AND REPORT PREPARERES

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SECTION 13 - STUDY TEAM MEMBERS AND REPORT PREPARERES

13.1 CORPS OF ENGINEERS

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Mr. Ron Dieckmann	Corps of Engineers, St. Louis District	Hydraulic Engineer	Hydrologic & Hydraulic Analysis/Design
Mr. Mark Alvey	Corps of Engineers, St. Louis District	Geotechnical Engineer	Geotechnical Analysis/Design
Ms. Marilyn Kwentus	Corps of Engineers, St. Louis District	Geotechnical Engineer	Geotechnical Design
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Mr. Glenn Shuetz	Mascoutah, IL

SECTION 14 - GLOSSARY OF TERMS AND ACRONYMS

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SECTION 14 - GLOSSARY OF TERMS AND ACRONYMS

14.1 TERMS

Alternative
In HEP analyses, this is the "With-Project" condition commonly used in restoration studies. An Alternative can be composed of numerous activities, measures and/or options; some examples of Alternatives include:

Alternative 1: Plant food plots, increase wetland acreage by 10 percent, install 10 goose nest boxes, and build a fence around the entire site.
Alternative 2: Build a dam, inundate 10 acres of riparian corridor, build 50 miles of supporting levee, and remove all wetlands in the levee zone.
Alternative 3: Reduce the grazing activities on the site by 50 percent, replant grasslands (10 acres), install a passive irrigation system, build 10 escape cover stands, use 5 miles of willow facines along the stream bank for stabilization purposes.

Average Annual Habitat Units (AAHUs)
A quantitative result of annualizing Habitat Unit (HU) gains or losses across all years in the period of analysis.

AAHUs =Cumulative HUs / Number of years in the life of the project, where

Cumulative HUs =Sum $(T_2 - T_1)[((A_1 H_1 + A_2 H_2) / 3) + ((A_2 H_1 + A_1 H_2) / 6)]$, and where:

T_1 = First Target Year time interval
T_2 = Second Target Year time interval
A_1 = Area of available habitat at beginning of T_1
A_2 = Area of available habitat at end of T_2
H_1 = HSI at beginning of T_1
H_2 = HSI at end of T_2

Average Annual Functional Capacity Units (AAFCUs)
A quantitative result of annualizing Functional Capacity Unit (FCU) gains or losses across all years in the period of analysis.

AAFCUs = Cumulative FCUs ? Number of years in the life of the project, where:

Cumulative FCUs =Sum $(T_2 - T_1)[((A_1 F_1 + A_2 F_2) / 3) + ((A_2 F_1 + A_1 F_2) / 6)]$, and where:

T_1 = First Target Year time interval
T_2 = Second Target Year time interval
A_1 = Area of available wetland assessment area at beginning of T_1
A_2 = Area of available wetland assessment area atend of T_2
F_1 = FCI at beginning of T_1
F_2 = FCI at end of T_2

14.1 TERMS - Continued

Baseline Condition
In the habitat assessment and planning analyses, baseline is the point in time before proposed changes, and is synonymous with Target Year (TY = 0).

Blue Book
The U. S. Fish and Wildlife Service is responsible for publishing documents identifying and describing HSI models for numerous species across the nation. Referred to as "Blue Books" in the field, due primarily to the light blue tint of their covers, these references fully illustrate and define habitat relationships and limiting factor criteria for individual species nationwide. Blue Books provide: HSI Models, life history characteristics, SI curves, methods of variable collection, and referential material that can be used in the application of the HSI model in the field. For copies of Blue Books, or a list of available Blue Books, contact your local USFWS office.

Compensation
Also referred to as mitigation, in terms of wildlife habitat value loss, functional capacity loss, or environmental impacts, these are the methods or actions by which the inflicting agency or group offsets the unavoidable loss, of or damage to, these resources due to the proposed action.

Cost Effectiveness Analysis (CEA)
An economic analysis completed to determine the least-cost, economically rational, alternatives. Economically rational alternatives are, by definition, both the efficient and effective alternatives. The results of a cost effectiveness analysis are often displayed in tables, bar charts and scatter plots.

Cover Type
A homogenous zone of similar vegetative species, geographic similarities and physical conditions that make the area unique. In general, cover types are defined on the basis of species recognition and dependence.

Delimiting Situations
Occur when project managers attempt to narrow the array of alternatives to a series of alternatives that meet certain restraining criteria. The project manager can eliminate the evaluation of costly alternatives and unproductive alternatives in cost analyses. For example, the project manager can declare an upper limit of costs – any alternative with a budget higher than this limit will be removed from further consideration. In this manner, project managers can limit the cost evaluation to alternatives that can be completed under the project's budget. Further, project managers can provide a minimum environmental productivity level. The cost analyses will "weed out" those alternatives that do not produce at least the minimal environmental output.

14.1 TERMS - Continued

DependentAlternatives
As a general rule, Dependent Alternatives cannot be implemented alone. Dependent Alternatives must be implemented in combination with their Independent Alternative to be successful. Dependent situations occur when the success of alternatives is contingent upon the presence of specific conditions (i.e., other alternatives) in the project. Often these situations arise when environmental, economic and/or management factors reinforce one another to produce favorable outcomes. For example, the construction of a series of food plots on a high desert bench will require the installation of an irrigation system, or a channel/culvert system, connected to the nearest water source. The project manager will identify the food plot alternative as "dependent" upon either the irrigation system alternative, or the channel/culvert system alternative, on the basis of operation and management dependability.

Ecosystem
An ecosystem is a biotic community, together with its physical environment, considered as an integrated unit. Implied within this definition is the concept of a structural and functional whole, unified through life processes. Ecosystems are hierarchical, and can be viewed as nested sets of open systems in which physical, chemical and biological processes form interactive subsystems. Some ecosystems are microscopic, and the largest comprises the biosphere. Ecosystem restoration can be directed at different-sized ecosystems within the nested set, and many encompass multi states, more localized watersheds or a smaller complex of aquatic habitat.

Ecosystem Services
The "conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life" (Daily et al. 1997). They are essential to our civilization, in that we cannot replace them with existing technology. A principal service of natural ecosystems is the maintenance of biodiversity and the production of economically important goods. Examples of fundamental life support services are numerous, and include air and water purification, flood and drought abatement, soil generation and preservation and replenishment of soil fertility, and pollination of agricultural and native plants, among others (Daily et al. 1997).

Effective Alternatives
When comparing alternatives, these alternatives produce increased levels of outputs (AAHUs from HEP or AAFCUs from HGM) for the same or lesser costs.

Efficient Alternatives
When comparing alternatives, these alternatives produced similar levels of output (AAHUs from HEP or AAFCUs from HGM) at a lesser expense.

14.1 TERMS - Continued

Equivalent Optimal Area (EOA)
The concept of EOA is used in HEP when the composition of the landscape, in relation to providing life requisite habitat, is an important consideration. An EOA is used to weight the value of the Life Requisite SI to compensate for this interrelationship. For example, for optimal wood duck habitat conditions, at least 20 percent of an area should be composed of cover types providing brood-cover habitat. If an area has less than 10 percent in this habitat, the suitability is adjusted downward.

Existing Condition
Also referred to as the Baseline Condition, the Existing Condition is the point in time before proposed changes, and is designated as Target Year TY = 0 in the analysis.

Field Data
In HEP and HGM, this information is collected on various parameters (i.e., variables) in the field, and from aerial photos, following defined, well-documented methodology. An example is the measurement of percent herbaceous cover, over ten quadrats, within a riparian forest cover type. The values recorded are each considered "field data." Means of variables are applied to derive suitability indices and/or functional capacity indices.

Flood Pulse
A seasonal rise in river levels beyond bankful, due to snowmelt and rain that triggers a complex variety of physical and biological processes that help maintain a healthy ecosystem.

Functional Capacity Index Model (FCI)
In the HGM, an FCI Model is a quantitative estimate of functional capacity for a wetland. The ideal goal of an FCI model is to quantify and produce an index that reflects functional capacity at the site. The results of an FCI analysis can be quantified on the basis of a standard 0-1.0 scale, where 0.00 represents low functional capacity for the wetland, and 1.0 represents high functional capacity for the wetland. An FCI model can be defined in words, or mathematical equations, that clearly describe the rules and assumptions necessary to combine functional capacity indices in a meaningful manner for the wetland.

For example:
$FCI = (VSI\ V_1 * VSI\ V_2) / 4$, where:

VSI V_1 is the Variable Subindex (VSI) for variable 1;
VSI V_2 is the VSI for variable 2

14.1 TERMS - Continued

Functional Capacity Units (FCUs)
A quantitative environmental assessment value considered the biological currency in HGM. Functional Capacity Units are calculated by multiplying the area of available wetland (quantity) by the quality of the wetland based on functionality. Quality is determined by measuring limiting factors describing wetland function, and is represented by values derived from Functional Capacity Indices (FCIs).

FCU = AREA X FCI.
Changes in FCUs represent potential impacts or improvements of proposed actions.

Future Factor (FF)
A unit of quality change, used to define the anticipated changes in mean field data, by target year, on a variable-percover type basis, rather than on a species-by-species basis. FF values are multiplicative factors (1.0, 1.5, 0.5, etc.), directly multiplied against the mean baseline condition, to allow project managers an opportunity to forecast changes over time on the site or project. For example, if the project manager anticipates a 50 percent increase in height of grass in the grassland cover type between TY_0 and TY_1, the baseline FF = 1.0, and the increase is an additional FF = 0.5, thus the overall FF = 1.0 + 0.5 = 1.5. In most instances, FFs less than 1.0 represent decreases in quality at the site, and FFs greater than 1.0 represent increases in quality at the site. Of course, this change is dependent upon the relationship between the species, the function, the cover type or PWAA, and the suitability index/functional capacity index for the model.

Guild
A group of functionally similar species with comparable habitat requirements whose members interact strongly with one another, but weakly with the remainder of the community. Often a species HSI model is selected to represent changes (impacts) to a guild.

Habitat Suitability Index Model (HSI)
In HEP, an HSI Model is a quantitative estimate of habitat conditions for an evaluation species or community. The ideal goal of an HSI model is to quantify and produce an index that reflects carrying capacity at the site. The results of an HIS analysis can be quantified on the basis of a standard 0-1.0 scale, where 0.00 represents low quality habitat for the species/community and 1.0 represents high quality habitat for the species/community. An HSI model can be defined in words, or mathematical equations that clearly describe the rules and assumptions necessary to combine suitability indices in a meaningful manner for the species.

For example:
$HSI = (SI\ V_1 * SI\ V_2) / 4$, where:

$SI\ V_1$ is the SI for variable 1;
$SI\ V_2$ is the SI for variable 2

14.1 TERMS - Continued

Habitat Units (HUs)
A quantitative environmental assessment value, considered the biological currency in HEP. Habitat Units are calculated by multiplying the area of available habitat (quantity) by the quality of the habitat for each species or community. Quality is determined by measuring limiting factors for the species (or community), and is represented by values derived from Habitat Suitability Indices (HSIs).

HU = AREA X HSI.
Changes in HUs represent potential impacts or improvements of proposed actions.

Increment In cost analyses
This term represents the change in cost divided, by the change in outputs between those solutions that survive the cost effectiveness filtration of alternatives. An increment then, is used to answer the question: "Is it worth it to take the next leap in cost?" Increments are displayed in bar charts and tabular reports.

Incremental Cost Analysis (ICA)
An economic analysis is completed to reveal and interpret changes in costs for increasing levels of outputs (e.g., AAHUs from HEP or AAFCUs from HGM). The results of an incremental cost analysis are often displayed in bar charts and tables.

Independent Alternatives
These alternatives can be implemented alone or in concert with their dependent alternatives.

Ineffective Alternatives
When comparing alternatives, these alternatives produce reduced levels of output (AAHUs from HEP or AAFCUs from HGM) for the same or greater costs.

Inefficient Alternatives
When comparing alternatives, these alternatives produced similar levels of output (AAHUs from HEP or AAFCUs from HGM) at a greater expense.

Life Requisite Suitability Index (LRSI)
In HEP, an LRSI is a mathematical equation that reflects a species' or community's sensitivity to a change in a limiting life requisite component within the habitat type. In HEP, LRSIs are depicted using scatter plots and bar charts (i.e., life requisite suitability curves). The LRSI value (Y axis) ranges on a scale from 0.0 to 1.0, where an LRSI = 0.0 means the factor is extremely limiting and an LRSI = 1.0 means the factor is in abundance (not limiting) in most instances.

Limiting Factor
A variable whose presence/absence directly restrains the existence of a species or community in a habitat. A deficiency of the limiting factor can reduce the quality of the habitat for the species or community, while an abundance of the limiting factor can indicate an optimum quality of habitat for the same species or community.

14.1 TERMS - Continued

Limits
See "Delimiting Situations."

Measure
The act of physically sampling variables such as height, distance, percent, etc., and the methodology followed to gather variable information (i.e., see "Method" below). In some economic terms, a "measure" is considered a hierarchy of alternatives that can be subdivided further into scales or increments.

Method
In HEP or HGM applications, this is the mode/protocol followed to collect and gather field data. It is important to document the relevant criteria limiting the collection methodology. For example, the time of data collection, the type of techniques used, and the details of gathering this data should be documented as much as possible. An example of a method would be:

Between March and April, run five random 50-m transects through the relevant cover types. Every 10-m along the transect, place a 10-m2 quadrat on the right side of the transect tape and record the percent herbaceous cover within the quadrat. Average the results per transect.

Multiple Formula Model (aka: Life Requisite Model)
In HEP, there are two types of HSI Models, the Single Formula Model (refer to the definition below) and the Multiple Formula Model. In this case a multiple formula model is, as one would expect, a model that uses more than one formula to assess the suitability of the habitat for a species or a community. If a species/community is limited by the existence of more than one life requisite (food, cover, water, etc.), and the quality of the site is dependent on a minimal level of each life requisite, then the model is considered a Life Requisite Model. In order to calculate the HSI for any Life Requisite Model, one must derive the value of a Life Requisite Suitability Index (see definition below) for each life requisite in the model – a process requiring the user to calculate multiple LRSI formulas. This multi-formula processing has led to the name "Multiple Formula Model" in HEP.

Non-Additive Situations
These situations occur when the combination of alternatives results in non-cumulative outputs or costs. Often this condition arises when environmental, economic and/or management factors contradict summative outcomes. For example, if the implementation of two separate alternatives can save on mobilization and demobilization costs, the project manager can reduce the overall combined cost to reflect this savings. The solution is considered "non-additive." This information is included in the cost analyses.

14.1 TERMS - Continued

Non-Combinable Situations
These situations occur when mutually exclusive alternatives exist in the project. Often this condition arises when environmental, economic and/or management factors contradict combinable outcomes. For example, the alternative "construction of a new highway through the Florida Everglades" will conflict with the alternative "preservation and enhancement of the existing wetlands, precluding any development." If the only alternatives are to provide protection to the wetlands, or build the highway, these two alternatives are deemed "non-combinable" on the basis of environmental incompatibility. This information is included in the cost analysis evaluations.

Partial Wetland Assessment Area (PWAA)
A homogenous zone of similar vegetative species, geographic similarities and physical conditions that make the area unique. In general, PWAAs are defined on the basis of species recognition and dependence, soils types and topography.

Plans of Interest
These situations occur when an outside qualitative factor directly influences the decision to implement an alternative, regardless of its environmental productivity or cost effectiveness. Several factors (i.e., political importance, aesthetic implications, environmental significance, community support, etc.) can compel decision-makers to evaluate alternatives that would have been eliminated under normal situations because of their ineffectiveness. For example, a "green belt" solution replacing a concrete channel through a business district might not be cost effective, or environmentally productive, but the co-sponsor (i.e., the local business associatio n) can insist this alternative be evaluated as part of the project. This alternative is now considered a "Plan of Interest" alternative in cost analyses.

Predevelopment
Referring to an area's physical and cultural conditions that existed prior to European settlement.

Project Area
The geographical area of focus for a study, delimited by boundaries. Synonymous with study area or reevaluation area.

Project Manager
Any biologist, economist, hydrologist, engineer, decision maker, resource project manager, planner, environmental resource specialist, limnologist, etc., who is responsible for managing a study, program, or facility.

Relative Value Index
A value that is used to adjust AAHUs/AAFCUs to accommodate social, economic, ecological and political considerations? Judging criteria for relative values are defined by the decision-making team. Relative weights are calculated for each criterion, and then each evaluation model is rated against each criterion.

14.1 TERMS - Continued

RVI = relative weight * value assigned to each evaluation model.

Relative Area
In HEP and HGM, the relative area is a mathematical process used to "weight" the various applicable cover types on the basis of quantity. To derive the relative area of a model's cover type, the following equa tion can be utilized:

$$\text{Relative Area} = \frac{\text{Cover Type Area}}{\text{Total Area}}$$

where:
Cover Type Area = only those acres assigned to the cover type (or PWAA) of interest

Total Area = the sum of the acres utilized in the model.

Scale
(1) In some geographical methodologies, the scale is the defined size of the image in terms of miles per inch, feet per inch, or pixels per acres; (2) scale can also refer to variations of the alternative in some cost analysis software packages.

Single Formula Model
In HEP, there are two types of HSI Models, the Single Formula Model and the Multiple Formula Model (refer to the definition above). In this instance, an HSI model (or an FCI model in HGM) is based on the existence of a single life requisite requirement (or single wetland function requirement in HGM), and a single formula is used to depict the relationship between quality and carrying capacity (or functional capacity in HGM) for the site.

Site
The location upon which the project manager will take action, evaluate alternatives and focus cost analysis.

Solutions
In cost analysis, this is the alternative (see definition above.) Spreadsheet A type of computer file or page that allows the organization of data (alpha-numeric information) in a tabular format. Spreadsheets are often used to complete accounting/economic exercises.

Study Area
The geographical area of focus for a study, delimited by boundaries. Synonymous with project area or reevaluation area

14.1 TERMS - Continued

Suitability Index (SI)
In HEP, an SI is a mathematical equation that reflects a species' or community's sensitivity to a change in a limiting factor (i.e., variable) within the habitat type. In HEP, SIs are depicted using scatter plots and bar charts (i.e., suitability curves). The SI value (Y-axis) ranges on a scale from 0.0 to 1.0, where an SI = 0.0 means the factor is extremely limiting, and an SI = 1.0 means the factor is in abundance (not limiting) for the species/community (in most instances).

Target Year (TY)
A unit of time measurement used in HEP, that allows the project manager to anticipate and direct significant changes (in area or quality) within the project (or site). As a rule, the baseline TY is always TY = 0, where the baseline year is defined as a point in time before proposed changes would be implemented. As a second rule, there must always be a TY = 1, and a TY = X_2. TY_1 is the first year land- and water- use conditions are expected to deviate from baseline conditions. TY_{X2} designates the ending target year. A new target year must be assigned for each year the project manager intends to develop or evaluate change within the site or project. The habitat conditions (quality and quantity) described for each TY are the expected conditions at the end of that year. It is important to maintain the same target years in both the environmental and economic analyses.

Trade-offs
Are used to adjust the AAHUs/AAFCUs by considering human values. There are no right or proper answers, only acceptable ones. If trade-offs are used, outputs are no longer directly related to optimum habitat.

Variable
A measurable parameter that can be quantitatively described, with some degree of repeatability, using standard field sampling and mapping techniques. Often, the variable is a limiting factor for a species (or community), used in the development of SI curves and measured in the field (or from aerial photos) by personnel, to fulfill the requirements of field data collection in a HEP or HGM application. Some examples of variables include: height of grass, percent canopy cover, distance to water, number of snags in 0.4 hectare or average annual water temperature.

Variable Subindex (VSI)
In HGM, a VSI is a mathematical equation that reflects a wetland function's sensitivity to a change in a limiting factor (i.e., variable) within the PWAA. In HGM, VSIs are depicted using scatter plots and bar charts (i.e., functional capacity curves). The VSI value (Y-axis) ranges on a scale from 0.0 to 1.0, where a VSI = 0.0 represents a variable that is extremely limiting and a VSI = 1.0 represents a variable in abundance (not limiting) for the wetland.

14.1 TERMS - Continued

With Project
Condition Also referred to as the alternative, this is the condition of the site after an alternative is implemented.

Without Project Condition
Sometimes referred to as the Baseline condition, or the Existing condition, this is the expected condition of the site without implementation of an alternative; referred to as the "No Action" condition in planning studies. The habitat conditions at TY 0 always refer to the pre-existing conditions.

14.2 ACRONYMS

AAFCU	Average Annual Functional Capacity Unit
AAHU	Average Annual Habitat Unit
Ac-Ft.	Acre Feet
ASA	Assistant Secretary of the Army (Civil Works)
B. P.	Before Present
CAR	Coordination Act Report
CEA	Cost Effectiveness Analysis
CFS	Cubic Feet per Second
CH	High Plasticity Clay
CL	Low Plasticity Clay
COE	Corps of Engineers
CT HIS	Cover Type Habitat Suitability Index
CU. YDS.	Cubic Yards
District	U. S. Army Corps of Engineers, St. Louis District
EL	U. S. Army Engineer Research and Development Center, Environmental Laboratory
EPA	Environmental Protection Agency
EQ	Environmental Quality
ESL-ER	East St. Louis and Vicinity, Illinois (Ecosystem Restoration and Flood Damage Reduction Project)
EXHEP	Expert Habitat Evaluation Procedures
EXHGM	Expert HydroGeoMorphic Approach to Wetland Assessments

14.2 ACRONYMS - Continued

FCI	Functional Capacity Index
FCU	Functional Capacity Unit
FEMA	U. S. Federal Emergency Management Agency
FEMA	Federal Emergency Management Agency
FWCAR	Fish and Wildlife Coordination Act Report
HEC	Hydrological Engineering Center
HEC-FDA	Hydrological Engineering Center-Flood Damage Reduction Analysis
HEC-RAS	Hydrological Engineering Center-River Analysis System
HEP	Habitat Evaluation Procedures
HGM	HydroGeoMorphic Assessment of Wetland Functions
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HSI	Habitat Suitability Index
HTRW	Hazardous, Toxic, and Radioactive Waste
HU	Habitat Unit
ICA	Incremental Cost Analysis
IDNR	Illinois Department of Natural Resources
IDOT	Illinois Department of Transportation
IEPA	Illinois Environmental Protection Agency
ILCD	Illinois Land Cover Database
INAI	Illinois Natural Areas Inventory
IWI	Illinois Wetland Inventory

14.2 ACRONYMS - Continued

MESD	Metro East Sanitary District
mm	Millimeter
MVD	Mississippi Valley Division
NEPA	National Environmental Policy Act
NEWFCORR	New forested corridor
NGVD	National Geodetic Vertical Datum
NLCD	National Land Cover Database
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
OM&R	Operation, Maintenance, and Repair
PCA	Project Cooperation Agreement
PED	Planning, Engineering, and Design
EIS	Environmental Impact Statement
PL	Public Law
PWAA	Partial Wetland Assessment Area
RA	Relative Area
ROW	Right-of-Way
RR	Railroad
RVI	Relative Value Index
SHPO	State Historic Preservation Office
SHPO	State Historic Preservation Officer
SI	Suitability Index

SLD	St. Louis District

14.2 ACRONYMS - Continued

TM	Trematic Mapper
TY	Target Year
USACE	U. S. Army Corps of Engineers
USFWS	U. S. Fish and Wildlife Service
USGS	U. S. Geological Survey
VSI	Variable Subindex
WHAG	Wildlife Habitat Appraisal Guide

SECTION 15 - BIBLIOGRAPHY

Adams, L.W. 1983. Urban Wetlands for Stormwater Control and Wildlife Enhancement: Analysis and Evaluation. Columbia, MD. Urban Wildlife Research Center.

Ainslie, W.B., R.D. Smith, B.A. Pruitt, T.H. Roberts, E.J. Sparks, L. West, G.L. Godshalk, and M. V. Miller. 1999. A regional guidebook for assessing the functions of low gradient, riverine wetlands in western Kentucky. Technical Report WRP-DE-17, U.S. Army Engineer District, Vicksburg, Mississippi.

Bailey, R.M., and B. Cross. 1954. River sturgeons of the American genus *Scaphirhynchus*: characters, distribution and synonymy. Paper Michigan Academy of Science, Art, and Letters. 39:169-208.

Bennett, G.W. 1971. Management of Lakes and Ponds (2nd ed.). Reprinted 1983 by Krieger Publishing Company, Malabar, Florida.

Bergstrom, R. E., and T. R. Walker. Groundwater Geology Of The East St. Louis Area, Illinois. Illinois State Geological Survey, Report of Investigation 191, 1956.

Bramblett, R.G. 1996. Habitat and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers, Montana and North Dakota. Ph.D. Dissertation. Montana State University, Bozeman. 210pp.

Bratton, K. M. "Preliminary Investigation of Wisconsinan (Pleistocene) Deposits in Madison and St. Clair Counties' Illinois." Unpublished research paper, Earth Science Department, Southern Illinois University, Edwardsville, 1971.

Brinson, M. 1993. A hydrogeomorphic classification for wetlands. Technical Report WRP-DE-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Brinson, M, F.R. Hauer, L.C. Lee, W.L. Nutter, R.D. Rheinhardt, R.D. Smith, and D. Whigham. 1995. A guidebook for application of hydrogeomorphic assessments to riverine wetlands. Technical Report WRP-DE-11, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Bruin, Jack, and H. F. Smith. Preliminary Investigation Of Groundwater Resources In The American Bottom In Madison And St. Clair Counties, Illinois. Illinois State Water Survey, Report of Investigation 17, 1953.

Burbrink, F.T., C.A. Phillips, and E.J. Heske. 1998. A riparian zone in southern Illinois as a potential dispersal corridor for reptiles and amphibians. Biological Conservation 86:107-115.

Bibliography – Continued

Center for Disease Control. National Center for Infectious Diseases. Division of Vector-Borne Infectious Diseases web page. Available at http://www.cdc.gov/ncidod/dvbid/westnile/index.htm.

Constant, G.C., W.E. Kelso, D.A. Rutherford, and C.F. Bryan. 1997. Habitat, movement and reproductive status of pallid sturgeon (*Scaphirhynchus albus*) in the Mississippi and Atchafalaya Rivers. Report prepared for the U.S. Army Corps of Engineers, New Orleans District, New Orleans, Louisiana.

Cowardin, L.M., V. Carter, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. FWS/OBS-79/31, 131 pp. Available at http://wetlands.fws.gov/Pubs_Reports/Class_Manual/class_titlepg.htm.

Cox, G. 1993. Conservation ecology: biosphere and biosurvival. Wm. C. Brown Publishers, Dubuque, Iowa. xvi + 352 pp.

Daily, G., S. Alexander, P. Ehrlich, L. Goulder, J. Lubchenco, P. Matson, H. Mooney, S. Postel, S. Schneider, D. Timan, and G. Woodwell. 1997. Ecosystem services: benefits supplied to human societies by natural ecosystems. Issues in Ecology, number 2, spring 1997. Published by the Ecological Society of America.

De Szalay, F., D. Helmers, D. Humburg, S.J. Lewis, B. Pardo, and M. Shieldcastle. 2000. Upper Mississippi Valley/Great Lakes regional shorebird conservation plan, version 1.0. Dated May 2000 (revised June 26, 2003). Prepared for the U.S. Shorebird Conservation Plan, Manomet, Massachusetts. Available at http://shorebirdplan.fws.gov/RegionalShorebird/RegionalPlans.htm.

East Side Health District (ESHD). 2001. Planning aid letter dated July 12, 2001 for the East St. Louis Interior Flood Control Study. Administrative Offices, East St. Louis, IL.

Ekblaw, G. E., L. Horberg, and M. M. Leighton. "Physiographic Divisions of Illinois." Journal of Geology, Vol. 56, 1948.

Engelmann, G. 1868. The variations in the stage of the Mississippi River at St. Louis. Transactions of the St. Louis Academy of Science 2:297-298, 419-423. Not seen, from White, J. 2000. Volume 5: early accounts of the ecology of the Big Rivers Area. Big Rivers Area assessment. Illinois Department of Natural Resources, Springfield. xiv + 453 pp.)

Environmental Science & Engineering, Inc. (ESE). 1990. Horseshoe Lake biological assessment, prepared for National Steel Corporation. December 1990. ESE No. 590-1127-0400, St. Louis, Missouri.

Bibliography – Continued

Fischer, R.A. 2000. Width of riparian zones for birds. EMRRP Technical Notes Collection (TN EMRRP-SI-09), U.S. Army Engineer Research and Development Center, Vickburg, MS. Available at http://www.wes.army.mil/el/emrrp/tnotes.html.

Fitzgerald, J.A., J.R. Herkert, and J.D. Brawn. 2000. Bird conservation plan for the Prairie Peninsula (Physiographic Area 31), version 1.0 (February 4, 2000). Partners in Flight. Available at http://www.blm.gov/wildlife/pl_31sum.htm.

Frye, J. C., H. D. Glass, and H. B. Willman. Stratigraphy and Mineralogy of the Wisconsinan Loesses of Illinois. Illinois State Geological Survey, Circular No. 334, 1962.

Gabel, J. D. And D. H. Les. 2001. *Neobeckia aquatica* (North American lake cress) conservation and research plan. New England Plant Conservation Program, Framingham, Massachusetts. Available at http://www.newfs.org/pdf/Neobeckiaaquatica.pdf.

Garner, J.D. and J.E. Gardner. 1992. Determination of summer distribution and habitat utilization of the Indiana bat (*Myotis sodalis*) in Illinois. Final Report: Project E-3. Endangered Species Act Section 6 Report. Illinois Department of Conservation.

Grimley, D. A. Quaternary Geology Of The St. Louis Metro East Area, 63rd Annual Tri-State Field Conference, sponsored by the Illinois State Geological Survey, ISGS Guidebook 32, 2000.

Gutreuter, S. and C. Theiling. 1999. Fishes. *In* Ecological status and trends of the Upper Mississippi River System 1998: a report of the long term resource monitoring program. LTRMP 99-T001. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. 236 pp.

Helm, E. 1905. The levee and drainage problem of the American Bottoms. Journal of the Association of Engineering Societies 35(3):91-116.

Herkert, J. R., editor. 1991. Endangered and threatened species of Illinois: status and distribution, volume 1 - plants. Illinois Endangered Species Protection Board, Springfield, Illinois, 158 pp.

Herkert, J.R. 1992. Endangered and Threatened Species of Illinois: Status and Distribution. Volume 2: Animals. Illinois Endangered Species Protection Board. Springfield, Illinois, 142 pp.

Herkert, J.R., R.E. Szafoni, V.M. Kleen, and J.E. Schwegman. Habitat establishment, enhancement and management for forest and grassland birds in Illinois. Natural Heritage Technical Publication #1, Division of Natural Heritage, Illinois Department of Conservation, Springfield. Available at http://www.npwrc.usgs.gov/resource/othrdata/manbook/MANBOOK.HTM.

Bibliography – Continued

History of St. Clair County, Illinois. Philadelphia: Brink, McDonough and Company, 1881.

Hoffmeister, D. Mammals of Illinois. University of Illinois Press, Urbana and Chicago. 348 pp.

Hofmann, J. 1996. Indiana bats in Illinois. INHS Reports March-April 1996. Illinois Natural History Survey, Champaign. Available at http://www.inhs.uiuc.edu/chf/pub/surveyreports/mar-apr96/bats.html.

Horseradish Information Council. 2002. Horseradish, the secret ingredient. Available at http://www.horseradish.org/homepage.html.

Hurst, R. E. and L. D. Boughton. 1971. *Subsidence Control – Backfilling of Water-Filled Mines*, American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., Meeting Preprint EQC 34.

Illinois Department of Energy and Natural Resources (IDENR). 1994a. The Changing Illinois Environment: Critical Trends. Volume 3, ecological resources. Illinois Department of Energy and Natural Resources, Illinois Natural History Survey Division, Champaign. ILENR/RE-EA-94/05.

Illinois Department of Energy and Natural Resources and The Nature of Illinois Foundation (IDENR/NIF). 1994b. The Changing Illinois Environment: Critical Trends. Summary Report. Illinois Department of Energy and Natural Resources, Springfield. ILENR/RE-EA-94/05.

Illinois Department of Natural Resources (IDNR). 1996a. Illinois Land Cover, An Atlas. Illinois Department of Natural Resources, Springfield, Illinois. IDNR/EEA-96-05.

Illinois Department of Natural Resources (IDNR). 1996b. Critical Trends Assessment Project, Phase II, Illinois Land Cover Database: Land Cover Database by Categories. Available at http://dnr.state.il.us/orep/ctap/MAP/category.htm.

Illinois Department of Natural Resources (IDNR). 1998a. Appendix 1 - Incomplete list of vascular plants known from the Sinkhole Plain Assessment Area, with notes on their habitat associations. Pages 151-177 *in:* Sinkhole Plain Area Assessment, Volume 3: Living Resources. Illinois Department of Natural Resources, Springfield, Illinois.

Illinois Department of Natural Resources (IDNR). 1998b. Birds. Pages 67-104 *in:* Sinkhole Plain Area Assessment, Volume 3: Living Resources. Illinois Department of Natural Resources, Springfield, Illinois.

Bibliography – Continued

Illinois Department of Natural Resources (IDNR). 1998c. Introduction. Pages 1-25 *in*: Illinois Department of Natural Resources. Sinkhole Plain area assessment, volume 3: living resources. Illinois Department of Natural Resources, Springfield.

Illinois Department of Natural Resources (IDNR). 1998d. Mammals. Pages 95-104 *in*: Illinois Department of Natural Resources. Sinkhole Plain area assessment, volume 3: living resources. Illinois Department of Natural Resources, Springfield.

Illinois Department of Natural Resources (IDNR). 1998e. Natural vegetation communities. Pages 27-65 *in*: Illinois Department of Natural Resources. Sinkhole Plain area assessment, volume 3: living resources. Illinois Department of Natural Resources, Springfield.

Illinois Department of Natural Resources (IDNR). 1998f. Amphibians and reptiles. Pages 105-112 *in:* Sinkhole Plain Area Assessment, Volume 3: Living Resources. Illinois Department of Natural Resources, Springfield, Illinois.

Illinois Department of Natural Resources (IDNR). 1998g. Aquatic biota. Pages 113-138 *in:* Sinkhole Plain Area Assessment, Volume 3: Living Resources. Illinois Department of Natural Resources, Springfield, Illinois.

Illinois Department of Natural Resources (IDNR). 2000. Volume 5, Early Accounts of the ecology of the Big Rivers Area, Big Rivers Area Assessment. Illinois Department of Natural Resources, Springfield, Illinois.

Illinois Department of Natural Resources (IDNR). Undated. Illinois Natural Areas Inventory site form for Levee Lake. Illinois Department of Natural Resources, Springfield, Illinois.

Illinois Department of Public Health (IDPH). 2002. Healthbeat – mosquitos. Available at http://www.idph.state.il.us/public/hb/hbmosquito.htm.

Illinois Environmental Protection Agency (IEPA). 1989. An intensive survey of the American Bottoms basin 1984. IEPA/WPC/89-211. December 1989. Illinois Environmental Protection Agency, Division of Water Pollution Control, Springfield.

Illinois Environmental Protection Agency (IEPA). 2000. An intensive survey of the Mississippi South Central Basin: data summary, summer 1998. IEPA/BOW/00-002. Draft, October 2000. Illinois Environmental Protection Agency, Bureau of Water, Springfield.

Illinois Environmental Protection Agency (IEPA). Undated *a*. Horseshoe Lake, Madison County: 1996 ALMP data results. Southern Monitoring Unit, Marion, Illinois. 4 pp.

Bibliography – Continued

Illinois Environmental Protection Agency (IEPA). Undated *b*. Frank Holten #1 Lake, St. Clair County: 1996 ALMP data results. Southern Monitoring Unit, Marion, Illinois. 4 pp.

Illinois Environmental Protection Agency (IEPA). Undated *c*. Frank Holten #2 Lake, St. Clair County: 1996 ALMP data results. Southern Monitoring Unit, Marion, Illinois. 4 pp.

Illinois Environmental Protection Agency (IEPA). Undated *d*. Frank Holten #3 Lake, St. Clair County: 1996 ALMP data results. Southern Monitoring Unit, Marion, Illinois. 4 pp.

Illinois Natural History Survey (INHS). 1998. Draft map of presettlement land cover of American Bottom and adjacent areas. John Nelson and Kathleen McKeever, Great Rivers Field Station, LTRMP Reach 26, Alton, Illinois.

Illinois Natural History Survey. 2001. Fishes of Illinois. Dated 12/31/2001, available at http://www.inhs.uiuc.edu/cbd/ilspecies/fishsplist.html.

Illinois Natural Resources Geospatial Data Clearinghouse (INRGDC). Undated. Illinois DOQ project. Illinois State Geological Survey. Available at http://www.isgs.uiuc.edu/nsdihome/webdocs/doqs/.

Illinois Natural Resources Information Network (INRIN). 2001. Illinois Birds, presented by Illinois Natural History Survey and Illinois Department of Natural Resources. Available at http://www.inhs.uiuc.edu/chf/pub/ifwis/birds/.

Illinois Plant Information Network (ILPIN). 2002. Taxonomic, biologic, geographic, and ecologic information on 3209 Illinois vascular plant taxa. Dated January 23, 2002, available at http://www.fs.fed.us/ne/delaware/ilpin/ilpin.html.

International Birding Information Resource Data (IBIRD). 2000. i-bird.com: guide to uncommon, common and abundant birds in over 350 sites in the United States. Available at http://i-bird.com.

Iverson, L.R., D. Ketzner, and J. Karnes. 1999. Illinois Plant Information Network. Illinois Natural History Survey and USDA Forest Service. Undated, available at http://www.fs.fed.us/ne/delaware/ilpin/ilpin.html.

Kallemeyn, L. 1983. Status of the pallid sturgeon *Scaphirhynchus albus*. Fisheries 8(1):3-9.

Bibliography – Continued

Keenlyne, K.D. and L.G. Jenkins. 1993. Age at sexual maturity of the pallid sturgeon. Transactions of the American Fisheries Society, 122:393-396.

Klimas, C. V. 1988. River regulation effects on floodplain hydrology and ecology. Pp. 40-49 In: D. D. Hook, et al. The Ecology and Management of Wetlands, Volume I: Ecology of Wetlands. Timber Press, Portland, Oregon.

Kulfinski, F.B., and D.G. Myer. 1981. Section XII, Biological Elements – Pestiferous Plants and Animals. Pages XII-1 – XII-8 *in:* Environmental Inventory Report (Volume 3 of 6), East St. Louis & Vicinity, Illinois, Cahokia Canal Drainage Area, Madison and St. Clair Counties, Illinois. St. Louis District, U.S. Army Corps of Engineers, St. Louis, Missouri.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl (Kushlan et al.). 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, version I. Waterbird Conservation for the Americas, Washington, D.C., U.S.A., 78 pp.

Lee, D.S. 1980. *Scaphirhynchus platorynchus* (Rafinesque), shovelnose sturgeon. Pp. 44, in Atlas of North American Freshwater Fishes, D.S. Lee, C.R.Gilbert, C.H. Hocutt, R.E. Jenkins, D.E. McAllister, and J.R. Stauffer (eds.). Publication #1980-12, North Carolina Biological Survey. 854 pp.

Lutzen, E. E. and P. B. DuMontelle. "Guidebook to Engineering Geological Features and Lane Use Relationships in the St. Louis Metropolitan Area." Edwardsville: Southern Illinois University, 1970

McClain, William E. 1997. Prairie establishment and landscaping. Division of Natural Heritage, Illinois Department of Natural Resources, Springfield, Illinois.

McClean, J. 1995. Mosquitos in Constructed Wetlands-A Management Bugaboo? Watershed Protection Techniques 1(4):203-207.

McMullen, K. 2001. Personal communication on July 3, 2001, with Keith McMullen, Regulatory Branch, St. Louis District, U.S. Army Corps of Engineers.

Middleton, B. 1998. Wetland restoration, flood pulsing, and disturbance dynamics. John Wiley & Sons, Inc., New York. xi + 388 pp.

Missouri Department of Conservation (MDOC). 2001. Best management practices for individual endangered species. Dated Apr. 12, 2001, available at http://www.conservation.state.mo.us/nathis/endangered/bmp.htm

Bibliography – Continued

Mitsch, W.J., and J.G. Gosselink. 1993. Wetlands. Second edition. Van Nostrand Reinhold, New York. xiii + 722 pp.

Mohlenbrock, R. H. 1975. Guide to the vascular flora of Illinois. Southern Illinois University Press, Carbondale and Edwardsville. ix + 494 pp.

National Research Council. 1976. Pest control: An assessment of present and alternative technologies, volume V. Pest Control and Public Health. National Academy of Sciences, pp 1-282.

Natural Resources Conservation Service (NRCS). 2000a. Madison County, Illinois, digital soil survey. Available at ftp://ftp.ftw.nrcs.usda.gov/pub/ssurgo/online98/data/il119/.

Natural Resources Conservation Service (NRCS). 2000b. St. Clair County, Illinois, digital soil survey. Available at ftp://ftp.ftw.nrcs.usda.gov/pub/ssurgo/online98/data/il163/.

Natural Resources Conservation Service (NRCS). 2002. Plants database. Available at http://plants.usda.gov/.

Nelson, J. 1998. Biologist with the Great Rivers Field Station, Alton, Illinois, Illinois Natural History Survey. Personal communication with Tim George, St. Louis District, dated March 19, 1998.

North American Bird Conservation Initiative (NABCI undated). Bird conservation regions: a framework for the conservation of North American birds. Available at http://www.bsc-eoc.org/international/bcrmain.html.

Norton, W.T. (editor). 1912. Centennial history of Madison County, Illinois, and its people. Lewis Publishing Company, Chicago. (Not seen, from White, J. 2000. Volume 5: early accounts of the ecology of the Big Rivers Area. Big Rivers Area assessment. Illinois Department of Natural Resources, Springfield. xiv + 453 pp.)

Odem, I. E. and W. E. Parham. 1968. *Petrography of Pennsylvanian Underclays in Illinois and Their Application in Some Mineral Industries*, Circular 429, Illinois State Geological Survey.

Page, L.M., K.S. Cummings, and C.A. Mayer. 1998. Aquatic Biota: Fishes. Pages 113-137 *in:* Sinkhole Plain Area Assessment, Volume 3: Living Resources. Illinois Department of Natural Resources, Springfield, Illinois.

Page, L.M., K.S. Cummings, C.A. Mayer, S.L. Post, and M.E. Retzer. 1992. Biologically significant Illinois streams: an evaluation of the streams of Illinois based on aquatic biodiversity. Illinois Natural History Survey Center for Biodiversity Technical Report 1992(1), Champaign.

Bibliography – Continued

Parker, R.B. 1973. Section XI, Terrestrial Vertebrates of the Harding Ditch Combined Area. Pages XI-1 - XI-22 *in:* Environmental Inventory Report (Part A), East St. Louis & Vicinity, Illinois, Harding Ditch Combined Area, St. Clair County, Illinois. St. Louis District, U.S. Army Corps of Engineers, St. Louis, Missouri.

Parker, R.B. 1974. Section X, Terrestrial Vertebrates of the Blue Waters Area. Pages X-1 - X-24 *in:* Environmental Inventory Report (Part A), East St. Louis & Vicinity, Illinois, Blue Waters Area, St. Clair County, Illinois. St. Louis District, U.S. Army Corps of Engineers, St. Louis, Missouri.

Parker, R.B. 1981. Section X, Biological Elements - Animals, General. Pages X-1 - X-25 *in:* Environmental Inventory Report (Volume 3 of 6), East St. Louis & Vicinity, Illinois, Cahokia Canal Drainage Area, Madison and St. Clair Counties, Illinois. St. Louis District, U.S. Army Corps of Engineers, St. Louis, Missouri.

Partners in Flight (PIP undated). Partners in Flight physiographic areas. Available at http://www.dodpif.org/site.htm.

Payne, N. 1941. *Structure of Herrin (No. 6) Coal Bed in Madison County and Western Bond, Western Clinton, Southern Macoupin, Southwestern Montgomery, Northern St. Clair, and Northwestern Washington Counties, Illinois,* Circular 71, Illinois State Geological Survey.

Pflieger, W.L. 1997. The Fishes of Missouri (revised edition). Missouri Department of Conservation, Jefferson City, Missouri. 372 pp.

Phillips, C.A., E.O. Moll, and R.A. Brandon. 1999. Field guide to amphibians and reptiles of Illinois. Illinois Natural History Survey Manual 8. 300 pp. Available at http://www.inhs.uiuc.edu/cbd/collections/AmphReptColln/herp_links/Field Guide/TOC.html.

Purdue University, Center for New Crops and Plants Products (Purdue). 2001. Crop INDEX, a list of scientific and common names of crops for information access. Available at http://www.hort.purdue.edu/newcrop/Indices/index_ab.html.

QST Environmental Inc. (QST). 1997. Horseshoe Lake biological 1997 assessment. November 7, 1997. St. Louis, Missouri.

Raman, R.K. 1992. Limnological characteristics of Horseshoe Lake and the impact of ground water discharges to the lake. *In:* Assessment of the proposed discharge of ground water to surface waters of the American Bottoms area of southwestern Illinois. Contract Report 539 prepared for the U.S. Army Corps of Engineers, St. Louis District, September 1992, by the Illinois State Water Survey, Hydrology and Chemistry Divisions, Champaign.

Bibliography – Continued

Raman, R.K. and W. C. Bogner. 1994. Frank Holten State Park lakes: phase III, post-restoration monitoring. Contract Report 564, prepared for the Illinois Environmental Protection Agency by the Illinois State Water Survey, Champaign.

Reavis 1876. Newspaper or journal account of 1863 riot in East St. Louis.

Reed, P. B., Jr. 1988. National list of plant species that occur in wetlands: North Central (Region 3). U.S. Fish and Wildlife Service Biological Report 88(26.3). 99 pp.

Rehfeldt, Kenneth R. Groundwater Sampling, Testing, Analyses, and Reporting for the American Bottoms Area of Southwestern Illinois. Illinois State Water Survey, Champaign, Illinois.

Reynolds, J. 1857. The agricultural resources of southern Illinois. Transactions of the Illinois State Agricultural Society 2:346-371. (Not seen, from White, J. 2000. Volume 5: early accounts of the ecology of the Big Rivers Area. Big Rivers Area assessment. Illinois Department of Natural Resources, Springfield. xiv + 453 pp.

Robinson, S.K., J.P. Hoover, and J.R. Herkert. 2000. Cowbird parasitism in a fragmented landscape: effects of tract size, habitat, and abundance of cowbirds and hosts. *In*: Ecology and management of cowbirds and their hosts. J.N.M. Smith, T.L. Cook, S.I. Rothstein, S.K. Robinson, and S.G. Sealy, eds. University of Texas Press.

Ross, H.H., and W.R. Horsfall. 1965. A Synopsis of the Mosquitoes of Illinois (Diptera, Culicidae). Illinois Natural History Survey, Biol. Notes No. 52, pp. 1-50.

Sandy, J. 1971.

Schicht, R. J. Groundwater Development In East St. Louis Area, Illinois. Illinois State Water Survey, Report of Investigation 51, 1965.

Schoen. 1972.

Schwegman, J.E. 1973. The Natural Divisions of Illinois. Part 2. Comprehensive Plan for the Illinois Nature Preserves System. Illinois Nature Preserves Commission, Rockford, Illinois. 32 pp.

Schwegman, J.E. and R.W. Nyboer. 1985. The taxonomic and population status of *Boltonia decurrens* (Torr. and Gray) Wood. *Castanea,* 50:112-115.

Sheehan, R.J., R.C. Heidinger, K.L. Hurley, P.S. Willis, and M.A. Schmidt. 1998. Middle Mississippi River pallid sturgeon habitat use project: Year 3 Annual Progress Report, December 1998. Fisheries Research Laboratory and Department of Zoology, Southern Illinois University at Carbondale, Carbondale, Illinois.

Bibliography – Continued

Shotola, S.J., G.T. Weaver, P.A. Robertson, and W.C. Ashby. 1992. Sugar maple invasion of an old-growth oak-hickory forest in southwestern Illinois. American Midland Naturalist 127(1):125-138.

Smith, M., T. Brandt, and J. Stone. 1995. Effect of soil texture and microtopography on germination and seedling growth in *Boltonia decurrens* (Asteraceae), a threatened floodplain species. *Wetlands Journal*, 15:392-396.

Smith, M., T. Keevin, P. Mettler-McClure, and R. Barkau. 1998. Effect of the flood of 1993 on *Boltonia decurrens*, a threatened plant species of the Illinois River floodplain. *Regulated Rivers: Research and Management*, 14: 191-202.

Smith, M., Y. Wu, and O. Green. 1993. Effect of light and water stress on photosynthesis and biomass production in *Boltonia decurrens*, a threatened species. *American Journal of Botany*, 80(8):859-864.

Smith, P.W. 1979. The Fishes of Illinois. University of Illinois Press, Urbana. xxix + 314 pp.

Snyder, S.A. 1994. Bluestem prairie. *In:* U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2001, July). Fire Effects Information System, available at http://www.fs.fed.us/database/feis/kuchlers/k074/index.html.

Suloway, L., and M. Hubbell. 1994. Wetland resources of Illinois: an analysis and atlas. Illinois Natural History Survey Special Publication 15, 88 pp.

Suloway, L., M. Joselyn, and P.W. Brown. 1996. Inventory of Resource Rich Areas in Illinois, An Evaluation of Ecological Resources. Critical Trends Assessment Project – Phase II. Illinois Department of Natural Resources, IDNR/EEA-96/08, Springfield.

Taft, J.B., G.S. Wilhelm, D.M. Ladd, and L.A. Masters. 1997. Floristic quality assessment for vegetation in Illinois, a method for assessing vegetation integrity. Erigenia 15:3-95.

Thomerson, J.E. 1973. Section XIII, Fish and Fisheries of the Harding Ditch Combined Area. Pages XIII-1 - XIII-26 *in:* Environmental Inventory Report (Part A), East St. Louis & Vicinity, Illinois, Harding Ditch Combined Area, St. Clair County, Illinois. St. Louis District, U.S. Army Corps of Engineers, St. Louis, Missouri.

Thomerson, J.E. 1974. Section XII, Fish and Fisheries in the Blue Waters Area. Pages XII-1 - XII-18 *in:* Environmental Inventory Report (Part A), East St. Louis & Vicinity, Illinois, Blue Waters Area, St. Clair County, Illinois. St. Louis District, U.S. Army Corps of Engineers, St. Louis, Missouri.

Bibliography – Continued

Thomerson, J.E. 1981. Section VIII, Biological Elements - Fish. Pages VIII-1 - VIII-16 *in:* Environmental Inventory Report (Volume 3 of 6), East St. Louis & Vicinity, Illinois, Cahokia Canal Drainage Area, Madison and St. Clair Counties, Illinois. St. Louis District, U.S. Army Corps of Engineers, St. Louis, Missouri.

U.S. Department of Transportation, Federal Highway Administration (USDOT). 2000. Draft environmental impact statement/section 4(f) evaluation, Federal aid primary 999, new Mississippi River crossing, relocated I-70 and I-64 connector, FHWA-IL-EIS-98-01-D/4(f). U.S. Department of Transportation, Federal Highway Administration, and Illinois and Missouri Departments of Transportation, April 2000.

U.S. Environmental Protection Agency (USEPA). 1996. Protecting natural wetlands, a guide to stormwater best management practices. EPA-843-B-96-001. Office of Water, Washington, D.C. Available at http://www.epa.gov/owow/wetlands/pdf/protecti.pdf.

U.S. Environmental Protection Agency (USEPA). 2000a. MRLC, Multi-Resolution Land Characteristics Consortium: NLCD Classification System. Dated 12 July 2001, available at http://landcover.usgs.gov/classes.html.

U.S. Environmental Protection Agency (USEPA). 2000b. National Land Cover Data, Illinois, version 05-20-00 (updated: December, 1998; June, 1999, May 2000). Available at http://landcover.usgs.gov/bin/mrlc_readme.cgi?file=/usr/local/ftp/pub/data/landcover/states/illinois_readme.txt.

U.S. Environmental Protection Agency (USEPA). 2001. National Land Cover Data availability. Dated (13 August 2001, available at http://landcover.usgs.gov/mrlcreg.html.

U.S. Environmental Protection Agency (USEPA). 2002a. CERCLIS Hazardous Waste Sites. Dated October 16, 2002, available at http://www.epa.gov/superfund/sites/cursites/index.htm.

U.S. Environmental Protection Agency (USEPA). 2002b. National priorities list (NPL). Dated October 4, 2002, available at http://www.epa.gov/superfund/sites/npl/index.htm.

U.S. Environmental Protection Agency (USEPA). 2002c. New proposed NPL sites. Dated October 4, 2002, available at http://www.epa.gov/superfund/sites/npl/newprop.tm.

U.S. Environmental Protection Agency (USEPA). 2002d. Archived sites. Web page dated October 17, 2002; http://www.epa.gov/superfund/sites/arcsites/index.htm [Accessed 25 October 2002].

U.S. Fish and Wildlife Service (USFWS). 1983. Northern States bald eagle recovery plan. U.S. Fish and Wildlife Service, Twin Cities, Minnesota, 76 pp.

Bibliography – Continued

U.S. Fish and Wildlife Service (USFWS). 1990. Decurrent false aster recovery plan. U.S. Fish and Wildlife Service, Twin Cities, Minnesota. 26 pp.

U.S. Fish and Wildlife Service (USFWS). 1993. Pallid sturgeon recovery plan. U.S. Fish and Wildlife Service, Bismarck, North Dakota. 55 pp.

U.S. Fish and Wildlife Service (USFWS). 1996. Technical draft, Indiana bat (*Myotis sodalis*) recovery plan. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

U.S. Fish and Wildlife Service (USFWS). 2001. Decurrent false aster recovery plan. U.S. Fish and Wildlife Service, Twin Cities, Minnesota.

U.S. Fish and Wildlife Service (USFWS). 2001. Letter dated ______, 2001. Marion Suboffice, Marion, Illinois.

U.S. Fish and Wildlife Service (USFWS). 2001. National wetlands inventory. Dated 16 August 2001, available at http://wetlands.fws.gov/.

U.S. Fish and Wildlife Service (USFWS). 2002. Birds of conservation concern 2002 (December 2002). U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. Available at http://migratorybirds.fws.gov/reports/BCC2002.pdf.

U.S. Fish and Wildlife Service (USFWS). 2002. Region 3 fish and wildlife resource conservation priorities, version 2.0 (January 2002). U.S. Fish and Wildlife Service, Twin Cities, Minnesota. Available at http://midwest.fws.gov/pdf/priority.pdf.

U.S. Fish and Wildlife Service (USFWS). 2003. North American Wetlands Conservation Act, United States standard grant, 2003 proposal instructions. Available at http://northamerican.fws.gov/NAWCA/2003ProposalInstructions.pdf.

University of Michigan Museum of Zoology (UMMZ). 2000. Animal Diversity Web. Available at http://animaldiversity.ummz.umich.edu/.

Wanless, H. R. Geology And Mineral Resources Of The Beardstown, Glasford, Havana, And Vermont Quadrangles. Illinois State Geological Survey, Bulletin 82, 1957.

White, J. 1978. Illinois natural areas inventory technical report. Volume 1, survey methods and results. Illinois Natural Areas Inventory, Urbana. 426 pp.

White, J. and M. H. Madany. 1978. Classification of natural communities in Illinois. Pages 310-405 (Appendix 30) *in*: White, J. Illinois Natural Areas Inventory Technical Report, volume 1. Survey methods and results. Illinois Natural Areas Inventory, Urbana.

Bibliography – Continued

White, P.S. and S.T.A. Pickett. 1985. Natural disturbance and patch dynamics: an introduction. Pages 3-13, in: Pickett, S.T.A. and P.S. White (eds.). The Ecology of Natural Disturbance and Patch Dynamics. Academic Press, San Diego, California.

Bibliography – Continued

White, W.P., S. Johannessen, P.G. Cross, and L.S. Kelly. 1984. Environmental Setting. Pages 15-33, in: Bareis, C.J. and J.W. Porter (eds.). American Bottom Archaeology, A Summary of the FAI-270 Project Contribution to the Culture History of the Mississippi River Valley. University of Illinois Press, Urbana. xviii + 286 pp.

Wilhelm, G. and L. Masters. 2000. Floristic quality assessment and computer applications, Michigan. Conservation Design Forum, Elmhurst, Illinois.

Wilhm, J.L. 1975. Biological indicators of pollution. In: B.S. Whitton, ed. River Ecology. University of California Press. Berkley, CA. Pp 375-402.

William 1975.

Willman, H. B., and J. C. Frye. Pleistocene Stratigraphy Of Illinois. Illinois State Geological Survey, Bulletin 94, 1970.

Wilson, D. E., and D. M. Reeder (eds). 1993. Mammal Species of the World. Smithsonian Institution Press, 1206 pp. [Available at http://www.nmnh.si.edu/msw/].

Woodward, C. M. A History of the St. Louis Bridge. 1880

Yarbrough, R. E. and R. Ciste. The Physical Regions of the American Bottoms. 1972

Zambrana Engineering, Inc (ZE). 1998. American Bottoms Interior Flood Control Project, Biological Analysis of Brushy Lake and Frank Holten State Park (November 16, 1998). Prepared for St. Louis District, U.S. Army Corps of Engineers.

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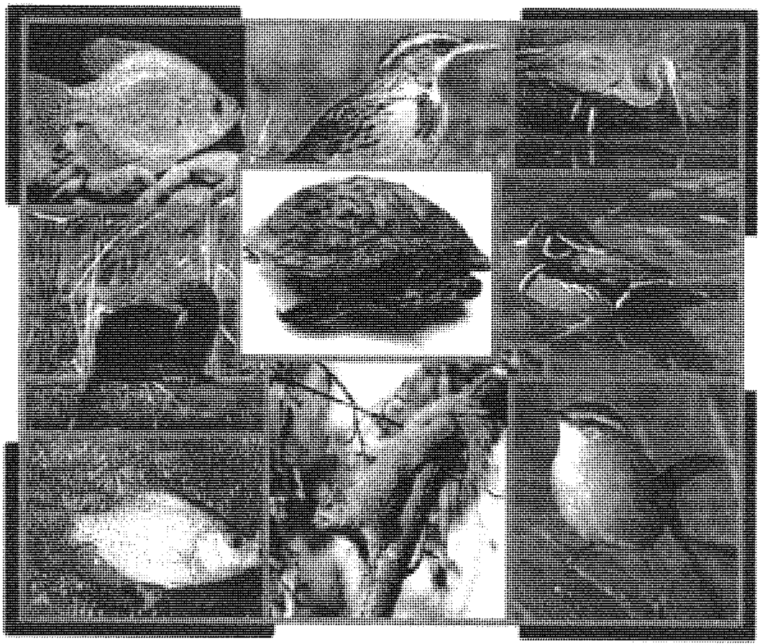

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US Army Corps of Engineers
St Louis District

November 2003

East St. Louis and Vicinity, Illinois
Ecosystem Restoration And Flood Damage Reduction Project

General Reevaluation Final Report with Integrated Environmental Impact Statement (EIS)

Lead Agency:

U.S. Army Corps of Engineers
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EAST ST. LOUIS AND VICINITY, ILLINOIS, ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION

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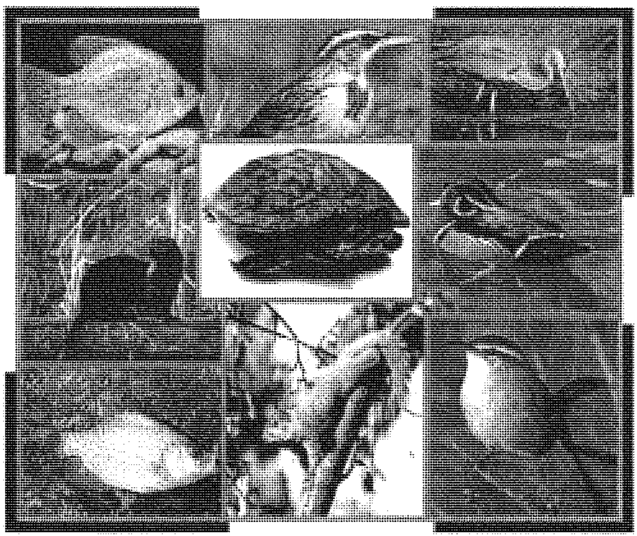

October 2003

PREPARED FOR THE U. S. ARMY ENGINEER DISTRICT ST. LOUIS
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PREFACE

The work described herein was conducted at the request of the U. S. Army Engineer District, St. Louis, Missouri. This report was prepared by Ms. Kelly A. Burks-Copes and Ms. Antisa C. Webb, U.S. Army Engineer Research and Development Center, Environmental Laboratory (EL), Vicksburg, Mississippi. At the time of this report, Ms. Burks-Copes and Ms. Webb were ecologists in the Ecological Resources Branch.

Many people contributed to the overall success of the habitat evaluation assessment conducted for this study. The authors wish to thank the following people for their hard work and persistence during the intensive months over which the project was assessed: Ms. Cydnie Rowe and Ms. Beattie Williams (Applied Research Associates, Inc.); Dr. L. Jean O'Neil, Ms. Cherry Cox, and Ms. Trish Richardson, (CEERD-EE-E); Mr. David Copes (CEERD-IM-C); Mr. Ben Webb (CEERD-GM-K); Ms. Benita Abraham (CEERD-GS-R), Ms. Rhonda DuBois (CEERD-EE-W), Ms. Virginia Dickerson (CEERD-EV-B); Ms. Shellie Wells and Ms. Leslie Madison (Will Staff, Inc.).

This report was prepared under the general supervision of Dr. David J. Tazik, Chief, Ecosystem Evaluation and Engineering Division. At the time of publication of this report, Dr. Edwin A. Theriot was Director of the Environmental Laboratory.

This report should be cited as follows:

Burks-Copes, K. A. and A. C. Webb. 2003. *Ecosystem Restoration Habitat Assessment for the Proposed East St. Louis and Vicinity, Illinois (Ecosystem Restoration and Flood Damage Reduction Project).* Draft Report. U. S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS. 506 pp. + appendices.

EXECUTIVE SUMMARY

The U. S. Army Engineer District, St. Louis Missouri (District) prepared a Programmatic Environmental Impact Statement (PEIS), as required under the tenets of the National Environmental Policy Act (NEPA), to evaluate the environmental benefits of proposed ecosystem restoration efforts in the East St. Louis area (Illinois). To determine ecosystem restoration benefits resulting from the proposed wetland design alternatives in the East St. Louis and Vicinity, Illinois (Ecosystem Restoration and Flood Damage Reduction Project) (ESL-ER), intensive Habitat Evaluation Procedures (HEP) assessments were completed. In three instances, an additional assessment [i.e., HydroGeoMorphic Wetland Assessment (HGM)] was completed to support the HEP findings. This project served as the first-ever planning study to integrate the use of HEP and HGM in an ecosystem context, demonstrating the effectiveness and power of these tools in the evaluation of ecosystem restoration success. The HEP and HGM assessments were designed to evaluate the future changes in quantity (acres) and quality (habitat suitability and functional capacity) of aquatic, wetland and terrestrial ecosystems. Outputs were calculated in terms of annualized changes anticipated over the life of the project [i.e., Average Annual Habitat Units (AAHUs) in the HEP analyses and Average Annual Functional Capacity Units (AAFCUs) in the HGM analyses]. Results were compared using standard U. S. Army Corps of Engineers (USACE) cost evaluation procedures. Early in the evaluation process, an interagency ecosystem assessment team was convened. Scientists from the U. S. Army Engineer Research and Development Center, Environmental Laboratory (EL) facilitated the efforts. Representatives from the District, USFWS, the Illinois Department of Natural Resources (IDNR), NRCS and EPA actively participated in the assessments. Both the HEP and HGM assessments in their entirety, in addition to the results of the cost analyses, are presented in the following chapters.

The Biological Team developed 256 alternatives for the study and selected 68 designs to intensively evaluate with HEP. Nine Habitat Suitability Index (HSI) models were deployed in the HEP assessments, and two Functional Capacity Index (FCI) models were used in the HGM assessments. The nine HSI models were developed by the USFWS, modified by the team, and used to evaluate the relationships among wetland-based species and communities in the East St. Louis ecosystem setting (i.e., the models included black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, white crappie and wood duck HSI models). Two FCI models were designed by EL focused on depressional wetlands (i.e., connected depression and isolated depression FCI models) within the East St. Louis study area. Together, the twelve models evaluated the restoration of 27 unique cover types across five watersheds (i.e., Cahokia, Harding, Powdermill, Long Lake and County Ditch).

In the Spring and Fall of 1999, the Team completed intensive baseline habitat sampling at 289 sites across the East St. Louis ecosystem. Seventy-one of these sites were considered "upland" sites, targeted as potential sediment detention basin locations above the floodplain. Two hundred and eighteen sites were located in the floodplain, and served

as potential wetland restoration sites. One hundred and sixty of these floodplain sites were used to develop baseline conditions in the HEP analysis. The remaining 112 sites were used to develop baseline conditions in the HGM analysis. Of the 112 HGM sites, 76 sites were located inside the boundaries of the ESL-ER study area, and the remaining 36 sites served as either additional sample sites or "reference standard sites" for the calibration of the FCI models. Eighty-four separate variables were assessed in an attempt to develop a description of the baseline (spring 1999) conditions at these sites (61 variables for the HEP assessment and 23 variables for the HGM assessment). Future alternative design outputs were projected as change from these baseline conditions over a 50-year project life in both the HEP and HGM assessments. EL facilitated a series of workshops, beginning in the fall of 1999 and continuing through the summer of 2003, in which the Ecosystem Assessment Team derived future projections for each upland and floodplain assessment site.

The results of the HEP and HGM analyses were compared using Cost Effectiveness (CEA) and Incremental Cost Analysis (ICA), and the top three biologically productive, cost-effective alternative designs were revealed. The results showed total net habitat gains ranging from -54 AAHUs (9D-1-(0) alternative at the Wedgewood site) to 3,105 AAHUs (1B-8-X alternative at the Spring Lake site). The District can expect to gain between 1,832-3,075 acres of habitat developed across the five watersheds - dependant upon the combination of proposed construction designs implemented.

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ACRONYMS

AAFCU	Average Annual Functional Capacity Unit
AAHU	Average Annual Habitat Unit
CAR	Coordination Act Report
CEA	Cost Effectiveness Analysis
CT HSI	Cover Type Habitat Suitability Index
District	U. S. Army Corps of Engineers, St. Louis District
EL	U. S. Army Engineer Research and Development Center, Environmental Laboratory
EMRRP	USACE's Ecosystem Management and Restoration Research Program
ESL-ER	East St. Louis and Vicinity, Illinois (Ecosystem Restoration and Flood Damage Reduction Project)
EPA	Environmental Protection Agency
EXHEP	EXpert Habitat Evaluation Procedures
EXHGM	EXpert HydroGeoMorphic Approach to Wetland Assessments
FCI	Functional Capacity Index
FCU	Functional Capacity Unit
FEMA	U. S. Federal Emergency Management Agency
HEP	Habitat Evaluation Procedures
HGM	HydroGeoMorphic Assessment of Wetlands
HSI	Habitat Suitability Index
HU	Habitat Unit
ICA	Incremental Cost Analysis
IDNR	Illinois Department of Natural Resources
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
PEIS	Programmatic Environmental Impact Statement
PWAA	Partial Wetland Assessment Area
QHEI	Qualitative Habitat Evaluation Index
RA	Relative Area
RVI	Relative Value Index
SHPO	State Historic Preservation Office
SI	Suitability Index
TY	Target Year
USACE	U. S. Army Corps of Engineers
USFWS	U. S. Fish and Wildlife Service
VSI	Variable Subindex
WHAG	Wildlife Habitat Appraisal Guide

I. INTRODUCTION

The U. S. Army Engineer District, St. Louis, St. Louis, Missouri (District), prepared a Programmatic Environmental Impact Statement (PEIS) in 2001, as required under the tenets of the National Environmental Policy Act (NEPA), to evaluate the environmental benefits of proposed ecosystem restoration efforts in the East St. Louis area U.S. Army Corps of Engineer (USACE) 2002. This effort involved, and will continue to involve, large-scale public communications and cooperation. In an effort to ensure comprehensive evaluations across the region, both the Environmental Protection Agency (USEPA) and the Natural Resources Conservation Service (NRCS) agreed to serve as cooperating agencies on the PEIS. Concurrently, the U. S. Fish and Wildlife Service, Marion, Illinois Suboffice (USFWS) prepared a Fish and Wildlife Coordination Act Report (CAR) under the National Transfer Fund agreement. In the future, as sites are re-evaluated and restoration alternatives are finalized, individual NEPA documents (Environmental Assessments or Supplemental Environmental Impact Statements) will be completed by the District on a site-by-site basis.

To determine ecosystem restoration benefits resulting from the proposed wetland alternatives in the East St. Louis and Vicinity, Illinois (Ecosystem Restoration and Flood Damage Reduction Project) (ESL-ER), intensive Habitat Evaluation Procedures (HEP) assessments were completed. In three instances, an additional assessment [i.e., Hydrogeomorphic Wetland Assessment (HGM)] was completed to support the HEP findings. This project served as the first-ever planning study to integrate the use of HEP and HGM in an ecosystem context, demonstrating the effectiveness and power of these tools in the evaluation of ecosystem restoration success. The HEP and HGM assessments were designed to evaluate the future changes in quantity (acres) and quality (habitat suitability and functional capacity) of aquatic, wetland and terrestrial ecosystems. Outputs were calculated in terms of annualized changes anticipated over the life of the project [i.e., Average Annual Habitat Units (AAHUs) in the HEP analyses and Average Annual Functional Capacity Units (AAFCUs) in the HGM analyses]. Results were compared using standard USACE cost evaluation procedures. Early in the evaluation process, an interagency Biological Team was convened. Scientists from the Environmental Laboratory (EL), U. S. Army Engineer Research and Development Center, facilitated the efforts. Representatives from the District, USFWS, the Illinois Department of Natural Resources (IDNR), NRCS and EPA actively participated in the assessments. Both the HEP and HGM assessments in their entirety, in addition to the results of the cost analyses, are presented in the following chapters.

The body of this report is divided into 13 chapters:

Chapter V: Brushy Lake
Chapter VI: Spring Lake
Chapter VII: Wedgewood
Chapter VIII: Mullens Slough
Chapter IX: Dobrey Slough
Chapter X: Elm Slough
Chapter XI: Cahokia Mounds
Chapter XII: Trade-offs
Chapter XIII: Summary and Conclusions

Four support chapters (Literature Cited, Glossary, Appendix A and Appendix B) have been included at the end of this report.

Chapter 2 (Methods) describes the selection, development, verification and deployment of the habitat and functional models used to assess the veracity of the proposed ESL-ER Project. Two sections have been devoted to these techniques (i.e., HEP and HGM), and the technical terminologies utilized in the application and descriptions of these tools are discussed. A description of the cost analysis process has also been included in this chapter. The interagency Biological Team is introduced, and the decisions and assumptions made during the evaluation processes are fully documented therein.

Chapter 3 begins the analysis of the proposed ecosystem restoration effort on a site-by-site basis, initiating at the northernmost site (Old Cahokia Creek in the County Ditch Watershed) and terminating at the most southern, inland site (Cahokia Mounds in the Harding Watershed) in Chapter 11. The format of each chapter has been standardized for ease of reading. The beginning of each chapter has been devoted to the description of baseline habitat conditions including the documentation of sampling techniques, delineations of cover types, data handling techniques, decisions made by the Team in the utilization of data in the analysis, and the derivation of baseline habitat units per species. Next, the assumptions and projected data used in the HEP and Incremental Cost Analyses (ICA) are presented, and the results of the analyses are detailed at the end of this section. Details of the wetland and uplands gains are summarized in a series of "results" tables within each chapter. A summary section at the end of each chapter providing comparisons among the various project alternatives and the identification of both the top three biological "winners" and the top three ICA "winners" has been included. Together, the nine chapters describe the HEP and ICA analyses in their entirety for the ESL-ER.

It was important to note that the HGM analysis was not completed for every site due to time constraints, and this project serves merely as a test of the application of the technique at the ecosystem level. EL developed two subclass models (i.e., a Connected Depressions model and an Isolated Depressions model), and asked the District to select sites that contained exclusive subclasses within its boundaries. The District selected to test the Connected Depressions model at both the Brushy Lake and Elm Slough sites.

The Dobrey Slough site was selected as a test site for the Isolated Depressions model. The chapters dedicated to these three sites are the only chapters containing both HEP and HGM analyses and results. The results of each tool are compared and suggestions for combining results are reviewed in the event that further HGM and HEP analyses are undertaken. The overall results across the five major watersheds (i.e. Cahokia, Harding, Powdermill, Long Lake and County Ditch) are reviewed in the final chapter (Summary and Conclusions). The Biological Team's recommended plans and plan selection justifications are provided in the PEIS (USACE 2002).

Appendix A contains a description of the Habitat Suitability Index (HSI) models utilized in the HEP analysis for this study. The life history characteristics, limiting factors (i.e., variables and suitability indices), supporting mathematical equations, and significant literature references contributing to the application of each model are documented within this appendix. Appendix B contains a description of the Functional Capacity Index (FCI) models utilized in the HGM analysis for this study. The limiting factors (i.e., variables and functional capacity indices), supporting mathematical equations, and significant literature references contributing to the application of each model are documented within this appendix.

II. METHODS

The restoration of an ecosystem must focus on the recovery of specific system attributes that promote human welfare independent of human use. Such "non-use" benefits can arise from the mere existence and/or maintenance of nationally or regionally rare and unique ecosystems. Indeed, the public is likely to view the protection of endangered species and their associated habitats as an important goal of ecosystem restoration. In 1999, the District began the process of formulating alternative designs for the East St. Louis and Vicinity, Illinois (Ecosystem Restoration and Flood Damage Reduction Project) (ESL-ER) and initiated a public involvement campaign to generate local support for the proposed ecosystem restoration activities therein. With USACE's history of concentrating solely on a flood control mission, the challenge (made by participating resource agencies) was to utilize ecosystem restoration as the overall study design. With areas of international cultural significance found throughout the study boundaries, the State Historic Preservation Office (SHPO) played an active role in the study process. Because large portions of the study area consisted of very rich and unique agricultural croplands (i.e., the "American Bottoms" is considered the "Horseradish Capital of the World"), the regional agricultural concerns also played heavily in the decision-making process. The District partnered with the EL and a number of resource agencies [i.e., USFWS, USEPA, NRCS, IDNR, and SHPO], to ensure all stakeholder issues were considered.

Given these "outside" interests, setting ecosystem restoration objectives and performance criteria on the holistic recovery of "non-use" benefits, such as fish and wildlife habitat, was critical to the overall planning process for the ESL-ER. It is important to note that the basic ecological premise behind species/community restoration is the recovery of limiting habitat features (e.g., life requisites), defined by their primary life-giving components, be they food, water, cover or reproduction. The primary goal of the ESL-ER study was therefore focused on the restoration of such life-giving components within the study area. To measure the success of the ESL-ER ecosystem restoration proposals, the best available science was brought to bear. In most ecosystem restoration studies, benefits are measured using quantifiable techniques rather than qualitative assessments. It was important, then, that the technique selected to quantify benefits for the ESL-ER be repeatable, efficient and effective, as results could be questioned by outside interests, and the participating agencies could not afford to spend excessive quantities of time justifying designs. Many rapid assessment techniques were readily available to the ESL-ER Biological Team in off-the-shelf formats in 1999, but for the various reasons described in the next section, the District selected HEP and HGM to quantify the anticipated habitat benefits gained by the proposed ESL-ER ecosystem restoration activities.

A. SELECTION OF THE HEP AND HGM METHODOLOGIES FOR THE ESL-ER

In prior studies, the District evaluated wildlife benefits primarily using a technique referred to as the Wildlife Habitat Appraisal Guide (WHAG) (Frye 1995). WHAG evaluates benefits by grouping wildlife species into guilds and associating these guilds with habitat types via characteristic matrices. Within each matrix, characteristic variables are used to rank the habitat quality. WHAG was designed to incorporate 28 species models that share characteristic planning and management orientations. However, when it came time to fully evaluate all alternatives for the ESL-ER study, the District, in conjunction with the USFWS, NRCS, and IDNR, made the decision to apply the more holistic HEP and HGM techniques. Although models used in the HEP methodology are often species-based and limited in their overall review of potential changes to the ecosystem dynamic and functionality, HEP can be utilized to assess ecosystem health if appropriate keystone species or guild-based species models are used in combinations to assess change. Thus, the selection of more than one species (preferably from multiple faunal families) can better describe the complex functions of an ecosystem, capturing both structure and process. When combined with an assessment tool such as HGM, the juxtaposition of wetlands and terrestrial environments can be captured successfully.

B. INTRODUCTION TO THE HEP PROCESS

The HEP methodology is an environmental accounting process developed to appraise habitat suitability for fish and wildlife species in the face of potential change (USFWS 1980a-c). Designed to predict the response of habitat parameters in a quantifiable fashion, HEP is an objective, reliable and well-documented process used nationwide to generate environmental outputs for all levels of proposed projects and monitoring operations in the natural resources arena. When applied correctly, HEP provides an impartial look at environmental effects and delivers measurable products to the user for comparative analysis.

In HEP, a Suitability Index, or SI, is a mathematical relationship that reflects a species' or community's sensitivity to a change in a limiting factor or variable within the habitat type. These suitability relationships are depicted using scatter plots and bar charts (i.e., suitability curves). The SI value (Y axis) ranges on a scale from 0.0 to 1.0, where an SI = 0.0 represents a variable that is extremely limiting and an SI = 1.0 represents a variable in abundance (not limiting) for the species or community. In HEP, a Habitat Suitability Index (HSI) model is a quantitative estimate of habitat conditions for an evaluation species or community. HSI models combine the Suitability Indices of measurable variables into a formula depicting the limiting characteristics of the site for the species or community on a scale of 0.0 (unsuitable) to 1.0 (optimal).

Users can select several indicator species to evaluate overall site fitness. In the HEP process, species are often chosen on the basis of their ecological, recreational, spiritual, or economic value. In other instances, species are chosen for their representative value (i.e., one species can "represent" a group or guild of species which have similar habitat requirements). Most of these species can, in turn, be described using single or multiple habitat models and a single HSI mathematical formula. In some studies, several cover types are evaluated in an HSI model to accurately reflect the complex interdependencies critical to the species' or community's existence. Regardless of the number of cover types incorporated within an HSI model, any HSI model based on the existence of a single life requisite requirement (e.g. food, water, cover or reproduction) uses a single formula to describe the relationship between quality and carrying capacity for the site. These single life requisite-based HSI models are referred to as Single Formula Models. However, some species are insufficiently examined using the single formula model approach. In these instances, a more detailed model can emphasize critical life requisites, increase limiting factor sensitivity, and improve the predictive power of the analysis. Multiple habitats and HSI formulas are often necessary to calculate the habitat suitability of these more intensive HSI models. The second type of HSI model (i.e., the Multiple Formula Model) is utilized to evaluate juxtaposition of habitats, essential dependencies, and performance requirements such as reproduction, roosting needs, escape cover demands, or winter cover that describe the sensitivity of a species or community. Multiple Formula HSI models require more extensive processing techniques to evaluate habitat suitability.

HSI models can be tailored to a particular situation or application and adapted to meet the level of effort desired by the user. Thus, a single model (or a series of inter-related models) can be adapted to reflect a site's response to a particular design at any scale (e.g., species, community, ecosystem, regional, or global dimensions). Several agencies and organizations have adapted the basic HEP methodology for their specific needs in this manner. HEP combines both the habitat quality (HSI) and quantity of a site to generate a measure of change referred to as Habitat Units (HUs). Once the HSI and habitat quantities have been determined, the HU values can be mathematically derived with the following equation: HU = HSI x Area (measured in acres). Under the HEP methodology, one HU is equivalent to one acre of optimal habitat for a given species or community.

In studies spanning several years, Target Years (TYs) must be identified early in the process. Target Years are units of time measurement used in HEP that allow users to anticipate and direct significant changes (in area or quality) within the project (or site). As a rule, the baseline TY is always TY = 0, where the baseline year is defined as a point in time before proposed changes would be implemented. As a second rule, there must always be a TY = 1 and a TY = X_2. TY1 is the first year land- and water-use conditions are expected to deviate from baseline conditions. TYX_2 designates the ending target year. A new target year must be assigned for each year the user intends to develop or evaluate change within the site or project. The habitat conditions (quality and quantity) described for each TY are the expected conditions at the end of that year. It is important to maintain the same target years in both the environmental and economic analyses, and between the baseline and future analyses. In studies focused on the long-term effects, HUs generated for indicator species are estimated for several TYs to reflect the life of the project. In such analyses, future habitat conditions can be estimated for both the Without Project and With Project conditions. Projected long-term effects of the project are reported in terms of Average Annual Habitat Units (AAHUs) values. Based on the AAHU outcomes, alternative designs can be formulated and trade-off analyses can be simulated to promote environmental optimization.

C. INTRODUCTION TO THE HGM PROCESS

Wetland ecosystems share a number of common attributes including relatively long periods of inundation or saturation, hydrophytic vegetation, and hydric soils. In spite of these common attributes, wetlands occur under a wide range of climatic, geologic, and physiographic situations and exhibit a wide range of physical, chemical, and biological characteristics and processes (Ainslie et al. 1999; Ferren, Fiedler, and Leidy 1996; Ferren et al. 1996a,b; Mitch and Gosselink 1993; Semeniuk 1987; Cowardin et al. 1979). The variability of wetlands makes it challenging to develop assessment methods that are both accurate (i.e., sensitive to significant changes in function) and practical (i.e., can be completed in the relatively short time frame available for conducting assessments). Existing "generic" methods, designed to assess multiple wetland types throughout the United States, are relatively rapid, but lack the resolution necessary to detect significant changes in function. One way to achieve an appropriate level of resolution within the available time frame is to reduce the level of variability exhibited by the wetlands being considered (Smith et al. 1995).

The HGM approach was developed specifically to accomplish this task (Ainslie et al. 1999; Brinson 1993). HGM identifies groups of wetlands that function similarly using three criteria (geomorphic setting, water source, and hydrodynamics) that fundamentally influence how wetlands function. "Geomorphic setting" refers to the landform and position of the wetland in the landscape. "Water source" refers to the primary water source in the wetland such as precipitation, overbank floodwater, or groundwater. "Hydrodynamics" refers to the level of energy and the direction that water moves in the wetland. Based on these three criteria, any number of "functional" wetland groups can be identified at different spatial or temporal scales. For example, on a continental scale, Brinson (1993) identified five hydrogeomorphic wetland classes. These were later expanded to the seven classes described in Table 1 (Smith et al. 1995).

Table 1. HGM wetland classes on a continental scale

HGM Wetland Class	Definition
Depression	Depression wetlands occur in topographic depressions (i.e., closed elevation contours) that allow the accumulation of surface water. Depression wetlands may have any combination of inlets and outlets or lack them completely. Potential water sources are precipitation, overland flow, streams, or groundwater/interflow from adjacent uplands. The predominant direction of flow is from the higher elevations toward the center of the depression. The predominant hydrodynamics are vertical fluctuations that range from diurnal to seasonal. Depression wetlands may lose water through evapotranspiration, intermittent or perennial outlets, or recharge to groundwater. Prairie potholes, playa lakes, vernal pools, and cypress domes are common examples of depression wetlands.
Tidal Fringe	Tidal fringe wetlands occur along coasts and estuaries, and are under the influence of sea level. They intergrade landward with riverine wetlands where tidal current diminishes, and river flow becomes the dominant water source. Additional water sources may be groundwater discharge and precipitation. The interface between the tidal fringe and riverine classes is where bi-directional flows from tides dominate over unidirectional ones controlled by floodplain slope of riverine wetlands. Because tidal fringe wetlands frequently flood and water table elevations are controlled mainly by sea surface elevation, tidal fringe wetlands seldom dry for significant periods. Tidal fringe wetlands lose water by tidal exchange, by overland flow to tidal creek channels, and by evapotranspiration. Organic matter normally accumulates in higher elevation marsh areas where flooding is less frequent, and the wetlands are isolated from shoreline wave erosion by intervening areas of low marsh. *Spartina alterniflora* salt marshes are a common example of tidal fringe wetlands.
Lacustrine Fringe	Lacustrine fringe wetlands are adjacent to lakes where the water elevation of the lake maintains the water. Fringe table in the wetland. In some cases, these wetlands consist of a floating mat attached to land. Additional sources of water are precipitation and groundwater discharge, the latter dominating where lacustrine fringe wetlands intergrade with uplands or slope wetlands. Surface water flow is bi-directional, usually controlled by water-level fluctuations resulting from wind or seiche. Lacustrine wetlands lose water by flow returning to the lake after flooding and evapotranspiration. Organic matter may accumulate in areas sufficiently protected from shoreline wave erosion. Unimpounded marshes bordering the Great Lakes are an example of lacustrine fringe wetlands.

Table 1. (cont.) HGM wetland classes on a continental scale

HGM Wetland Class	Definition
Slope	Slope wetlands are found in association with the discharge of groundwater to the land surface or sites with saturated overland flow with no channel formation. They normally occur on sloping land ranging from slight to steep. The predominant source of water is groundwater or interflow discharging at the land surface. Precipitation is often a secondary contributing source of water. Hydrodynamics are dominated by down-slope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is a dominant source to the wetland surface. Slope wetlands lose water primarily by saturated subsurface flows, surface flows, and by evapotranspiration. Slope wetlands may develop channels, but the channels serve only to convey water away from the slope wetland. Slope wetlands are distinguished from depression wetlands by the lack of a closed topographic depression and the predominance of the groundwater/interflow water source. Fens are a common example of slope wetlands.
Mineral Soil Flats	Mineral soil flats are most common on interfluves, extensive relic lake bottoms, or large floodplain terraces where the main source of water is precipitation. They receive virtually no groundwater discharge, which distinguishes them from depressions and slopes. Dominant hydrodynamics are vertical fluctuations. Mineral soil flats lose water by evapotranspiration, overland flow, and seepage to underlying groundwater. They are distinguished from flat upland areas by their poor vertical drainage due to impermeable layers (e.g., hardpans), slow lateral drainage, and low hydraulic gradients. Mineral soil flats that accumulate peat can eventually become organic soil flats. They typically occur in relatively humid climates. Pine flatwoods with hydric soils are an example of mineral soil flat wetlands.
Organic Soil Flats	Organic soil flats, or extensive peatlands, differ from mineral soil flats in part because their elevation and topography are controlled by vertical accretion of organic matter. They occur commonly on flat interfluves, but may also be located where depressions have become filled with peat to form a relatively large flat surface. Water source is dominated by precipitation, while water loss is by overland flow and seepage to underlying groundwater. They occur in relatively humid climates. Raised bogs share many of these characteristics but may be considered a separate class because of their convex upward form and distinct edaphic conditions for plants. Portions of the Everglades and northern Minnesota peatlands are examples of organic soil flat wetlands.

Table 1. (cont.) HGM wetland classes on a continental scale

HGM Wetland Class	Definition
Riverine	Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. Additional sources may be interflow, overland flow from adjacent uplands, tributary inflow, and precipitation. When overbank flow occurs, surface flows down the floodplain may dominate hydrodynamics. In headwaters, riverine wetlands often intergrade with slope, depressional, poorly drained flat wetlands, or uplands as the channel (bed) and bank disappear. Perennial flow is not required. Riverine wetlands lose surface water via the return of floodwater to the channel after flooding and through surface flow to the channel during rainfall events. They lose subsurface water by discharge to the channel, movement to deeper groundwater (for losing streams), and evapotranspiration. Peat may accumulate in off-channel depressions (oxbows) that have become isolated from riverine processes and subjected to long periods of saturation from groundwater sources. Bottomland hardwoods on floodplains are an example of riverine wetlands.

In many cases, the level of variability in continental-scale wetland hydrogeomorphic classes is still too immense to develop assessment models that can be rapidly applied while being sensitive enough to detect changes in function at a level of resolution appropriate to the planning process. For example, at a continental geographic scale the depression class includes wetlands as diverse as California vernal pools (Zedler 1987), prairie potholes in North and South Dakota (Kantrud et al. 1989; Hubbard 1988), playa lakes in the high plains of Texas (Bolen et al. 1989), kettles in New England, and cypress domes in Florida (Kurz and Wagner 1953; Ewel and Odum 1984).

To reduce both inter- and intra-regional variability, the three classification criteria (geomorphic setting, water source, and hydrodynamics) are applied at a smaller, regional geographic scale to identify regional wetland subclasses. In many parts of the country, existing wetland classifications can serve as a starting point for identifying these regional subclasses (Stewart and Kantrud 1971; Golet and Larson 1974; Wharton et al. 1982; Ferren, Fiedler, and Leidy 1996; Ferren et al. 1996a,b; Ainslie et al. 1999). In addition to the three primary classification criteria, certain ecosystem or landscape characteristics may also be useful for distinguishing regional subclasses in certain regions. For example, depression subclasses might be based on water source (i.e., groundwater versus surface water) or the degree of connection between the wetland and other surface waters (i.e., the flow of surface water in or out of the depression through defined channels). Tidal fringe subclasses might be based on salinity gradients (Shafer and Yozzo 1998). Slope subclasses might be based on the degree of slope, landscape position, source of water (i.e., through-flow versus groundwater), or other factors. Riverine subclasses might be based on water source, position in the watershed, stream order, watershed size, channel gradient, or floodplain width. Examples of potential regional subclasses are shown in Table 2 (Smith et al. 1995; Reinhardt et al. 1997).

Table 2. Potential regional wetland subclasses in relation to geomorphic setting, dominant water source, and hydrodynamics

Geomorphic Setting	Dominant Water Source	Dominant Hydrodynamics	Potential Regional Wetland Subclasses: Eastern USA	Potential Regional Wetland Subclasses: Western USA/Alaska
Depression	Groundwater or interflow	Vertical	Prairie pothole marshes, Carolina Bays	California vernal pools
Fringe (tidal)	Ocean	Bidirectional, horizontal	Chesapeake Bay and Gulf of Mexico tidal marshes	San Francisco Bay marshes
Fringe (lacustrine)	Lake	Bidirectional, horizonal	Great Lakes marshes	Flathead Lake marshes
Slope	Groundwater	Unidirectional, horizontal	Fens	Avalanche chutes
Flat (mineral soil)	Precipitation	Vertical	Wet pine flatwoods	Large playas
Flat (mineral soil)	Precipitation	Vertical	Peat bogs; portions of Everglades	Peatlands over permafrost
Riverine	Overbank flow from channels	Unidirectional, horizonal	Bottomland hardwood forests	Riparian wetlands

Regional Guidebooks include a thorough characterization of the regional wetland subclass in terms of its geomorphic setting, water sources, hydrodynamics, vegetation, soil, and other features that were taken into consideration during the classification process. Classifying wetlands based on how they function narrows the focus of attention to a specific type or subclass of wetland, the functions that wetlands within the subclass are most likely to perform, and the landscape/ecosystem factors that are most likely to influence how wetlands in the subclass function. This increases the accuracy of the assessment, allows for repeatability, and reduces the time needed to conduct the assessment.

Designed to assess wetlands as a whole, the HGM technique focuses on a wetland's structural components and the processes that link these components within a system (Bormann and Likens 1969). Structural components of the wetland and the surrounding landscape (e.g., plants, soils, hydrology, and animals) interact with a variety of physical, chemical, and biological processes. Understanding the interactions of the wetland's structural components and the surrounding landscape features is the basis for assessing wetland functions and the foundation of the HGM Approach. By definition, wetland functions are the normal or characteristic activities that take place in wetland settings. Wetlands perform a wide variety of functions, although not all wetlands perform the same functions, nor do similar wetlands perform the same functions to the same level of performance. The ability to perform a function is influenced by the characteristics of the wetland and the physical, chemical, and biological processes within the wetland. Wetland characteristics and processes influencing one function often also influence the performance of other functions within the same wetland system. Examples of wetland functions evaluated with Functional Capacity Index (FCI) models are found in Table 3.

Table 3. Wetland functions measured in HGM and their value to the ecosystem

Functions Related to Hydrologic Processes Wetland Function	**Benefits, Products, and Services Resulting from the Wetland Function**
Short-Term Storage of Surface Water: the temporary storage of surface water for short periods.	Onsite: Replenish soil moisture, import/export materials, conduit for organisms. Offsite: Reduce downstream peak discharge and volume and help maintain and improve water quality.
Long-Term Storage of Surface Water: the temporary storage of surface water for long periods.	Onsite: Provide habitat and maintain physical and biogeochemical processes. Offsite: Reduce dissolved and particulate loading and volume and help maintain and improve surface water quality.
Storage of Subsurface Water: the storage of subsurface water.	Onsite: Maintain biogeochemical processes. Offsite: Recharge surficial aquifers and maintain baseflow and seasonal flow in streams.
Moderation of Groundwater Flow or Discharge: the moderation of groundwater flow or groundwater discharge.	Onsite: Maintain habitat. Offsite: Maintain groundwater storage, baseflow, seasonal flows and surface water temperatures.
Dissipation of Energy: the reduction of energy in moving water at the land/water interface.	Onsite: Contribute to nutrient capital of ecosystem. Offsite: Reduced dowstream particulate loading helps to maintain or improve surface water quality.
Cycling of Nutrients: the conversion of elements from one form to another through abiotic and biotic processes.	Onsite: Contributes to nutrient capital of the ecosystem Offsite: Reduced downstream particulate loading helps to maintain or improve surface water quality.
Removal of Elements and Compounds: the removal of nutrients, contaminants or other elements and compounds on a short-term or long-term basis through physical processes.	Onsite: Contributes to nutrient capital of the ecosystem Contaminants are removed, or rendered innocuous. Offsite: Reduced downstream loading helps to maintain or improve surface water quality.
Retention of Particulates: the retention of organic and inorganic particulates on a short-term or long-term basis through physical processes.	Onsite: Contributes to nutrient capital of the ecosystem Offsite: Reduced downstream particulate loading helps to maintain or improve surface water quality.

Table 3. Wetland functions measured in HGM and their value to the ecosystem

Functions Related to Hydrologic Processes Wetland Function	Benefits, Products, and Services Resulting from the Wetland Function
Export of Organic Carbon: the export of dissolved or particulate organic carbon.	Onsite: Enhances decomposition and mobilization of metals. Offsite: Supports aquatic food webs and downstream biogeochemical processes.
Maintenance of Plant and Animal Communities: the maintenance of plant and animal community that is characteristic with respect to species composition, abundance and age structure.	Onsite: Maintain habitat for plants and animals (e.g., endangered species and critical habitats) forest and agriculture products, and aesthetic, recreational, and educational opportunities. Offsite: Maintain corridors between habitat islands and landscape/regional biodiversity.

Wetland functions represent the currency or units of the wetland system for assessment purposes, but the integrity of the system is not disconnected from each function; rather it represents the collective interaction of all wetland functions. Consequently, wetland assessments using the HGM Approach require the recognition by both the Assessment Team (i.e., the A-Team) and the end user that this link (i.e., between wetland function and system integrity) is critical. One cannot develop criteria, or models, to maximize a single function without having potentially negative impacts on the overall ecological integrity and sustainability of the wetland system as a whole. For example, one should not attempt to create a wetland to maximize water storage capacity without the recognition that other functions (e.g., plant species diversity) will likely be altered from those similar wetland types with less managed conditions. This does not mean that a wetland cannot be developed to maximize a particular function, but that it will typically not be a sustainable system without future human intervention.

The HGM Approach is characterized and differentiated from other wetland assessment procedures in that it first classifies wetlands based on their ecological characteristics (i.e., landscape setting, water source, and hydrodynamics). Second, it uses reference sites to establish the range of wetland functions. Finally, the HGM Approach uses a relative index of function (Functional Capacity Index or FCI), calibrated to reference wetlands, to assess wetland functions. In the HGM methodology, a Variable Subindex (VSI) is a mathematical relationship that reflects a wetland function's sensitivity to a change in a limiting factor or variable within the Partial Wetland Assessment Area or PWAA (a homogenous zone of similar vegetative species, geographic similarities, and physical conditions that make the area unique). Similar to cover types in HEP, PWAAs are defined on the basis of species recognition and dependence, soils types, and topography. In HGM, VSIs are depicted using scatter plots and bar charts (i.e., functional capacity curves). The VSI value (Y axis) ranges on a scale from 0.0 to 1.0, where an SI = 0.0 represents a variable that is extremely limiting and an SI = 1.0 represents a variable in abundance (not limiting) for the wetland.

Reference wetlands are wetland sites selected from a reference domain (a defined geographic area), selected to "represent" sites that exhibit a range of variation within a particular wetland type, including sites that have been degraded/disturbed as well as those sites with minimal disturbance (Ainslie et al. 1999). The use of reference wetlands to scale the capacity of wetlands to perform a function is one of the unique features of the HGM Approach. Reference wetlands provide the standard for comparison in the HGM Approach. Unlike other methods which rely on data from published literature or best professional judgment, the HGM Approach requires identification of wetlands from the same regional subclass and from the same reference domain, collection of data from those wetlands, and scaling of wetland variables to those data. Since wetlands exhibit a wide range of variability, reference wetlands should represent the range of conditions within the reference domain. A basic assumption of the HGM Approach is that the highest sustainable functional capacity is achieved in wetland ecosystems and landscapes that have not been subject to long-term anthropogenic disturbance (Smith et al. 1995). It is further assumed that under these conditions the structural components and physical, chemical, and biological processes within the wetland and surrounding landscape reach a dynamic equilibrium necessary to achieve the highest, sustainable functional capacity. Reference standards are derived from these wetlands and used to calibrate variables. However, it is also necessary to recognize that many wetlands occur in less than standard conditions. Therefore, data must be collected from a wide range of conditions in order to scale model variables from 0.0 to 1.0, the range used for each variable subindex. To assist the user, key terms related to the reference wetland concept in the HGM methodology are defined in (Table 4).

Table 4. Reference wetland terms and definitions

Term	Definition
Reference domain	The geographic area from which reference wetlands representing the regional wetland subclass are selected
Reference Wetland	A group of wetlands that encompass the known range of variability in the regional wetland subclass resulting from natural processes and disturbance and from human alteration.
Reference standard wetlands	The subset of reference wetlands that perform a representative suite of functions at a level that wetlands is both sustainable and characteristic of the least human altered wetland sites in the least human altered landscapes. By definition, the functional
Reference standard wetlands variable condition	The range of conditions exhibited by model variables in reference standard wetlands. By wetland variable definition, reference standard conditions receive a variable subindex score of 1.0.
Site potential - Mitigation Project Context	The highest level of function possible, given local constraints of disturbance history, land use, (mitigation project or other factors. Site potential may be less than or equal to the levels of function in reference context) standard wetlands of the regio
Project target - Mitigation Project Context	The level of function identified or negotiated for a restoration or creation project.
Project standards - Mitigation Project Context	Project standards Performance criteria and/or specifications used to guide the restoration or creation activities (mitigation context) toward the project target. Project standards should specify reasonable contingency measures if the project target is not

In the HGM Approach, an assessment model is a simple representation of a function performed by the wetland ecosystem (Ainslie et al. 1999). It defines the relationship between one or more characteristics or processes of the wetland ecosystem or surrounding landscape and the functional capacity of a wetland ecosystem. Functional capacity is simply the ability of a wetland to perform a function compared to the level of performance in reference standard wetlands. The HGM methodology is based on a series of predictive Functional Capacity Indices (FCIs), an index of the capacity of wetland to perform a function relative to other wetlands from a regional wetland subclass in a reference domain. Functional capacity indices are by definition scaled from 0.0 to 1.0. An index of 1.0 indicates that a wetland performs a function at the highest sustainable functional capacity, the level equivalent to a wetland under reference standard conditions in a reference domain. An index of 0.0 indicates the wetland does not perform the function at a measurable level and will not recover the capacity to perform the function through natural processes. FCI models combine VSIs in a mathematical equation to rate the functional capacity of a wetland on a scale of 0.0 (not functional) to 1.0 (optimum functionality). An HGM subclass model is basically an assimilation of several FCI models combined in a specific fashion to mimic a site's functionality. Users can review and select several FCI models to evaluate the overall site functionality. All FCI models are described using a single FCI formula (refer to the Single Formula Subclass Models section below). Some examples of HGM FCI models include floodwater detention, internal nutrient cycling, organic carbon export, removal and sequestration of elements and compounds, maintenance of characteristic plant communities, and wildlife habitat maintenance.

HGM model variables represent the characteristics of the wetland ecosystem (and surrounding landscape) that influence the capacity of a wetland ecosystem to perform a function. HGM model variables are ecological quantities that consist of five components (Schneider 1994). These include: 1) a name, 2) a symbol, 3) a measure of the variable and procedural statement for quantifying or qualifying the measure directly or calculating it from other measurements, 4) a set of values [i.e., numbers, categories, or numerical estimates (Leibowitz and Hyman 1997)] that are generated by applying the procedural statement, and 5) units on the appropriate measurement scale. Table 5 provides several examples.

Table 5. Components of typical HGM model variables

Name (Symbol)	Measure/Procedural Statement	Resulting Values	Units (Scale)
Redoximorphic Features (V_{REDOX})	Status of redoximorphic features/visual inspection of soil profile for redoximorphic features.	Present/ Absent	unitless (Nominal Scale)
Floodplain Roughness (V_{ROUGH})	Manning's Roughness Coefficient (n) Observe wetland characteristics to determine adjustment values for roughness component to add to base value.	0.01 0.1 0.21	unitless (Interval Scale)
Tree Biomass (V_{TBA})	Tree basal area/measure diameter of trees in sample plots (cm), convert to area (m), and extrapolate to per hectare basis.	5 12.8 36	m^2/ha (Ratio Scale)

HGM model variables occur in a variety of states or conditions in reference wetlands (Ainslie et al. 1999). The state or condition of the variable is denoted by the value of the measure of the variable. For example, tree basal area, the measure of the tree biomass variable, could be large or small. Similarly, recurrence interval, the measure of overbank flood frequency variable, could be frequent or infrequent. Based on its condition (i.e., value of the metric), model variables are assigned a variable subindex. When the condition of a variable is within the range of conditions exhibited by reference standard wetlands, a variable subindex of 1.0 is assigned. As the condition deflects from the reference standard condition (i.e., the range of conditions that the variable occurs in reference standard wetland), the variable subindex is assigned based on the defined relationship between model variable condition and functional capacity. As the condition of a variable deviates from the conditions exhibited in reference standard wetlands, it receives a progressively lower subindex reflecting its decreasing contribution to functional capacity. In some cases, the variable subindex drops to zero. For example, when no trees are present, the subindex for tree basal area is zero. In other cases, the subindex for a variable never drops to zero. For example, regardless of the condition of a site, Manning's Roughness Coefficient (n) will always be greater than zero.

HGM combines both the wetland functionality (FCIs measured with variables) and quantity of a site to generate a measure of change referred to as Functional Capacity Units (FCUs). Once the FCI and PWAA quantities have been determined, the FCU values can be mathematically derived with the following equation: FCU = FCI x Area (measured in acres). Under the HGM methodology, one FCU is equivalent to one optimally functioning wetland acre. Like HEP, HGM can be used to evaluate further conditions and the long-term effects of proposed alternatives by generating FCUs for wetland functions over several TYs. In such analyses, future wetland conditions are estimated for both Without Project and With Project conditions. Projected long-term effects of the project are reported in terms of Average Annual Functional Capacity Units (AAFCUs) values. Based on the AAFCU outcomes, alternative designs can be formulated, and trade-off analyses can be simulated, to promote environmental optimization.

D. CROSSWALKS BETWEEN HEP AND HGM

Ecosystems are generally characterized in terms of their structural components and the processes that link these components (Bormann and Likens 1969). Structural components of the ecosystem and the surrounding landscape, such as plants, animals, detritus, soil, and the atmosphere, interact through a variety of physical, chemical, and biological processes such as the movement of air and water, and the flow of energy and nutrients. Understanding how the structural components of the ecosystem, and the surrounding landscape are linked together by processes, is the basis for assessing ecosystem functions. Since both the HEP and HGM methodologies were used in the assessment of ecosystem restoration success for the ESL-ER, it is important to address similarities in their approaches to measuring ecosystem integrity, and discuss the use of multiple tools in evaluations of this magnitude. It is also important to validate the use of these two tools in an ecosystem setting, to assure users that the success of ecosystem restoration studies in the future can be evaluated effectively and efficiently using a combination of the HEP and HGM methodologies.

As one might expect, the HEP and HGM approaches are quite similar, varying only in matters of terminology and assessment focus. Probably the most important issue to address when approaching a combined HEP-HGM study is the communication of results in scientific syntax to the applicants and users. To that end, Table 6 has been included here to demonstrate crosswalks between terms used in HEP and "sister" terms used in the HGM application process.

Table 6. Terminology crosswalks between the HEP and HGM methodologies

Parameters	HEP Terminology	HGM Terminology
Measureable parcel of land defined by its vegetative cover, soils and topography	Cover Type (CT)	Partial Wetland Assessment Area (PWAA)
An attribute or characteristic of landscape (or the surrounding landscape) that influences the capacity of wetland to perform a function or the suitability of the area to support a species or community	Variable	Variable
The index that rates the variable relative to optimum conditions. Both Indices are by definition scaled from 0.0 to 1.0.	Suitability Index (SI)	Variable Subindex (VSI)
An mathematical aggregation of the Variable Indices used to describe the interelationships among variables which define the suitability or functionality of the site.	Habitat Suitability Index (HSI)	Functional Capacity Index (FCI)
The product of the quality of the site (determined by the HSI or FCI) multiplied by the quantity of the site. Unit = Quality Index X Quantity	Habitat Unit	Functional Capacity Unit (FCU)
Target Years are units of time measurement that allow users to anticipate and direct significant changes (in area or quality) within the project (or site).	Target Year	Target Year
The measure of future habitat conditions estimated for both baseline (Without Project) and design (With Project) conditions. Projected long-term effects of the project are reported in terms of average annual units. Average Annual Units = For each Target Year . . . Average Quality X Average Quantity	Average Annual Habitat Unit (AAHU)	Average Annual Functional Capacity Unit (AAFCU)
A technique deployed to emphasize the value or priority of the results in a "weighting" fashion.	Relative Value Index (RVI)	Relative Value Index (RVI)

The distinguishing difference between the HEP and HGM methodologies is the biological component they each were designed to assess. HEP was designed to interpret the effects of environmental change through a species or community-based habitat suitability relationship across the landscape - a habitat maintenance function in the ecosystem setting. Although the HEP technique was not initially developed to assess additional ecosystem functions, combinations of HSI models in the HEP methodology indirectly measure ecosystem functionality across terrestrial and aquatic systems. In other words, HSI model parameters correlate closely with measures of ecosystem integrity such as improved water quality (i.e., turbidity, pH, salinity, and temperature - factors in many fish HSI models), patchiness and/or disturbance (i.e., distance to cover and water, riparian zone widths, human disturbance - factors of many bird and mammal HSI models) and both plant community and wildlife habitat maintenance (a factor of all the HSI models developed). Of course, HSI models are limited because they define only animal habitats as they pertain to physical and chemical characteristics of the landscape. HSI models do not, for example, include geomorphic setting, water source, and hydrodynamics - features that directly relate to aquatic ecosystem integrity. But a combination of well-chosen species- or community-based models can be deployed to capture and reflect change in ecosystem functions across the site.

The model selection process can "make" or "break" an ecosystem study, and it is extremely important that the selection process focuses on the study's performance measures (i.e., success criteria), community incidence and architecture, and model parameters directly contributing to the ecosystem function. To do this, it has been suggested that habitat evaluation teams select guild representative models rather than game species models. A guild representative is, by definition, an animal (or plant) that belongs to a group of functionally similar species with comparable habitat requirements whose members interact strongly with one another. If results indicate a decline in a guild representative's habitat, it is assumed that species within this guild will be subject to same decrease in habitat suitability, and the guild as a whole will decline. Thus, species HSI models should be selected as representatives of identifiable guilds.

In addition, model selection should be based on sensitivity of the species or community to the proposed changes. Thus, identification of proposed actions and limiting factors within a model must be reviewed and compared prior to model selection. Although results are tallied in terms of habitat change to the specific species (or community), projected change is derived at the variable level. In other words, the team does not project a decline in habitat suitability for Species A. Instead, the evaluation team generates estimated changes on a variable-by-variable basis given a proposed project design (i.e., water depth will decrease, herbaceous vegetation will increase by 25 percent, the forested wetlands will expand by 15 percent, etc) regardless of species or community association. Thus ecosystem functions (floodwater detention, habitat maintenance, characteristic plant community maintenance, etc) are inadvertently captured in the application of a species-based or community-based HSI model. To this end, HSI models can be relied upon to measure at least some, but obviously not all, ecosystem functions in both terrestrial and aquatic systems (including wetlands), the primary function being Maintenance of Wildlife Habitat, and secondarily the Maintenance of Characteristic Plant Communities.

HGM, on the other hand, was specifically designed to assess wetland functions rather than individual wildlife species requirements. Strictly speaking, HGM applications are limited to wetlands defined as areas with less than one meter of standing water present. Thus, HGM was not designed to evaluate all systems within the ecosystem. However, HGM is a powerful tool that can define the normal, or characteristic, activities that take place in a wetland ecosystem setting. As wetlands perform a wide variety of simple and complex activities based on their physical, chemical, and biological attributes, HGM has been designed to measure functional capacity. The combination of HGM, with its functional assessment approach, and HEP, with its coverage of both aquatic and terrestrial settings, can blanket the entire study area, capturing changes in ecosystem activities across the landscape. Maintenance of ecological integrity, the function that encompasses all of the structural components and processes in an aquatic and/or terrestrial ecosystem, can therefore be assessed using a combination of HEP and HGM.

E. INTRODUCTION TO THE 12 STEPS TO ECOSYSTEM EVALUATION USING HEP AND HGM

Based on the USFWS's Ecological Service Manual series on HEP (USFWS 1980a-c), and a series of protocols for HGM application developed by EL (Brinson 1993; Smith et al. 1995), there are 12 steps involved in the application of HEP and HGM when assessing an ecosystem restoration project:

1) Build a multidisciplinary Evaluation Team.
2) Define the project.
3) Determine goals and objectives, project life, and Target Years.
4) Cover type map the site(s).
5) Select, modify and/or create model(s).
6) Conduct field sampling.
7) Perform data management and statistical analysis.
8) Calculate Baseline Conditions.
9) Generate Without Project Conditions and calculate outputs.
10) Generate With Project Conditions and calculate outputs.
11) Develop relative value indices and perform trade-offs
12) Report the results of the analyses.

The following sections describe these steps in further detail and discuss their various applications to the ESL-ER study.

E.1. Building an Evaluation Team

In HEP and HGM, an interagency, interdisciplinary team must be formed both to lead the model selection/development phase of the project and to establish the baseline and future conditions of the site(s). Participants often include representatives from USACE District, the USEPA, the USFWS, the NRCS, State Fish and Game offices, and other Federal, State, and local governments as well as tribes as is deemed necessary. The technical expertise necessary to support planning efforts should include, but is not restricted to, representatives from botany, soils, hydrology, and wildlife ecology disciplines. The team should also include those individuals responsible for project design and management [i.e., engineers, project managers, NEPA consultants, cost-share sponsors, university professors, etc.].

A multidisciplinary ecosystem evaluation team was convened early in March of 1999 to conduct both the HEP and HGM evaluations for the ESL-ER. The multi-disciplinary, multiagency team included various interests and technical expertise. To date, the following team members have contributed to the effort, and are referred to as the "Biological Team" throughout this document:

Mr. Tim George and Ms. Debbie Roush (St. Louis, District)
Mr. Brian Weibler, Ms. Myra Myoshi, and Mr. Steve Schacht (USFWS)
Ms. Ellen Starr (NRCS)
Mr. Pat Malone (IDNR)
Ms. Mary White (USEPA)
Ms. Kelly Burks-Copes, Ms. Antisa Webb, and Dr. Michael Passmore (ERDC-EL)
Dr. Ellis Clairain (ERDC-EL)
Dr. Chester C. Watson (CO. State University).

E.2. Defining the Project

The following information (geographic location, project purpose, presettlement conditions, and the overall ecosystem restoration approach) gathered by the District has been used to define the overall ESL-ER project.

Geographic Location, Counties, Watersheds and Primary Water Resources

The ESL-ER study area is located in southwestern Illinois, in the western portions of Madison and St. Clair Counties, and lies within the Metro East St. Louis area along the east bank of the Mississippi River. The study area encompasses approximately 107,000 acres (167 square miles), and is approximately 20 miles long and 15 miles wide at its widest point. Approximately 58,000 acres of the study area are considered bottomlands on the Mississippi River floodplain (locally called the "American Bottoms"), and Uplands watersheds that drained into these Bottoms comprise the remaining 49,000 acres of the study area. After New Orleans, the American Bottoms has the second largest concentration of residential, commercial, and industrial land use on the Mississippi River floodplain. Agriculture is also a significant land use in the Bottoms.

The topography in the floodplain is nearly level. The floodplain typically exhibits river meander scars, abandoned channel oxbow lakes, low-relief ridges, and swales. In addition, prehistoric Indian mounds can be found on the floodplain - the largest, Monks Mound, stands 100 feet above the adjacent floodplain, and is located east of Fairmont City. The floodplain generally slopes to the south, and drops in elevation approximately 0.5-foot per mile, mirroring the gradient of the Mississippi River's channel Bottoms. The average floodplain elevation to the north near Alton is 415 feet, and to the south near Dupo is 405 feet. In the northern portion, there are terraces located along the foot of the Bluffs between East Alton and Roxana. The terraces are approximately 25 to 35 feet above the floodplain with elevations between 440 and 450 feet. The study area north of Horseshoe Lake is typically higher than the adjacent floodplain with elevations between 420 and 435 feet. The topography near the Bluffs on the eastern edge of the floodplain is generally higher than the adjacent floodplain with elevations between 435 and 465 feet.

The Bluffs rise steeply between 150 to 200 feet above the floodplain. The Bluffs have a rather rugged topography with the drainage channels forming valleys with steep slopes. Beyond the Bluffs-line, the topography consists of rolling hills and valleys with elevations ranging between 500 and 600 feet. East of the Bluffs-line, a number of shallow surface depressions (less than 5 feet deep) were created as a result of mine subsidence in the last 100 years.

There are numerous major man-made drainage channels located throughout the floodplain constructed in the early 1900's to improve drainage. Numerous railroad embankments were constructed like a spider's web in the American Bottoms. These railroad embankments often cut off drainage ways - impounding runoff in some areas. An urban design (500-year) flood control system, comprised of large earthen levees and floodwalls, was constructed to protect the study area within the floodplain. The northern study boundary coincides with a levee located on the left descending bank of the Cahokia Creek Diversion Canal, which ties into the Bluffs west of Edwardsville. The study boundary at its most western point is the Mississippi River. The southern study boundary is represented by a levee located on the right descending bank of the Prairie DuPont Creek (tying into the Bluffs).

The natural overbank drainage and meandering creeks flowing into the Mississippi River were blocked by flood protection systems constructed in the early 1900's. Prior to 1910, the original Cahokia Creek channel in the Bottoms received

260 square miles of Uplands drainage that extended 51 miles north of the study area. The creek meanders across the American Bottoms for 30 miles, and discharges into the Mississippi River south of East St. Louis near Mississippi River Mile 179. In 1910, Cahokia Creek's 30 miles of floodplain channel was bypassed when the Uplands drainage area was diverted into a new canal (Cahokia Creek Diversion Canal). This diversion canal is 4.5 miles long and flows directly west into the Mississippi River at Mile 195. The study area spans five watersheds - Cahokia, Harding, Powdermill, Long Lake and County Ditch (Figure 1).

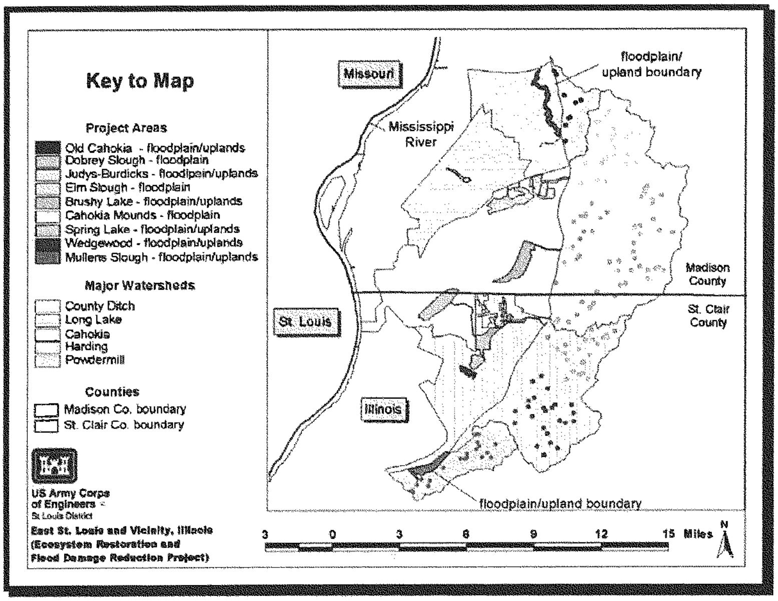

Figure 1. Location of the ESL-ER

Each watershed, with the exception of Long Lake, extends from the Bottoms into the Uplands. Acreages were calculated for each watershed and are enumerated in Table 7.

Table 7. Watersheds in the ESL-ER

Watershed	Bottomland Area (ac)	Upland Area (ac)	Total	Percent of Study Area
Cahokia	24,543	28,161	52,704	49%
Harding	13,757	14,633	28,390	26%
County Ditch	9,001	2,850	11,851	11%
Long Lake	9,811	0	9,811	9%
Powdermill	1,108	3,714	4,822	4%
Totals	**58,220**	**49,358**	**107,578**	

Cahokia watershed, the largest watershed in the study, spans six Uplands sub-watersheds: 1) Judy's Branch, 2) Burdick Branch, 3) Bluffs #2, 4) Schoolhouse Branch, 5) Bluffs #3, and 6) Canteen Creek. Together the six sub-watersheds encompass 28,161 Uplands acres. The second largest watershed in the study, Harding, contains four sub-watersheds in the Uplands: 1) Little Canteen Creek, 2) Bluffs #4, 3) Schoenberger Creek, and 4) Bluffs #5. Together the four sub-watersheds encompass 14,633 Uplands acres. The third largest watershed, County Ditch, contains a single sub-watershed - Bluffs #1. Bluffs #1 spans 2,850 acres in the Uplands. The majority of lands in the smallest watershed in the study (Powdermill) are located in the Uplands. Two sub-watersheds contribute to Powdermill Watershed's Uplands territories: 1) Powdermill Creek and 2) Bluffs #6. A total of 3,714 Uplands acres can be found in these two sub-watersheds.

Under existing conditions, the study area drains to the Mississippi River through a system of hillside streams flowing into man-made channels in the Bottoms. All the hillside watersheds have become urbanized or are in the process of becoming primarily urbanized. In the Cahokia Canal area, the hillside areas are drained by four major streams plus several small areas. The runoff from these hillside streams flows through the Bottoms through the Cahokia Canal system. Gravity drains through the spoil bank berms that line much of the canal control drainage from the Bottoms into the Cahokia Canal. The Cahokia Canal was connected to Horseshoe Lake with a man-made diversion canal that allows the enormous amount of storage available in the lake to be utilized during flood events. In the Harding Ditch area, hillside areas are drained by two major hillside streams plus several small areas. The runoff from Little Canteen and Schoenberger Creeks flows through the Bottoms, through Harding Ditch, and then into the Mississippi River via the Prairie DuPont Diversion Channel. Similar to Cahokia Canal, gravity drains through the spoil bank berms that line most of the ditch control drainage from the Bottoms into Harding Ditch. Excess floodwaters back into three lakes at Frank Holten State Park during flood events. In the Canal No.1 area, one major hillside stream (Powdermill Creek) as well as a small, unnamed tributary flow into Canal No. 1. A very small amount of Bottoms area drains into Canal No.1 through a spoil bank berm via gravity drains.

Given the vast extent of the ESL-ER study area (>100,000 acres), the District made the decision to focus on nine specific sites, or sub-ecosystems, within the five watersheds for intensive habitat evaluation (refer to Figure 1 above). In the County Ditch Watershed, an ~458 acre riverine sub-ecosystem was selected and named **Old Cahokia Creek**. In the Powdermill Watershed, a ~432-acre lacustrine area was selected and named **Mullens Slough**. In the Long Lake Watershed, a small ~83-acre agricultural cropland area was selected and named **Dobrey Slough**. In the Cahokia Watershed, three sites were selected - **Judy's-Burdick Branches** (~765 acres, primarily agricultural cropland), **Brushy Lake** (~849 acres of predominantly palustrine forest) and **Elm Slough** (~670 acres of mostly agricultural cropland and palustrine scrub-shrublands). In the Harding Watershed two additional sites were selected, namely **Cahokia Mounds** (a predominantly prairie-based site spanning 525 acres) and **Wedgewood** (a smaller site comprising mostly of urban fields and some palustrine forest totaling 330 acres). The ninth site (**Spring Lake**) spanned two watersheds (e.g., Cahokia and Harding) and totaled more than 2,050 acres predominantly covered by marshes and urban residential areas. The assessments documented here focus on these nine sub-ecosystems and their contribution to the overall recovery of ecosystem health in the five watersheds and across the entire study area.

Lead District

The ESL-ER falls under the purview of the U. S. Army Engineer District, St. Louis, St. Louis, Missouri (District). The District was one of six districts that make up the US Army Engineer Division, Mississippi Valley (Figure 2).

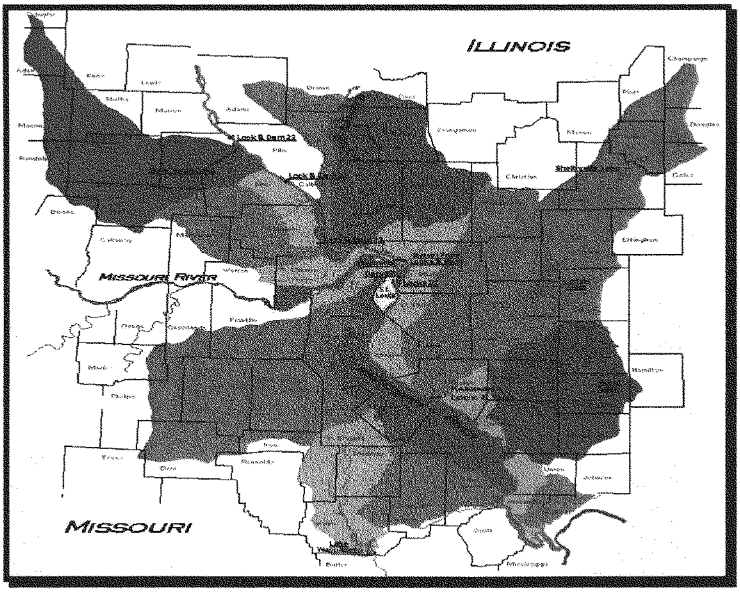

Figure 2. U. S. Army Engineer District, St. Louis, St. Louis, Missouri (District) boundaries map

The St. Louis District is comprised of 28,000 square miles of land and 48,000 miles of waterways in eastern Missouri and southwestern Illinois. The area population was roughly three million - two million are located in the St. Louis Metropolitan area. The District headquarters is located in downtown St. Louis, Missouri. The District manages 300 miles of the Upper Mississippi River, from the mouth of the Ohio (at Cairo, Illinois) to just south of Saverton, Missouri (tailwaters of Lock and Dam 22). The District was also responsible for the lower Missouri River (in St. Charles and St. Louis Counties), and the lower 80 miles of the Illinois River. The District oversees the Salt and Meramec Rivers, the Upper St. Francis Basin in Missouri, the Kaskaskia River, the Big Muddy River, and the Lower Cache River in Illinois, and a number of smaller tributary streams and creeks. The project manager for the ESL-ER was Ms. Deborah Roush (CEMVS-PM-F), and the lead biologist for the study was Mr. Timothy K. George (CEMVS-PM-EA).

Project Evolution and Purpose

Since the early 1900's, the East St. Louis area has suffered from frequent, recurring interior flooding. Although these areas have been protected from direct flooding from the Mississippi River by a series of levees and floodwalls built by USACE in the 1940's, severe interior flooding indirectly contributes to prolonged high stages in the river that prevent the occurrence of necessary gravity flows. In addition, pumping stations of the era were not designed with the capacity to drain these large runoff volumes from the drainage area. Most interior flooding in the area occurs as direct result of heavy runoff discharges that exceed the capacity of the drainage canals from the Uplands drainage areas, while interior ponding in low-lying areas lack structures to transport water into the drainage canals.

Interior ponding occurs in low-lying areas (old sloughs and shallow lake beds) where surface water runoff collects. Most of these areas are undeveloped or partially farmed, and the water collects during small rainfall events causing minor crop damage. During heavy rainfall events, runoff volume exceeds the ponding area capacity, and the surrounding areas are consequently flooded. Interior flooding was also attributed to seasonal flows that occur every two to five years, which exceed the capacity of existing creeks entering the floodplain from the hillsides and the canals. Interior floods associated with very large rainfall events were recorded during the storm events of August of 1915, July of 1942, August of 1946, July of 1952, June of 1957, May of 1961 and May of 1995. The 1946 flood was estimated to be greater than the 100-year event in terms of inches of rain that fell, and produced an average depth of 15.1 inches over the entire study area. The 1957 and recent 1995 events also produced approximately the 100-year rainfall event, with average depths of over 8 inches across the region.

High levels of erosion and sedimentation have contributed to the region's flooding problems, as sediment carried in flooding events fills drainage canals, resulting in a loss of flood conveyance capacity. The runoff from the hillside creeks enters the canals in the floodplain at high-velocities capable of transporting heavy loads of sediment. However, when these high velocity flows reach the floodplain, their gradient flattens, the velocity drops substantially, and the canal can no longer transport the sediment load.

In the late 1960's, the District was authorized to study and define the need for flood control efforts in the areas surrounding East St. Louis (in Illinois). Although the project was never undertaken, results supported the proposed flood control efforts. In the late 1980's, Congress asked the District to re-evaluate and develop a feasible flood control solution for the problems in the area. As a result, a new pump station was added to provide flood protection to the southern end of the study area. However, no economically feasible solutions could be justified for the vast majority of the study area.

From 1993 to 1996 the area suffered severe interior flooding - the Federal Government [U. S. Federal Emergency Management Agency (FEMA), USACE, and NRCS] spent approximately $60 million to provide emergency disaster relief, clean existing drainage ditches, and buyout frequently flooded areas. However, this work was only a temporary solution to the region's flooding problems. In 1998 Congress once again authorized the District to re-evaluate the area. This time, the District resolved to reassess the problem from a different perspective, identifying, and developing solutions that corrected the current flooding problems by restoring ecosystem function, rather than addressing the problems with a purely engineering-based approach. The result was the East St. Louis and Vicinity, Illinois (Ecosystem Restoration and Flood Damage Reduction Project) (ESL-ER).

Presettlement Conditions of the Region

Presettlement Cultural Setting

Prehistoric occupation of the study area began more than twelve thousand years ago when nomadic hunters and gatherers first entered what was now known as the Metro-East area. At that time, a variety of large herding animals, including now-extinct species like the mastodon, giant sloth, and giant bison, lived in the region. Archaeological evidence recovered from the Bluffs tops above the Mississippi River floodplain in the study area suggested that the region's bountiful natural resources were a natural magnet to hunters and gatherers. Over time, climatic changes and other factors resulted in the gradual disappearance, and ultimate extinction, of many animal species from the study area, resulting in an increased reliance on edible plants. In the past, the soils within the floodplain portion of the study area were among the most productive in North America, and supported a wide range of edible plants, small mammals, and birds. By 800 AD, the population of the area had increased dramatically, and most of the prehistoric residents of the Middle Mississippi River valley lived in small villages, surrounded by fields of domesticated varieties of corn, squash, and pumpkins.

For reasons that are still unclear to modern scholars, approximately 1,100 years ago the residents of these isolated villages and farming hamlets coalesced and established a large, strategically located, permanent settlement. This village, referred to today as Cahokia, was located near the center of the study area on the wide alluvial floodplain, directly across from the present city of St. Louis, Missouri. Over the next three centuries, Cahokia grew to eventually become the largest prehistoric site in North America. At its zenith (around AD 1200), this site encompassed approximately 5 square miles and supported a population of 10,000-40,000 inhabitants. A 100-foot-high earthen temple mound that covered approximately 14 acres dominated the center of this powerful chiefdom. About 120 lesser temple, burial, and specialized function mounds surrounded this temple mound. Cahokia was surrounded by literally hundreds of smaller villages, hamlets, and farmsteads that were located throughout the Middle Mississippi River valley. Landuse was primarily farming-oriented. Modern scholars refer to the culture of these mound builders and farmers collectively as the Mississippians Cultural Period. Today, the archaeological remains of this occupation are known as the Cahokia Mounds State Historic Site. During the 14th century, the population of Cahokia declined dramatically. Recent studies suggest that natural resource depletion (particularly trees) was a significant problem in the area and may have directly contributed to the demise of Cahokia early in the 15th century.

Presettlement Ecological Setting

A wealth of historical information concerning the physical and biological characteristics of the area referred to as the American Bottoms was gathered and assessed in this study, and formed the basis for characterizing the structure, disturbance dynamics, and functions of the pre-development ecosystem. For this study, it was imperative to develop the earliest possible portrait of the landscape before the onset of any significant development. Compilations of chronological sequence historic maps document the location of many natural features, and the nature and extent of man-made alterations over time. The earliest maps date back to the late 1600's, and were considered crude when compared to today's standards. Maps possessing more accurate depictions of the area first appeared in the last quarter of the eighteenth century. However, even these maps did not allow accurate "then and now" comparisons of natural and cultural landforms within the region. The first of what would be considered "modern" maps of the area were drafted during the first quarter of the 19^{th} century, a time when the first United States government surveyors established the modern section, township, and range coordinate system across the county. In addition to these records, detailed readings of surface elevations of the Mississippi River at St. Louis extended back for over two centuries. These records documented the cycle of seasonal flooding, an integral component of the "pre-development" environment.

For purposes of the ESL-ER, the point in time representing "pre-development" conditions was taken as early as the existing documentation would allow. The analysis concluded that the earliest reliable pre-development reference point could be considered "circa 1800," or around the year 1800. This date corresponded to the American frontier settlement period of this region's history. Although selection of an earlier reference point, specifically a prehistoric one, was suggested for this study, this approach was not feasible for two reasons. First, there were few written records prior to 1800 that included accurate descriptions of the ecosystem's conditions. More importantly, reconstruction of more distant environmental conditions could not be described in detail using existing information.

Prior to development, vast expanses of forest and prairie could be found within the study area's boundaries. On the floodplain, complexes of backwater lakes, sloughs and marshes punctuated the forests and prairies. Streams, originating in the Uplands, meandered across the floodplain and discharged into the Mississippi River. Because these examples of natural features could be readily distinguished one from the other on maps and aerial surveys, they were denoted as land cover classification features (Figure 3).

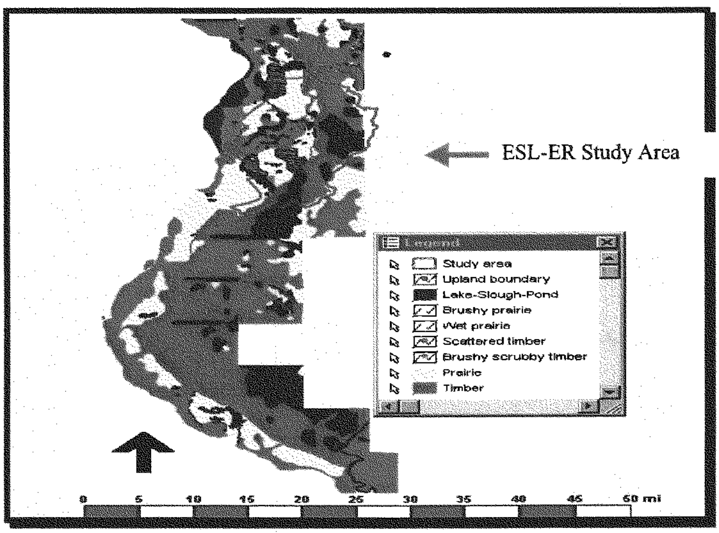

Figure 3. Map of presettlement (~1800's) cover types found within the ESL-ER boundary

From the surveyors' notes, various kinds of land cover were consistently mentioned. Six occurred in the study area, including timber, scattered timber, lake-slough-pond, prairie, wet prairie, and brushy prairie. Of the 106,600 acres surveyed, approximately 70 percent of the study area was classified as forest, and approximately 23 percent of the area was classified as prairie (Figure 4).

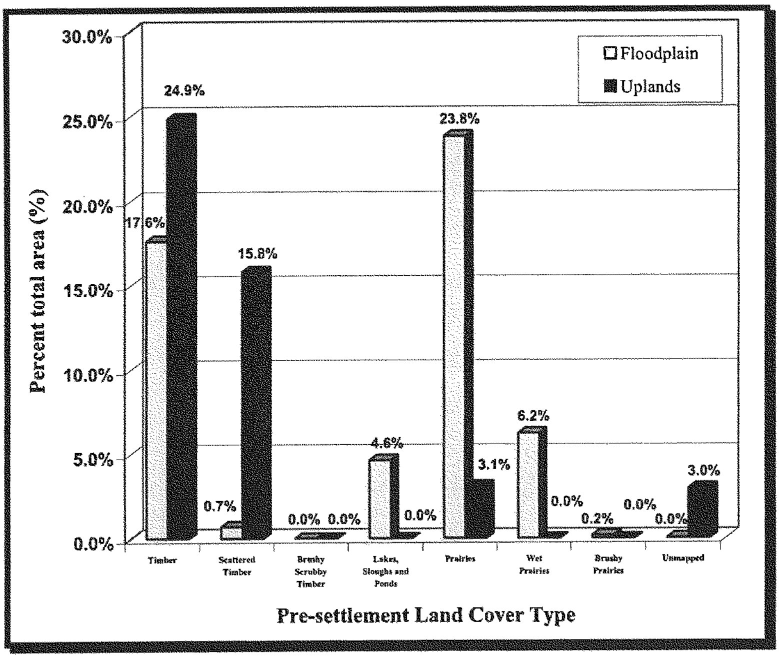

Figure 4. Presettlement (~1800's) cover types found within the boundary of the ESL-ER

Aquatic areas, including lakes, sloughs and ponds, covered approximately 6 percent of the land's surface. With respect to the distribution of these cover classes across the Uplands and the Bottoms, approximately 69 percent of the forests were located in the Uplands, and more than 90 percent of the prairies were located in the Bottoms. All lakes, sloughs, and ponds were located in the Bottoms.

Presettlement Hydrological Setting

Wetland water sources in the study area include rainfall (including local runoff), overbank flooding from rivers and creeks, adjacent lakes/ponds, and groundwater. By virtue of their topographic position in this area, water gravitates toward wetlands. Their flat or depressional topography naturally impedes surface drainage, and the natural impermeability of the area's soils inhibits groundwater recharge. When it rains, direct rainfall collects in the wetlands; and if storm intensity and duration are sufficient to saturate the landscape, rainwater flows as surface runoff into wetlands from adjacent higher ground (i.e. sheet flow).

In the past as the Mississippi River overtopped its banks, river waters backed up into the floodplain segments of the Uplands tributary channels and entered floodplain lakes. The two principal tributaries that experienced this phenomenon were Cahokia Creek and Prairie DuPont Creek. As the Mississippi River continued rising, water levels in these channels spilled out into the floodplain and inundated adjacent terrestrial areas. During flood events, most of the American Bottoms was under water, and relatively little ground remained dry. Such great events were typically of long duration.

More than 15 tributaries connected the five watersheds (County Ditch, Long Lake, Cahokia, Harding and Powdermill) across the study area. With respect to the Uplands tributaries in the area, Cahokia Creek was considered the primary source of Uplands drainage in the past. Under pre-development conditions, all hillside streams in the study area (with the exception of Powdermill Creek) drained into Cahokia Creek as it meandered through the Bottoms. Cahokia Creek flowed naturally through the Brushy Lake, Horseshoe Lake, and Indian Lake areas, before skirting the northern edge of East St. Louis, and turning south through East St. Louis where it entered the Mississippi River. The original Cahokia Creek channel flowed closer to the Bluffs-line than the man-made Cahokia Canal (built in the 1900's). Little Canteen Creek also flowed through Brushy Lake, as it entered Cahokia Creek. Schoenberger Creek flowed northwesterly out of the Bluffs, through the Crooked Lake and Spring Lake areas, and then westerly to Cahokia Creek (downstream of Indian Lake). Cahokia Creek drains 315 square miles of the Uplands, and two-thirds of the Bottoms, and was subject to frequent inundation and internal ponding. Duration of the flood events in Cahokia Creek was less than that of large Mississippi River floods. Conditions were similar for the other Uplands tributaries, although they contributed less volume yet affected more localized areas. For more information regarding the presettlement conditions of the study area, refer to Section 2 of the PEIS (USACE 2002).

Ongoing Problems the Project is Addressing

Uplands watersheds adjacent to the study area are experiencing rapid residential and commercial development at the onset of this study. In the Cahokia Watershed, for example, projected growth trends suggest more than 75 percent of the available land will be developed in the next 50 years. Harding Watershed's growth trends are somewhat less severe, but still significant – approximately 35 percent of the available land will be developed in the next 50 years. In the Powdermill Watershed, an anticipated loss of 40 percent of the existing open lands is expected to occur within the next 50 years. And in the County Ditch Watershed, a loss of 20 percent of the open areas to development was anticipated over the next 50 years. In the past, land clearing and other factors have led to high rates of soil loss from the Uplands, more intense Uplands runoff, and more frequent overtopping of drainage ditches in the floodplain. At the same time, high rates of sedimentation have caused a significant drain on local community budgets with the burdened operation and maintenance of the drainage system. Sedimentation over the years has eradicated or degraded many existing wetlands and natural water bodies in the Bottoms. Further, the historical conversion of temporary storage basins (e.g., swamps, marshes, and wet prairies located in topographic depressions in the Bottoms) into drainage improvements, agricultural lands, and urban centers has been extensive.

The natural topography of the area is a major factor contributing to storm drainage and flooding problems as well. Both natural and man-made drainage channels have very little slope and are not efficient in moving surface water from either the Bluffs or the Bottoms to reach the outlets into the Mississippi River. Surface water meanders slowly to the Mississippi River or remains in numerous natural depressions. These problems have been exacerbated by the flows from the Bluffs. The flows out of the Bluffs entered the American Bottoms with high velocities and suspended more sediments than slower moving waters. The slower moving surface waters allowed the sediments to aggrade (deposit sediments) in the channels and adjacent lands with overland (out-of-bank) flows.

Although the ESL-ER cannot hope to reverse the urban growth trends or altogether halt the massive flooding events experienced throughout the American Bottoms, the study proposes to slow the waters as they move off the Bluffs areas, trapping sediment in catch basins both in the Uplands and in the Bottoms. Where possible, the ESL-ER proposes to return marshes and wet prairies to the area, thereby increasing the American Bottom's capacity to slow and retain waters in a more controlled setting.

The Ecosystem Restoration Approach

Previous District investigations of the area's problems focused on traditional (man-made) solutions to the region's flooding issues (e.g., levee improvements, pump stations, etc.). The ESL-ER took a different approach and focused on the restoration of the functioning, self-regulating ecosystem by reestablishing a more natural spatial- and temporally variable flow regime or "flood pulse" from the Uplands down into the Bottoms. By definition, an ecosystem can be described as an integrated unit, identified as a biotic community enjoined with its physical environment. Inherent within this definition is the concept of a structural and functional system, unified through life processes. According to Stakhiv et al., an ecosystem is characterized as a viable unit of the community and a interactive habitat (2001). Ecosystems, then, are hierarchical and can be viewed as nested sets of open systems in which the physical, chemical, and biological processes form interactive subsystems. It is important to note that by definition ecosystems can be microscopic in size or can be as large as the biosphere. Thus, ecosystem restoration efforts can be directed at different sized ecosystems within the nested set, spanning multiple states, more localized watersheds (as in the case of the ESL-ER) or smaller complexes of habitat.

The remainder of this document focuses on the Biological Team's assessment of ecosystem restoration success for the ESL-ER. Given the enormous size of the study's scope, the ecosystem was divided into the five watersheds described above (i.e., Cahokia, Harding, Powdermill, Long Lake, and County Ditch) which in turn, were broken into nine manageable "units" referred to as restoration sites throughout the remainder of this analyses. The biotic communities are defined, and the techniques used to assess these communities are described in detail below. The results of these assessments follow in consecutive site-by-site chapters.

E.3. Setting Goals and Objectives

In an attempt to generate quantifiable objectives for the ESL-ER study, the District set out specific ecosystem goals, and developed a series of performance measures to assess the success of the ecosystem restoration designs. This information was, in turn, converted to manageable community-based targets, and linked to the life of the project and the study's target years.

ESL-ER Project Goals

The ESL-ER's primary goal is to restore the presettlement hydrology ("flood pulse") to the project area, thereby increasing the region's biodiversity via the reestablishment of wet prairies, forested wetlands, meandering streams, and marshes. An ESL-ER secondary goal is the improvement of water quality attained by reducing sediment loads in the system, thereby increasing dissolved oxygen levels. A third ESL-

ER goal is the creation, preservation, and restor4ation of natural areas across the region. In addition, the ESL-ER strove to improve stream hydrogeomorphology (e.g., improve stream channel characteristics, restore channel morphology, improve riffle and pool profiles, and reduce the Upland erosion/floodplain deposition dynamic). As a by-product of the restorative efforts proposed in the ESL-ER, the District anticipates an improvement in flood protection across the ecosystem.

To that end, the ESL-ER Biological Team was asked to outline the primary systems or communities within the project area, generate a list of performance measures upon which restoration success could be measured, and select an evaluation tool to measure the success of restoration efforts within these communities. Eight major communities or systems were identified: Uplands Deciduous Forests, Floodplain Deciduous Forests, Wetland Forests, Prairies, Wetlands, Lakes And Ponds, Streams, and Cultural settings.

Ecosystem Assessment Performance Measures

The goal of Civil Works ecosystem restoration activities is to restore significant ecosystem function, structure, and dynamic processes that have been degraded (Stakhiv et al., 2001). Early in the evaluation process, the interagency the Biological Team reviewed the relevant ecosystem problems and the ESL-ER's study goals and objectives. They then generated a list of quantifiable ecosystem restoration success criteria (i.e., performance measures) to gauge the success of the proposed alternatives, and compared these alternatives in an iterative fashion. Specifically, these performance measures focused on the existing habitat quantity and quality, but additionally expanded to incorporate presettlement conditions of the region. First, District developed a list of existing cover types in the region. These included:

CODE	COVER TYPE DESCRIPTION
AGCROP	Agricultural Croplands
CHANNEL	Channels and Rivers
DF	Deciduous Forests
DFBOTTOMS	Deciduous Forests in the Bottoms
DITCH	Man-made Ditches, Channels
FCORRIDOR	Forested Corridors
FIELD	Old Fields, Haylands and Pastures
LACUST	Lacustrine
MARSH	Marshes
PFO	Palustrine Forested Wetlands
PSS	Palustrine Scrub-Shrub Wetlands
STREAMS	Existing Streams Connecting the Floodplain Channels to the Upper Watershed
URBAN	Urban Development, Roads
URBFIELD	Urbanized Old Fields, Haylands and Pastures

Next, the District biologist (Mr. Tim George) described the past cover type conditions prior to European settlement in the area (~ 1800's) (refer to the *Presettlement Ecological Setting Section*). These presettlement cover types were added to the list:

CODE	COVER TYPE DESCRIPTION
PRAIRIE	Prairies (Wet & Dry)
RIPARIAN	Riparian Corridors

Then the project manager (Ms. Deborah Roush) outlined the potential construction activities, and the Biological Team created a list of proposed changes to the cover types. These changes resulted in "newly developed" cover types including:

CODE	COVER TYPE DESCRIPTION
DETENTION	Detention Basins - Degraded Marshes
GRASS	Grass-sloped Sides of Ditches
NEWCHANNEL	Newly Developed Riverine Channels
NEWDITCH	Newly Developed Man-made Ditches, Channels
NEWFCORR	Newly Planted Forested Corridors
NEWMARSH	Newly Planted Marshes
NEWPFO	Newly Planted Forested Wetlands
NEWPFO2	Newly Planted PFO from PSS
NEWRIPAR	Newly Developed Riparian Corridors
PBUFFER	Prairie Buffer Strips
UNDREDGED	Undredged Prairies[1]

With the cover types identified, and their presettlement distributions and quantities revealed, the Biological Team attempted to set quantifiable restoration performance measures for the proposed study. In most instances, these success criteria focused on the recovery of a specific community or land-use patterns, defined on the basis of quantity recovered (measured in acres), and obtainable habitat quality (measured in terms of Habitat Suitability Indices or HSIs) (Table 8).

[1] Undredged prairie cover types are found on the outside or exterior of habitat areas receiving a flood pulse.

Table 8. Goals and objectives per cover type developed by the Biological Team for the habitat assessment of the ESL-ER

CT CODE	COVER TYPE DESCRIPTION	ACRES	QUALITY	NOTES
CHANNEL	Channels and Rivers	19.4	0	2 miles - 5 % of presettlement conditions (note NEWCHANNEL)
DF	Deciduous Forest	-100.0	0	Expect construction to impact a small % of the wooded habitat in the uplands
DFBOTTOMS	Deciduous Forest in the Bottoms	34.3	0	Attempt to maintain existing acreasges - Avoid/minimize
DITCH	Man-made Ditches, Channels	19.1	0.25	No Net Loss
FCORRIDOR	Forested Corridor	79.5	0.5	3 miles - 2/3 NEWFCORR and 1/3 FCORRIDOR
LACUST	Lacustrine	460.1	150%	By Reconnecting floodplain flood pulse - should improve quality of existing habitat by 50% (no net loss)
MARSH	Marsh	375.8	150%	By Reconnecting floodplain flood pulse - should improve quality of existing habitat by 50% (no net loss)
NEWCHANNEL	Newly Developed Riverine Channel	19.4	0.5	40 miles of Presettlement channel - try to restore 10% - 4 miles 1/2 New AND 1/2 Existing restored
NEWDITCH	Newly Developed Man-made Ditches, Channels	42.3	0	1 mile
NEWFCORR	Newly Planted Forested Corridor	159.0	0.5	3 miles - 1/3 FCORRIDOR and 2/3 NEWFCORR
NEWMARSH	Newly Planted Marsh	100.0	0.5	Presettlement conditions didn't distinguish this CT.
NEWPFO	Newly Planted Forested Wetlands	626.7	0.5	
NEWPFO2	Newly Planted PFO from PSS	626.7	0	
NEWRIPAR	Newly Developed Riparian Corridor	159.0	0	
PFO	Palustrine Forested Wetland	626.7	0	Presettlement conditions = 18,800 acres - and 10% will be restored or developed and 1/2 is NEWPFO and 1/2 PFO
PRAIRIE	Prairies (Wet & Dry)	1612.5	0.5	5% of Presettlement Conditions on the Floodplain
PSS	Palustrine Scrub-Shrub Wetlands	147.6	0	Successional declines expected and accepted
RIPARIAN	Riparian Corridor	159.0	0.5	Riparian and New Riparian mimics channel
STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed	956.8	0	No Net Loss

As a general rule, the Biological Team set a goal to develop new areas (i.e., NEWCHANNEL, NEWDITCH, etc.), and restore several existing areas (FCORRIDOR, PFO, and RIPARIAN) to a level of moderate habitat suitability (HSI = 0.5 for any given species) by the end of the project life. In some instances, changes were proposed in various cover type settings (i.e., DFBOTTOMS and CHANNEL) that could produce either a positive or a negative result. In these instances, the Team formulated a "No Net Loss" goal. In other words, the Team assumed that some negative effects might be encountered, but steps would be taken to avoid these impacts if possible. When impacts could not be avoided, the Team attempted to design solutions to minimize the impacts. The Team anticipated the restoration of existing lakes and marshes within the study area boundaries, and set a goal to improve their habitat suitabilities by 50 percent by the end of the project life. At the onset of the project, the Team was aware that two cover types would be impacted either as a direct result of proposed alternatives (as in the case of DF) or as a result of natural succession (i.e., PSS). In the case of the DF cover type, the construction of sedimentation basins in the Uplands was expected to reduce the amounts of deciduous forest in the immediate area. However, the benefits gained in the Bottoms as a direct result of this sedimentation trapping were thought to outweigh the loss of habitat acres in the Uplands. In the case of the PSS cover type, the Biological Team assumed that natural succession (not the project alternatives) would lead to a general decline in palustrine scrub-shrub habitats across the basin.

Documents and cover type maps suggest that more than 40 miles of channel existed in the presettlement era. The Biological Team set a goal to restore 2 miles (~19 acres) of existing channel (CHANNEL), and create an additional 2 miles (~19 acres) of new channel (NEWCHANNEL). Together these efforts would restore approximately 10 percent of the riverine acreages known to exist in the presettlement era. In addition, the Team proposed to preserve the streams connecting the upper watershed to the floodplain (an additional 957 acres). Along the banks of the existing channels and the newly constructed channels, the Team set a goal to restore existing riparian corridors (~159 acres), and create an additional 2 miles (~159 acres) of newly planted riparian corridors (NEWRIPAR). One mile of forested corridor (FCORRIDOR) was identified within the ESL-ER project boundaries. The Team proposed to restore this corridor (~79 acres), and create an additional two miles (~159 acres) of newly planted forested corridor (NEWFCORR) along the new channels. In the Uplands, the Team set a goal to minimize the loss of deciduous forested acres (DF), and proposed a loss of no more than 100 acres of this cover type. Although the Team proposed restoration improvements for existing lacustrine habitats, no new lakes were proposed. The presettlement documents did not distinguish a marshland habitat exclusively, so the Team set a goal to restore existing marshes (MARSH), and develop an additional 100 acres of newly planted marshlands (NEWMARSH). In order to channel the waters from the Uplands to these newly planted marshes, the Team set a goal to construct a one-mile ditch system with moderate habitat suitability (~42 acres of NEWDITCH). Documents and maps further suggest that more than 18,000 acres of forested and shrubby wetlands existed in the presettlement era. The Team set the goal to restore 10 percent of these forested habitats, namely PFO, NEWPFO, and NEWPFO2 (~ 626 acres per cover type). More than 16,125 acres of wet and dry prairies were known to exist in the presettlement conditions of the area. The Team set the goal to restore and create 10 percent of these acreages (1,612 acres of PRAIRIE).

Communities Targeted in the Ecosystem Restoration Effort

To simplify the goals defined above, the Biological Team redefined the previously described goals set out in the section above into primary community groups based on White and Madany's Illinois state natural community classification scheme (1978). This effort facilitated the selection of appropriate HEP models, and assisted in the development of new HGM models. The eight communities, and their associated cover types, can be found in Table 9 below.

Table 9. Primary communities within the ESL-ER boundary and their associated cover types

PRIMARY COMMUNITIES	ASSOCIATED COVER TYPES
UPLANDS DECIDUOUS FORESTS	DF
FLOODPLAIN DECIDUOUS FORESTS	DFBOTTOMS
WETLAND FORESTS	PFO NEWPFO NEWPFO2 FCORRIDOR NEWFCORR RIPARIAN NEWRIPAR
PRAIRIES	PRAIRIE PBUFFER UNDREDGED
WETLANDS	MARSH NEWMARSH DETENTION PSS
LAKES AND PONDS	LACUST
STREAMS	CHANNEL NEWCHANNEL DITCH NEWDITCH STREAMS
CULTURAL	FIELD URBFIELD

In terms of quantifiable objectives for these community designations, the Biological Team combined the cover type acreages per community category to develop an acreage objective. In terms of quality objectives, the Biological Team made the decision to set a minimum threshold (HSIs = 0.5) for the majority of the community categories (Table 10).

Table 10. Goals and objectives per community developed by the Biological Team for the habitat assessment of the ESL-ER

PRIMARY COMMUNITIES	ASSOCIATED COVER TYPES	ACRES	QUALITY
UPLANDS DECIDUOUS FORESTS	DF	-100.0	0.5
FLOODPLAIN DECIDUOUS FORESTS	DFBOTTOMS	34.3	0.5
WETLAND FORESTS	PFO NEWPFO NEWPFO2 FCORRIDOR NEWFCORR RIPARIAN NEWRIPAR	2436.5	0.5
PRAIRIES	PRAIRIE PBUFFER UNDREDGED	1612.5	0.5
WETLANDS	MARSH NEWMARSH DETENTION PSS	475.8	0.5
LAKES AND PONDS	LACUST	460.1	+50%
STREAMS	CHANNEL NEWCHANNEL DITCH NEWDITCH STREAMS	1057.1	0.5
CULTURAL	FIELD URBFIELD	0.0	0.5

Although the Team had not selected models at this point, they made an effort to address multi-cover type model outputs by setting rules for data handling and management. For example, the Team made the decision to review the overall results of the multi-cover type model assessments at an overall annualized unit level, at an overall HSI level, and at an individual cover type HSI (CT HSI) level. The Team decided to weight all CT HSI scores by relative area to capture each model's contribution to the overall community outputs.

Selection of a Project Life and Target Years

Given these goals and objectives, the District designated a "Project Life" of 50 years for the ESL-ER, and asked the Biological Team to develop a series of Target Years within this 50-year setting to generate projections of both Without Project and With Project activities. Target years for the ESL-ER therefore included TY0 (Baseline Conditions), TY1 (Year of Construction) and TY51 (End of Project) to capture this 50-year span. Between TY1 and TY51, the Biological Team opted to add two TYs (TY11 and TY21) to capture significant anticipated changes in vegetative cover and structure in the study area.

E.4. Cover Typing

To evaluate the habitat conditions for a species or community using HEP, the study area is divided into manageable sections and quantified in terms of hectares or acres. This process is known as cover typing. A cover type in HEP is a parcel of land (or water) that has similar physical, chemical, and biological characteristics contained within its borders. Cover typing includes defining the differences between vegetative covers (e.g., tall grass prairie, forested wetlands, shrub lands, lakes, and streams, etc.), and clearly delineating these distinctions on a map. The quality of each cover type for the selected species or community is determined by measuring individual species-definitive variables within the site. Some examples of HEP variables can include the amount of herbaceous cover, the distance to water, the number of pools, the height of grass, and/or the percent of canopy cover within a given cover type. In most instances, these variables are measured using aerial photographs, maps and/or onsite sampling activities.[2]

Once the Biological Team identified the various ESL-ER communities and their associated cover types, the District undertook a massive effort to cover type each restoration area. The respective cover types and their associated acres are documented fully in the following chapters, but a summary of the acres affected per site per watershed, and the total acres evaluated in this study, can be found below in Table 11.

[2]For more information regarding sampling techniques, increasing the efficiency of a HEP analysis, and/or reducing the effort necessary to complete an analysis refer to Wakeley and O'Neil (1988) and the subsequent references therein.

Table 11. Cover types and acreages for the five watersheds in the ESL-ER study area

Code	Description	Watersheds					Total
		County Ditch	Long Lake	Cahokia	Harding	Powdermill	
DF	Deciduous Forests	16.24	0.00	281.18	136.71	59.13	493
MARSH	Marshes (Herbaceous Emergent Wetlands)	0.00	2.40	378.69	70.85	0.00	452
LACUST	Lacustrine	0.00	2.00	88.83	53.62	227.43	372
CHANNEL	Channels and Rivers	33.50	0.00	34.75	0.00	3.40	72
PFO	Palustrine Forested Wetlands	0.00	2.80	256.97	117.19	44.85	422
PSS	Palustrine Scrub-Shrub Wetlands	0.00	7.50	179.84	49.53	1.31	238
URBAN	Urban Development, Roads	21.20	0.40	71.96	155.84	0.00	249
AGCROP	Agricultural Croplands	275.30	60.50	1215.54	168.16	31.00	1751
FIELD	Old Fields, Haylands and Pastures	0.00	0.00	0.00	537.55	0.00	538
PRAIRIE	Prairies (Wet & Dry)	0.00	0.00	25.10	0.00	0.00	25
PBUFFER	Prairie Buffer Strips	0.00	0.00	0.00	0.00	0.00	0
RIPARIAN	Riparian Corridors	76.00	0.00	212.10	0.00	0.00	288
FCORRIDOR	Forested Corridors	0.00	0.00	5.00	0.00	0.00	5
UNDREDGED	Undredged Prairies - Exterior	0.00	0.00	0.00	0.00	0.00	0
DETENTION	Detention Basins (with Degraded Marsh Inside)	0.00	0.00	0.00	0.00	0.00	0
NEWPFO	Newly Planted Forested Wetlands	0.00	0.00	0.00	0.00	0.00	0
GRASS	Grass-sloped Sides of Ditches	4.30	7.20	35.30	68.90	4.24	120
NEWCHANNEL	Newly Developed Riverine Channels	0.00	0.00	0.00	0.00	0.00	0
NEWMARSH	Newly Planted Marshes (HEW)	0.00	0.00	0.00	0.00	0.00	0
NEWFCORR	Newly Planted Forested Corridors	0.00	0.00	0.00	0.00	0.00	0
DFBOTTOMS	Deciduous Forests in the Bottoms	0.00	0.00	35.56	4.18	0.00	40
URBFIELD	Urbanized Old Fields, Haylands and Pastures	0.00	0.00	0.00	128.51	0.00	129
NEWRIPAR	Newly Developed Riparian Corridors	0.00	0.00	0.00	0.00	0.00	0
NEWPFO2	Newly Planted PFO from PSS	0.00	0.00	0.00	0.00	0.00	0
DITCH	Man-made Ditches, Channels	2.60	0.20	5.85	7.75	0.00	16
NEWDITCH	Newly Developed Man-made Ditches and Channels	0.00	0.00	0.00	0.00	0.00	0
STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed	28.82	0.00	587.42	279.58	61.01	957
	TOTALS:	458	83	3414	1778	432	6166

E.5. Selecting and Modifying the HSI Models

A workshop was convened in March of 1999 to review and select HSI models for the ESL-ER study. Prior to this meeting, the District compiled a list of existing cover types, and generated a list of potential restoration actions with accompanying cover types, to facilitate the models selection process. Seven distinct communities were identified as a result of this effort (i.e., marshes, wetland forests, deciduous forests, shrublands, lakes, channels, and prairies). In addition, the District compiled lists of known regional species including mammals, birds, reptiles, amphibians, fish, and plants (for more details regarding species lists, refer to Section 3 in the PEIS) (USACE 2002). Together these lists were used to narrow the choices of available HSI models, and focus the selection on critical community dynamics across the ecosystem.

Review of Potential HSI Models for the Study

In an attempt to streamline the HEP process, EL facilitators presented the Biological Team with a list of 21 potential HSI models selected primarily on the basis of each geographic range and cover type applicability. Comprised entirely of published USFWS "Blue Book " models, EL used the District's species list to further narrow the selection options (Table 12).

Table 12. List of potential HSI models considered for the ESL-ER study

HSI Blue Book Titles	FWS/OBS Report #	Author(s) and Date of Publication ( )
MAMMALS		
Beaver	82(10.30)	Allen (1982a)
Fox Squirel	82(10.18)	Allen (1982b)
Eastern Cottontail	82(10.66)	Allen (1984)
Mink (Revised)	82(10.127)	Allen (1986)
Gray Squirrel (Revised)	82(10.135)	Allen (1987a)
REPTILES		
Snapping Turtle	82(10.141)	Graves and Anderson (1987)
Slider Turtle	82(10.125)	Morreale and Gibbons (1986)
WATERFOWL / SHORE BIRDS		
American Coot	82(10.115)	Allen (1985)
Mallard (Wintering) (Lower Miss Valley)	82(10.132)	Allen (1987b)
Great Blue Heron	82(10.99)	Short and Cooper (1985)
Wood Duck	82(10.43	Sousa and Farmer (1983)
SONGBIRDS		
Brown Thrasher	82(10.118)	Cade (1986)
Marsh Wren	82(10.139)	Gutzwiller and Anderson (1987)
Yellow-headed Blackbird	82(10.26	Schroeder (1982a)
Yellow Warbler	82(10.27	Schroeder (1982b)
Downy Woodpecker	82(10.38	Schroeder (1983)
Eastern Meadowlark	82(10.29	Schroeder and Sousa (1982)
Red-winged Blackbird	82(10.95)	Short (1985)
Veery	82(10.22	Sousa (1982)
Field Sparrow	82(10.62	Sousa (1983)
Hairy Woodpecker	82(10.146)	Sousa (1987)
Riverine Communities		
Qualitative Habitat Evaluation Index (QHEI)	NA	Rankin (1989)

Initially, each Team member was asked to choose and provide justification for the application of three terrestrial HSI models that captured the proposed restoration efforts in the terrestrial communities (i.e., in the marshes, wetland forests, deciduous forests, and shrublands systems). EL facilitators tallied votes, and the models were ranked on the basis of votes. Next, the Team associated the models with each community, and discussed relationships among species and their cover type associations (Table 13).

Table 13. Potential HSI models in the ESL-ER and their associations to ESL-ER communities

	Applicable HSI Models	UPLANDS DECIDUOUS FORESTS	FLOODPLAIN DECIDUOUS FORESTS	WETLAND FORESTS	PRAIRIES	WETLANDS	LAKES AND PONDS	STREAMS
MAMMALS	Beaver			x		x	x	x
	Fox Squirel	x	x					
	Eastern Cottontail	x	x		x			
	Mink (Revised)	x	x	x		x	x	x
	Gray Squirrel (Revised)	x	x	x				
REPTILES	Snapping Turtle			x		x	x	x
	Slider Turtle			x		x	x	x
WATERFOWL & SHORE BIRDS	American Coot					x	x	x
	Mallard (Wintering) (Lower Miss Valley)			x		x	x	x
	Great Blue Heron	x	x	x		x	x	x
	Wood Duck	x	x	x		x		x
SONGBIRDS	Brown Thrasher	x	x		x			
	Marsh Wren					x		
	Yellow-headed Blackbird					x		
	Yellow Warbler					x		
	Downy Woodpecker	x	x	x				
	Eastern Meadowlark				x			
	Red-winged Blackbird					x		
	Veery	x	x					
	Field Sparrow				x			
	Hairy Woodpecker	x	x	x				
FISH	Black Crappie							x
	White Crappie						x	
RIVERINE	Qualitative Habitat Evaluation Index (QHEI)							x

HSI Model Selections

Ultimately, the Team narrowed their selection to six species-based HSI models:

1) Fox Squirrel (*Sciurus niger*) (Allen 1982b)
2) Mink (*Mustela vison*) (Allen 1986)
3) Slider Turtle (*Pseudemys scripta*) (Morreale and Gibbons 1986)

4) Great Blue Heron (*Ardea herodias L.*) (Short and Cooper 1985)
5) Wood Duck (*Aix sponsa*) (Sousa and Farmer 1983)
6) Marsh Wren (*Cistothorus palustri*) (Gutzwiller and Anderson 1987).

Next, the Team asked IDNR's fish biologist (Mr. Randy Sauer) to offer some suggestions for aquatic models. In the end, two species were offered as "good" representatives for the study on the basis of restorative need and cover type association. The first was associated with the channel and stream communities evaluated in the study:

7) Black Crappie (*Poxmoxis nigromaculatus*) (Edwards et al. 1982a),

and the second was associated with deep-water habitats in the study area:

8) White Crappie (*Poxmoxis anularis*) (Edwards et al. 1982b).

It should be noted here, that restoration of the "Prairies" community was not a primary focus of the original ESL-ER study, and was not included in the initial model selection process, but became a focus in the winter of 1999. At that time, the Team reviewed the list of available prairie-based HSI models developed by the USFWS, and selected the following representative species:

9) Eastern Meadowlark (*Sturnella magna*) (Schroeder and Sousa 1982).

Although the Team had always assumed the streams connecting the floodplain to the upper watersheds would be preserved and protected under the proposed plans, technical reviewers suggested a HEP value be placed on these systems to support this assumption. In the summer of 2003, the Team added a tenth model to the analysis to quantify and characterize these communities:

10) Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989, Chagrin Water Institute website 2000, Cleveland State University website 2000, Ohio State University website 2001).

Justifications for these 10 model selections ranged from faunal group representation (i.e., two mammals, two fishes, one amphibian, two waterfowl, etc.) to public awareness issues including the public's interest in game species populations (e.g., the wood duck, fox squirrel, and mink). Furthermore, these models were selected on the basis of their representation of ongoing critical ecosystem processes. For example, the great blue heron HSI model, as well as both the black and white crappie HSI models, all contained variables measuring water quality conditions (i.e., dissolved oxygen, water temperature, and pH) and sedimentation deposition reduction efforts (i.e., turbidity and overall water clarity). The marsh wren and mink models were selected because they captured functions such as surface water storage monitoring (i.e., water regime, water depth) and species diversity changes (i.e., dominant growth forms, and both tree and shrub canopy coverage). Of course, the primary function the selected HSI models evaluated was the maintenance of plant and wildlife communities across the East St. Louis ecosystem.

Detailed information regarding each of the HSI models selected above can be found in Appendix A. Similarly, detailed information regarding the FCI models for the two-wetland subclasses can be found in Appendix B. It is important to note the associations among models and cover types in the field (Table 14) and the community representatives (Table 15).

Table 14. Cover type crosswalks among HSI models selected for the ESL-ER habitat assessment

Cover Type/PWAA Descriptions			HEP Crosswalks Species Applicability									
ID#	CT Code	Cover Type Description	Black Crappie	Eastern Meadowlark	Fox Squirrel	Great Blue Heron	Marsh Wren	Mink	Slider Turtle	White Crappie[1]	Wood Duck	QHEI
1	DF	Dry Deciduous Forest			0						0	
2	MARSH	Herbaceous Emergent Wetlands				0	0	0	0		0	
3	LACUST	Lacustrine				0		0	0	0		
4	CHANNEL	Riverine Channels	0			0		0	0		0	
5	PFO	Palustrine Forested Wetlands				0		0	0		0	
6	PSS	Palustrine Scrub-Shrub Wetlands				0	0	0	0		0	
7	URBAN	Urban Development, Roads, Lawns										
8	AGCROP	Agricultural Croplands										
9	FIELD	Old Fields, Haylands, Pastures		0								
10	PRAIRIE	Wet & Dry Prairie		0								
11	PBUFFER	Prairie Buffer Strip		0								
12	RIPARIAN	Riparian Corridor				0		0	0		0	
13	FCORRIDOR	Forested Corridor				0		0	0		0	
14	UNDREDGED	Undredged Prairie -- Exterior		0								
15	DETENTION	Herbaceous Marsh inside a Detention Basin				0	0	0	0		0	
16	NEWPFO	Newly Planted Forested Wetlands				0		0	0		0	
17	GRASS	Grass-sloped sides of ditches							0			
18	NEWCHANNEL	Newly Developed Channel	0			0		0	0		0	
19	NEWMARSH	Newly Planted Herbaceous Emergent Wetland				0	0	0	0		0	
20	NEWFCORR	Newly Planted Forested Corridor				0		0	0		0	
21	DFBOTTOMS	Deciduous Forest in Bottoms			0							
22	URBFIELD	Urbanized Old Fields, Haylands, Pastures (FEMA Buy-Out Lands)		0								
23	NEWRIPAR	Newly Developed Riparian Corridor				0		0	0		0	
24	NEWPFO2	Newly Planted Palustrine Forest from Palustrine Scrub-Shrub (PSS)				0		0	0		0	
25	DITCH	Man-made Ditches, Channels	0			0		0	0		0	
26	NEWDITCH	Newly Developed Man-made Ditches, Channels	0			0		0	0		0	
27	STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed										0
	TOTAL COVER TYPES / SPECIES		4	5	2	16	4	16	17	1	16	1

Footnotes:
[1]Applicable only to Mullens Slough, LACUST Cover Type

Table 15. Final HSI models selected for the ESL-ER and their associations to ESL-ER communities

Applicable HSI Models		UPLANDS DECIDUOUS FORESTS	FLOODPLAIN DECIDUOUS FORESTS	WETLAND FORESTS	PRAIRIES	WETLANDS	LAKES AND PONDS	STREAMS
MAMMALS	Beaver			x		x	x	x
	Fox Squirel	x	x					
	Eastern Cottontail	x	x		x			
	Mink (Revised)	x	x	x		x	x	x
	Gray Squirrel (Revised)	x	x	x				
REPTILES	Snapping Turtle			x		x	x	x
	Slider Turtle			x		x	x	x
WATERFOWL & SHORE BIRDS	American Coot					x	x	x
	Mallard (Wintering) (Lower Miss Valley)			x		x	x	x
	Great Blue Heron	x	x	x		x	x	x
	Wood Duck	x	x	x		x		x
SONGBIRDS	Brown Thrasher	x	x		x			
	Marsh Wren					x		
	Yellow-headed Blackbird					x		
	Yellow Warbler					x		
	Downy Woodpecker	x	x	x				
	Eastern Meadowlark				x			
	Red-winged Blackbird					x		
	Veery	x	x					
	Field Sparrow				x			
	Hairy Woodpecker	x	x	x				
FISH	Black Crappie							x
	White Crappie						x	
RIVERINE	Qualitative Habitat Evaluation Index (QHEI)							x

Life History Characteristics, Associations, and Guilds

The selected HSI models share life history characteristics, namely the need for permanent and semi-permanently flooded wetlands to support life requisites such as food, cover, and reproduction. In addition, three models (i.e., marsh wren, eastern meadowlark, and great blue heron) are considered Single Formula Models, and are associated directly with the proposed wetland improvements and developments in the study's construction plans. The black crappie and white crappie were also considered Single Formula Models because only one of the Life Requisites was evaluated for each fish species (i.e., water quality for the black crappie and cover for the white crappie). The fox squirrel, mink, slider turtle, and wood duck models are considered Multiple Formula Models, and consider the juxtaposition of woody vegetation and marsh crucial to habitat suitability.

HSI Model Sensitivity and Limiting Characteristics

The HSI models selected for the ESL-ER habitat assessment are responsive to changes in marshes, forested wetlands, prairies, rivers, lakes, and deciduous forested Uplands. The models will be particularly sensitive to changes in vegetative cover, water regimes, and species diversity. In addition, two models (i.e., marsh wren and wood duck) are known to have minimum habitat areas. If the project's With Project condition cannot meet this minimum requirement, and connectivity among the proposed project's sites is removed or unavailable, the habitat suitability for the marsh wren and wood duck is unattainable, and the site will be assigned an HSI = 0.00. For more details, refer to Appendix A.

HSI Model Modifications

The study area is heavily impacted by urbanization and human disturbance, which led the Team to modify the HSI species models from their original USFWS version for more natural conditions. Modifications to the models are summarized below.

1) A "Human Factor" was added to each model to adjust HSIs from the original model equations designed to mimic "urbanized" conditions. The "Human Factor" was applied to the HSI equation for Single Formula Models and to each Life Requisite SI equation for Multi Formula Models. The "Human Factor" consists of two variables: HUMANTYPE and HUMAN. HUMANTYPE refers to the type of Human disturbance present. HUMAN** refers to the disturbance-free zone (measured in meters), and was based on an escape factor for each species. Human interference within the zone decreases the suitability of the habitat. This zone was determined to be different for each

species, and thus, an independent relationship for each species was defined. Exceptions to the "Human Factor" are the white crappie, black crappie, and great blue heron. The great blue heron model has a distance to human disturbance variable in the original model, so only HUMANTYPE was added. The fish species (white and black crappie) were assumed not to be impacted by human disturbance, and thus, the variables were not added to their HSI formulas.

2) The great blue heron model had several modifications based on the amount of human disturbance in the study area and the tolerance of the species to the disturbance. The first of these modifications was for distance to human disturbance variable in the original USFWS model. The model uses a different SI curve for distance to human disturbance depending on whether the disturbance is on land or water. Thus for the purpose of the EXHEP software, this variable was separated into two variables: DISTURB100 and DISTURB250, to represent the distance to land disturbance and the distance to water disturbance, respectively. Second modification was for variables that dealt with distance to nest sites and/or heronries (NESTDIST and HERONRY). Members of the Biological Team acknowledged that the herons in the area were known to travel greater distances than the description in the USFWS original model. Thus, these curves were modified to incorporate longer travel distances. Third modification was for the TREE250 variable; this was a variable that would remain constant throughout the evaluation, and so it was dropped from the evaluation.

3) Only the Water Quality Life Requisite was used for the black crappie due to the assumption that the proposed action will affect only Water Quality, thus only evaluate impacts from the proposed action.

4) Lacustrine cover was present only at the Mullens Slough site, and there were no proposed alternatives to create lakes. Therefore, white crappie was evaluated only at the Mullens Slough site. Only the Cover Life Requisite was used due to the assumption that the proposed actions will only affect potential cover. The percentage Littoral area variable was replaced with depth of deep pools (POOLDEPTH) to account for overwintering habitat.

5) As its name implies, the QHEI was not originally intended for use in a quantitative habitat evaluation assessment process. Many parameters in the original model were scaled to produce results ranging from –2 to +2 (Rankin 1989). The primary tenet of the HSI modeling process is its suitability score, which ranges from 1.0 (optimal conditions) to 0.00 (unsuitable) values. In order to use the QHEI model within the HEP

framework, it was necessary to modify the model's parameters to meet the rigid 0-1 HSI scale. The EL HEP certified biologists were responsible for modifying the model.

For more detailed information on model modifications, variable curves, and model formulas, refer to Appendix A.

E.6. Selecting and Modifying the FCI Models

Unlike HSI models, FCI models for HGM subclasses are only just beginning to become available for application. At the time of this study, very few HGM subclass models were published for distribution. EL was leading a research work unit under the Ecosystem Management and Restoration Research Program (EMRRP) for the development of HGM subclass models. After several interviews with District personnel regarding the wetland subclasses existing in the study area, EL facilitators identified the need to develop five subclass models: Connected Depressions, Isolated Depressions, Riverine Overbank, Flats, and Fringe.

Due to time constraints, the EL facilitators focused on the development of two HGM subclass models for evaluation: Connected Depressions and Isolated Depressions. As the development process required three years to complete, the Team realized they would not have time to develop and apply the two models across the suite of sites and alternatives. Therefore, the District made the decision to "test" the efficacy of the two models at only three sites: Brushy Lake, Elm Slough, and Elm Slough. The District did not base any decisions on the outcome of the HGM analyses, but rather used the results to support the HEP analyses.

Initially, each team member was asked to identify wetland functions they deemed important to the success of the wetland subclasses. EL facilitators tallied votes, and the functions were ranked on the basis of votes. Seven functions were identified for the two HGM subclass models:

1) Floodwater Detention (Connected Depressions subclass only),
2) Surface Water Storage (Isolated Depressions subclass only),
3) Internal Nutrient Cycling,
4) Organic Carbon Export (Connected Depressions subclass only),
5) Remove and Sequester Elements and Compounds (Connected Depressions subclass only),
6) Maintain Characteristic Plant Community, and
7) Wildlife Habitat Maintenance.

These FCI models were selected on the basis of their representation of ongoing critical ecosystem processes within each wetland subclass. Based on Clairain's report (draft), both depression subclass models were associated with palustrine emergent and palustrine scrub-shrub, forested, and wet prairie habitats. It is important to note the associations among models and cover types in the field (Table 16).

Table 16. PWAA crosswalks among FCI models selected for the ESL-ER habitat assessment

PWAA Descriptions			HGM Crosswalks Functions Applicability: Connected & Isolated Depressions						
ID#	PWAA Code	PWAA Descriptions	Fxn1: Floodwater Detention [1]	Fxn2: Surface Water Storage [2]	Fxn3: Nutrient Cycling	Fxn4: Organic Carbon Export [1]	Fxn5: Remove & Sequester Elements & Compounds [1]	Fxn6: Plant Characterisitic Maintenance	Fxn7: Wildlife Habitat Maintenance
1	DF	Dry Deciduous Forest							
2	MARSH	Herbaceous Emergent Wetlands	1	1	1	1	1	1	1
3	LACUST	Lacustrine							
4	CHANNEL	Riverine, Channels							
5	PFO	Palustrine Forested Wetlands	1	1	1	1	1	1	1
6	PSS	Palustrine Scrub-Shrub Wetlands	1	1	1	1	1	1	1
7	URBAN	Urban Development, Roads, Lawns							
8	AGCROP	Agricultural Croplands							
9	FIELD	Old Fields, Haylands, Pastures	1	1	1	1	1	1	1
10	PRAIRIE	Wet & Dry Prairie	1	1	1	1	1	1	1
11	PBUFFER	Prairie Buffer Strip	1	1	1	1	1	1	1
12	RIPARIAN	Riparian Corridor	1	1	1	1	1	1	1
13	FCORRIDOR	Forested Corridor	1	1	1	1	1	1	1
14	UNDREDGED	Undredged Prairie -- Exterior							
15	DETENTION	Herbaceous Marsh inside a Detention Basin	1	1	1	1	1	1	1
16	NEWPFO	Newly Planted Forested Wetlands							
17	GRASS	Grass-sloped sides of ditches							
18	NEWCHANNEL	Newly Developed Channel							
19	NEWMARSH	Newly Planted Herbaceous Emergent Wetland	1	1	1	1	1	1	1
20	NEWFCORR	Newly Planted Forested Corridor							
21	DFBOTTOMS	Deciduous Forest in Bottoms							
22	URBFIELD	Urbanized Old Fields, Haylands, Pastures (FEMA Buy-Out Lands)							
23	NEWRIPAR	Newly Developed Riparian Corridor	1	1	1	1	1	1	1
24	NEWPFO2	Newly Planted Palustrine Forest from Palustrine Scrub-Shrub (PSS)	1	1	1	1	1	1	1
25	DITCH	Man-made Ditches, Channels							
26	NEWDITCH	Newly Developed Man-made Ditches, Channels							
27	TOTAL COVER TYPES / SPECIES		12	12	12	12	12	12	12

Footnotes:
[1] Applicable to Connected Depressions only
[2] Applicable to Isolated Depressions only

Next, EL associated the models with each community, and discussed relationships among functions and their PWAA associations (Table 17).

Table 17. Draft FCI models for the ESL-ER and their associations to ESL-ER communities

Applicable FCI Models		UPLANDS DECIDUOUS FORESTS	FLOODPLAIN DECIDUOUS FORESTS	WETLAND FORESTS	PRAIRIES	WETLANDS	LAKES AND PONDS	STREAMS
CONNECTED DEPRESSIONS	Fxn 1: Floodwater Detention			x	x	x		
	Fxn 3: Internal Nutrient Cycling			x	x	x		
	Fxn 4: Organic Carbon Export			x	x	x		
	Fxn 5: Remove and Sequester Elements and Compounds			x	x	x		
	Fxn 6: Maintain Characteristic Plant Community			x	x	x		
	Fxn 7: Wildlife Habitat Maintenance			x	x	x		
ISOLATED DEPRESSIONS	Fxn 2: Surface Water Storage			x	x	x		
	Fxn 3: Internal Nutrient Cycling			x	x	x		
	Fxn 6: Maintain Characteristic Plant Community			x	x	x		
	Fxn 7: Wildlife Habitat Maintenance			x	x	x		

E.7. Conducting the Field Sampling

Basic site characterization and data collection are the first steps in inventorying an ecosystem restoration site (USACE 2000; Fischenich 1999). Characterization for the ESL-ER included gathering data on water quality, geochemistry, hydrology, fluvial geomorphology, substrate conditions, flora, and fauna, and to the greatest extent possible, identifications of underlying stressors in the region. In particular, land-use activities, physical habitat alterations, and invasive species were identified. In addition to the physical and chemical characteristics of the study area, land ownership and regulatory jurisdictions played an important role in determining opportunities for restoration. Much of this information was geographically based, and thus was stored in a Geographic Information System. As part of the basic site characterization, historical data on landscape-scale habitat conditions, land-use characteristics and ownership patterns was collected as well. Site- and landscape-level data were collected in the spring and fall of 1999. Historical data was obtained and reviewed over the winter of 1999. These datasets, in turn, were used to characterize the baseline conditions of the ESL-ER study area.

Several members of the ESL-ER Biological Team participated in the field sampling efforts initiated in the early spring months of 1999 and continuing on through the summer of 2003. The 37-member field crew (facilitated by the EL) included members from 10 separate Federal, State, and local agencies, as well as volunteers from the local community, and experts from nearby universities (* indicates Biological Team member):

St. Louis District
Mr. Timothy George*
Ms. Debbie Roush*
Mr. Ward Lenz
Mr. Charles Frerker
Ms. Kathrine Kelley
Mr. David Baum
Mr. John Cannon
Mr. Rich Chiles
Ms. Kathrine Kelley
Mr. Craig Litteken
Mr. Lynn Neher
Mr. Francis Walton

U.S. Fish and Wildlife Service, Marion
Mr. Steve Schacht*

U.S. Environmental Protection Agency, Chicago
Dr. Mary White*

Natural Resources Conservation Service
Ms. Ellen Starr*, Vienna
Ms. Donna Beauchamp, Belleville
Mr. Jerry Berning, Edwardsville
Mr. Matt McCauley, Benton

Illinois Department of Natural Resources, Springfield
Mr. Pat Malone*

Illinois Department of Transportation, Springfield
Mr. Charles Perino
Ms. Bridgett Calhoun, Collinsville
Ms. Jane Farrington, Collinsville
Mr. Thomas Brooks, Springfield
Ms. Amy Karhliker, Springfield
Mr. Charles Perino, Springfield

Illinois Natural History Survey, Champaign
Ms. Mary Cooprider
Mr. Dennis Keene
Mr. David Ketzner
Dr. Allen Plocher
Mr. Paul Tessene
Ms. Alicia Admiraal
Ms. Mary Ann Feist
Mr. Richard Larimore
Mr. Scott Wiesbrook
Mr. Brian Wilm

Illinois State Geological Survey, Champaign
Mr. Michael Miller
Biotic Consultants, Inc.
Dr. Robert Mohlenbrock
Private Landowner
Mr. Glenn Schuetz

ERDC Environmental Laboratory
Ms. Kelly Burks-Copes
Ms. Antisa Webb
Mr. Ellis Clairain

Variables Measured in the Field

A total of 35 HSI variables were measured during the field sampling effort. Ranging from measurements of vegetative cover to the identification of specific vegetative species, the sampling effort on 50-m transects could be completed efficiently. These variables are described in detail in Table 18 below. A total of 13 FCI variables were below. Variables were sampled according to protocols listed in these tables.

Table 18. HSI variables measured in the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
AMTINSTRM	The Amount of the Stream Characterized by In-Stream Cover (%)	Over bank, within 1 m of bank, 1-m^2 quadrats, record percent NOT class Class Data: Nearly absent < 5 percent Sparse 5 - 25 percent Moderate 25 - 75 percent Extensive > 75 percent	Rivers and Streams (QHEI)	STREAMS	Transect, Quadrat
AVGHTHERB	Avg Height of Herbaceous Canopy (Average Spring Conditions)	Every 10 m on 50-m transect lay down quadrat and measure with meter stick the average height of herbaceous canopy in the Spring (measure in cm)	Eastern Meadowlark	PRAIRIE FIELD	Transect, Quadrat
BROODCOVER	Percent of Water Surface Covered by Potential Brood Cover	Every 10 m on 50-m transect use quadrat to measure percent of water's surface covered by Brood Cover; Brood Cover = shrub cover, overhanging tree crowns within 1 m of the water's surface, wood downfall, and herbaceous vegetation	Wood Duck	PFO PSS MARSH CHANNEL RIPARIAN FCORRIDOR DITCH	Transect, Quadrat and Visual Estimate
DEPTHPOOLS	Maximum Depth of Pools (m)	Using a 100-m transect, use 1-m^2 quadrat measure center using meter stick - if > 1 m, record >1 m	Rivers and Streams (QHEI)	STREAMS	Transect
DEPTHRIFFL	Depth of Riffles and Runs (cm)	Belt transect, measure 30 riffles, in middle of stream Class Data: 1 = Riffle/Run depth > 10 cm; Max > 50 cm 2 = Riffle/Run depth > 10 cm; Max < 50 cm 3 = Riffle/Run depth = 5 - 10 cm 4 = Riffle/Run depth < 5 cm (Riffle = 0)	Rivers and Streams (QHEI)	STREAMS	Transect
EMBEDED	Degree to Which Cobble and Rocks are Stuck in the Stream	Record point and record as class Class Data: 1 = Extensive 2 = Moderate 3 = Normal 4 = None	Rivers and Streams (QHEI)	STREAMS	Transect

Table 18. (cont.) HSI variables measured in the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
EMERGCAN	Percent Canopy Cover of Emergent Herbaceous Vegetation	Every 10 m on 50-m transect measure percent of the water surface shaded by a vertical projection of the emergent canopy cover, both persistent and non-persistent	Marsh Wren Mink	MARSH PSS DF DFBOTTOMS FCORRIDOR PFO RIPARIAN	Transect, Quadrat
EROSNPOTNT	Permanence and Erosion Potential of the Stream Banks	Record point and record as class Class Data: 1 = High 2 = Moderate 3 = Low	Rivers and Streams (QHEI)	STREAMS	Transect
EROSNBANK	Degree of Erosion Present on Each Bank	Class Data: 1 = None/Little 2 = Moderate 3 = Heavy/Severe	Rivers and Streams (QHEI)	STREAMS	Transect
GRAIN	Distance to Available Grain (m)	Ocular estimate of the linear distance from sample point to grain corps - every 10 m on 50-m transect (measure in m)	Fox Squirrel	DF DFBOTTOMS	Transect, Visual Estimate
GRASS	Proportion of Herbaceous Canopy Cover that is Grass	Every 10 m on 50-m transect lay down quadrat and measure percent herbaceous canopy cover that is grass	Eastern Meadowlark	PRAIRIE FIELD	Transect, Quadrat
GROWTHFORM	Growth Form of Emergent Hydrophytes	Class Data: 1 = Cattails, cordgrasses, bulrushes 2 = Bluejoint reedgrass, reed canary grass, sedges 3 = buttonbush, mangrove 4 = other growth forms not listed	Marsh Wren	MARSH PSS	Transect, Quadrat and Visual Estimate
HDTREECAN	Percent Tree Canopy Closure - Hard Mast Only	Measure Hard Mast tree crown diameters every 10 m on 50-m transect Trees must be > 10" dbh	Fox Squirrel	DF DFBOTTOMS	Transect, Optic Tube

Table 18. (cont.) HSI variables measured in the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
HERBCAN	Percent Herbaceous Canopy Cover	Every 10 m on 50-m transect lay down quadrat and measure percent herbaceous canopy cover	Eastern Meadowlark	PRAIRIE FIELD	Transect, Quadrat
HUMAN	Distance to Human Disturbance (m)	Distance to potential human activity measured at beginning of transect and end of transect. Human activity includes structures, roads, etc. (measure in m)	All	All (Not Fish Models)	Visual Estimate
HUMANTYPE	Type of Human Disturbance	Cropland vs Structural vs Roads Define all other disturbance in detail	All	All (Not Fish Models)	Visual Estimate
MORPHPOOLS	Shape of Pools when Compared with Riffles	Belt transect; Record class data Class Data: 1 = Pool Width > Riffle Width 2 = Pool Width = Riffle Width 3 = Pool Width < Riffle Width	Rivers and Streams (QHEI)	STREAMS	Transect
NESTBOX	Number of Nest Boxes per acre	Every 10 m on 50-m transect, stop and count number of nest boxes	Wood Duck	PFO PSS MARSH CHANNEL RIPARIAN FCORRIDOR DITCH DF DFBOTTOMS	Transect, Visual Estimate
NUMSUBSTR	Number of Substrate Types (count)	Belt transect; Record class data Class Data: 1 = 4 or less 2 = 5 or more	Rivers and Streams (QHEI)	STREAMS	Transect

Table 18. (cont.) HSI variables measured in the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
PERCHDIST	Distance to Perch Site	Distance to perch site measured at beginning of transect and end of transect. Perch site includes tall forb, shrub, tree, fence, or telephone wires, etc. (measure in m)	Eastern Meadowlark	PRAIRIE FIELD	Transect
REGIME***	Water Regime	Class data based on Cowardian Scale (to be verified by Corps) Class Data: 1 = Permanently flooded 2 = Intermittently exposed 3 = Semipermanently flooded 4 = Seasonally flooded 5 = Temporarily flooded 6 = Saturated 7 = Intermittently flooded	Slider Turtle	PFO PSS MARSH CHANNEL DITCH LACUST FCORRIDOR RIPARIAN	Transect, Visual Estimate
RIFFLEPOOL	Development of Complexes of Fast-Moving Turbulent Riffles and Slowly-Moving Deep Pools	Class Data: 1 = Excellent 2 = Good 3 = Fair 4 = Poor	Rivers and Streams (QHEI)	STREAMS	Transect
SHORECOV	Percent Shoreline Cover Within 1 m of Water's Edge	Every 10 m on a 50-m transect estimate vegetative and structural complexity at the land/water interface Cover may be provided by overhanging or emergent vegetation, undercut banks, logjams, debris, exposed roots, boulders, or rock crevices	Mink	CHANNEL DITCH LACUST	Transect, Quadrat
SHRUBCAN	Percent Shrub Canopy Cover	Every 10 m on 50-m transect measure percent ground shaded by vertical projection of the canopies of wood vegetation < 20 ft tall	Fox Squirrel Mink Eastern Meadowlark	DF DFBOTTOMS PFO PSS FCORRIDOR RIPARIAN PRAIRIE FIELD	Transect, Quadrat and Visual Estimate
SUBMERGCAN	Percent Canopy Cover of Submerged and Emergent Vegetation	Every 10 m on 50-m transect, measure presence of midsummer aquatic substrate which, when viewed from above, is covered by leaf or stem tissue of emergent or submerged aquatic plants	Slider Turtle	CHANNEL DITCH LACUST FCORRIDOR RIPARIAN	Transect, Quadrat

Table 18. (cont.) HSI variables measured in the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
SUBSTRATE	Substrate Composition for Riffles and Runs	Belt transect; Record class data Class Data: 1 = Stable 2 = Moderate to Stable 3 = Unstable	Rivers and Streams (QHEI)	STREAMS	Transect
SUBSTRFINE	Degree to Which Substrates are Surrounded by Fine Material not to be Dislodged Easily	Class Data: 1 = None 2 = Low 3 = Moderate 4 = No Riffles 5 = Extensive	Rivers and Streams (QHEI)	STREAMS	Transect
TREECAN***	Percent Tree Canopy Closure - All Tree Species	Measure tree crown diameters every 10 m on 50-m transect Trees must be > 20 ft tall	Fox Squirrel Mink	DF DFBOTTOMS PFO PSS FCORRIDOR RIPARIAN	Transect, Optic Tube
TREECAV	Number of Potentially Suitable Tree Cavities per acre	Every 10 m on 50-m transect, stop and count number of nest cavities > 3" x 4" in diameter Live and Dead trees should be combined together	Wood Duck	PFO PSS MARSH CHANNEL RIPARIAN FCORRIDOR DITCH DF DFBOTTOMS	Transect, Visual Estimate
TREEDBH	Tree Diameter at Breast-Height of Overstory Trees	Select tallest tree along transect every 10 m on 50-m transect - must be in the top 80 percent of the tallest trees in area	Fox Squirrel	DF DFBOTTOMS	Transect, DBH Tapes or Meter Stick
TRSHRCAN***	Percent Trees and Shrubs Canopy Cover within 100m of Wetland's Edge	Every 10 m on 50-m transect measure percent of terrestrial ground surface within 100 m of wetland's edge that is shaded by vertical projection of the canopies of all woody vegetation ***N/A if not within 100 m from wetland edge***	Marsh Wren Mink	PSS MARSH CHANNEL DITCH LACUST DF DFBOTTOMS FCORRIDOR PFO RIPARIAN	Transect, Quadrat & Visual Estimate

Table 18. (cont.) HSI variables measured in the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
TYPESTRM	Sum of all Types of In-Stream Cover	Belt Transect Straight Count Class Data: 1 = Deep Pool = 2 points 2 = All other types count for 10 point for input value 3 = Maximum = 11 points Categories include: Undercut Banks Overhanging Vegetation Shallows (in slow water) Rootmats Deep Pools > 70 cm Rootwads Boulders Oxbows Aquatic Macrophytes Logs or Woody Debris	Rivers and Streams (QHEI)	STREAMS	Transect
VELOCITY	Water Velocity	Measure number of propeller turns for a 2 minute interval in cm/sec	Slider Turtle	PFO PSS MARSH CHANNEL DITCH LACUST FCORRIDOR RIPARIAN	Flow Meter Top = Stop/Reset Middle = Neutral Bottom = Start
WATERDEEP	Mean Depth of Water (cm)	Every 10 m on 50-m transect measure mean depth of water (measure in cm) Samples must be taken within 10m of the shore	Marsh Wren Slider Turtle	MARSH PSS CHANNEL DITCH LACUST PFO FCORRIDOR RIPARIAN	Transect, Meter Stick
WATERTEMP	Water Temperature	Measure temperature 1 time per transect Record in Celsius	Slider Turtle	PFO PSS MARSH CHANNEL DITCH LACUST FCORRIDOR RIPARIAN	Thermometer

Table 19. FCI variables measured in the field sampling effort for the ESL-ER habitat assessment

Variable Code	Variable Description	Sampling Protocol	Model Applicability	WAA	Tool or Technique
COMP	Species Composition of the Dominant Plant Stratum	Data collected from 0.04 ha plots and 0.004 ha subplots nested within 0.04 ha plots	Fxn 6: Maintain Characteristic Plant Community Fxn 7: Wildlife Habitat Maintenance	MARSH PFO PSS PRAIRIE RIPARIAN	Direct sampling
CWD	Volume of Course Woody Debris	Course woody debris includes: Different size classes of twigs, sticks, and logs; Computations are based on procedures developed by the U.S. Forest Service to determine the amount of fuel on the forest floor for calculating potential fire hazards	Fxn 3: Internal Nutrient Cycling	PFO PSS RIPARIAN	Forest Service Computations; Using sample transects
GVC	Percent Ground Cover by Herbaceous Vegetation	Sample plots 0.04 ha	Fxn 1: Floodwater Detention Fxn 3: Internal Nutrient Cycling Fxn 4: Organic Carbon Export Fxn 6: Maintain Characteristic Plant Community Fxn 7: Wildlife Habitat Maintenance	MARSH PFO PSS PRAIRIE RIPARIAN	Quadrats, Visual Estimate

Table 19. (cont.) **FCI variables measured in the field sampling effort for the ESL-ER habitat assessment**

Variable Code	Variable Description	Sampling Protocol	Model Applicability	WAA	Tool or Technique
LITTER	Percent of Ground Surface covered with litter or partially decomposed plant material.	Sample plots 0.04 ha	Fxn 1: Floodwater Detention Fxn 3: Internal Nutrient Cycling Fxn 4: Organic Carbon Export Fxn 6: Maintain Characteristic Plant Community	MARSH PRAIRIE	Quadrats, Visual Estimate
LOG	Volume of down and dead woody stems >7.5 cm in diameter and no longer attached to living plants	Transects of 15.24 m	Fxn 1: Floodwater Detention Fxn 3: Internal Nutrient Cycling	PFO PSS RIPARIAN	Counts
MAST	Mast Producing Trees Species (Class data)	Sample plots 0.04 ha	Fxn 7: Wildlife Habitat Maintenance	PFO PSS RIPARIAN	Identification; Counts
SNAG	Density of Snags (per ha)	Sample plots 0.04 ha	Fxn 3: Internal Nutrient Cycling Fxn 4: Organic Carbon Export Fxn 7: Wildlife Habitat Maintenance	PFO PSS RIPARIAN	Counts

Table 19. (cont). FCI variables measured in the field sampling effort for the ESL-ER habitat assessment

Variable Code	Variable Description	Sampling Protocol	Model Applicability	WAA	Tool or Technique
SSD	Shrub-Sapling Density (per ha)	Sample plots 0.04 ha	Fxn 1: Floodwater Detention Fxn 4: Organic Carbon Export	PFO PSS RIPARIAN	Quadrats, Visual Estimate
TBA	Tree Basal Area (per ha)	Sample plots 0.04 ha	Fxn 3: Internal Nutrient Cycling Fxn 4: Organic Carbon Export Fxn 6: Maintain Characteristic Plant Community Fxn 7: Wildlife Habitat Maintenance	PFO PSS RIPARIAN	Counts
TCOMP	Overstory Tree Species Composition	Sample plots 0.04 ha	Fxn 7: Wildlife Habitat Maintenance	PFO PSS RIPARIAN	Tree Identification
TDENS	Tree Density (per ha)	Sample plots 0.04 ha	Fxn 1: Floodwater Detention Fxn 6: Maintain Characteristic Plant Communities	PFO PSS RIPARIAN	Counts

Variables Obtained Without Field Sampling

Some variables could be obtained through various historical records, aerial photos or mathematical calculations rather than through active field sampling. A total of 23 HSI variables were obtained from District resources and spreadsheet calculations. These variables are described in detail in Table 20. In addition, a total of 13 FCI variables were obtained from District resources and spreadsheet calculations. These variables are described in detail in Table 21.

Table 20. HSI variables obtained from methods other than the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
AMTSILT	Amount of Silt Within the Substrate Materials in the Stream	Class Data: 1 = Silt Heavy 2 = Silt Moderate 3 = Silt Normal 4 = Silt-Free	Rivers and Streams (QHEI)	STREAMS	Historical Data
CHANNELIZE	Types of Channelization	Class Data: 1 = None (No Channelization) 2 = Recovered 3 = Recovering 4 = Recent or No Recovery	Rivers and Streams (QHEI)	STREAMS	GIS
DISTURB100	Presence of a Disturbance-Free Zone up to 100 m Around the Potential Foraging Area	GIS	Great Blue Heron	MARSH CHANNEL LACUST PFO PSS RIPARIAN FCORRIDOR DFBOTTOMS DITCH	GIS
DISTURB250	Presence of a 250 m (land) or 150 m (Water) Disturbance-Free Zone Around Potential Nest Sites	GIS	Great Blue Heron	PFO FCORRIDOR RIPARIAN DFBOTTOMS	GIS
FISHCOVER	Percent Cover Beneath the Water's Surface for Fish to Hide from Predators	See SUBMERGCAN	White Crappie	LACUST	Transect, Quadrat - extrapolated

Table 20. (cont.) HSI variables obtained from methods other than the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
GRADIENT	Gradient of River or Channel (ft/mile)	Pick Gradient from Table based on Stream Width	Rivers and Streams (QHEI)	STREAMS	Historical Data
HERONRY	Proximity of Potential Nest Sites to an Active Heronry	GIS	Great Blue Heron	PFO FCORRIDOR RIPARIAN DFBOTTOMS	GIS
MAXTURBID	Maximum Monthly Average Turbidity During Summer (May - Aug)	Historical Records	Black Crappie	CHANNEL DITCH	Park Data
MINDISOXY	Minimum Dissolved Oxygen Levels During Mid-Summer (Jul-Aug)	Historical Records	Black Crappie	CHANNEL DITCH	Park Data
NESTDIST	Distance Between Potential Nest Sites and Foraging Areas	GIS	Great Blue Heron	MARSH CHANNEL LACUST PFO PSS RIPARIAN FCORRIDOR DFBOTTOMS DITCH	GIS
ORIGINSUB	Parental Material that the Stream Substrate is Derived	1 = Limestone, Tills 2 = Wetlands, Hardpans,	Rivers and Streams (QHEI)	STREAMS	Historical Data
PHRANGE	pH Range During Year	Historical Records	Black Crappie	CHANNEL DITCH	Park Data
POOLDEPTH	Depth (m) of Pools used by Fish for Overwintering Habitat	See WATERDEEP	White Crappie	LACUST	Meter Stick - extrapolated

Table 20. (cont.) HSI variables obtained from methods other than the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
SINUOSITY	Ratio of the Stream Distance Between Two Points on Channel and Straight-line Distance Between Points (Negative Curve)	Class Data: 1 = High 2 = Moderate 3 = Low 4 = None	Rivers and Streams (QHEI)	STREAMS	GIS
SUITABLTMP	Most Suitable Water Temperature in Pools and Backwaters (R) During Mid-Summer (Jul-Aug) (Adult)	Historical Records	Black Crappie	CHANNEL DITCH	Park Data
TEMPEPILIM	Avg Water Temperature within Epilimnion(L) During Mid-Summer (Jul-Aug) (Adult, Juvenile)	Historical Records	White Crappie	LACUST	Park Data
TEMPLITTRL	Avg Water Temperature in Littoral Areas (L) or in Pools & Backwaters (R) During Mid-Summer (Jul-Aug) (Fry)	Historical Records	Black Crappie	CHANNEL DITCH	Park Data
TEMPSPAWN	Avg Water Temperature in Backwaters (R) During Spawning (Embryo)	Historical Records	Black Crappie	CHANNEL DITCH	Park Data
TYPEADJRIP	Land Cover Classes in the Area Outside the Riparian Zone or > 100 feet from Stream	For left and right banks, add together then take the average Class Data: 1 = Forest/Swamp/Woods 2 = Shrub or Old Field 3 = Residential/Park, New Field, Conservation Tillage/Fenced Pasture 4 = Urban or Industrial, Open Pasture/Row Crop, Mining/Construction	Rivers and Streams (QHEI)	STREAMS	GIS

Table 20. (cont). HSI variables obtained from methods other than the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
TYPESUBSTR	Percent Fish Passage Impediments Down-Stream	You may pick two classes and add them together: Class Data: 0 = Artificial 2 = Silt or Muck 3 = Detritus 4 = Hardpan 5 = Bedrock 6 = Sand 7 = Gravel 8 = Cobble 9 = Boulder 10 = Boulder Slabs	Rivers and Streams (QHEI)	STREAMS	GIS
VELOCITY	Current Velocity within Pools and Riffles	You may pick all classes that apply: - Eddies - Fast - Moderate - Slow - Torrential - Interstitial - Intermittent	Rivers and Streams (QHEI)	STREAMS	Historical Data
WATERPREY	Presence of Water Body With Suitable Prey Population and Foraging Substrate	GIS	Great Blue Heron	MARSH CHANNEL LACUST PSS DITCH	GIS
WIDTHRIPAR	Width (m) of Streamside Vegetation from the Bank to First Artificial Structure	Class Data: 0 = None = 0 1 = 1 - 5 m = Very Narrow 2 = 6 - 10 m = Narrow 3 = 11 - 50 m - Moderate 4 = 51 m or more - Wide	Rivers and Streams (QHEI)	STREAMS	GIS

Table 20. (cont). HSI variables obtained from methods other than the field sampling effort for the ESL-ER habitat assessment

VAR Code	Variable Description	Sampling Protocol	Model Applicability	Cover Type	Tool or Technique
WIDTHSTRM	Width of the River or Channel (ft)	Used to determine variable: GRADIENT	Rivers and Streams (QHEI)	STREAMS	GIS
YRSURFWAT	Percent of the Year With Surface Water Present	Historical Records	Mink	MARSH CHANNEL DITCH LACUST DF DFBOTTOMS FCORRIDOR PFO PSS RIPARIAN	GIS

Table 21. FCI variables obtained from methods other than the field sampling effort for the habitat assessment of the ESL-ER

Variable Code	Variable Description	Sampling Protocol	Model Applicability	WAA	Tool or Technique
CLAY	Percent of Clay Content in the Wetland Soil	Derived from the soil survey	Fxn 2: Surface Water Storage	MARSH PFO PSS PRAIRIE RIPARIAN	Soil Survey
CONNECT	Proportion of the Perimeter of the Wetland Tract that is Connected to Suitable Wildlife Habitat	Adjacent habitats are considered connacted if they occur within 0.5 km of the boundary of the WAA; Suitable habitats are: upland forests and other wetlands	Fxn 7: Wildlife Habitat Maintenance	MARSH PFO PSS PRAIRIE RIPARIAN	maps, GIS, photos
CORE	Portion of a Wetland Tract that is Considered Core Area	Core area is that proportion of the wetland tract within a 300 m buffer inside the boundary of the wetland tract	Fxn 7: Wildlife Habitat Maintenance	MARSH PFO PSS PRAIRIE RIPARIAN	maps, GIS, photos
DUR	Duration of Flooding	Derived from the water modifiers in the NWI classification and scaled similar to the HEP study	Only Fxn 3: Internal Nutrient Cycling Fxn 7: Wildlife Habitat Maintenance	MARSH PRAIRIE	NWI Classification Categories
DUR	Duration of Ponding	Derived from the water modifiers in the NWI classification and scaled similar to the HEP study	Isolated Depressions Only Fxn 3: Internal Nutrient Cycling Fxn 7: Wildlife Habitat Maintenance	MARSH PRAIRIE	NWI Classification Categories

Table 21. (cont). FCI variables obtained from methods other than the field sampling effort for the habitat assessment of the ESL-ER

Variable Code	Variable Description	Sampling Protocol	Model Applicability	WAA	Tool or Technique
ERODE	Erodability Factor - Texture of Soils in the Catchment area Adjacent to the Wetland	Determined by touch at the site. Comparison made to the soil survey and the deviation from anticipated reference standard condition is determined	Fxn 6: Maintain Characteristic Plant Communities	MARSH PFO PSS PRAIRIE RIPARIAN	Soil Survey and Direct Observation
FREQ	Frequency of Flooding	Frequency with which overbank or backwater flooding from an adjacent stream inundates the assessment area	Fxn 4: Organic Carbon Export Fxn 5: Remove and Sequester Elements and Compounds	MARSH PFO PSS PRAIRIE RIPARIAN	Historical Data; Direct Observations and maps
HUMAN	Distance to Human disturbance (m)	Used to determine HUMAN50; Derived from HEP data; If Distance is < 50m then use HUMAN SI score; If Distance is > 50m then SI = 1.0; If HUMANTYPE = 1.0 then HUMAN = 1.0 If Distance = 0 m then SI = 0.10		MARSH PFO PSS PRAIRIE RIPARIAN	HEP data
HUMAN50	Product of the categories of human disturbances in the watershed and distance to the disturbance	Use same categories developed in the HEP study. Derived from (HUMAN * HUMANTYPE)^1/2; SI score does not go to zero; Lowest SI can be is 0.10	Fxn 7: Wildlife Habitat Maintenance	MARSH PFO PSS PRAIRIE RIPARIAN	Calculation
HUMANTYPE	Type of Human Disturbance (class data)	Used to determine HUMAN50; Derived from HEP data; If HUMAN = 1.0 then HUMANTYPE = 1.0 SI score does not go to zero; Lowest SI can be is 0.10		MARSH PFO PSS PRAIRIE RIPARIAN	HEP data

Table 21. (cont). FCI variables obtained from methods other than the field sampling effort for the habitat assessment of the ESL-ER

Variable Code	Variable Description	Sampling Protocol	Model Applicability	WAA	Tool or Technique
POND	Percent of Area Subject to Ponding	Derived from GIS, aerial photography, maps	Fxn 2: Surface Water Storage	MARSH PFO PSS PRAIRIE RIPARIAN	Maps, GIS, Photos
SLOPE	Percent Slope of Soils in the Watershed Adjacent to WAA	Derived from the soil survey	Fxn 6: Maintain Characteristic Plant Communities	MARSH PFO PSS PRAIRIE RIPARIAN	Soil Surveys
SOIL	Soil Integrity	Designed to indicate the occurrence of altered soil conditions; In the lack of evidence of soil alterations, it is assumed that the soil conditions are consistent with reference standard conditions established by soil survey data; Where alterations are observed, the proportion of the WAA representing the disturbed soil conditions is the metric used to assess this variable	Fxn 5: Remove and Sequester Elements and Compounds	MARSH PFO PSS PRAIRIE RIPARIAN	Soil Surveys to establish expected depth range of A-horizon and direct observation of deviations from expected.
TEX	Soil Texture in the WAA	Determined by feel at the site; Comparison made to the soil survey and the deviation from anticipated reference standard condition is determined	Fxn 1: Floodwater Detention Fxn 3: Internal Nutrient Cycling Fxn 5: Remove and Sequester Elements and Compounds	MARSH PFO PSS PRAIRIE RIPARIAN	Soil Survey and Direct Observation
TRACT	Wetland Tract	The area of all adjacent wetland areas, consisting of the area of all adjacent wetland polygons	Fxn 7: Wildlife Habitat Maintenance	MARSH PFO PSS PRAIRIE RIPARIAN	maps, GIS, photos

Field Sampling Locations

Field data was collected for the HSI variables at a total of 177 sites across five watersheds and nine existing cover types (CHANNEL, MARSH, PSS, PFO, LACUSTRINE, PRAIRIE, DF, FIELD, and STREAMS) during the spring and fall of 1999. Seventy-one of the total sites were located in the Uplands (i.e., Bluffs), and 106 were located in the Bottoms (Figure 5).

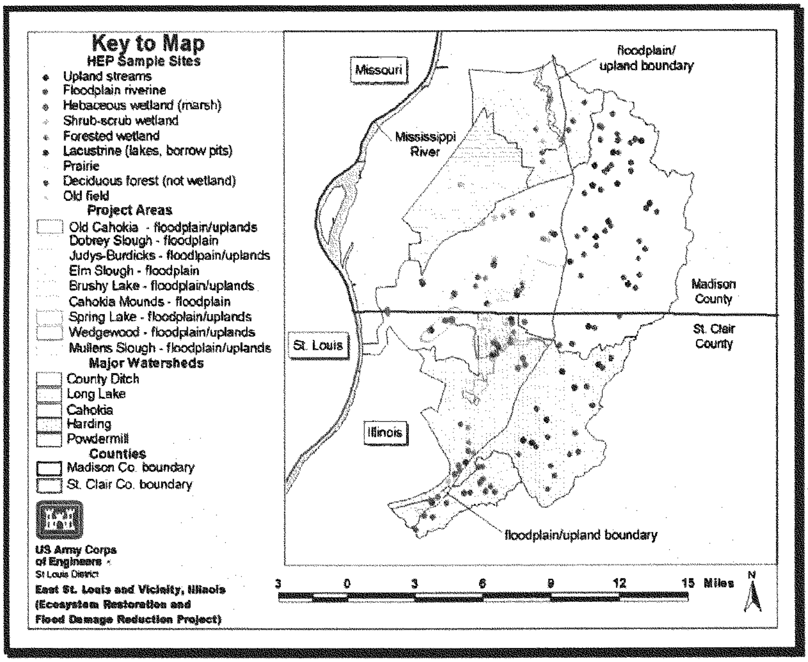

Figure 5. HEP sample site locations for the ESL-ER

Field data was also collected for the HGM subclass models during the spring of 1999 at a total of 112 sites across five watersheds and six existing PWAAs (DF, MARSH, CHANNEL, LACUST, PFO, and PSS). Six of the total sites were sampled for the connected depression subclass. Thirty of the sites were sampled for the isolated depression subclass (Figure 6). The remaining sites were associated with the riverine overbank, flats or fringe subclasses (n = 54, 7, and 15, respectively).

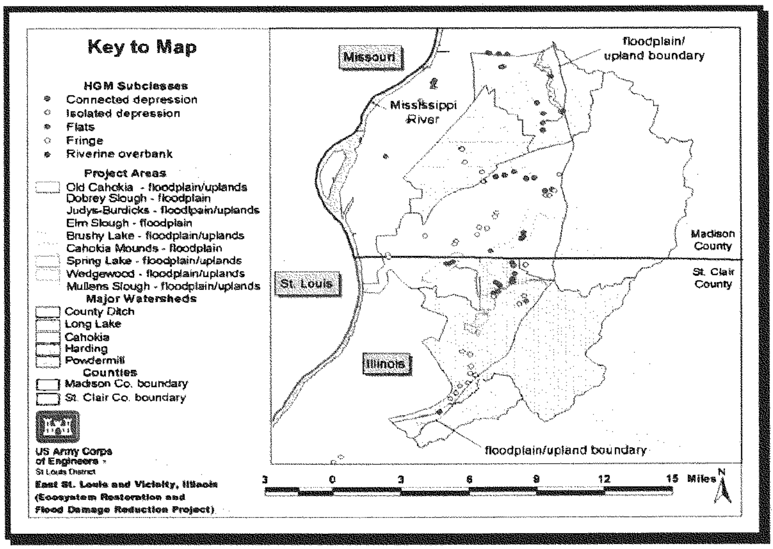

Figure 6. HGM sample site locations for the ESL-ER

Field Sampling Protocol

As indicated in the HEP variable tables above, a single 50-m transect was laid down within the boundaries of the indicated cover type at each site, and variables were measured at 10-m intervals (i.e., five sampling stops or stations per transect were made). In this manner, 505 separate stations (i.e., 101 x 5 = 505) recorded data in the study. In most instances, data collected on the cover type transects were averaged to generate a cover type score for the site. This strategy reduced the coefficients of variance (i.e., standard deviations of the field data). The one exception to this data-handling rule was the management of class data (e.g., GROWTHFORM, HUMANTYPE, REGIME, etc). When class data was recorded (i.e., class data), the modes were calculated instead of averages across transects within the cover type. As indicated in the HGM variable tables above, ¼-acre circular plots were used to sample HGM variables in each PWAA at each site. Just as the HEP analyses averaged values within cover types per site, the HGM variables were averaged where appropriate, and modes were calculated for class data when necessary. For more details regarding data handling and management, refer to the *Performing Data Management and Statistical Analysis* section below.

E.8. Performing Data Management and Statistical Analysis

Some limits to the assessment's data should be acknowledged. In some instances, variables were sampled incorrectly (namely SHRUBCAN, GROWTHFORM, TREECAN, GRAIN, etc.,) or not measured at all in some settings (WATERTEMP, HUMAN, BROODCOVER, NESTBOX, etc.), and extrapolations or corrections were made several weeks after sampling was concluded. In addition, some of the cover type mapping originally developed was ground-truthed, and found to be inaccurate. As a result of these area-based changes, some transects were thrown out due to incompatibility with the new classification. In those instances where transects were discarded or absent, extrapolations were made from watershed means. It should also be noted that the selection of the ninth and tenth models (eastern meadowlark and QHEI) were made after the data sampling effort was completed. Members of the Biological Team returned to the field in late fall/early winter of 1999, and late in the summer of 2003, to sample variables for these models. Estimates of "living" vegetation parameters were extrapolated based on persistent winter vegetation and historical information. The majority of the sites measured for existing prairie community conditions were considered "restoration" sites, rather than remnant prairie sites (i.e., the sites had been actively restored in the last 10 years), and were therefore expected to return higher baseline scores than "suffering" prairies – a fact the Team was willing to accept and incorporate into the analyses. When data management problems arose, EL consulted with the Biological Team prior to data handling, and solutions were devised with their knowledge and consent. Detailed notes and minutes were taken during these meetings to provide documentation for the assessment (HEP Field Data.xls and Watershed Statistics - HEP.xls).

E.9. Calculating Baseline Conditions

Once the baseline inventory was conducted, and both the variable means/modes and the cover type acreages were determined, the baseline conditions in terms of Habitat Units (HUs) were generated by multiplication. Strictly speaking, the means/mode values for each variable were applied to the Suitability Index graphs as dictated by the model documentation. For example, if the mean water depth of the LACUST cover type at Site X was 20 cm deep on average, the value "20" was entered into the "X-axis" on the Suitability Index curve below (Figure 7), and the resultant SI score (Y-axis) was recorded (SI = 1.0).

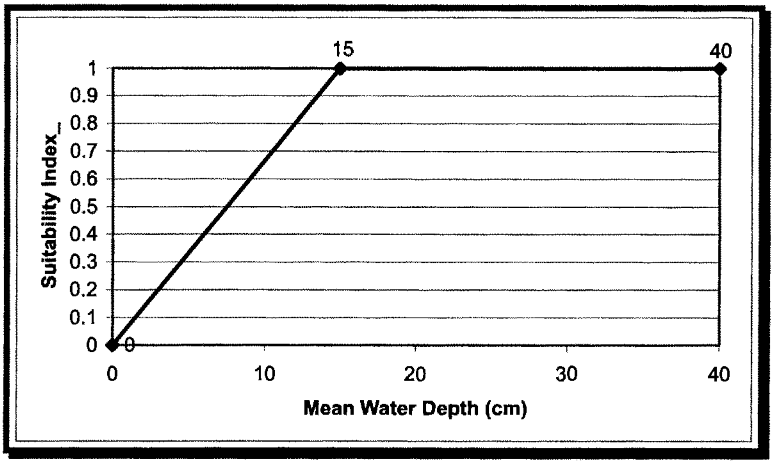

Figure 7. Example Suitability Index (SI) curve

The process was repeated for every associated variable and cover type per model. The individual SI scores were then entered into the HSI formula on a cover type-by-cover type basis, and individual cover type HSIs were generated. Each answer, referred to as the cover type HSI or CT HSI, was weighted by the relative area (RA)[3] of the cover type, and combined with the answers from the remaining associated cover types in an additive fashion. The model's formula was considered to be the sum of the CT HSIs, or arithmetically speaking:

$$\mathbf{HSI}_{\text{Species Model}} = \sum \left(\mathbf{CT\ HSI \times RA}\right)_X$$

where :

CT HSI = Results of the cover type HSI calculation
X = Number of cover types associated with the model
RA = Relative area of each cover type.

The final step was to multiply the HSI result against the habitat acres (i.e., cover type

[3] Relative Area: In HEP, the relative area is a mathematical process used to "weight" the various applicable cover types on the basis of quantity. To derive the relative area of a model's cover type for the study, the following equation was utilized:

$$\text{Relative Area} = \frac{\text{Cover Type Area}}{\text{Total Area}}$$

where:

Cover Type Area = only those acres assigned to the cover type of interest
Total Area = the sum of the acres utilized in the model

acres associated with the model). The final results, referred to as Habitat Units (HUs), quantified the quality and quantity of the wetland conditions at the site at TY0 (Baseline).

This same process was completed for the HGM functional models - the means/mode values for each variable were applied to the Variable Subindex graphs as dictated by the model documentation. For example, if the percent of ground cover in the PFO PWAA's at Site X was 50 percent on average, the value "20" was entered into the "X-axis" on the Variable Subindex curve below (Figure 8 and the resultant VSI score Y-axis) was recorded (VSI = 1.0).

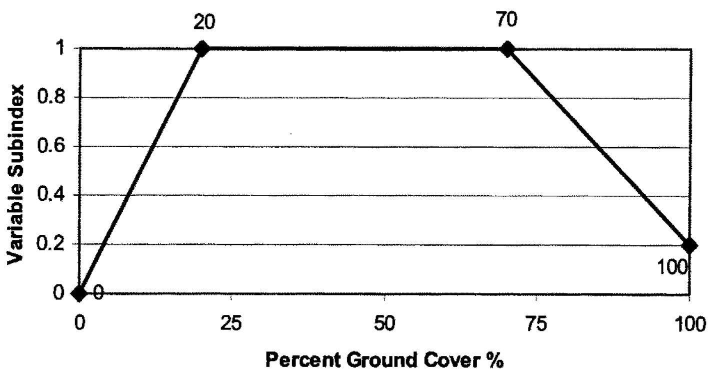

Figure 8. Example Variable Subindex (VSI) curve

The process was repeated for every associated variable and PWAA per model. The individual VSI scores were then entered into the HSI formula on a PWAA-by-PWAA basis, and individual PWAA FCIs were generated. Each answer, referred to as the PWAA FCI or PWAA FCI, was then weighted by the relative area (RA)[4] of the PWAA, and combined with the answers from the remaining associated PWAAs in an additive fashion.

[4] Relative Area: In HGM, the relative area is a mathematical process used to "weight" the various applicable PWAAs on the basis of quantity. To derive the relative area of a model's PWAA for the study, the following equation was utilized:

$$\text{Relative Area} = \frac{\text{PWAA Area}}{\text{Total Area}}$$

where:

PWAA Area = only those acres assigned to the PWAA of interest
Total Area = the sum of the acres utilized in the model

The model's formula was considered to be the sum of the PWAA FCIs, or arithmetically speaking:

$$\mathbf{FCI_{Subclass\ Model} = \sum (PWAA\ FCI\ x\ RA)_X}$$

where :

PWAA FCI = Results of the PWAA FCI calculation,
X = Number of PWAAs associated with the model, and
RA = Relative area of each PWAA.

The final step was to multiply the FCI result against the habitat acres (i.e., PWAA acres associated with the model). The final results, referred to as Functional Capacity Units (FCUs), quantified the quality and quantity of the wetland conditions at the site at TY0 (Baseline). For details regarding the results of the baseline analyses for the ESL-ER, refer to the *Baseline Evaluation* section of the individual site chapters.

E.10. Generating Without Project Conditions and Calculating the Outputs

To develop plans for a community or region, it becomes necessary to predict both the short-term and long-term future conditions of the environment (USACE 2000). Forecasting, the process of developing these predictions, is undertaken to identify patterns in natural systems and human behavior, and to discover relationships among variables and systems, so that the timing, nature, and magnitude of change in future conditions can be estimated. Though many forecasting methods can be used in a standard assessment application such as HEP, a judgment-based method, supported by the scientific and professional expertise of the evaluation team, is often relied upon to forecast the effectiveness of ecosystem restoration alternatives, rate project performance, and determine many other important aspects of both Without Project and With Project conditions.

The Without Project condition is universally regarded as a vital and important element of the evaluation (USACE 2000). No single element is more critical to the planning process than the prediction of the most likely future conditions anticipated for the study area if no action is taken as a result of the study. It is important to note that by definition the "No Action Alternative" in NEPA is the Without Project condition that describes the future that society would have to forego if action was taken. Conversely, the Without Project condition is the result when no action is taken. NEPA regulations require that the No Action Alternative always be considered during the formulation of plans. In essence, this requires that any action taken be more "in the public interest" than doing nothing. The Without Project condition becomes the default recommendation.

The Without Project descriptions must adequately describe the future (USACE 2000). Significant variables, elements, trends, systems, and processes must be sufficiently described to support good decision-making. Without Project descriptions must be rational. Forecasts must be based on appropriate methods, and professional standards must be applied to the use of those methods. Accuracy is an important element of a rational scenario. All future scenarios should be based on the assumption of rational behavior by future decision-makers - future scenarios must make sense. Scenarios that rely on an unlikely series of events or irrational behavior do not make sense. A good scenario must pass the test of making common sense. Without Project conditions are not "before-and-after" comparisons. "Before-and-after" comparisons can overlook the causality that is important to effective plan evaluation. Without Project conditions have to be future oriented. Conditions that concentrate on causality of existing conditions, and focus too narrowly on how existing conditions might change, fail to be future-oriented. Without Project conditions are not mere extensions of existing conditions, and should be oriented toward comparing alternative future scenarios. There should never be deliberately misleading information in a scenario, nor should any important information ever be deliberately withheld. This quality goes beyond basic honesty, however, to include the forthrightness about the strengths and weaknesses of the analysis that is needed to enable an interested stakeholder or a decision-maker to make their own qualitative assessment of the work you have done. An honest scenario would point out weaknesses and soft spots in the analysis, identifying the implications of these "faults." Honesty also implies a sincere effort to convey the full implications of the scenario. Honesty requires that significant differences in the future scenario be honestly and completely described as alternate Without Project conditions. The Without Project condition must be inclusive in the sense that it is subjected to rigorous review and comment as part of the public participation process (and throughout the coordination and review process). Because the Without Project condition occupies such a critical role in the planning process, it is essential that it be developed in the "open," and subjected to the scrutiny of all project stakeholders, before the project proceeds too far. In some cases, this will simply mean that technical data and information receive an unbiased thorough technical review. In other cases, where judgmental or technological changes are being considered, the review and coordination may have a structured part in the public participation process.

Specific Without Project Trends

When forecasting the Without Project condition for the ESL-ER, it was crucial that the Team captured the most important aspects of life in the study area over the next several decades. These predictions were based on the existing condition (i.e., Baseline) as described in the section above. All future Without and With Project forecasting efforts were built from this base condition. Using a variety of forecasting techniques, the Biological Team painted a series of pictures depicting the Without Project future in the region. From these various future conditions, the Biological Team selected the single most likely future condition. This most likely future condition was not necessarily the only possible future condition, but it became the baseline picture of the future for the study. When the Team considered how the alternative designs changed the future, they always compared the alteration of future conditions resulting from the designs to the Without Project condition. When the Biological Team selected an alternative design that looked "best" under all forecasted futures, they were then confident to have the best plan. Every alternative design developed per site was compared to the same Without Project condition. It was the No Action alternative the Biological Team identified (and quantified using HEP and HGM), to describe the explicit differences among alternative designs, and they made judgments about the relative merits of the proposed alternative designs via comparisons against the No Action Alternative prior to selecting a "recommended plan." For details regarding the Without Project condition developed for the ESL-ER, refer to Section 4 of the PEIS (USACE 2002). For purposes of the HEP and HGM evaluation, the Biological Team developed a series of growth/loss trends for the region based on cover type identities and public/private land ownerships (Table 22).

Table 22. Rules and assumptions developed for acreage projections of the Without Project condition for all ESL-ER sites and alternatives

Cover Type Code	Rule or Assumption
ALL	Assume for ALL cover types that no change in area will occur between TY0 & TY1.
DF	Assume private DF in uplands will lose area based on growth projections per watershed (TY11 - TY51) from June '99 Minutes, page 15: Cahokia = 25%, 50%, 75% loss to urban from baseline Harding =10%, 30%, 80% loss to urban from baseline County Ditch = 5%, 10%, 20% loss to urban from baseline Powdermill = 5%, 20%, 40% loss to urban from baseline
LACUST	Assume some lake areas will lose 1.5% in surface area every 10 yrs, and other will have no loss of surface area over time - dependent upon location in the Bottoms.
CHANNEL/DITCH	Assume all channels and ditches will have no loss in area - maintenance and sedimentation are constant.
STREAMS	Assume all streams connecting the upper watershed to the floodplain will have no loss in area.
Public Holdings Only	
MARSH PSS PFO RIPARIAN	Assume all wetland polygons of protected lands (public) will have no loss in area.
AGCROP	Assume croplands in public holdings will not decrease over time
FIELD	Assume fields in public holdings will not decrease over time
FCORRIDOR	Assume forested corridors in public holdings will not decrease over time
PRAIRIE	Assume prairie in public holdings will not decrease over time
Private Holdings Only	
AGCROP	Assume all private agricultural croplands smaller than 10 acres will be lost to development by TY51.
AGCROP	Assume all private agricultural croplands greater than 10 acres will have a 75% loss to urbanization over 50 years (1.5%/yr)
FIELD	Assume all private fields smaller than 10 acres will be lost to development by TY51.
FIELD	Assume all private fields greater than 10 acres will have a 75% loss to urbanization over 50 years (1.5%/yr)
FCORRIDOR	Assume all forested corridors in private holdings will lose 75% of their area over 50 years time (1.5%/yr)
DFBOTTOMS	Assume all forested corridors in private holdings will lose 75% of their area over 50 years time (1.5%/yr)
MARSH PSS PFO RIPARIAN	Assume all wetland polygons of private lands will have 25% loss in area over 50 yrs (0.5%/yr) as a direct result of development.
PRAIRIE	Assume all private prairies smaller than 10 acres will be lost to development by TY51.
PRAIRIE	Assume all private prairies greater than 10 acres will have a 75% loss to urbanization over 50 years (1.5%/yr)
URBAN	Assume URBAN will gain 25% over 50 yrs (0.5% /yr) (i.e., the loss from all wetland polygons (MARSH, PSS, PFO) of private lands will have 25% loss in area over 50 yrs (0.5% /yr) as a direct result of development).
MARSH	Assume MARSH at sites will gain 1.5% area every 10 yrs.

In particular, the Team assumed that significant urban encroachment pressures would be placed on all upland forest communities, and that this trend would be watershed-specific. In the County Ditch watershed, the Team assumed 20 percent of the existing deciduous forests would be lost (~570 acres). In the Powdermill watershed, this figure increased to 40 percent (~1485 acres). In Cahokia and Harding, the figures were even higher - 75 percent (~ 12,120 acres) and 80 percent (11,700 acres), respectively. In the Bottoms, some local lakes were expected to be filled in, while others would remain constant (refer to specific site chapters for more details). The Team also assumed the channel and ditch systems in the Bottoms would be maintained, and therefore would not experience any measurable change in surface area.

On public lands, the Team assumed the majority of the cover types would remain protected from any significant urbanization pressures and thus would not lose any area over time. The assumptions for the private holdings were vastly different. For example, the team assumed that parcels of land smaller than 10 acres, be they agricultural croplands, fields, haylands, pastures or prairies, would be completely consumed by urban encroachment by TY51. These same cover types would be reduced to a lesser extent (75 percent losses by TY51) if their stands were larger than 10 acres. Wetlands (marshes and palustrine scrub-shrublands) and wetland forests (palustrine forests and riparian corridors) on private lands were expected to suffer similar fates – loss of 25 percent of their areas to urbanization by TY51. Even agricultural croplands were expected to fall to urban encroachment at a rate of 1.5 percent per year (i.e., 75 percent over 50 years).

In terms of variable projections over the life of the project in the Without Project setting, the Team made some general assumptions that were refined on a site-by-site basis. In general, the quality of the sites were assumed to either remain constant or degrade slightly due to increases in adverse human-based impacts. For example, in most instances, vegetation parameters (i.e., tree canopy cover, tree densities and composition, submergent canopy cover, shoreline cover, emergent canopy, shrub canopy, litter, tract size, etc.) and hydrological parameters (i.e., water clarity and prey availability, turbidity, pH, dissolved oxygen levels, water depth, water temperature, frequency and duration of flooding events, etc.) were projected to decline over the long term. In addition, the projected loss of habitat in the Uplands and Bottoms due to urban encroachment led to the assumption that human interference factors (i.e., adjacent land-use practices, distance to the nearest human-based activity and the rate of encounters with humans) would increase significantly, thereby degrading the existing habitats even further.

In terms of HEP versus HGM applications, the Team took great pains to assure that the assumptions made in the HEP variable forecasting were carried throughout the HGM forecasting. For example, improvements in tree canopy cover (a HEP variable) were mimicked in "sister" HGM variables such as tree composition, coarse woody debris, species composition and diversity (including mast producers), snags, tree densities and tree basal areas. For details regarding the specific quantity and quality projections made for the ESL-ER assessment, refer to the *Project Alternatives* section of the individual site chapters.

Calculating Annualized Units for the Without Project Condition

Most Federal agencies use annualization as a means to display benefits and costs, and ecosystem restoration analyses should provide data that can be directly compared to the traditional benefit: cost analyses typically portrayed in standard evaluations of this nature. Federal projects are evaluated over a period of time that is referred to as the "life of the project," defined as that period between the time that the project becomes operational and the end of the project life as dictated by the construction effort or lead agency. However, in many cases, gains or losses in wildlife habitat may occur before the project becomes operational, and these changes should be considered in the assessment. Examples of such changes include construction impacts, implementation and compensation plans, and/or other land-use impacts. Ecosystem restoration analyses incorporate these changes into their evaluations by using a "period of analysis" that includes pre-start impacts. However, if no pre-start changes are evident, then the "life of the project" and the "period of analysis" are the same (as was the case in the ESL-ER). In HEP, Habitat Units (HUs) are annualized by summing HUs across all years in the period of analysis and dividing the total (cumulative HU) by the number of years in the life of the project. In this manner, pre-start changes can be considered in the analysis. The results of this calculation are referred to as Average Annual Habitat Units (AAHUs), and can be expressed mathematically in the following fashion:

$$\textbf{AAHUs} = \sum \textbf{Cumulative HUs} \div \textbf{Number of years in the life of the project}$$

where: **Cumulative HUs =**

$$\sum (T_2 - T_1)\left[\left((A_1 H_1 + A_2 H_2) \div 3\right) + \left((A_2 H_1 + A_1 H_2) \div 6\right)\right]$$

and where:

T_1 = First Target Year time interval
T_2 = Second Target Year time interval
A_1 = Area of available habitat at beginning of T_1
A_2 = Area of available habitat at end of T_2
H_1 = HSI at beginning of T_1
H_2 = HSI at end of T_2

This is a generalized formula and requires that the HSI and area of the available habitat for each target year. The numbers "3" and "6" are constants derived from the integration of HSI x Area for the interval between any two target years. This formula is applied to the time intervals between target years. The formula was developed to precisely calculate cumulative HUs when either HSI or area or both change over a time interval. The rate of change of HUs may be linear (either HSI or area change over the time interval) – the formula will work in either case. The shaded area in Figure 9 represents the cumulative HUs for all years in the period of analysis, and is calculated by summing the products of HSI and area of available habitat for all years in the period of analysis.

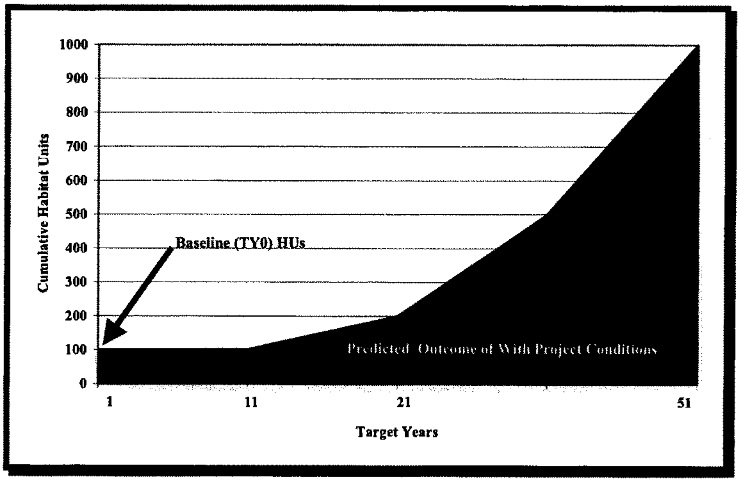

Figure 9. Example of cumulative HU availability in a With Project scenario

This same approach is used for the annualization of the HGM results.

AAFCUs = $\sum$Cumulative FCUs ÷ Number of years in the life of the project

where: **Cumulative FCUs =**

$$\sum (T_2 - T_1)\left[\left((A_1 F_1 + A_2 F_2) \div 3\right) + \left((A_2 F_1 + A_1 F_2) \div 6\right)\right]$$

and where:

T_1 = First Target Year time interval
T_2 = Second Target Year time interval
A_1 = Area of available habitat at beginning of T_1
A_2 = Area of available habitat at end of T_2

F_1 = FCI at beginning of T_1
F_2 = FCI at end of T_2

All HEP and HGM results developed for the ESL-ER were calculated in this manner and reported herein in terms of annualized units for the Without and With conditions.

E.11. Generating With Project Conditions and Calculating the Outputs

Between June of 1999 and January of 2002 the Biological Team met on a regular basis (in person and via conference calls) to develop projection trends for each alternative at each site across the ESL-ER. The Team was presented with nine sites and a total of 256 alternatives to review (Table 23).

Table 23. Alternatives conceived, dropped and evaluated per site for the ESL-ER habitat assessment

Watershed	Site Name	Alternative Counts		
		Conceived	Dropped	Evaluated
County Ditch	Old Cahokia Creek	24	12	12
Cahokia	Judy's-Burdick Branches	40	20	20
Cahokia	Brushy Lake	30	24	6
Cahokia	Elm Slough	6	1	5
Cahokia/Harding	Spring Lake	126	120	6
Harding	Wedgewood	6	2	4
Harding	Cahokia Mounds	12	6	6
Powdermill	Mullens Slough	6	0	6
Long Lake	Dobrey Slough	6	3	3
	Totals:	256	188	68

After intensive consideration, the Team reduced this number to 68. Alternatives were dropped from the analysis if their approaches were too costly, if their designs were incongruous with the overall "restoration concept," if their designs were impossible to achieve due to conflicting relationships or if the results were thought to biologically unproductive. For example, alternatives at Old Cahokia Creek were dropped if they called for pumping stations on sections of channels that did not need flow augmentation. Other alternatives were dropped for reasons ranging from negative impacts derived from the maintenance of detention ponds (i.e., regular dredging to remove excess sediment would negatively impact the resident marsh vegetative component), to the ineffectiveness of various ditch design options (i.e., no distinction could be made between straight concrete ditches with trapezoidal configurations versus straight concrete ditches with rectangular configurations).

As they did in the Without Project setting, the Team generated a list of general trends for the overall study. Such concepts as improved hydrologic conditions and habitat improvements with each project were assumed for all alternatives. The Team made an effort to distinguish clearly between Uplands-based sediment retention activities and floodplain-based sediment trapping actions within the site boundaries. Various design and operation/maintenance activities were discussed in detail, and the outcomes of each were incorporated into the forecasting. For details regarding the specific quantity and quality projections made for the ESL-ER assessment, refer to the *Project Alternatives* section of the individual site chapters.

E.12. Developing RVIs and Performing Trade-Offs

The "best" alternatives cannot be selected from among a set of "good" alternatives unless there is a means by which to compare them. It is only by comparison that an alternative is no longer "good enough," or that a "good" alternative becomes the "best" alternative. The purpose of the comparison step is to identify the most important criteria alternatives can be evaluated against, and compare the various alternatives across those criteria. Ideally, the comparison of alternatives concludes with a ranking of alternatives or some identification of the best course of action for the decision-makers. When all the important alternative designs are measured in the same units (e.g., ecological units, acres, dollars, etc.), the comparison can be simple. More realistically, alternative designs are measured in a combination of dollars, ecological units, acres, housing relocations, water quality changes, noise levels, navigation safety, changed erosion rates, or a host of other tangible or intangible units. When this occurs, planners have to advise decision-makers about trade-offs (i.e., value judgments). Trade-offs are made throughout the planning process, throughout all screening activities, but they take on special significance as the study team, decision-makers and other stakeholders move toward selecting the best, most likely alternative future for a society. These trade-offs are first made regarding the individual alternatives under evaluation. The question is asked: "Is it good enough to warrant further consideration?" Alternative designs can be dropped from further analysis for a variety of reasons including cost ineffectiveness, design inconsistencies, and biological unproductiveness to name a few. Afterwards, trade-offs are considered across, and among, all the alternatives. Trade-offs are undertaken when contrasting outputs are encountered. For example, Alternative 1 may be less costly, but restores fewer wetlands than Alternative 2, a more costly design that restores significantly more wetland acres.

Trade-off analysis is a multicriteria evaluation method commonly used by USACE when it is impossible (or not desirable) to express all alternative effects in a single metric. More than one evaluation metric can be considered (i.e., HEP, HGM, and costs together) in a trade-offs analysis (Edmunds and Letey 1973). Trade-offs enable planners to account for the entire gamut of differing (but relevant) criteria when comparing alternatives. Trade-offs can be as simple, or as complex, as necessary to afford the greatest suite of comparisons. In a simple application, trade-offs can frequently rely on professional judgment. Planners "trade-off" alternative contributions to objectives based on their own accumulated technical expertise, general experience, and specific knowledge of the study area (including stakeholder views and values). In essence, planners sit down and develop an alternative with "a little more of this" and "a little more of that, " where the trade-offs made tend to be of a subjective nature. However, more quantifiable approaches exist to conduct trade-off analyses in a controlled environment.

Simple weighting is a sophisticated and simple approach to trade-offs that can be used when there are no apparent "winning" or dominant alternatives among those compared. In HEP, models are selected to emphasize the importance of specific species or communities, and can be "traded-off" by incorporating a weighting scheme into the calculation of final HUs. By applying Relative Value Indices (RVIs) to the resultant outputs, species priorities can be characterized, and mathematical "weights" can be applied to HEP activities accordingly. For example, projected impacts to a state-sensitive species, such as the Columbia sharp-tailed grouse, could have more importance to the management of a study area than impacts experienced by game animals such as the mule deer. In HEP, RVIs would be applied to the sharp-tailed grouse HU or AAHU outputs to emphasize the significance of loss of impacted habitat within the study area. In the overall scheme of project design, RVIs serve as prisms to concentrate attention on those changes that will impact the area's significant resources. The determination of "value" is a somewhat subjective exercise in the HEP process, but the HEP methodology provides avenues of documentation and justification necessary to support decisions in this arena (USFWS 1980b). Thus, RVIs can be used to perform trade-offs among species or communities, or simply to "level" the playing field. RVIs were incorporated into the ESL-ER analyses, and are fully documented in Chapter XII in this report.

E.13. Reporting the Results of the Analyses

The success of any evaluation lies in the planner's ability to report the assessment strategies and findings to the public. Reporting simply refers to communicating the methodologies and results of the habitat assessment in a clear and concise manner to the reader. Underlying the HEP and HGM processes is the concept of "repeatability." To assure that the assessment is reasonable and reliable, the reader should be able to follow the descriptions of approach and application presented, and repeat the analyses just as the planner did. To assure the repeatability aspects of the assessments, it behooves the planner to document, to the fullest extent, the evaluation in its entirety. Most often this is done through an assessment report medium. Typically, depending on the type of planning effort undertaken, there are a series of 5+ chapters provided in every assessment report: Introduction, Methods, Results, Trade-offs, and Summary/Conclusions. In addition, the report typically carries a Literature Cited section and an appendix documenting the models used in the assessment. Further reporting of the assessment results can include (but is not limited to) the production of interactive graphics (maps, graphs, tables, etc.), that visually depict the conditions (both Without and With Project) of the study area under evaluation. In HEP and HGM, it is important to document the results in terms of habitat units/functional capacity units, quality (HSIs/FCIs) and quantity (acres). In addition, any factors that significantly affected the outcome of the study (e.g., minutes of team meetings, data extrapolations, etc.) should be documented, either in the report itself, or in an appendix to the report.

F. SOFTWARE USED IN THE ESL-ER ECOSYSTEM ASSESSMENT

The sheer number of calculations necessary to conduct both a HEP and an HGM analysis on a project the size of the ESL-ER led the District to contact EL for technical assistance. Using the latest technological advancements, EL performed the necessary evaluations in less than three years. In addition to facilitating the application of HEP and HGM in the study, EL's biologists used the EXHEP (EXpert Habitat Evaluation Procedures) and EXHGM (EXpert Hydrogeomorphic Approach to Wetland Assessments) software packages to generate restoration benefits in a timely manner (refer to the software section later in this chapter). The EL team performed more than 2,500 iterations in the evaluation of the proposed designs in the habitat assessment described herein using the EXHEP and EXHGM software packages.

EXHEP is an Microsoft Access© 2000 software package developed by EL to automate standard HEP calculations. It facilitates large-scale HEP assessments efficiently and effectively. EXHEP uses Microsoft® Windows-compatible programming to (1) solve complex mathematical calculations quickly, and (2) provide a highly intuitive, visual interface to facilitate communication between the system and the user. As with any sophisticated mathematical evaluation, a well-tested, efficiently written, standard software package is a critical tool that saves time, and improves the reliability and repeatability of the results. However, this software cannot replace the user's understanding of the conceptual basis of HEP, or its application to the decision making process. EXHEP should not be viewed as the end-all means to providing the only predictive environmental response to project development. Rather, the program should be viewed as a tool that can provide a rational, supportable, focused, and traceable evaluation of environmental effects.

EXHGM is also an Microsoft Access© 2000 software package developed by EL to automate standard HGM calculations. EXHGM's programming architecture is similar to that of the EXHEP package described above, which afforded the EL staff the opportunity to compare the resultant outputs of the two methodologies on similar platforms (i.e., results were reported in terms of units derived from quality and quantity calculations that could be reviewed in common software environments, namely Microsoft Excel and Microsoft Access formats). Again, the EXHGM program should be viewed as a tool that can provide a rational, supportable, focused, and traceable evaluation of wetland functionality, and its application to the decision-making process is unquestionable. However, the user must understand the basic HGM tenets as defined in supporting literature (Brinson 1993; Smith et al. 1995) prior to attempting application of the software. In other words, the user should not expect the EXHGM software to provide the only predictive environmental response to project development scenarios, and should understand the limitations of the methodology's response to predictive evaluations prior to its application.

The EXHEP and EXHGM programs were both designed to process large amounts of data quickly and efficiently, handling a large number of HSI and FCI models simultaneously. Each model can incorporate any number of cover types (or partial wetland assessment areas). Each cover type can include a large number of variables, and the user can incorporate as many life requisites or functions within each model as necessary. These capabilities support the examination of complex studies with large numbers of permutations. In some studies, it is not unusual to evaluate 10 - 15 HSI/FCI models (with more than 25 cover types) in an attempt to describe complex interdependencies (i.e., interrelationships) within the ecosystem. The large amount of tedious mathematical calculations necessary to compute HEP and HGM at this level requires a powerful tool to evaluate environmental output. EXHEP and EXHGM, enhanced by their abilities to communicate these activities in an organized fashion, can quickly accomplish this task. The number of permutations, processing speed, and program performances are limited only by the capacity of the user's hardware, where data storage becomes the limiting factor.

The EXHEP and EXHGM programs allow the user to evaluate a large number of projected changes (future factors) across numerous years for each alternative design. Each package allows the user to assign future factors to each model for each year considered within the life of the project (i.e., each TY). This capability allows the user to manage forecasts across the long-term planning horizon, in an attempt to better reflect reality through the life of the project. Again, the number of permutations is limited only by the user's computer storage capacity. EXHEP evaluates any species or community HSI model. In most instances, a species or community can be described based upon its single cover type dependence. A standard HEP tool must complete these computations regardless of whether the model utilizes a single cover type or multiple cover types. EXHEP can be used to calculate suitability for any single or multiple cover type models whether it is a Single Formula Model or a Multiple Formula Model. EXHGM evaluates any FCI-based model. In most instances, a wetland cannot be described using a single PWAA. A standard HGM tool must complete these computations, regardless of whether the model utilizes a single PWAA or multiple PWAAs. EXHGM can be used to calculate suitability for any single or multiple PWAA model whether the wetlands functionality is based on one or more multi-faceted functions.

The two tools are capable of reevaluating HSI and FCI models as the user adapts previously created alternative designs to fit new situations. It is not necessary to reinvent HSI/FCI models, cover type interdependencies, or life requisite interrelationships once a standard evaluation configuration has been created. The software packages allow the user to open a previously created configuration and introduce change (e.g., adding field data, future factors, TYs, species, cover types, acreage quantities, etc.). This capability supports the software's utilization in a wide range of agency activities over the long term. For example, an alternative design developed to evaluate project impacts for a stream restoration study in the past can be adapted to evaluate stream restoration projects throughout the region in the future. By simply altering the cover type composition of a previously developed EXHEP/EXHGM datafile, the software can account for regional variations, and quickly define species, community, and/or functionality impacts. Thus, as projects are funded or evolve, EXHEP and EXHGM can both be easily implemented with little effort devoted to modeling "setup."

G. INTRODUCTION TO THE COST ANALYSIS PROCESS

Between 1986 and 1987, Headquarters, U.S. Army Corps of Engineers, provided policy directing Corps Districts to perform a type of cost analysis referred to as Incremental Cost Analysis (ICA) for all feasibility-level studies. The required ICA is, in effect, a combination of both a Cost Effectiveness Analysis (CEA) and Incremental Effectiveness Analysis (ICA). Together, the CEA/ICA evaluations combine the environmental outputs of various alternative designs with their associated costs, and systematically compare each alternative on the basis of productivity. Cost effectiveness analyses focus on the identification of the least cost alternatives and the elimination of the economically irrational alternatives (e.g., alternative designs which are inefficient and ineffective). By definition, inefficient alternative designs produce similar environmental returns at greater expense. Ineffective alternative designs result in reduced levels of output for the same or greater costs. The incremental cost analysis is employed to reveal and interpret changes in costs for increasing levels of environmental outputs.

In 1990, USACE issued Engineer Regulation 1105-2-100 (U.S. Army Corps of Engineers 1990) directing planners, economists, and resource managers to conduct CEA/ICA for all recommended mitigation plans. Later, in 1991, USACE produced Policy Guidance Letter Number 24 that extended the use of cost analysis to projects that restored fish and wildlife habitat resources (U.S. Army Corps of Engineers 1991). In the Corps' Engineering Circular 1105-2-210, the incorporation of cost analysis was declared "fundamental" to project formulation and evaluation (U.S. Army Corps of Engineers 1995b). To facilitate the inclusion of these basic economic concepts into the decision-making process, USACE published two reports detailing the procedures to complete both incremental and cost effective analysis (Orth 1994; Robinson et al. 1995). Based on these reports, there were nine steps that should be completed to evaluate alternative designs based on CEA/ICA. These were as follows:

A. Formulate all possible combinations of alternative designs by:

1. Displaying all outputs and costs.
2. Identifying filters, which restrict the combination of alternative designs.
3. Calculating outputs and costs of combinations.

B. Complete a cost effective analysis by:

4. Eliminating economically inefficient alternative designs.
5. Eliminating economically ineffective alternative designs.

C. Develop an incremental cost curve by:

6. Calculating the average costs.
7. Recalculating average costs for additional outputs.

D. Complete an incremental cost analysis by:

8. Calculating incremental costs.
9. Comparing successive outputs and incremental costs.

In the ICA terminology, an alternative design is considered the With Project condition (i.e., "Build A Dam," "Develop a Wetland," "Restore the Riparian Zone," "Management Plan A," etc.). Under an alternative design, a series of scales (i.e., variations) can be defined which are modifications or derivations of the initial With Project conditions (i.e., "Develop 10 acres of Low Quality Wetlands," "Develop 1,000 acres of High Quality Wetlands," etc.). Often, these scales are based on differences in intensity of similar treatments and can, therefore, can be "lumped" under an alternative design class or category. During the first steps of CEA/ICA, all possible combinations of alternative designs and their scales are formed. As a general rule, intra-scale combinations (i.e., combinations of variations within a single alternative design) are not allowed - these activities would occupy the same space and time.

In most instances, CEA/ICA results are displayed in tables, scatter plots, and/or bar charts. These illustrative products assist decision-makers in the progressive comparisons of alternative design costs, and the increasing levels of environmental outputs. Before users make a decision based upon the outputs generated by the CEA/ICA, they must determine whether cost thresholds exist which limit production of the next level of environmental output (i.e., cost affordability). In addition, factors such as curve anomalies (i.e., abrupt changes in the incremental curve), output targets, and output thresholds can influence the selection of alternative designs.

III. OLD CAHOKIA CREEK

A. PROJECT DESCRIPTION

A.1. Location

The Old Cahokia Creek Site is located in Madison County, Illinois, in the County Ditch watershed. The floodplain component lies parallel to the Bluffs, and extends in a north-south direction from the Cahokia Creek Diversion Channel to the south side of Interstate 270. The site consists of remnants of historic Cahokia Creek and its adjacent floodplain. The "Bluff 1" watershed, to the north of Judy's Branch, comprises the entire Uplands component of the site (Figure 10).

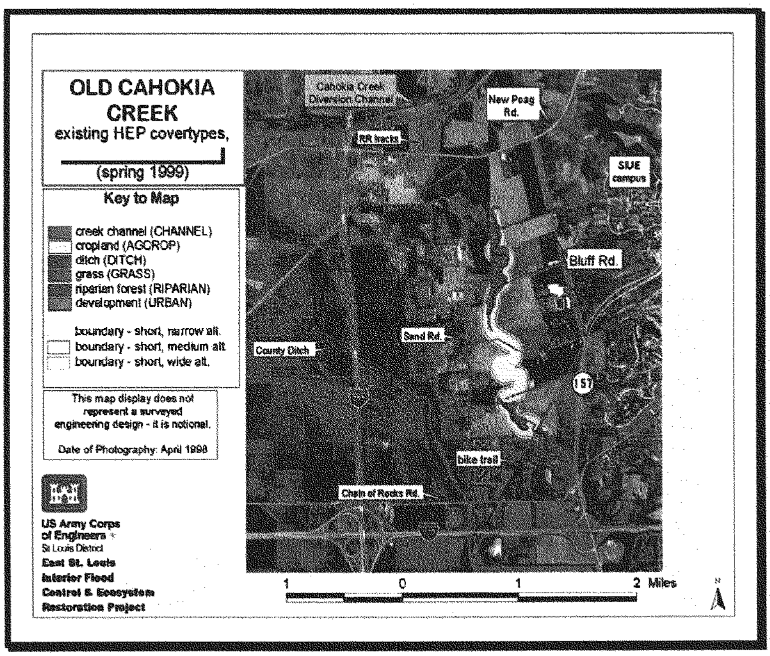

Figure 10. Old Cahokia Creek site map

A.2. Purpose

The proposed alternatives for this site were developed to address three goals: (1) restoration of a portion of Cahokia Creek on the floodplain to a free-flowing stream with an adjacent forested corridor supporting natural plant and animal communities and a flood regime similar to pre-settlement (ca. 1800) conditions; (2) the minimization of upland erosion and management of sedimentation in the "Bluff 1" sub-watershed; and (3) the reduction of flood damages in the County Ditch watershed focusing on Sand Road and the nearby areas.

A.3. Measures Under Consideration

In order to address these goals, the District generated two lists of design measures that, when combined in series, served as unique alternatives for the assessment. The first list of features was considered essential to meet these goals and, therefore, formed the basis for each design. These commonly shared features included:

1) The reopening of a portion of the Cahokia Creek channel on the floodplain. Segments of historic channel that were filled over the years would be reopened under these alternatives, and existing channel areas would be excavated to remove accumulated sediment to recreate a floodplain stream that once flowed from north to south.

2) The creation of a continuous forested corridor along the reopened channel. In all alternatives, trees would be planted on both sides of the creek where they currently do not occur.

3) The construction of an earthen hydraulic feature along the west side of the reopened channel. This feature, located along the west edge of the forest on the west side of the creek, would allow for a riverine overflow regime to be reestablished, while restricting overflow from the creek to the forested corridor and adjacent lands to the east.[5]

In addition to these commonly shared features, the alternatives deployed various combinations of features from the following four options:

(1) Uplands versus Bottomlands sediment detention, sediment originating in the Uplands and ultimately moving into the

[5]Remnants of an old berm still exist in some areas.

floodplain would be detained either in the Uplands (by constructing 10 new tributary stream sediment detention basins in the "Bluff 1" watershed), or in the Bottoms (in existing ditches and in the restoration area itself).

(2) Length of channel restoration. Two lengths of channel restoration were considered. From the south end of the project area, the shorter channel option would extend north along the creek for a distance of approximately 2.9 miles. The longer channel option would extend the length of the diversion channel for a distance of approximately 4.2 miles.

(3) Augmentation versus no augmentation of stream flows. For the longer channel alternatives, a new pump station could be installed at the diversion channel, and would be used to augment low stream flows to enhance environmental returns.

(4) Width of forested corridor. On *each* side of the creek, widths of approximately 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters) were considered.

(5) A number of pool and riffle complexes will be deployed at this site (number to be determined during the design phase of the study)[6].

A.4. Alternatives Under Evaluation

Given the above mentioned design measures, the District generated no less than 24 unique alternatives for the site (Table 24). Twelve of these alternatives were dropped from consideration due to their excessive costs, design inconsistencies (e.g., flow augmentation via pumping stations was required for the long-channel alternatives, but

[6]A pilot study at Judy's Branch was constructed in 2000, and the District will monitor the site over the next 3 years. The results of the pilot project will assist the District in determining the number of riffle:pool complexes necessary on a site-by-site basis to meet the proposed beneficial productivity assumed herein. Section 9 of the main report discusses this pilot project in greater detail (USACE 2002).

were unnecessary for the short-channel alternatives) and/or biologically ineffective configurations. These alternatives have been illustrated in Figure 11 and Figure 12.

Table 24. Old Cahokia Creek alternative matrix

Options	Uplands On	Uplands Off (Sedimentation Expected)
	Restoration of the Cahokia Creek channel to recreate a floodplain stream Creation of NEWRIPAR in three widths = XYZ (100m, 75m and 50m) Construction of an earthen berm along Cahokia Creek All sediment detention basins = AGCROP converted to DETENTION (marshes) DETENTION = basins dredged every 3-5 years Areas surrounding DETENTION = dredged every 50 years Pumping Station Deployed (Yes = 1, No = 0)	Restoration of the Cahokia Creek channel to recreate a floodplain stream Creation of NEWRIPAR in three widths = XYZ (100m, 75m and 50m) Construction of an earthen berm along Cahokia Creek No DETENTION Sedimentation expected = area dredged every 3-5 years for maintenance. Pumping Station Deployed (Yes = 1, No = 0)
Short-channel (~2.9 mi.) (extends north from I-270 along the creek)	2A-1-(0)-X	2B-1-(0)-X
	2A-1-(0)-Y	2B-1-(0)-Y
	2A-1-(0)-Z	2B-1-(0)-Z
	2A-1-(1)-X	2B-1-(1)-X
	2A-1-(1)-Y	2B-1-(1)-Y
	2A-1-(1)-Z	2B-1-(1)-Z
Long-channel (~4.2 mi.) (extends all the way to the diversion channel)	2A-2-(0)-X	2B-2-(0)-X
	2A-2-(0)-Y	2B-2-(0)-Y
	2A-2-(0)-Z	2B-2-(0)-Z
	2A-2-(1)-X	2B-2-(1)-X
	2A-2-(1)-Y	2B-2-(1)-Y
	2A-2-(1)-Z	2B-2-(1)-Z

Alternatives dropped from consideration due to low biological productivity, cost ineffectiveness, and/or design inefficiencies.
"2" denotes Old Cahokia Creek Site
A/B denotes presence/absence of an Uplands detention basin
1/2 denotes length of channel (1 = ~2.9 miles, 2 = ~4.2 miles)
(1)/(0) denotes preserve/absence of pumping station
XYZ denotes width of riparian corridor on each side of the creek

**Alternative dropped from the analysis due to design inconsistencies, each of biological productivity or cost ineffectiveness

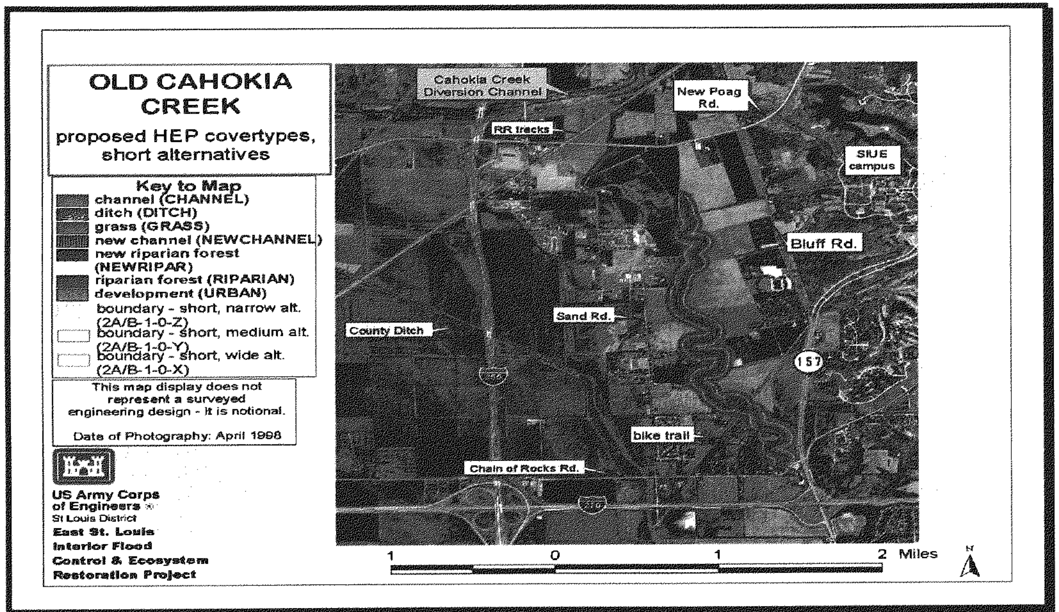

Figure 11. Proposed alternatives for the short-channel options at the Old Cahokia Creek Site (HEP cover types shown)

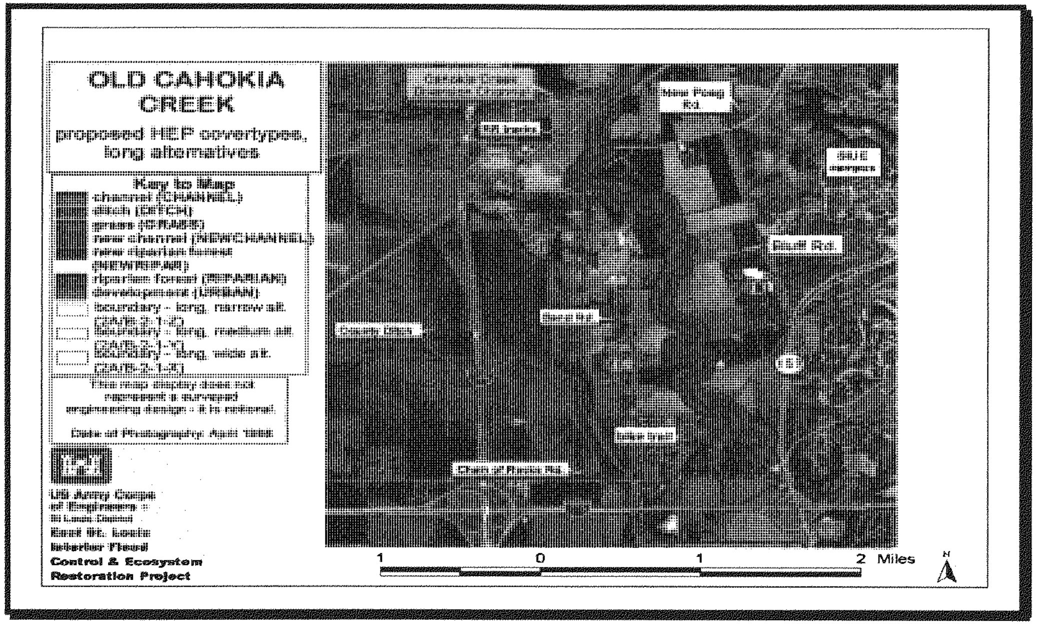

Figure 12. Proposed alternatives for the long-channel options at the Old Cahokia Creek Site (HEP cover types shown)

B. BASELINE CONDITIONS

B.1. Baseline Acres and Cover Types

At present, the study area encompasses approximately 458 acres, predominantly classed as agricultural croplands. The long-channel alternatives propose to affect these acres in their entirety, while the short-channel alternatives proposed to affect approximately ~343 acres. Thus two separate baseline conditions were established – one for the short-channel alternatives and another for the long-channel alternatives. Although the District identified 27 distinct cover types across the entire ESL-ER study area, only eight cover types were in evidence at the Old Cahokia Creek Site (i.e., deciduous forest in the Uplands, channels and rivers, urban areas, agricultural croplands, riparian corridors, grass-sloped sides of ditches, man-made ditches and streams connecting the site to the upper watershed). Of the eight, five cover types (i.e., DF, DITCH, CHANNEL, RIPARIAN, and STREAMS) were associated with the various HSI models selected, and were therefore used to evaluate baseline conditions. The cover types and their respective baseline acreages can be found below in Table 25.

Table 25. Baseline acres and cover types for the Old Cahokia Creek Site

No.	Code	Description	Baseline Acres Long Channel	Baseline Acres Short Channel
1	DF	Deciduous Forests	16.24	16.24
2	MARSH	Marshes (Herbaceous Emergent Wetlands)	0.00	0.00
3	LACUST	Lacustrine	0.00	0.00
4	CHANNEL	Channels and Rivers	33.50	22.30
5	PFO	Palustrine Forested Wetlands	0.00	0.00
6	PSS	Palustrine Scrub-Shrub Wetlands	0.00	0.00
7	URBAN	Urban Development, Roads	21.20	13.60
8	AGCROP	Agricultural Croplands	275.30	183.70
9	FIELD	Old Fields, Haylands and Pastures	0.00	0.00
10	PRAIRIE	Prairies (Wet & Dry)	0.00	0.00
11	PBUFFER	Prairie Buffer Strips	0.00	0.00
12	RIPARIAN	Riparian Corridors	76.00	71.70
13	FCORRIDOR	Forested Corridors	0.00	0.00
14	UNDREDGED	Undredged Prairies - Exterior	0.00	0.00
15	DETENTION	Detention Basins (with Degraded Marsh Inside)	0.00	0.00
16	NEWPFO	Newly Planted Forested Wetlands	0.00	0.00
17	GRASS	Grass-sloped Sides of Ditches	4.30	4.30
18	NEWCHANNEL	Newly Developed Riverine Channels	0.00	0.00
19	NEWMARSH	Newly Planted Marshes (HEW)	0.00	0.00
20	NEWFCORR	Newly Planted Forested Corridors	0.00	0.00
21	DFBOTTOMS	Deciduous Forests in the Bottoms	0.00	0.00
22	URBFIELD	Urbanized Old Fields, Haylands and Pastures	0.00	0.00
23	NEWRIPAR	Newly Developed Riparian Corridors	0.00	0.00
24	NEWPFO2	Newly Planted PFO from PSS	0.00	0.00
25	DITCH	Man-made Ditches, Channels	2.60	2.60
26	NEWDITCH	Newly Developed Man-made Ditches and Channels	0.00	0.00
27	STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed	28.82	28.82
		TOTALS:	457.96	343.26

B.2. Baseline Variable Values for Each Cover Type

Baseline field data was collected in the spring of 1999 through the summer of 2003 to determine existing conditions for this site. Data for each variable per cover type was recorded and the variable means/modes were calculated to generate baseline HSIs per model (Table 26). For detailed information regarding the field data collected by the Biological Team, refer to the tables in the attached electronic files (HEP Field Data.xls, St. Louis Baseline Acres.xls, St. Louis Baseline Means.xls, Watershed Statistics.xls).

Table 26. Baseline variable values for the Old Cahokia Creek Site HEP assessment[7]

Variable Codes	DF	DITCH	CHANNEL	RIPARIAN	STREAMS
AMTINSTRM					85.00
AMTSILT					2.00
AVGHTHERB					
BROODCOVER		5.00	15.00	0.05	
CHANNELIZE					1.00
DEPTHPOOLS					0.57
DEPTHRIFFL					4.00
DISTURB100		0.05	1.00	1.00	
DISTURB250				0.40	
EMBEDED					2.00
EMERGCAN	0.00			0.00	
EROSNPOTNT					2.00
EROSNBANK					2.00
FISHCOVER					
GRADIENT					8.00
GRAIN	800.00				
GRASS					
GROWTHFORM					
HDTREECAN	18.33				
HERBCAN					
HERONRY				42.00	
HUMAN	200.33	5.00	107.00	100.00	
HUMANTYPE	1.00	0.50	1.00	1.00	
MAXSALIN					
MAXTURBID		50.00	50.00		
MINDISOXY		4.00	3.00		
MORPHPOOLS					1.00
NESTBOX	0.00	0.00	0.00	0.00	
NESTDIST		8.00	8.00	8.00	
NUMSUBSTR					2.00
ORIGINSUB					2.00
PERCHDIST					
PHRANGE		7.23	7.23		
POOLDEPTH					
REGIME	4.00	2.00	4.00	7.00	
RIFFLEPOOL					3.00

[7]Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

Table 26. (cont.) Baseline variable values for the Old Cahokia Creek Site HEP assessment [8]

Variable Codes	DF	DITCH	CHANNEL	RIPARIAN	STREAMS
SHORECOV		14.00	14.00		
SINUOSITY					2.00
SHRUBCAN	13.33			17.50	
SUBMERGCAN		5.00	5.00	0.00	
SUBSTRATE					3.00
SUBSTRFINE					3.00
SUITABLTMP		18.87	18.87		
TEMPEPILIM					
TEMPLITTRL		18.87	18.87		
TEMPSPAWN		18.87	18.87		
TREECAN	86.67			70.00	
TREECAV	1.67	0.20	0.50	1.60	
TREEDBH	40.60				
TRSHRCAN	100.00	2.00	65.00	87.50	
TYPEADJRIP					3.00
TYPESTRM					6.00
TYPESUBSTR					11.00
VELOCITY		5.00	0.00	0.00	
VELOCITY - QHEI					4.00
WATERDEEP		20.00	10.00	10.00	
WATERPREY		0.50	0.25		
WATERTEMP		2.00	2.00	2.00	
WIDTHRIPAR					29.00
YRSURFWAT	40.00	90.00	40.00	5.00	
POTENESTS	0.15	0.02	0.05	0.14	
HUMANSQ	1.00				
HUMANTYPE	0.10				
HUMANWD	1.00	0.10	1.00	1.00	
HUMANTYPE	0.10	0.00	0.00	0.10	
HUMANST		0.05	1.00	1.00	
HUMANMK	1.00	0.20	1.00	1.00	

[8]Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

B.3. Baseline Evaluation

Of the ten HSI models used to evaluate ecosystem restoration benefits for alternatives in the ESL-ER study, seven [e.g., black crappie, fox squirrel, great blue heron, mink, slider turtle, wood duck and the Qualitative Habitat Evaluation Index (QHEI)] were used to assess the site for existing conditions and proposed future alternatives. Moderate baseline conditions existed for the black crappie (HSI = 0.54) and the fox squirrel (HSI = 0.32) and QHEI (HSI= 0.64). Low baseline conditions existed for the remaining models (HSIs < 0.4) (Figure 13 and Figure 14).

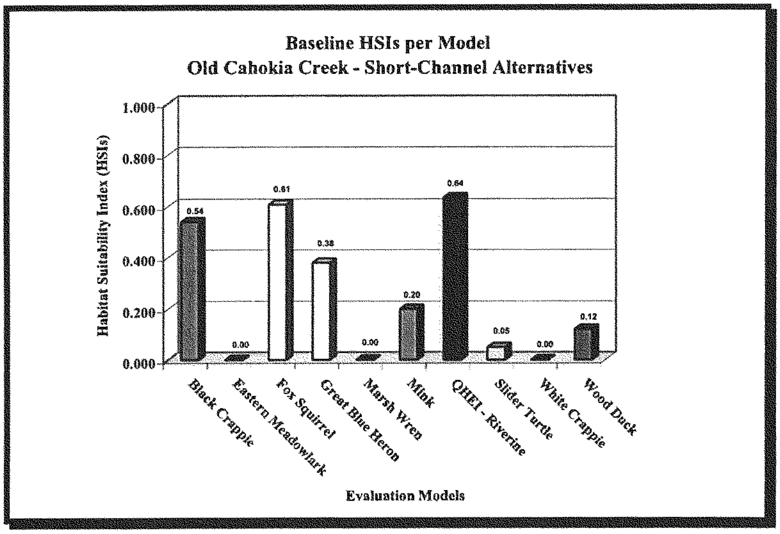

Figure 13. Baseline HSIs for the Old Cahokia Creek Site (short-channel alternatives)

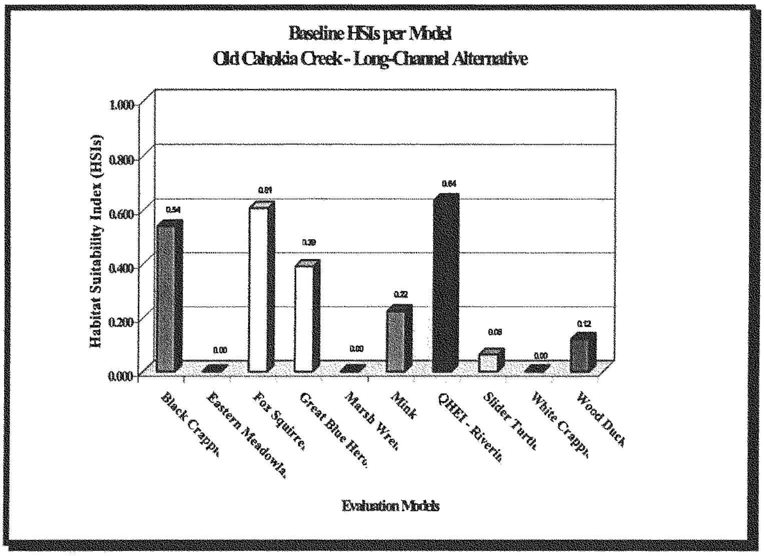

Figure 14. Baseline HSIs for the Old Cahokia Creek Site (long-channel alternatives)

Based on these index scores and the existing cover types acreages, Habitat Units (HUs) were generated by multiplication. Low HU values were the result of the moderate and low HSI values. Baseline HUs for Old Cahokia Creek can be found in Figure 15 and Figure 16.

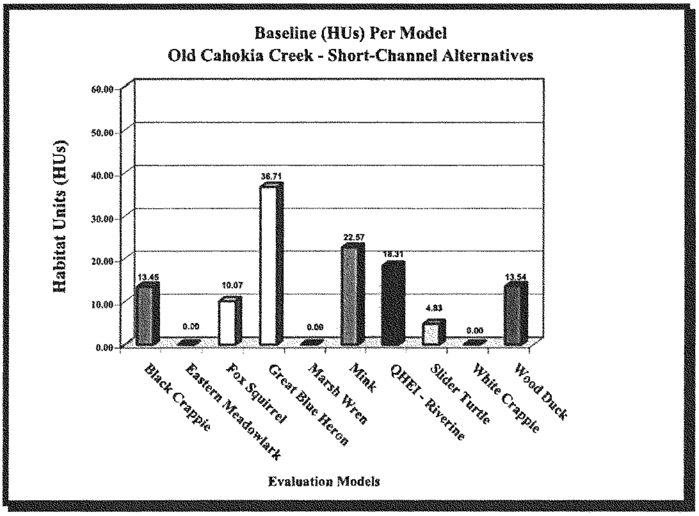

Figure 15. Baseline HUs for the Old Cahokia Creek Site (short-channel alternatives)

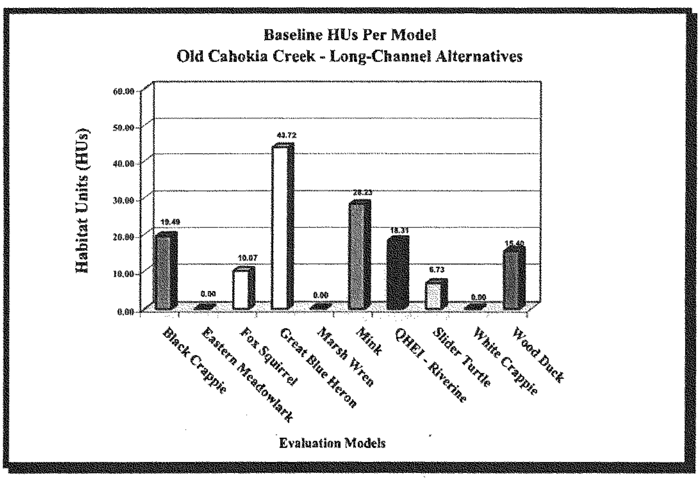

Figure 16. Baseline HUs for the Old Cahokia Creek Site (long-channel alternatives)

C. FUTURE CONDITIONS

C.1. Without Project Conditions

Based on the general Without Project trends described earlier in Chapter II, the ESL-ER Biological Team developed a series of incremental habitat quality and quantity projections to describe future conditions at the site given its location within the County Ditch watershed boundaries. The single dominating factor of these projections was the anticipated increase in urban encroachment in the watershed over the next 50 years. For example, more than 20 percent of the Uplands deciduous forest and 25 percent of the wetlands (marshes, shrublands, forests, lakes and streams) in the Bottoms are expected to be lost to urbanization in County Ditch watershed alone. Not only did the Team forecast these impacts in terms of acreage losses, but they also attempted to capture the impacts in terms of degrading water quality and vegetative composition/structure scores. Thus, turbidity is expected to increase and dissolved oxygen levels are expected to decrease. Shoreline and submerged cover will decline as pools are filled with sediment. Water depths will decrease and available prey populations will decline as a direct result. In addition, the Team assumed that the human interference factors (distance to nearest human activities and the type of human activities occurring nearby) would significantly degrade future habitat conditions. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Old Cahokia Creek Alternatives.xls)

C.2. With Project Conditions

With the general trends of the Without Project condition (i.e., the No Action Alternative) in mind, the Biological Team developed acreage and variable projections for the twelve alternatives proposed by the District. When possible, the Team offered suggestions to enhance the alternatives given the goals and objectives developed earlier in the process. As a general rule, the Biological Team assumed that available agricultural croplands would be converted to productive wetland settings, and the existing Uplands deciduous forests and floodplain wetlands would be protected from urban development. Alternatives that incorporated the deployment of detention ponds in the Uplands were assumed to have higher habitat quality than those alternatives that opted for floodplain sediment retention. Regardless of the manner in which it was achieved, the Team assumed the reduction in sediment would result in the overall improvement of both water quality (i.e., reduced turbidity and increased dissolved oxygen levels) and vegetative growth and health (i.e., increased submerged and shoreline coverage). Wetland quality would be further improved by the construction of a new ditch to funnel water to the wetland during pulse flood flows. One significant design feature, the development of 160+ acres of riparian corridor, was projected to greatly enhance the overall value of the wetlands by providing new cover, food and water for the wildlife species of concern.

The Biological Team attempted to capture the vegetative succession of these areas in increments over time (low quality early on and high quality by TY30). By restoring existing wetlands, developing new wetlands and protecting these areas in perpetuity, the Biological Team assumed the habitat would be buffered from human disturbance factors, thereby improving the overall value of the wetlands in the urban setting. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Old Cahokia Creek Alternatives.xls).

D. EVALUATION OF ALTERNATIVES

D.1. Overall Review of the HEP Results

The overall gains and losses per alternative are summarized in Table 27.

Table 27. Net AAHUs for each HEP Model per alternative for the Old Cahokia Creek Site

Old Cahokia Creek Alternatives				Net AAHUs					Net AAHUs				
Alternative Description		Alternative Code	Sum of Net AAHUs	Black Crappie	Eastern Meadowlark	Fox Squirrel	Great Blue Heron	Marsh Wren	Mink	QHEI	Slider Turtle	White Crappie	Wood Duck
Upland Detention	SHORT CHANNEL (~2.9 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Width of Forested Corridor: X = 100m Y = 75m Z = 50m	2A-1-(0)-X	185.45	14.56	0.00	0.53	74.96	0.00	25.99	6.88	49.37	0.00	13.17
		2A-1-(0)-Y	164.50	14.56	0.00	0.53	65.55	0.00	25.97	6.88	39.14	0.00	11.87
		2A-1-(0)-Z	133.02	12.29	0.00	-0.13	48.04	0.00	25.96	6.88	28.73	0.00	11.26
	LONG CHANNEL (~4.2 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Width of Forested Corridor: X = 100m Y = 75m Z = 50m	2A-2-(1)-X	254.94	18.41	0.00	0.53	108.69	0.00	33.31	6.88	67.03	0.00	20.09
		2A-2-(1)-Y	221.36	18.41	0.00	0.53	91.18	0.00	33.27	6.88	53.33	0.00	17.75
		2A-2-(1)-Z	173.86	15.37	0.00	-0.13	64.59	0.00	33.25	6.88	38.69	0.00	15.21

Table 27 (cont.) Net AAHUs for each HEP Model per alternative for the Old Cahokia Creek Site

Old Cahokia Creek Alternatives				Net AAHUs					Net AAHUs					
Alternative Description		Alternative Code	Sum of Net AAHUs	Black Crappie	Eastern Meadowlark	Fox Squirrel	Great Blue Heron	Marsh Wren	Mink	QHEI	Slider Turtle	White Crappie	Wood Duck
No Upland Detention	SHORT CHANNEL (~2.9 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Width of Forested Corridor: X=100m Y=75m Z=50m	2B-1-(0)-X	175.39	8.56	0.00	0.00	102.15	0.00	8.08	0.00	51.35	0.00	5.25
		2B-1-(0)-Y	125.67	8.56	0.00	0.00	65.51	0.00	8.06	0.00	39.67	0.00	3.87
		2B-1-(0)-Z	92.84	5.68	0.00	0.00	47.30	0.00	8.04	0.00	28.21	0.00	3.62
	LONG CHANNEL (~4.2 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Width of Forested Corridor: X=100m Y=75m Z=50m	2B-2-(1)-X	207.53	9.40	0.00	0.00	108.69	0.00	8.60	0.00	70.98	0.00	9.87
		2B-2-(1)-Y	181.02	9.40	0.00	0.00	95.15	0.00	13.96	0.00	55.06	0.00	7.46
		2B-2-(1)-Z	121.81	6.13	0.00	0.00	63.84	0.00	8.51	0.00	38.05	0.00	5.27

Overall, the District can expect to see the creation of approximately 174 acres of new habitat (primarily new channels/ditches and riparian zones) and the preservation and restoration of approximately 151 acres of existing habitat with the implementation of the "winning" long-channel alternatives. The District can expect to see the creation of approximately 116 acres of new habitat (primarily new channels/ditches and riparian zones) and the preservation and restoration of approximately 130 acres of existing habitat with the development of the "winning" short-channel alternatives. Based on the assessment, the black crappie, fox squirrel and riverine communities (based on QHEI results) achieved optimum or near-optimum conditions under the "winning" design scenarios (HSIs $\geq$ 0.5 were realized by TY51). The great blue heron's outputs were the highest among models evaluated, representing approximately 50 percent (on average) of the total net gains. The second highest outputs were attained in the slider turtle's returns, whose AAHUs contributed an additional 30 percent (on average) to the total net gains at the site. Low HSI scores (< 0.5) in the evaluation of the four lacustrine-based wetland species (great blue heron, mink, slider turtle and wood duck) can be directly attributed to less than optimal design of pond ecosystems for the study site. For detailed information regarding these results, refer to the tables in the attached electronic files (Old Cahokia Creek Overall Results.xls, Old Cahokia Creek Baseline HSIs Summarized.xls, Old Cahokia Creek Baseline HUs Summarized.xls).

D.2. Top Three Biological Winners Using HEP

The top three biologically productive solutions among the short-channel alternatives were:

#1 **2A-1-(0)-X** - Short-channel with a 100-m forested corridor and Uplands detention produced 185.45 net AAHUs

#2 **2B-1-(0)-X** - Short-channel with a 100-m forested corridor and no Uplands detention component produced 175.39 net AAHUs; and

#3 **2A-1-(0)-Y** - Short-channel with a 75-m forested corridor and Uplands detention produced 164.50 net AAHUs.

The top three biologically productive solutions among the long-channel alternatives were:

#1 **2A-2-(1)-X** - Long-channel with a pumping station, a 100-m forested corridor and Uplands detention produced 254.94 net AAHUs;

#2 **2A-2-(1)-Y** - Long-channel with a pumping station, a 75-m forested corridor and Uplands detention produced 221.36 net AAHUs; and

#3 **2B-2-(1)-X** - Long-channel with a pumping station, a 100-m forested corridor and no Uplands detention component produced 207.53 net AAHUs.

D.3. Individual HEP Model Results

Creating habitats under these "winning" scenarios, even though the quality of these areas was less than optimal for the species (i.e., HSIs > 0, but ≤ 1.0 by TY51), nevertheless resulted in favorable wetland returns for the proposed "winning" alternatives when evaluated as a whole. On a model-by-model basis, the following summations could be made regarding the long-channel alternative winners:

Black Crappie: Although optimum conditions (HSI = 1.0) were not achieved under either the "winning" long-channel alternative [i.e., 2A-2-(1)-X] or the short-channel alternative (2A-1-(0)-X), the species can expect to see a **TY51 HSI ≅ 0.84** under either scenario. These HSI scores resulted in a net gain of **18.41 AAHUs** for the 2A-2-(1)-X alternative and **14.56 AAHUs** for the 2A-1-(0)-X,respectively.

Eastern Meadowlark: This species was not applicable to this site.

Fox Squirrel: Although optimum conditions (HSI = 1.0) were not achieved under either the "winning" long-channel alternative [i.e., 2A-2-(1)-X] or the short-channel alternative (2A-1-(0)-X), the species can expect to see a **TY51 HSI ≅ 0.63** under either scenario. These HSI scores resulted in a net gain of **0.53 AAHUs** for the 2A-2-(1)-X alternative and **0.53 AAHUs** for the 2A-1-(0)-X, respectively.

Great Blue Heron: Although optimum conditions (HSI = 1.0) were not achieved under either the "winning" long-channel alternative [i.e., 2A-2-(1)-X] or the short-channel alternative (2A-1-(0)-X), the species can expect to see a **TY51 HSI ≅ 0.38** under either scenario. These HSI scores resulted in a net gain of **108.69 AAHUs** for the 2A-2-(1)-X alternative and **74.96 AAHUs** for the 2A-1-(0)-X, respectively.

Marsh Wren: This species was not applicable to this site.

Mink: Although optimum conditions (HSI = 1.0) were not achieved under either the "winning" long-channel alternative [i.e., 2A-2-(1)-X] or the short-channel alternative (2A-1-(0)-X), the species can expect to see a **TY51 HSI ≅ 0.15** under either scenario. These HSI scores resulted in a net gain of **33.31 AAHUs** for the 2A-2-(1)-X alternative and **25.99 AAHUs** for the 2A-1-(0)-X, respectively.

QHEI - Riverine Community: Near optimum conditions were achieved under both the "winning" long-channel alternative [i.e., 2A-2-(1)-X] and the "winning" short-channel alternative [i.e., 2A-1-(0)-X], and the community can expect to see a **TY51 HSI = 0.84** under either scenario. These HSI scores results in a net gain of **6.88 AAHUs** for both scenarios.

Slider Turtle: Although optimum conditions (HSI = 1.0) were not achieved under either the "winning" long-channel alternative [i.e., 2A-2-(1)-X] or the short-channel alternative (2A-1-(0)-X), the species can expect to see a **TY51 HSI ≅ 0.18** under either scenario. These HSI scores resulted in a net gain of **67.03 AAHUs** for the 2A-2-(1)-X alternative and **49.37 AAHUs** for the 2A-1-(0)-X, respectively.

White Crappie: This species was not applicable to this site.

Wood Duck: Although optimum conditions (HSI = 1.0) were not achieved under either the "winning" long-channel alternative [i.e., 2A-2-(1)-X] or the short-channel alternative (2A-1-(0)-X), the species can expect to see a **TY51 HSI ≅ 0.10** under either scenario. These HSI scores resulted in a net gain of **20.09 AAHUs** for the 2A-2-(1)-X alternative and **13.17 AAHUs** for the 2A-1-(0)-X, respectively.

The specific details of the EXHEP runs are reported in the attached electronic files (Attained Goals.xls). Each alternative is identified, the gains or losses in terms of acres and HSIs are recorded, and both cumulative and net AAHUs are documented. The variations among model outputs are illustrated in Figure 17 and Figure 18.

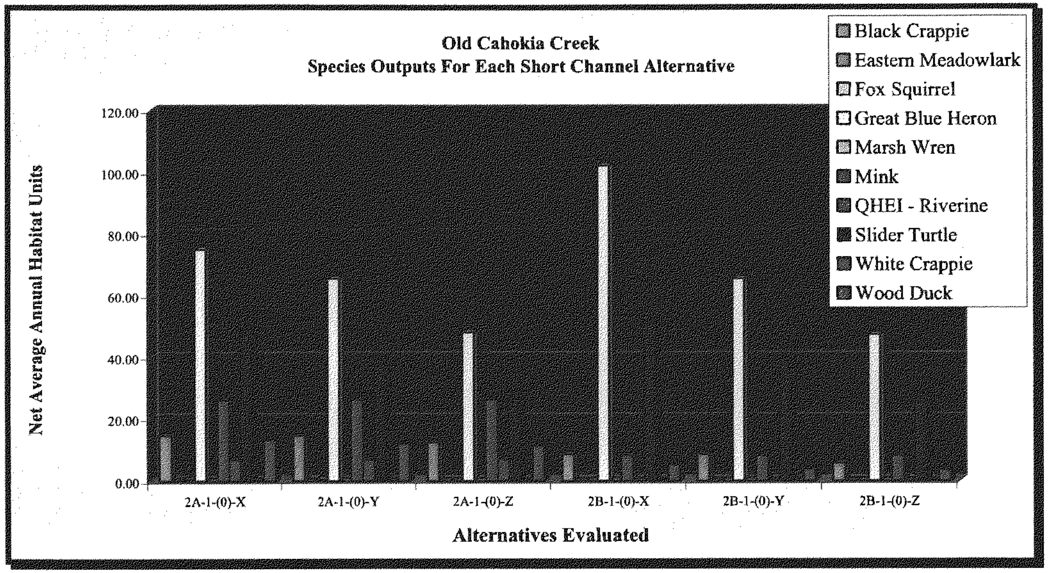

Figure 17. HSI Model outputs per short-alternative for the Old Cahokia Creek Site

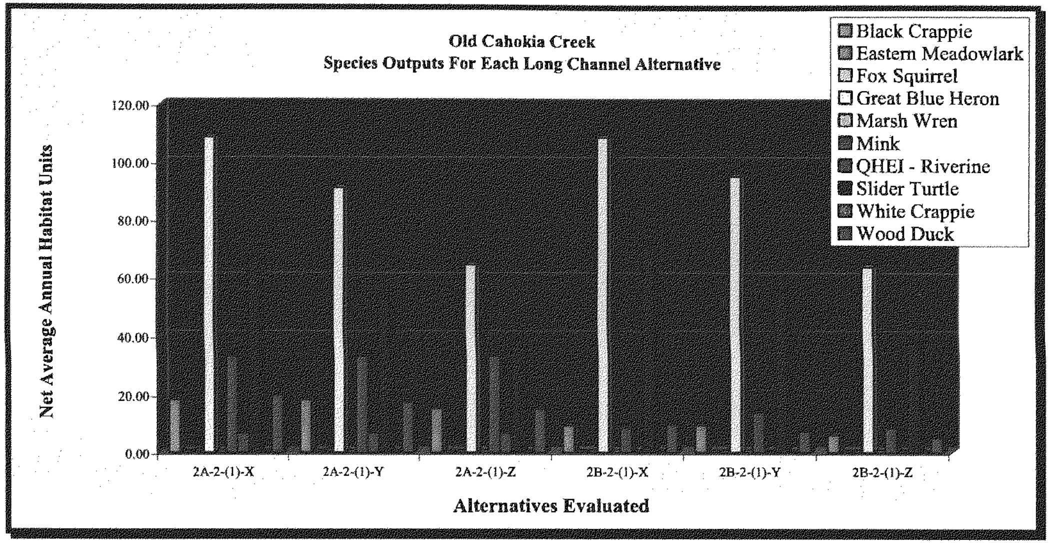

Figure 18. HSI Model outputs per long-alternative for the Old Cahokia Creek Site

E. COST ANALYSES

As described earlier in this report, two techniques were used to determine the winning solution in the cost evaluation process. First, the results of the habitat assessment were compared using Cost Effectiveness Analyses (CEA). When alternatives are compared using CEA, those alternatives that produce increased levels of output (AAHUs) for the same or lesser costs were considered "effective" solutions and were retained. These alternatives were, in turn, compared on the basis of cost efficiency [i.e., those alternatives that produce similar levels of output (AAHUs) at a lesser expense]. The "efficient" solutions were submitted to Incremental Cost Analyses (ICA) (i.e., determining changes in costs for increasing levels of outputs). Once evaluated on the basis of incremental effectiveness, the "winning" solutions were revealed (those that are both cost effective and incrementally effective). The annualized costs and outputs, as well as the results of the CEA and ICA evaluations for the Old Cahokia Creek Site, are presented below.

E.1. Project Costs

In Table 28, the total costs, annualized costs and annualized biological returns (i.e., AAHUs) are recorded for each alternative. The most expensive proposal (i.e., 2A-2-(1)-X) will cost more than $11.4M to implement. The least expensive proposal (i.e., 2B-1-(0)-Z) will cost more than $4.8M to undertake.

Table 28. Total project costs and annualized costs per alternative for the Old Cahokia Creek Site

	Alternative Description	Alternative Code	Total Alternative Costs	Total Annualized Costs	Net AAHUs	Cost Per AAHU	AAHU Per $1000.00
Uplands Detention	SHORT CHANNEL (~2.9 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Type of Forested Corridor: X = 100m Width Y = 75m Width Z = 50m Width	2A-1-(0)-X	$9.69M	$647,000.00	185.45	$3,488.81	0.2866
		2A-1-(0)-Y	$9.3M	$621,000.00	164.50	$3,775.17	0.2649
		2A-1-(0)-Z	$8.93M	$596,600.00	133.02	$4,484.95	0.2230
	LONG CHANNEL (~4.2 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Type of Forested Corridor: X = 100m Width Y = 75m Width Z = 50m Width	2A-2-(1)-X	$11.48M	$766,700.00	254.94	$3,007.33	0.3325
		2A-2-(1)-Y	$10.91M	$729,000.00	221.36	$3,293.32	0.3036
		2A-2-(1)-Z	$10.31M	$688,700.00	173.86	$3,961.32	0.2524

Table 28. (cont.) Total project costs and annualized costs per alternative for the Old Cahokia Creek Site

	Alternative Description	Alternative Code	Total Alternative Costs	Total Annualized Costs	Net AAHUs	Cost Per AAHU	AAHU Per $1000.00
No Uplands Detention	SHORT CHANNEL (~2.9 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Type of Forested Corridor: X = 100m Width Y = 75m Width Z = 50m Width	2B-1-(0)-X	$5.64M	$377,000.00	175.39	$2,149.49	0.4652
		2B-1-(0)-Y	$5.24M	$350,000.00	125.67	$2,785.13	0.3590
		2B-1-(0)-Z	$4.89M	$326,300.00	92.84	$3,514.72	0.2845
	LONG CHANNEL (~4.2 miles) Pumping Station: (0) - Not Deployed (1) - Deployed Type of Forested Corridor: X = 100m Width Y = 75m Width Z = 50m Width	2B-2-(1)-X	$7.43M	$496,000.00	207.53	$2,389.97	0.4184
		2B-2-(1)-Y	$6.86M	$458,200.00	181.02	$2,531.19	0.3951
		2B-2-(1)-Z	$6.25M	$417,700.00	121.81	$3,429.19	0.2916

E.2. Top Three Cost Effective Solutions Based on the HEP Results

The CEA results for both the short-channel and long-channel alternatives for this site can be found in Table 29 and Table 30 below. The top three cost effective solutions in the short-channel analyses were: **2B-1-(0)-X, 2B-1-(0)-Y** and **2A-1-(0)-X**. For the 2B-1-(0)-X alternative, the District can expect to generate one AAHU for every $2,149.49 expended annually. For the 2B-1-(0)-Y alternative, the costs increased to $2,785.13 for each AAHU (an increase of $635.65). And, for the 2B-1-(0)-Z alternative, an AAHU could be gained at a cost of $3,488.81 – a cost $1,339.32 above the "winning" solution's cost. For detailed information regarding these cost analyses, refer to the tables in the attached electronic files (Old Cahokia Creek HEP CEA.xls, Old Cahokia Creek Long HEP CEA.xls, Old Cahokia Creek Short HEP CEA.xls).

The top three cost effective solutions in the long-channel analyses were: **2B-2-(1)-X, 2B-2-(1)-Y** and **2A-2-(1)-X**. For the 2B-2-(1)-X alternative, the District can expect to generate one AAHU for every $2,389.97 expended annually. For the 2B-2-(1)-Y alternative, the cost increased to $2,531.19 for each AAHU (an increase of $141.22). And, for the 2A-2-(1)-X alternative, an AAHU could be gained at a cost of $3,007.33 – a cost $617.36 above the "winning" solution's cost.

Table 29. Cost effective solutions for the short-channel alternatives on the Old Cahokia Creek Site evaluated with HEP

CEA Ranking	ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU
1	1	2	2B-1-(0)-X	175.39	$377,000.00	$2,149.49
2	3	5	2B-1-(0)-Y	125.67	$350,000.00	$2,785.13
3	2	1	2A-1-(0)-X	185.45	$647,000.00	$3,488.81
4	5	6	2B-1-(0)-Z	92.84	$326,300.00	$3,514.72
5	4	3	2A-1-(0)-Y	164.50	$621,000.00	$3,775.17
6	6	4	2A-1-(0)-Z	133.02	$596,600.00	$4,484.95

#1 Ranked Alternative
#2 Ranked Alternative
#3 Ranked Alternative

Table 30. Cost effective solutions for the long-channel alternatives on the Old Cahokia Creek Site evaluated with HEP

CEA Ranking	ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU
1	1	3	2B-2-(1)-X	207.53	$496,000.00	$2,389.97
2	3	4	2B-2-(1)-Y	181.02	$458,200.00	$2,531.19
3	2	1	2A-2-(1)-X	254.94	$766,700.00	$3,007.33
4	4	2	2A-2-(1)-Y	221.36	$729,000.00	$3,293.32
5	5	6	2B-2-(1)-Z	121.81	$417,700.00	$3,429.19
6	6	5	2A-2-(1)-Z	173.86	$688,700.00	$3,961.32
	#1 Ranked Alternative					
	#2 Ranked Alternative					
	#3 Ranked Alternative					

E.3. Top Three Incrementally Effective Solutions Based on the HEP Results

The results of the Short-Channel ICA assessment are displayed in Figure 19. At this site, the top three incrementally effective solutions evaluated for the short-channel option included:

#1 **2B-1-(0)-X**- Short-channel with a 100-m forested corridor and no Uplands detention component produced 175.39 net AAHUs at a cost of $2,149.49 per AAHU;

#2 **2A-1-(0)-X**- Short-channel with a 100-m forested corridor and Uplands detention produced 178.57 net AAHUs at a cost of $3,623.19 per AAHU; and

#3 **2B-1-(0)-Y**- Short-channel with a 75-m forested corridor and no Uplands detention component produced 125.67 net AAHUs at a cost of $2,785.13 per AAHU.

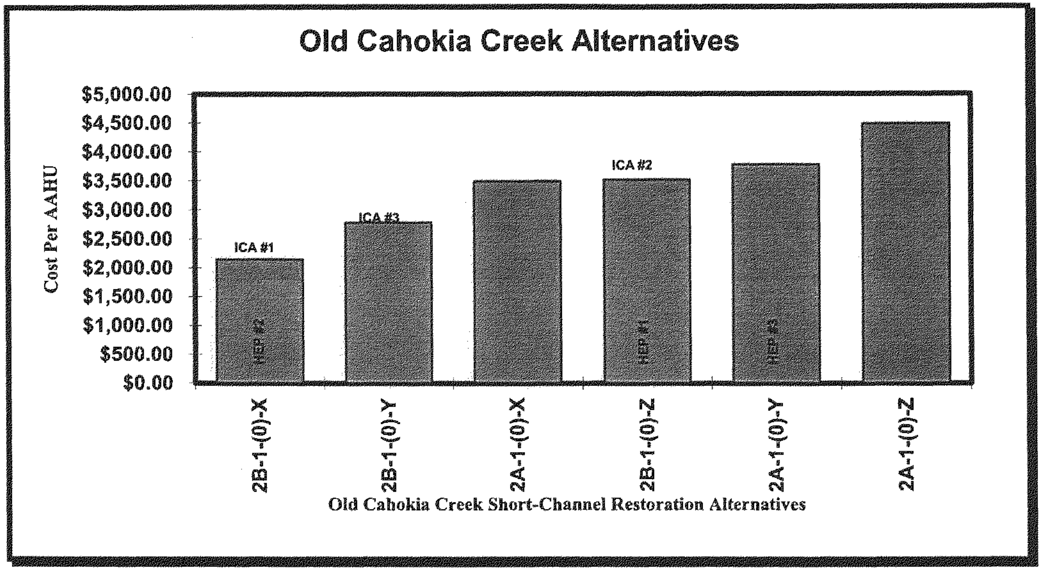

Figure 19. ICA results based on the HEP assessment of the short-channel alternatives for the Old Cahokia Creek Site

In essence, only the top two alternatives (i.e., 2B-1-(0)-X and 2A-1-(0)-X) were found to be "Best Buy" plans – that is they were the most, biologically productive, incrementally effective plans (Figure 20 and Table 31).

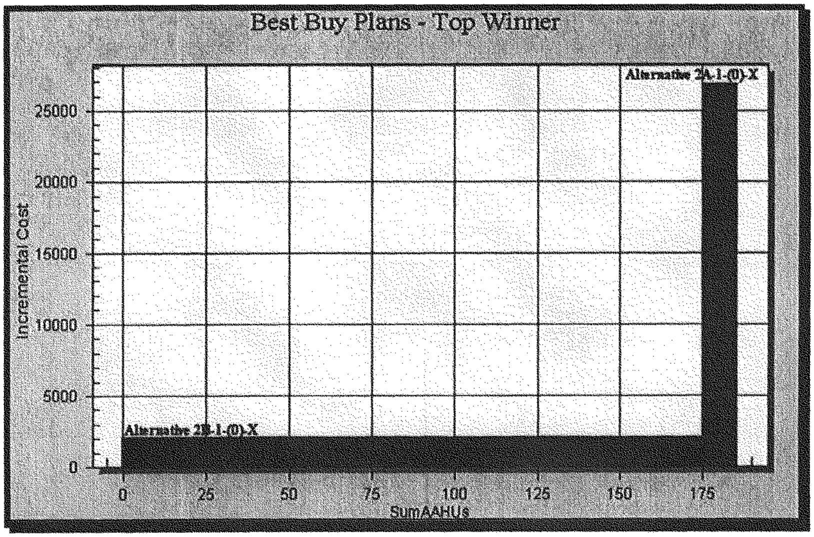

Figure 20. "Best Buy" options from the ICA analysis of the HEP results on the short-alternatives at the Old Cahokia Creek Site

Table 31. Incremental outputs for the "Best Buy" options resulting from the ICA analysis of the HEP results on the short-alternatives at the Old Cahokia Creek Site

Alternative	Incremental Output	Incremental Output/Unit Output
No Action	0.00	$0.00
2B-1-(0)-X	175.39	$2,149.49
2A-1-(0)-X	10.06	$26,840.23

The top three incrementally effective solutions evaluated for the long-channel option included:

#1 **2B-2-(1)-X**- Long-channel with a pumping station, a 100-m forested corridor and no Uplands detention component produced 207.53 net AAHUs at a cost of $2,389.97 per AAHU;

#2 **2A-2-(1)-X**- Long-channel with a pumping station, a 100-m forested corridor and Uplands detention produced 248.07 net AAHUs at a cost of $3,090.71 per AAHU; and

#3 **2B-2-(1)-Y** - Long-channel with a pumping station, a 75-m forested corridor and Uplands detention produced 181.02 net AAHUs at a cost of $2,531.19 per AAHU.

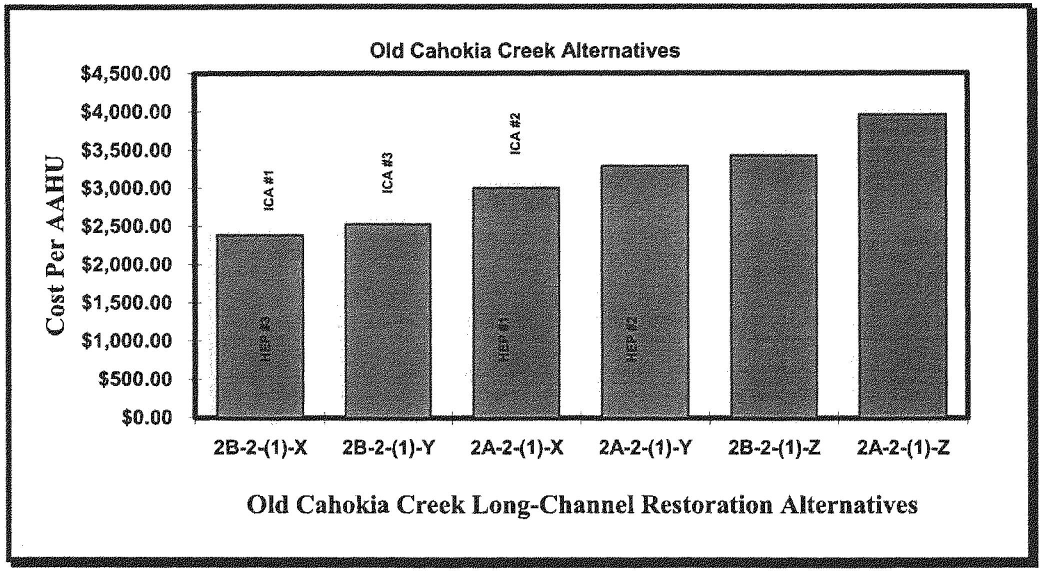

Figure 21. ICA results based on the HEP assessment of the long-channel alternatives for the Old Cahokia Creek Site

In essence, only the top two alternatives (i.e., 2B-2-(1)-X and 2A-2-(1)-X) were found to be "Best Buy" plans – that is they were the most, biologically productive, incrementally effective plans (Figure 22 and Table 32).

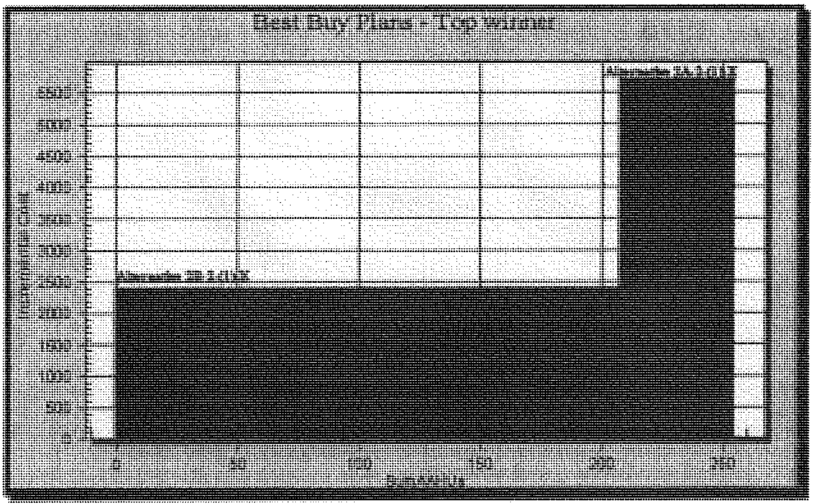

Figure 22. "Best Buy" options from the ICA analysis of the HEP results on the long-alternatives at the Old Cahokia Creek Site

Table 32. Incremental outputs for the "Best Buy" options resulting from the ICA analysis of the HEP results on the long-alternatives at the Old Cahokia Creek Site

Alternative	Incremental Output	Incremental Output/Unit Output
No Action	0.00	$0.00
2B-2-(1)-X	207.53	$2,389.97
2A-2-(1)-X	47.41	$5,709.78

IV. JUDY'S-BURDICK BRANCHES

A. PROJECT DESCRIPTION

A.1. Location

The project area is located in Madison County, Illinois, in the Cahokia watershed. The floodplain component lies at the southern end of historic Rattan's Prairie, southeast of the junction of Interstate 255 and Route 162, at the confluence of Judy's Branch, Burdick Branch and Cahokia Canal. The watersheds of Judy's Branch, Burdick Branch and a portion of the "Bluff 1" tributary compose the Uplands component (Figure 23).

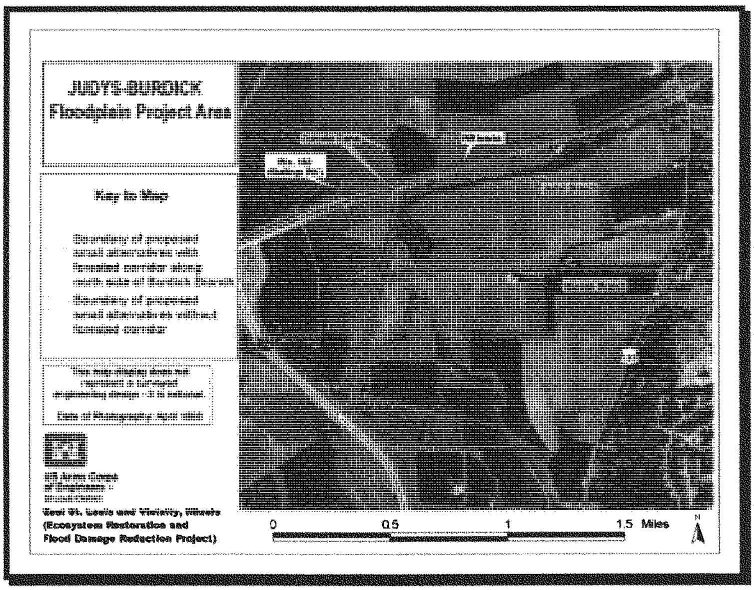

Figure 23. Judy's-Burdick Branches site map

A.2. Purpose

The proposed alternatives for this site were developed to address three goals: (1) the creation of an area on the floodplain to support natural plant and animal communities with a flood regime similar to presettlement (ca. 1800) conditions; (2) the minimization of upland erosion and management of sedimentation in the Judy's, Burdick and "Bluff 1" sub-watersheds; and (3) the reduction of flood damages in the Bottoms within the Cahokia watershed.

A.3. Measures Under Consideration

In order to address these goals, the District generated two lists of design measures that, when combined in series, served as unique alternatives for the assessment. The first list of features was considered essential to meet these goals and, therefore, formed the basis for each design. These commonly shared features included:

1) The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Judy's and Burdick Branches combined.

2) The modification of the existing levee, along the south side of Burdick Branch, to ensure delivery of stormwater events from the Judy's and Burdick tributaries into the new habitat area.

3) The creation of a 330-foot-wide (100-meter-wide) wide prairie buffer surrounding the perimeter of the habitat area's earthen hydraulic feature.

In addition to these commonly shared features, the alternatives deployed various combinations of features from the following four options:

(1) Uplands versus Bottomlands sediment detention. Sediment originating in the Uplands, and ultimately moving into the floodplain, would be detained either in the Uplands (by constructing 28 new tributary stream sediment detention basins - 23 in the Judy's Branch, 4 in the Burdick Branch and 3 in the "Bluff 1" watersheds), or in the Bottoms (in existing channels, and in a sediment detention basin within the new habitat area itself).

(2) Size of habitat area. Given existing urban constraint, three options are being considered to provide a variety of habitat

options and hydrologic regimes (the "small" option would restore 131 acres, the "medium" option would restore 230 acres and a "large" option would restore 350 acres). Under the small and medium size options, a moderate-extensive excavation activity will support the development of a new marsh. For the larger option, prairie would be created with little or no excavation needed.

(3) Restoration of the historic Cahokia Creek channel within the habitat area. A channel would be excavated to replace the historic channel that has degraded over time in an effort to recreate the floodplain stream similar to that which once flowed from north to south across the site.[9]

(4) Create a 330-foot-wide (100-meter-wide) wide forested corridor along the north side of Burdick Branch extending from Cahokia Canal to Route 157.

(5) A number of pool and riffle complexes will be deployed at this site (number to be determined during the design phase of the study)[10].

A.4. Alternatives Under Evaluation

Given the above mentioned design measures, the District generated no less than 40 unique alternatives for this site (Table 33). Twenty of these alternatives were dropped

[9]The option to restore the Cahokia Creek Channel would be implemented only in combination with the Uplands sediment detention feature.
[10]A pilot study at Judy's Branch was constructed in 2000, and the District will monitor the site over the next 3 years. The results of the pilot project will assist the District in determining the number of riffle:pool complexes necessary on a site-by-site basis to meet the proposed beneficial productivity assumed herein. Section 9 of the main report discusses this pilot project in greater detail (USACE 2002).

from consideration due to their excessive costs, design inconsistencies and/or biologically ineffective configurations. These alternatives have been illustrated in Figure 24 (small site options), Figure 25 (medium site options) and Figure 26 (large site options).

Table 33. Judy's-Burdick Branches alternative matrix

Options	Uplands ON (no Detention basin)		Uplands OFF (Dentention basin needed)
	Prairie Only	Marsh Only	Prairie with Marsh Detention Basin
Small Site (131 ac)	3A-1-X	3B-1-X	3C-1-X
Medium Site (230 ac)	3A-2-X	3B-2-X	3C-2-X
Large Site (350 ac)	3A-3-X	3B-3-X	3C-3-X
Large Site (350 ac) - Horseradish Lands Excluded	3A-4-X	3B-4-X	3C-4-X
Small Site (131 ac) w/o NEWFCORR	3A-1-(0)	3B-1-(0)	3C-1-(0)
Medium Site (230 ac) w/o NEWFCORR	3A-2-(0)	3B-2-(0)	3C-2-(0)
Large Site (350 ac) w/o NEWFCORR	3A-3-(0)	3B-3-(0)	3C-3-(0)
Large Site (350 ac) w/o NEWFCORR - Horseradish Lands Excluded	3A-4-(0)	3B-4-(0)	3C-4-(0)

[shaded] Alternatives dropped from consideration due to low biological productivity, cost ineffectiveness, and/or design inefficiencies.

Forested Corridor Options:
- -X = 100-m forested corridor strips (100-m width needed for optimum conditions)
- -(0) = No forested corridor strips present

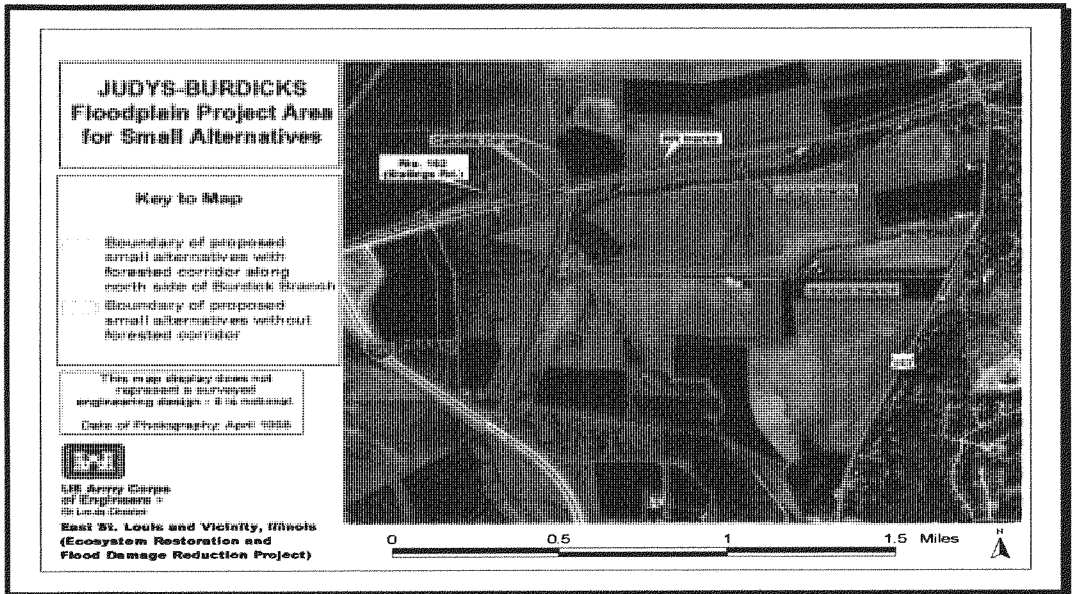

Figure 24. Proposed alternatives for the small site options at the Judy's-Burdick Branches Site (HEP cover types shown)

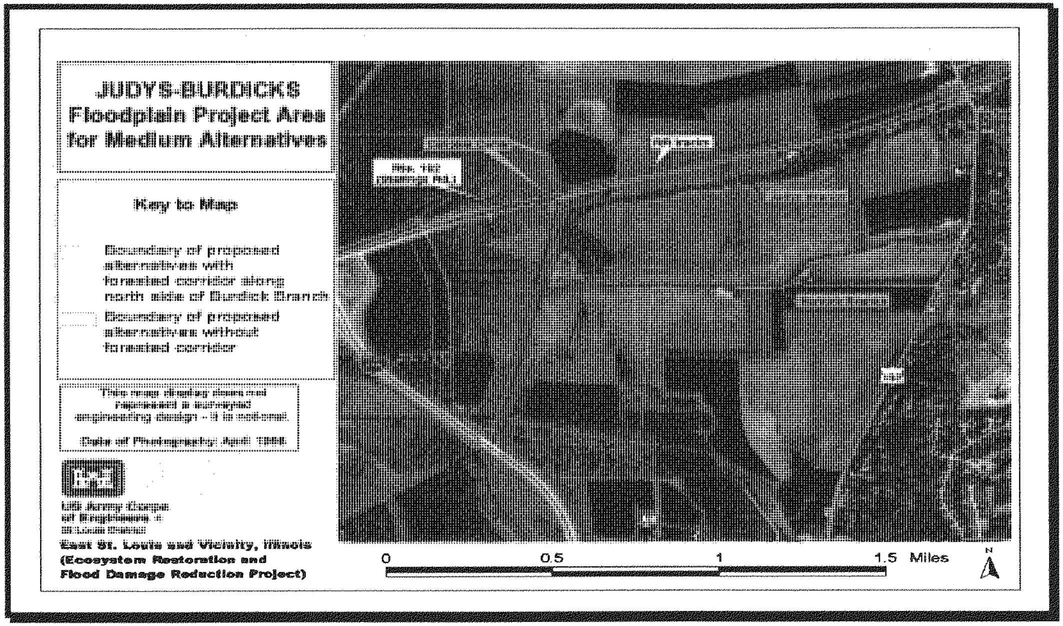

Figure 25. Proposed alternatives for the medium site options at the Judy's-Burdick Branches Site (HEP cover types shown)

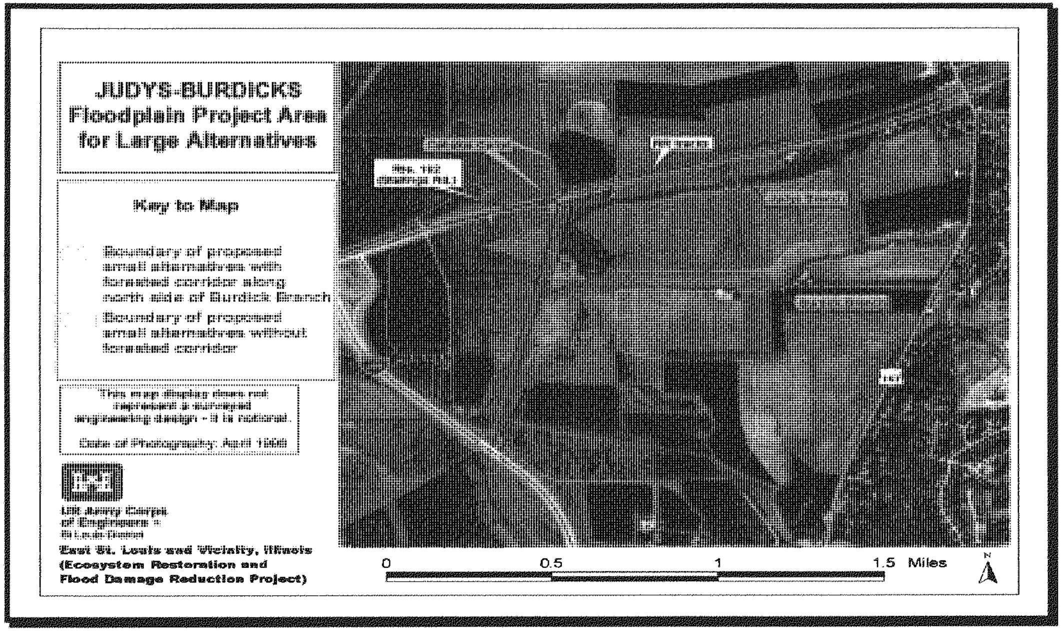

Figure 26. Proposed alternatives for the large site options at the Judy's-Burdick Branches Site (HEP cover types shown)

B. BASELINE CONDITIONS

B.1. Baseline Acres and Cover Types

Currently, the study area encompasses approximately 765 acres, predominantly covered by agricultural croplands. Although the District identified 27 distinct cover types across the entire ESL-ER study area, only eight were in evidence at the Judy's-Burdick Branch Site (i.e., deciduous forest in the Uplands, lakes, channel/rivers, urban areas, agricultural croplands, forested corridors, grass-sloped sides of ditches, and streams connecting the site to the upper watershed). Of the eight, five cover types (i.e., DF, CHANNEL, LACUST, FCORRIDOR, and STREAMS) were associated with the various HSI models selected, and were therefore used to evaluate baseline conditions. The cover types and their respective baseline acreages can be found in Table 34.

Table 34. Baseline acres and cover types for the Judy's-Burdick Branches Site

No.	Code	Description	Baseline Acres
1	DF	Deciduous Forests	92.78
2	MARSH	Marshes (Herbaceous Emergent Wetlands)	0.00
3	LACUST	Lacustrine	21.10
4	CHANNEL	Channels and Rivers	2.90
5	PFO	Palustrine Forested Wetlands	0.00
6	PSS	Palustrine Scrub-Shrub Wetlands	0.00
7	URBAN	Urban Development, Roads	0.70
8	AGCROP	Agricultural Croplands	459.70
9	FIELD	Old Fields, Haylands and Pastures	0.00
10	PRAIRIE	Prairies (Wet & Dry)	0.00
11	PBUFFER	Prairie Buffer Strips	0.00
12	RIPARIAN	Riparian Corridors	0.00
13	FCORRIDOR	Forested Corridors	5.00
14	UNDREDGED	Undredged Prairies - Exterior	0.00
15	DETENTION	Detention Basins (with Degraded Marsh Inside)	0.00
16	NEWPFO	Newly Planted Forested Wetlands	0.00
17	GRASS	Grass-sloped Sides of Ditches	17.20
18	NEWCHANNEL	Newly Developed Riverine Channels	0.00
19	NEWMARSH	Newly Planted Marshes (HEW)	0.00
20	NEWFCORR	Newly Planted Forested Corridors	0.00
21	DFBOTTOMS	Deciduous Forests in the Bottoms	0.00
22	URBFIELD	Urbanized Old Fields, Haylands and Pastures	0.00
23	NEWRIPAR	Newly Developed Riparian Corridors	0.00
24	NEWPFO2	Newly Planted PFO from PSS	0.00
25	DITCH	Man-made Ditches, Channels	0.00
26	NEWDITCH	Newly Developed Man-made Ditches and Channels	0.00
27	STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed	165.58
		TOTALS:	764.96

B.2. Baseline Variable Values for Each Cover Type

Field data was collected in the spring of 1999 through the summer of 2003 to determine existing conditions for this site. Data for each variable per cover type was recorded and the variable means/modes were calculated to generate baseline HSIs per model Table 35). For detailed information regarding the field data collected by the Biological Team, refer to the tables in the attached electronic files (HEP Field Data.xls, St. Louis Baseline Acres.xls, St. Louis Baseline Means.xls, Watershed Statistics.xls).

Table 35. Baseline variable values for the Judy's-Burdick Branches Site HEP assessment[11]

Variable Codes	DF	LACUST	CHANNEL	FCORRIDOR	STREAMS
AMTINSTRM					85.00
AMTSILT					2.00
AVGHTHERB					
BROODCOVER			5.00	0.00	
CHANNELIZE					1.00
DEPTHPOOLS					0.57
DEPTHRIFFL					4.00
DISTURB100			0.05	8.50	
DISTURB250				8.50	
EMBEDED					2.00
EMERGCAN	0.00			0.00	
EROSNPOTNT					2.00
EROSNBANK					2.00
FISHCOVER					
GRADIENT					8.00
GRAIN	678.00				
GRASS					
GROWTHFORM					
HDTREECAN	3.71				
HERBCAN					
HERONRY				40.00	
HUMAN	221.14	0.00			
HUMANTYPE	0.10	0.75	0.75	0.75	
MAXSALIN					
MAXTURBID			50.00		
MINDISOXY			4.00		
MORPHPOOLS					1.00
NESTBOX	0.00		0.00	0.00	
NESTDIST		3.00	3.00	3.00	
NUMSUBSTR					2.00
ORIGINSUB					2.00
PERCHDIST					
PHRANGE			7.23		
POOLDEPTH					
REGIME	4.00	1.00	2.00	7.00	
RIFFLEPOOL					3.00

[11]Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

Table 35. (cont.) Baseline variable values for the Judy's-Burdick Branches Site HEP assessment[12]

Variable Codes	DF	LACUST	CHANNEL	FCORRIDOR	STREAMS
SHORECOV		10.00	14.00		
SINUOSITY					2.00
SHRUBCAN	14.29			24.00	
SUBMERGCAN		1.00	5.00	0.00	
SUBSTRATE					3.00
SUBSTRFINE					3.00
SUITABLTMP			18.87		
TEMPEPILIM					
TEMPLITTRL			18.87		
TEMPSPAWN			18.87		
TREECAN	85.71			39.00	
TREECAV	1.66		0.20	1.00	
TREEDBH	40.10				
TRSHRCAN	100.00	0.00	2.00	63.00	
TYPEADJRIP					3.00
TYPESTRM					6.00
TYPESUBSTR					11.00
VELOCITY		0.00	15.00	0.00	
VELOCITY - QHEI					4.00
WATERDEEP		120.00	46.00	0.00	
WATERPREY		0.70	0.75		
WATERTEMP		2.00	2.00	0.00	
WIDTHRIPAR					29.00
YRSURFWAT	40.00	100.00	90.00	5.00	
POTENESTS	0.15		0.02	0.09	
HUMANSQ	1.00				
HUMANTYPE	0.10				
HUMANWD	1.00		0.10	0.14	
HUMANTYPE	0.10		0.00	0.10	
HUMANST		0.00	0.05	0.09	
HUMANTYPE		0.75	0.00	0.10	
HUMANMK	1.00	0.00	0.20	0.34	

[12]Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

B.3. Baseline Evaluation

Of the ten HSI models used to evaluate ecosystem restoration benefits for alternatives in the ESL-ER study, nine [e.g., black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, wood duck, and the Qualitative Habitat Evaluation Index (QHEI)]) were used to assess the site for existing conditions and proposed future alternatives. Moderate baseline conditions existed for the black crappie (HSI = 0.56), the mink (HSI = 0.45), and the QHEI (0.64). Low baseline conditions were found for the remaining models (HSIs < 0.3) (Figure 27).

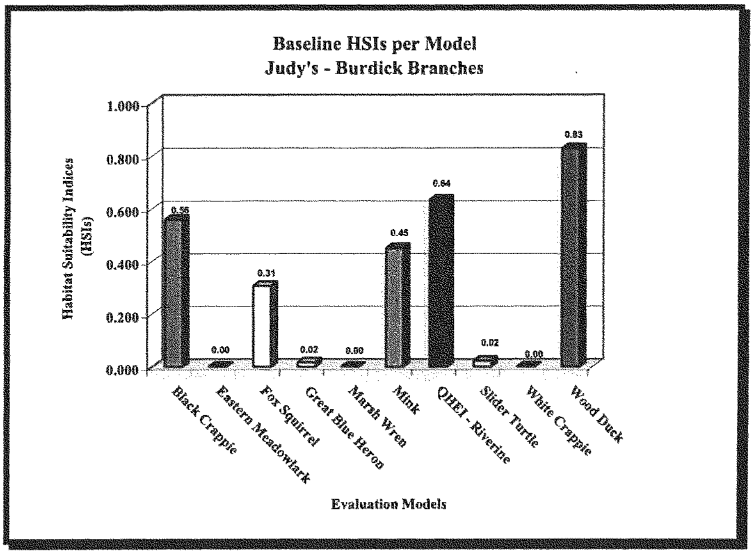

Figure 27. Baseline HSIs for the Judy's-Burdick Branches Site

Based on these index scores and the existing cover type acreages, Habitat Units (HUs) were generated by multiplication. Low HU values were the result of the moderate and low HSI values. Baseline HUs for Judy's-Burdick Branches can be found in Figure 28.

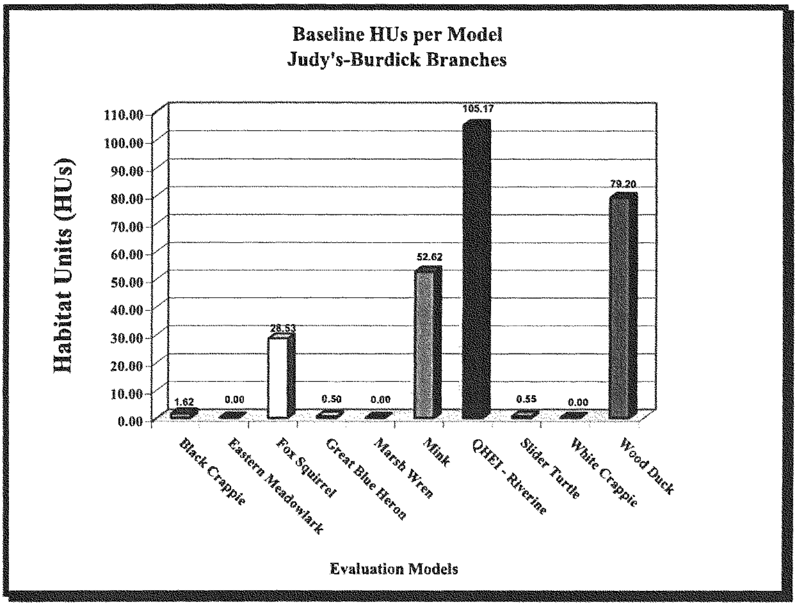

Figure 28. Baseline HUs for the Judy's-Burdick Branches Site

C. FUTURE CONDITIONS

C.1. Without Project Conditions

Based on the general Without Project trends described earlier in Chapter II, the ESL-ER Biological Team developed a series of incremental habitat quality and quantity projections to describe future conditions at the site given its location within the Cahokia watershed boundaries. The single dominating factor of these projections was the anticipated increase in urban encroachment in the watershed over the next 50 years. For example, more than 75 percent of the Uplands deciduous forest and 25 percent of the wetlands (marshes, shrublands, forests, lakes and streams) in the Bottoms are expected to be lost to urbanization in Cahokia watershed alone. Not only did the Team forecast these impacts in terms of acreage losses, but they also attempted to capture the impacts in terms of degrading water quality and vegetative composition/structure scores. Thus, turbidity is expected to increase and dissolved oxygen levels are expected to decrease. Shoreline and submerged cover will decline as pools are filled with sediment. Water depths will decrease and available prey populations will decline as a direct result. In addition, the Team assumed that the human interference factors (distance to nearest human activities and the type of human activities occurring nearby) would significantly degrade future habitat conditions. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Judy's-Burdick Branches Alternatives.xls).

C.2. With Project Conditions

With the general trends of the Without Project condition (i.e., the No Action Alternative) in mind, the Biological Team developed acreage and variable projections for the twenty alternatives proposed by the District. When possible, the Team offered suggestions to enhance the alternatives given the goals and objectives developed earlier in the process. As a general rule, the Biological Team assumed that available agricultural croplands would be converted to productive wetland settings, and the existing Uplands deciduous forests and floodplain wetlands would be protected from urban development. Alternatives that incorporated the deployment of detention ponds in the Uplands were assumed to have higher habitat quality than those alternatives that opted for floodplain sediment retention. Regardless of the manner in which it was achieved, the Team assumed the reduction in sediment would result in the overall improvement of both water quality (i.e., reduced turbidity and increased dissolved oxygen levels) and vegetative growth and health (i.e., increased submerged and shoreline coverage). Wetland quality would be further improved by the construction of a new riverine channel through the center of the site. One significant design feature, the development of 50-110+ acres of dry prairie on the exterior of the site, was projected to greatly enhance the overall value of the wetlands by providing "escape" territory for wildlife species moving out of the inundation zone during high flooding. The Biological Team attempted to capture the vegetative succession of these areas and the forested areas, in increments over time (low quality early in the life of the project, and higher quality by TY30). By restoring existing wetlands, developing new wetlands and protecting these areas in perpetuity, the Biological Team assumed the habitat would be buffered from human disturbance factors, thereby improving the overall value of the wetlands in the urban setting. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Judy's-Burdick Branches Alternatives.xls).

D. EVALUATION OF ALTERNATIVES

D.1. Overall Review of the HEP Results

The overall gains and losses per alternative are summarized in Table 36.

Table 36. Net AAHUs for each HSI model per alternative for the Judy's-Burdick Branches Site

Alternative Description		Alternative Code	Sum of Net AAHUs	Net AAHUs: Black Crappie	Eastern Meadowlark	Fox Squirrel	Great Blue Heron	Marsh Wren	Mink	QHEI	Slider Turtle	White Crappie	Wood Duck
Upland Detention	Prairie Restoration = A	3A-1-X	**260.02**	2.86	130.12	8.78	14.04	0.00	60.30	39.52	4.67	NA	**-0.28**
	Site Size:	3A-2-X	**376.87**	2.83	210.27	8.78	27.08	0.00	74.59	39.52	13.39	NA	0.41
	1 = 131ac	3A-4-X	**439.99**	3.83	251.56	31.54	27.17	0.00	62.00	39.52	14.22	NA	10.15
	2 = 230ac	3A-1-(0)	**257.40**	2.86	130.12	8.78	9.75	0.00	59.73	39.52	4.68	NA	1.97
	3 = 350ac	3A-2-(0)	**369.09**	2.83	210.27	8.78	22.81	0.00	68.26	39.52	13.41	NA	3.21
	4 = 350ac	3A-4-(0)	**446.37**	3.83	251.56	31.54	21.13	0.00	62.00	39.52	14.22	NA	22.57
	Marsh Restoration = B	3B-1-X	**498.36**	2.86	37.22	8.78	108.71	99.27	169.70	39.52	4.68	NA	27.62
	Site Size:	3B-2-X	**1033.89**	3.69	9.39	31.54	194.08	186.00	234.37	39.52	98.84	NA	236.45
	1 = 131ac	3B-1-(0)	**471.39**	2.86	37.22	8.78	104.41	97.80	158.41	39.52	4.68	NA	17.71
	2 = 230ac	3B-2-(0)	**1033.31**	3.77	13.03	31.54	189.79	186.00	234.37	39.52	98.84	NA	236.45
No Upland Detention	Prairie Restoration with	3C-1-X	**176.10**	**-0.05**	90.42	0.00	28.42	16.89	30.37	0.00	4.65	NA	5.41
	Marshy Detention Basin	3C-2-X	**309.84**	**-0.07**	138.97	0.00	54.26	30.67	63.06	0.00	13.39	NA	9.56
	= C	3C-4-X	**383.01**	0.71	167.22	0.00	71.26	45.50	60.61	0.00	36.50	NA	1.22
	Site Size:	3C-1-(0)	**164.00**	**-0.05**	90.42	0.00	24.14	16.89	26.95	0.00	4.65	NA	1.01
	1 = 131ac	3C-2-(0)	**284.98**	**-0.07**	138.97	0.00	49.98	30.67	50.49	0.00	13.39	NA	1.55
	2 = 230ac	3C-4-(0)	**376.97**	0.71	167.22	0.00	65.22	45.50	60.61	0.00	36.50	NA	1.22

Overall, the results show that the 3B-2-X alternative (the 230-acre marsh restoration alternative with a 100-m forested corridor and Uplands detention) produced the highest net AAHUs across the suite of species (~1034 AAHUs). The least productive alternative was 3C-1-(0) (the 130-acre prairie restoration alternative with a degraded marshy detention basin, no forested corridor and no Uplands detention activities) generating ~164 AAHUs across the species evaluated. Several alternatives [namely 3A-1-X, 3C-1-X, 3C-2-X,3X-1-(0), and 3C-4-(0)] resulted in a loss of AAHUs for the wood duck and black crappie that can be directly attributed to a decline in projected habitat quality, even though habitat acreage is expected to increase.

Overall, the District can expect to see the creation of approximately 309 acres of new habitat (predominantly newly created marsh, forested corridor, riparian corridor, detention basins and prairies), and the preservation and restoration of approximately 235 acres of existing habitat under the proposed scenarios. Based on the assessment, the black crappie, eastern meadowlark, mink, and riverine communities (based on the QHEI results) achieved optimum or near-optimum conditions under the majority of proposed design scenarios (HSIs $\geq$ 0.5 were realized by TY51). The eastern meadowlark's outputs were the highest among models evaluated for the majority of the alternatives, representing approximately 50 percent (on average) of the total net gains. The second highest outputs were attained in the mink's returns, whose AAHUs contributed an additional 20 percent (on average) to the total net gains at the site. Low HSI scores (< 0.5) in the evaluation of three of the marsh-based wetland species (marsh wren, slider turtle and wood duck) and the Uplands forest-based species (i.e., fox squirrel), can be directly attributed to less than optimal design of pond ecosystems, and the impact of construction in the Upland forests of the study area. For detailed information regarding these results, refer to the tables in the attached electronic files (Judy's-Burdick Branches Overall Results.xls, Judy's-Burdick Branches Baseline HSIs Summarized.xls, Judy's-Burdick Branches Baseline HUs Summarized.xls).

D.2. Top Three Biological Winners Using HEP

The top three biologically productive solutions among the alternatives were:

#1 **3B-2-X** - The 230-acre marsh restoration alternative with a 100-m forested corridor and Uplands detention produced 1,033.89 net AAHUs;

#2 **3B-2-(0)** - The 230-acre marsh restoration alternative with no forested corridor and Uplands detention produced 1,033.31 net AAHUs; and

#3 **3B-1-X** - The 131-acre marsh restoration alternative with a 100-m forested corridor and Uplands detention produced 498.36 net AAHUs.

D.3. Individual HSI Model Results

Creating habitats under these winning scenarios, even though the quality of these areas was less than optimal for the species (i.e., HSIs > 0, but ≤ 1.0 by TY51), nevertheless resulted in favorable wetland returns for the proposed winning alternatives when evaluated as a whole. On a model-by-model basis, the following summations could be made.

Black Crappie: Although optimum conditions (HSI = 1.0) were not achieved under the "winning" alternatives [i.e., 3B-2-X, 3B-2-(0) and 3B-1-X], the species still achieved high TY51 HSIs (**0.82, 0.82** and **0.69** respectively), resulting in net gains of **3.69, 3.77** and **2.86 AAHUs,** respectively.

Eastern Meadowlark: Although sub-optimum conditions (HSI < 0.25) were experienced under the top two "winning" alternatives by this species, the 3B-2-X and 3B-2-(0) alternatives still managed to generate some small returns by TY51 (**HSI ≅ 0.19**), resulting in a net gain of **9.39** and **13.03 AAHUs,** respectively. However, the #3 "winner" (i.e., 3B-1-X) resulted in a significantly higher return for the species (**TY51 HSI ≅ 0.73, net AAHU gains = 37.22**).

Fox Squirrel: Although optimum conditions (HSI = 1.0) were not achieved under the top two "winning" alternatives [i.e., 3B-2-X and 3B-2-(0)], the species still achieved high TY51 HSIs (**0.63**), resulting in a net gain of **31.54 AAHUs,** respectively. However, the #3 "winner" (i.e., 3B-1-X) resulted in significantly lower returns for the species (**TY51 HSI ≅ 0.28, net AAHU gains = 8.78**).

Great Blue Heron: Although optimum conditions (HSI = 1.0) were not achieved under the "winning" alternatives [i.e., 3B-2-X, 3B-2-(0) and 3B-1-X], the species still achieved high TY51 HSIs (**0.75, 0.90** and **0.65,** respectively), resulting in significant net gains of **194.08, 189.79,** and **108.71 AAHUs,** respectively.

Marsh Wren: Near optimum conditions were achieved under the "winning" alternatives [i.e., 3B-2-X, 3B-2-(0) and 3B-1-X] (**TY51 HSIs = 0.98, 0.98** and **0.95**), resulting in a net gain of **186.00, 186.00** and **99.27 AAHUs,** respectively.

Mink: Near optimum conditions were achieved under the top two "winning" alternatives [i.e., 3B-2-X and 3B-2-(0)] (**TY51 HSIs ≅ 0.90**), resulting in a net gain of **234.37 AAHUs,** respectively. However, the #3 "winner" (i.e., 3B-1-X) resulted in lower returns for the species (**TY51 HSI ≅ 0.78, net AAHU gains = 169.70** - a result of reduced habitat availability).

QHEI - Riverine Community: Near optimum conditions were achieved under the "winning" alternatives [i.e., 3B-2-X, 3B-2-(0) and 3B-1-X] (all **TY51 HSIs = 0.85**), resulting in a net gain of **39.52 AAHUs** under each alternative.

Slider Turtle: Although sub-optimum conditions (HSI < 0.50) were experienced under the "winning" alternatives by this species, the 3B-2-X and 3B-2-(0) alternatives still managed to generate some small measure of return for this species by TY51 (**TY51 HSI ≅ 0.45**), resulting in a net gain of **98.84 AAHUs**. However, the #3 "winner" (i.e., 3B-1-X) resulted in significantly lower returns for the species (**TY51 HSI ≅ 0.03, net AAHU gains = 4.68** - a result of reduced habitat availability).

White Crappie: This species was not applicable to this site.

Wood Duck: Near optimum conditions were achieved under the top two "winning" alternatives [i.e., 3B-2-X and 3B-2-(0)] (**TY51 HSIs = 0.89**), resulting in a net gain of **236.45 AAHUs**. However, the #3 "winner" (i.e., 3B-1-X) resulted in significantly lower returns for the species (**TY51 HSI ≅ 0.14, net AAHU gains = 27.62**).

The specific details of the EXHEP runs are reported in the attached electronic files (Attained Goals.xls). Each alternative is identified, the gains or losses in terms of acres and HSIs are recorded, and both cumulative and net AAHUs are documented. The variations among model outputs are illustrated in (Figure 29).

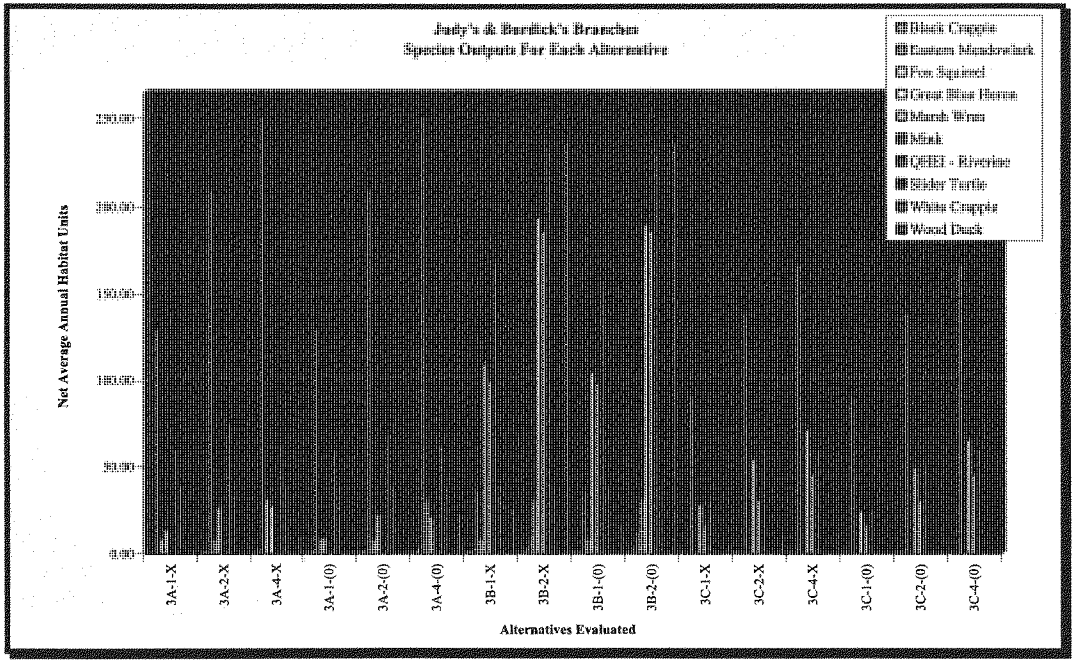

Figure 29. HSI Model outputs per alternative for the Judy's-Burdick Branches Site

E. COST ANALYSES

As described earlier in this report, two techniques were used to determine the winning solution in the cost evaluation process. First, the results of the habitat assessment were compared using Cost Effectiveness Analyses (CEA). When comparing alternatives are compared using CEA, those alternatives that produce increased levels of output (AAHUs) for the same or lesser costs were considered "effective" solutions and were retained. These alternatives were, in turn, compared on the basis of cost efficiency [i.e., those alternatives that produce similar levels of output (AAHUs) at a lesser expense]. The "efficient" solutions were submitted to Incremental Cost Analyses (ICA) (i.e., determining changes in costs for increasing levels of outputs). Once evaluated on the basis of incremental effectiveness, the "winning" solutions were revealed (those that are both cost effective and incrementally effective). The annualized costs and outputs, as well as the results of the CEA and ICA evaluations for the Judy's-Burdick Branches Site, are presented below.

E.1. Project Costs

In Table 37, the total costs, annualized costs and annualized biological returns (i.e., AAHUs) are recorded for each alternative. The most expensive proposal, 3A-1-X, will cost more than $25.9M to implement. The least expensive proposal, 3C-4-(0), will cost more than $5.6M to undertake.

Table 37. Total project costs and annualized costs per alternative for the Judy's-Burdick Branches Site

	Alternative Description	Alternative Code	Total Alternative Costs	Total Annualized Costs	Net AAHUs	Cost Per AAHU
Uplands Detention	Prairie Restoration = A Site Size: 1 = 131ac	3A-1-X	$25.98M	$1,735,100.00	260.02	$6,673.05
	2 = 230ac	3A-2-X	$22.54M	$1,505,700.00	376.87	$3,995.31
	~~3 = 350 ac~~	3A-4-X	$18.9M	$1,262,400.00	439.99	$2,869.16
	4 = 350 ac	3A-1-(0)	$25.77M	$1,721,100.00	257.40	$6,686.40
	+Horseradish	3A-2-(0)	$20.1M	$1,496,500.00	369.09	$4,054.53
	Exclusion	3A-4-(0)	$18.8M	$1,255,700.00	446.37	$2,813.12
	Marsh Restoration = B Site Size: 1 = 131ac	3B-1-X	$25.82M	$1,724,600.00	498.36	$3,460.54
	2 = 230ac	3B-2-X	$22.36M	$1,493,300.00	1033.89	$1,444.35
	~~3 = 350 ac~~	3B-1-(0)	$25.55M	$1,706,200.00	471.39	$3,619.51
		3B-2-(0)	$22.12M	$1,477,400.00	1033.31	$1,429.77
No Uplands Detention	Prairie Restoration with Marshy Detention Basin = C Site Size: 1 = 131ac	3C-1-X	$13.31M	$888,700.00	176.10	$5,046.51
	2 = 230ac	3C-2-X	$9.67M	$645,700.00	309.84	$2,083.97
	~~3 = 350 ac~~	3C-4-X	$5.96M	$398,200.00	383.01	$1,039.65
	4 = 350 ac	3C-1-(0)	$13.1M	$874,800.00	164.00	$5,334.21
	+Horseradish	3C-2-(0)	$9.46M	$631,700.00	284.98	$2,216.65
	Exclusion	3C-4-(0)	$5.68M	$379,500.00	376.97	$1,006.72

E.2. Top Three Cost Effective Solutions Based on the HEP Results

The CEA results for the Judy's-Burdick Branches alternatives can be found in (Table 38). The top three cost effective solutions in the analyses were **3C-4-(0), 3C-4-X** and **3B-2-(0).** For the 3C-4-(0) alternative, the District can expect to generate one AAHU for every $1,006.72 expended annually. For the 3C-3-X alternative, the cost increased to $1,039.65 for each AAHU (an increase of $32.94). And, for the 3C-4-(0) alternative, an AAHU could be gained at a cost of $1,429.77 – a cost $390.12 above the "winning" solution's cost. For detailed information regarding these cost analyses, refer to the tables in the attached electronic files (Judy's-Burdick Branches HEP CEA.xls).

Table 38. Cost effective solutions for alternatives on the Judy's-Burdick Branches Site evaluated with HEP

CEA Ranking	ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU
1	1	8	3C-4-(0)	376.97	$379,500.00	$1,006.72
2	4	7	3C-4-X	383.01	$398,200.00	$1,039.65
3	2	2	3B-2-(0)	1033.31	$1,477,400.00	$1,429.77
4	3	1	3B-2-X	1033.89	$1,493,300.00	$1,444.35
5	6	11	3C-2-X	309.84	$645,700.00	$2,083.97
6	9	12	3C-2-(0)	284.98	$631,700.00	$2,216.65
7	7	5	3A-4-(0)	446.37	$1,255,700.00	$2,813.12
8	10	6	3A-4-X	439.99	$1,262,400.00	$2,869.16
9	5	3	3B-1-X	498.36	$1,724,600.00	$3,460.54
10	8	4	3B-1-(0)	471.39	$1,706,200.00	$3,619.51
11	11	9	3A-2-X	376.87	$1,505,700.00	$3,995.31
12	12	10	3A-2-(0)	369.09	$1,496,500.00	$4,054.53
13	13	15	3C-1-X	176.10	$888,700.00	$5,046.51
14	15	16	3C-1-(0)	164.00	$874,800.00	$5,334.21
15	14	13	3A-1-X	260.02	$1,735,100.00	$6,673.05
16	16	14	3A-1-(0)	257.40	$1,721,100.00	$6,686.40

#1 Ranked Alternative
#2 Ranked Alternative
#3 Ranked Alternative

E.3. Top Three Incrementally Effective Solutions Based on the HEP Results

The results of the ICA are displayed in (Figure 30). At site, the top three, incrementally effective solutions evaluated included:

#1 **3C-4-(0)** - The 350-acre prairie restoration alternative that excluded the adjacent horseradish farm, had no forested corridor and deployed a marshy floodplain detention basin produced 376.97 net AAHUs at a cost of $1,006.72 per AAHU;

#2 **3B-2-(0)** - The 230-acre marsh restoration alternative with no forested corridor and Uplands detention produced 993.79 net AAHUs at a cost of $1,486.63 per AAHU; and

#3 **3B-2-X** - The 230-acre marsh restoration alternative with a 100-m forested corridor and Uplands detention produced 994.37 net AAHUs at a cost of $1,501.75 per AAHU.

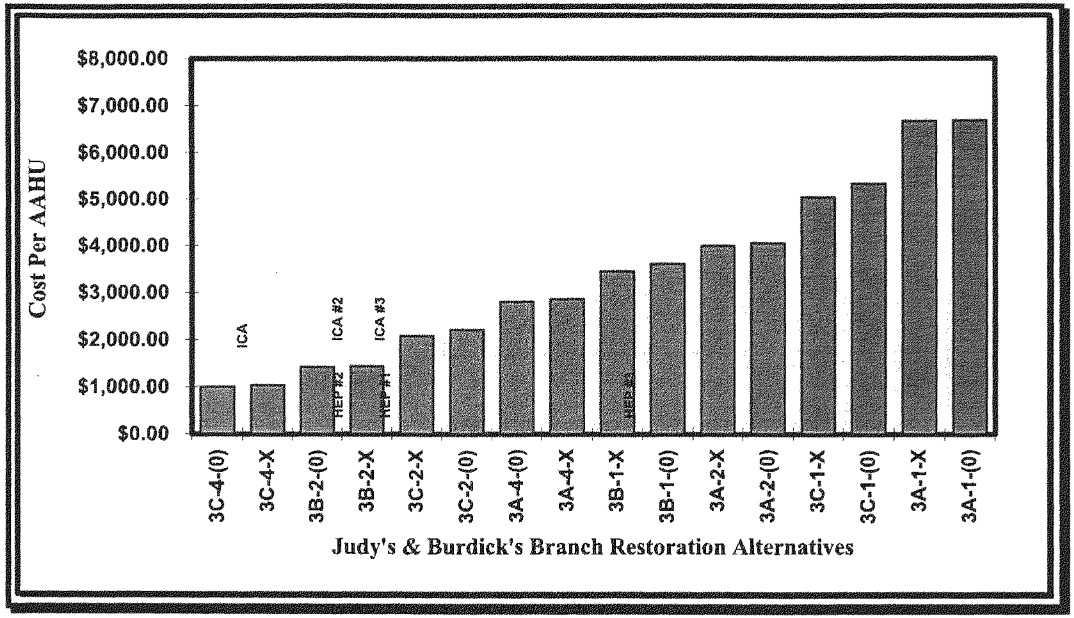

Figure 30. ICA results based on the HEP assessment of the alternatives for the Judy's-Burdick Branches Site

In essence, the top three alternatives [i.e. 3C-4-(0), 3B-2-(0), and 3B-2-(X)] were found to be "Best Buy" plans – that is they were the most biologically productive, incrementally effective plans (Figure 31 and Table 39).

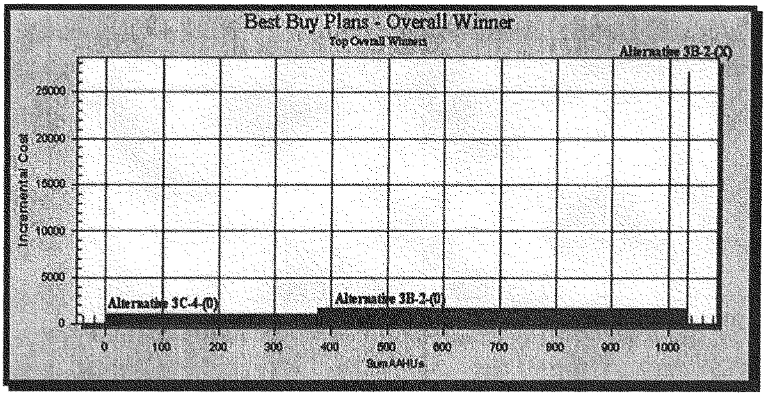

Figure 31. "Best Buy" options from the ICA analysis of the HEP results at the Judy's-Burdick Branches Site

Table 39. Incremental outputs for the "Best Buy" options resulting from the ICA analysis of the HEP results at the Judy's-Burdick Branches Site

Alternative	Incremental Output	Incremental Output/Unit Output
No Action	0.00	$0.00
3C-4-(0)	376.97	$1,006.72
3B-2-(0)	656.34	$1,672.76
3B-2-(X)	0.58	$27,315.21

V. BRUSHY LAKE

A. PROJECT DESCRIPTION

A.1. Location

The project area is located in Madison County, Illinois, in the Cahokia watershed. The floodplain component is bounded on the west by Cahokia Canal, on the east by Route 157, on the south by Interstates 55 and 70, and on the north by Horseshoe Lake Road. The Schoolhouse Branch and Snyder Ditch ("Bluff 3") watersheds compose the Uplands component of the site. Much of the floodplain component is a Mississippi River meander scar. Two centuries ago, Cahokia Creek flowed through this area. Forest is the predominant vegetative cover (Figure 32).

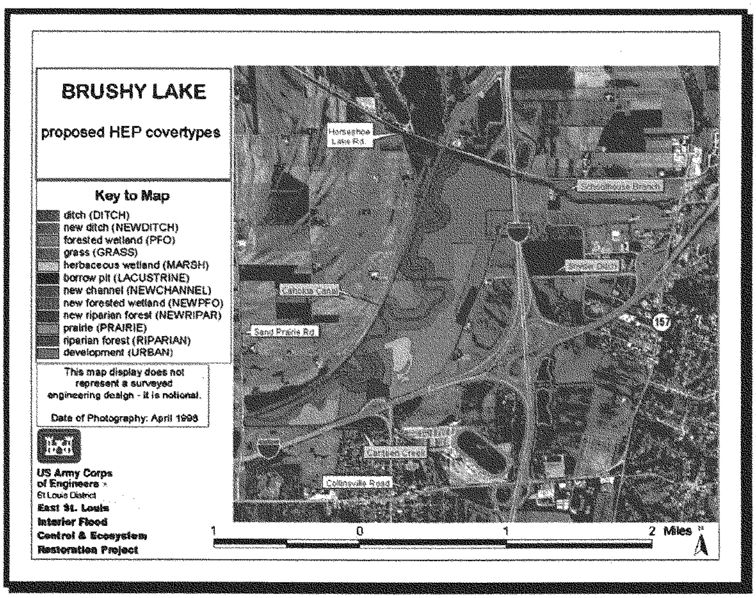

Figure 32. Brushy Lake site map

A.2. Purpose

The proposed alternatives for this site were developed to address three restoration goals: (1) the creation of an area on the floodplain to support natural plant and animal communities and a flood regime similar to presettlement (ca. 1800) conditions; (2) the minimization of upland erosion and management of sedimentation in the Schoolhouse Branch and "Bluff 3" watersheds; and (3) the reduction of flood damages within the Cahokia watershed.

A.3. Measures Under Consideration

In order to address these goals, the District generated two lists of design measures that, when combined in series, served as unique alternatives for the assessment. The first list of features was considered essential to meet these goals and, therefore, formed the basis for each design. These commonly shared features included:

1) The creation of a 710-acre forested habitat area on the floodplain to utilize stormwater events delivered by both Schoolhouse Branch and Snyder Creek that will include planting of trees where they do not currently exist.

2) The restoration of the historic Cahokia Creek channel within the habitat area. Segments of channel that have been filled will be reopened, and existing remnants will be excavated to remove accumulated sediments. These actions will recreate a floodplain stream similar to that which once flowed from north to south across the site.

3) Modification of the existing channels and levees of Schoolhouse Branch and Snyder Ditch to ensure delivery of stormwater events from these two bluff tributaries into the new habitat area. The current channel conditions (i.e., grassy side slopes and earthen bottom) will be utilized.

In addition to these commonly shared features, the alternative design deployed various combinations of features from the following two options:

(1) Uplands versus Bottomlands sediment detention. Sediment originating in the Uplands and ultimately moving into the floodplain would be detained either in the Uplands (by constructing 15 new tributary stream sediment detention basins -14 in the Schoolhouse Branch watershed and 1 in the "Bluff 3" watershed), or in the Bottoms (in the existing channels of Schoolhouse Branch and Snyder Ditch, and in a

sediment detention basin within the new habitat area itself).

(2) Presence or absence of a prairie filter. Under the Bottomland sediment detention option, a 330-foot-wide (100 meter-wide) wide vegetative buffer would be established in the habitat area outside the detention basin. The buffer would consist of prairie plantings to intercept sediment carried by stormwater overtopping the basin.

(3) A number of pool and riffle complexes will be deployed at this site (number to be determined during the design phase of the study)[13].

A.4. Alternatives Under Evaluation

Given the above mentioned design measures, the District generated no less than 30 unique alternatives for this site (Table 40). Twenty-four of these alternatives were dropped from consideration due to their excessive costs, design inconsistencies and/or biologically ineffective configurations. These alternatives have been illustrated in Figure 33 through Figure 37.

[13]A pilot study at Judy's Branch was constructed in 2000, and the District will monitoring the site over the next 3 years. The results of the pilot project will assist the District in determining the number of riffle: pool complexes necessary on a site-by-site basis to meet the proposed beneficial productivity assumed herein. Section 9 of the main report discusses this pilot project in greater detail (USACE 2002).

Table 40. Brushy Lake alternative matrix

Channel Type and Corridor Type Options	Uplands ON (No Detention Basin)	Uplands OFF (Detention Basin Needed)	
	Croplands planted to forested wetlands, Corridor bringing water in, Always have riparian meander down the middle	Croplands planted to forested wetlands, Corridor bringing water in and Detention Basin, AGCROP converts to urban Grassland along berm, Always have riparian meander down the middle	Croplands planted to forested wetlands, Prairie buffer strip added around sediment basin, Corridor bringing water in and Detention Basin, Always have riparian meander down the middle, Quality of forest is higher due to capture of sediment in the buffers
Concrete Sides, Dirt	4A-1-0	4B-1-0	4C-1-0
Bottoms	4A-1-X	4B-1-X	4C-1-X
Concrete Channel	4A-2a-0	4B-2a-0	4C-2a-0
	4A-2a-X	4B-2a-X	4C-2a-X
	4A-2b-0	4B-2b-0	4C-2b-0
	4A-2b-X	4B-2b-X	4C-2b-X
Grass-lined	4A-3-0	4B-3-0	4C-3-0
	4A-3-X	4B-3-X	4C-3-X
Riparian/Meander	4A-4-0	4B-4-0	4C-4-0
	4A-4-X	4B-4-X	4C-4-X

[shaded] Alternatives dropped from consideration due to low biological productivity, cost ineffectiveness, and/or design inefficiencies.
All Detention Basins = degraded Marshlands
Prairie buffers surrounding marshlands are wetter prairies with less depth due to sedimentation trapping.
With detention basins, basins dredged every 3-5 years, no external dredging necessary. (outside detention basin, but still within project boundary).

Ditch Options Considered:
- -1 Ditch Option: Straight channel/concrete sides/dirt bottoms
- -2a Ditch Option: Straight, all concrete - Rectangular
- -2b Ditch Option: Straight, all concrete - Trapezoidal
- -3 Ditch Option: Straight, grassy-slopes, dirt bottom
- -4 Ditch Option: Meandering, riparian corridor

Forested Corridor Options Considered:
- -(0) = No FCORRIDOR
- -(1) = 100-m forested corridor strips (HSI weight = 1.0)

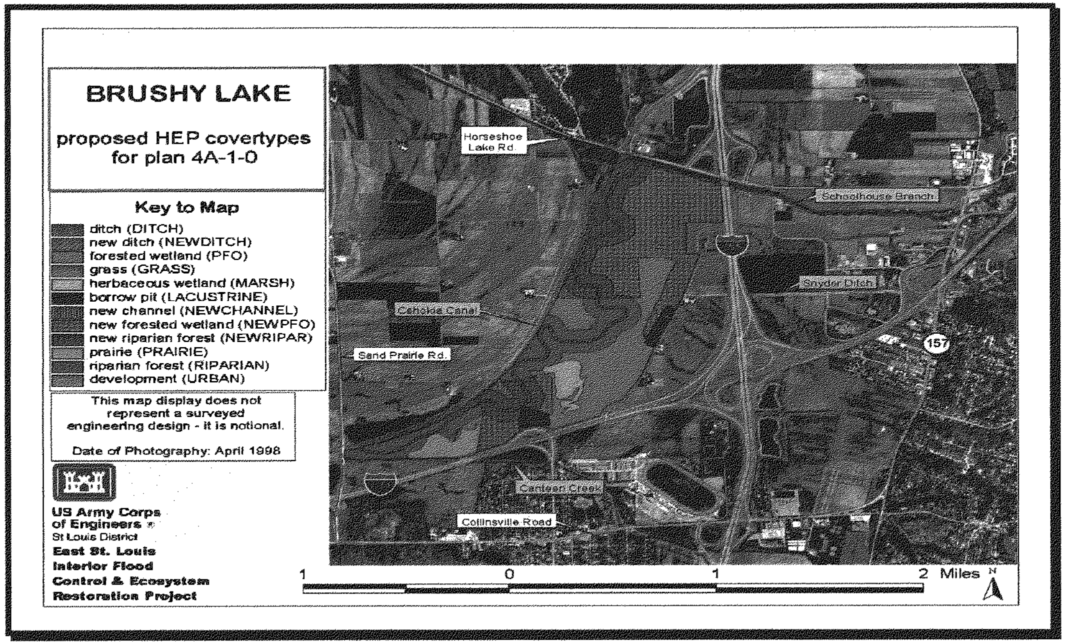

Figure 33. Proposed alternatives for the Uplands detention options at Brushy Lake Site (HEP cover types shown)

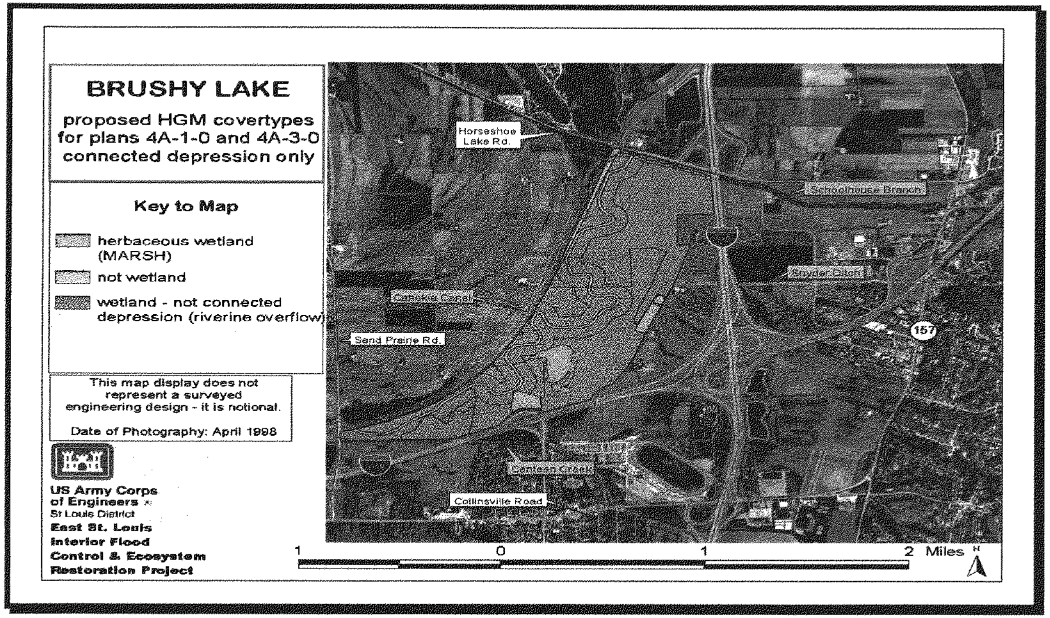

Figure 34. Proposed alternatives for the Uplands detention options at Brushy Lake Site (HGM PWAA's shown)

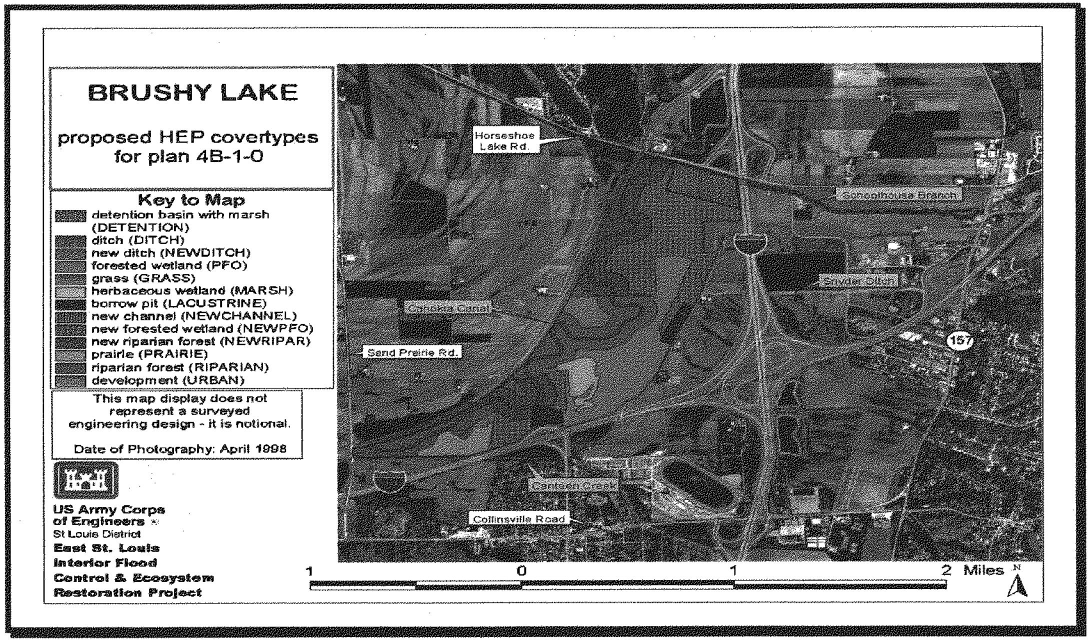

Figure 35. Proposed alternatives for the Bottoms detention options at Brushy Lake Site (HEP cover types shown)

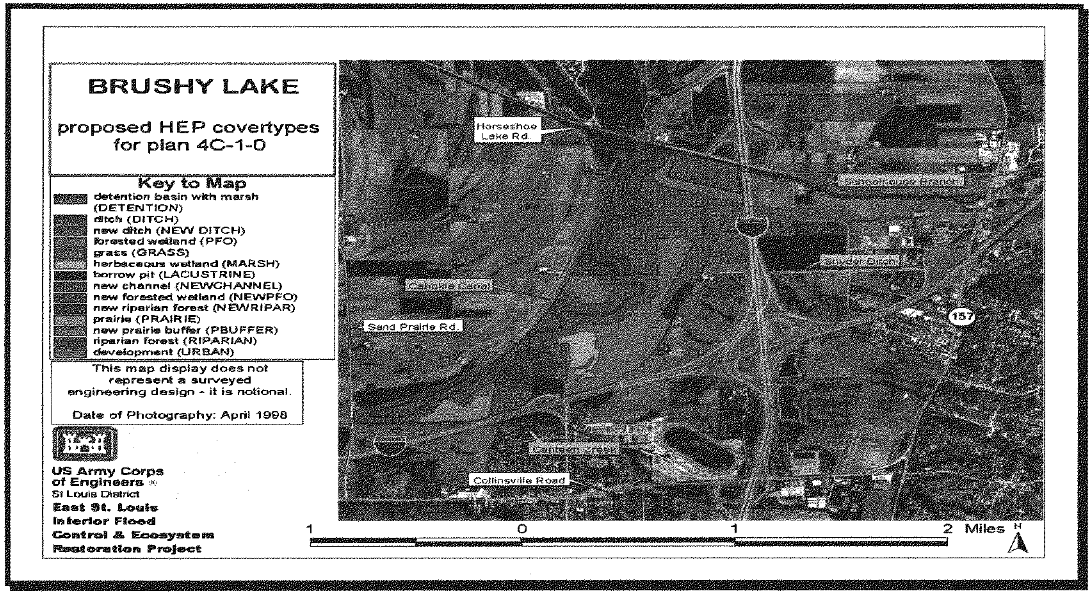

Figure 36. Proposed alternatives for the Bottoms detention/prairie strips options at Brushy Lake Site (HEP cover types shown)

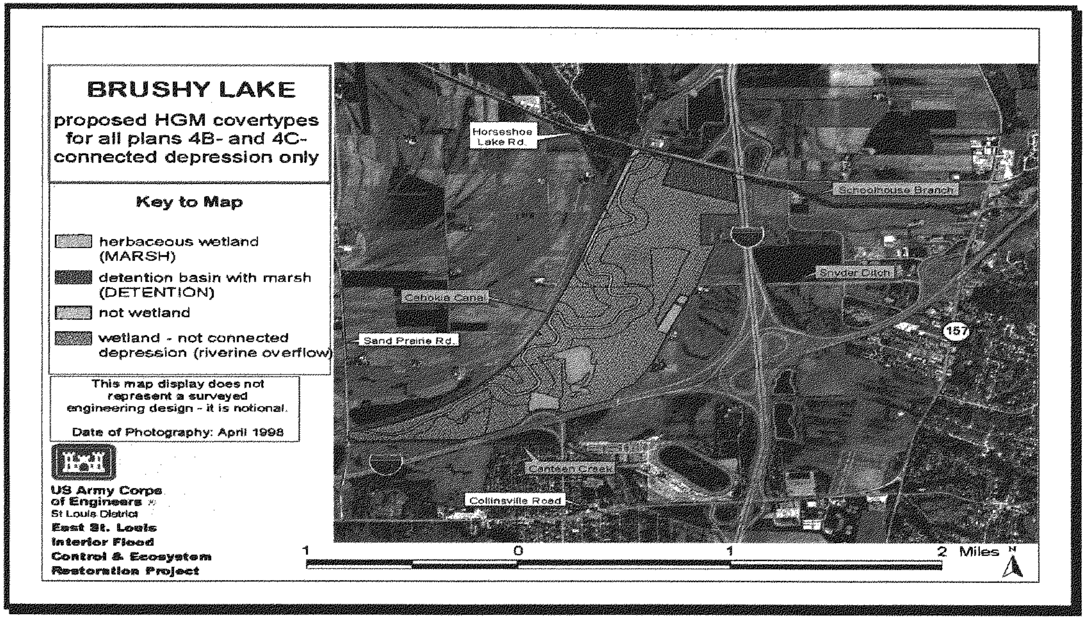

Figure 37. Proposed alternatives for the Bottoms detention/prairie strips options at Brushy Lake Site (HGM PWAA's shown)

B. BASELINE CONDITIONS

B.1. Baseline Acres and Cover Types

Currently, the study area encompasses approximately 850 acres, covered predominately in agricultural croplands and forests. Although the District identified 27 distinct cover types across the entire ESL-ER study area, only 11 were in evidence at the Brushy Lake Site (i.e., deciduous forest in the Uplands, marshes, lakes, channels/rivers, palustrine forests, agricultural croplands, prairies, riparian corridors, grass-sloped sides of ditches, man-made ditches, and streams connecting the site to the upper watershed). Of the 11, nine (i.e., DF, MARSH, LACUST, CHANNEL, PFO, PRAIRIE, RIPPARIAN, DITCH, and STREAMS) were associated with the various HSI and FCI models selected, and were therefore, used to evaluate baseline conditions. The cover types and their respective baseline acreages can be found in Table 41.

Table 41. Baseline acres and cover types for the Brushy Lake Site

No.	Code	Description	Baseline Acres
1	DF	Deciduous Forests	28.28
2	MARSH	Marshes (Herbaceous Emergent Wetlands)	35.55
3	LACUST	Lacustrine	14.35
4	CHANNEL	Channels and Rivers	12.60
5	PFO	Palustrine Forested Wetlands	96.30
6	PSS	Palustrine Scrub-Shrub Wetlands	0.00
7	URBAN	Urban Development, Roads	0.00
8	AGCROP	Agricultural Croplands	356.89
9	FIELD	Old Fields, Haylands and Pastures	0.00
10	PRAIRIE	Prairies (Wet & Dry)	25.10
11	PBUFFER	Prairie Buffer Strips	0.00
12	RIPARIAN	Riparian Corridors	154.10
13	FCORRIDOR	Forested Corridors	0.00
14	UNDREDGED	Undredged Prairies - Exterior	0.00
15	DETENTION	Detention Basins (with Degraded Marsh Inside)	0.00
16	NEWPFO	Newly Planted Forested Wetlands	0.00
17	GRASS	Grass-sloped Sides of Ditches	18.10
18	NEWCHANNEL	Newly Developed Riverine Channels	0.00
19	NEWMARSH	Newly Planted Marshes (HEW)	0.00
20	NEWFCORR	Newly Planted Forested Corridors	0.00
21	DFBOTTOMS	Deciduous Forests in the Bottoms	0.00
22	URBFIELD	Urbanized Old Fields, Haylands and Pastures	0.00
23	NEWRIPAR	Newly Developed Riparian Corridors	0.00
24	NEWPFO2	Newly Planted PFO from PSS	0.00
25	DITCH	Man-made Ditches, Channels	4.35
26	NEWDITCH	Newly Developed Man-made Ditches and Channels	0.00
27	STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed	103.84
		TOTALS:	849.46

B.2. Baseline Variable Values for Each Cover Type

Two assessment methods (HEP and HGM) were used to assess baseline conditions at this site. Baseline field data was collected in the spring of 1999 through the summer of 2003 to determine existing conditions for the site. Data for each variable per cover type was recorded and the variable means/modes were calculated to generate baseline HSIs and FCIs per model (Table 42and Table 43, respectively). For detailed information regarding the field data collected by the Biological Team, refer to the tables in the attached electronic files (HEP Field Data.xls, St. Louis Baseline HEP Acres.xls, St. Louis Baseline HEP Means.xls, Watershed Statistics.xls, St. Louis Baseline HGM Acres.xls, St. Louis Baseline HGM Means.xls, Isolated Depression FieldKit.xls, Connected Depression FieldKit.xls).

Table 42. Baseline variable values for the Brushy Lake Site HEP assessment[14]

Variable Codes	DF	MARSH	LACUST	CHANNEL	DITCH	PFO	PRAIRIE	RIPARIAN	STREAMS
AMIINSTRM					85.00				
AMISILT					2.00				
AVGHTHERB							40.00		
BROODCOVER		25.00		15.00	30.00	4.33		6.00	
CHANNELIZE					1.00				
DEPTHPOOLS					0.57				
DEPTHRIFFL					4.00				
DISTURB100		1.00	0.50	0.10	1.00	1.00		1.00	
DISTURB250						1.00		0.40	
EMBEDED					2.00				
EMERGCAN	0.00	42.50				8.78		1.70	
EROSNPOINT					2.00				
EROSNBANK					2.00				
FISHCOVER									
GRADIENT					8.00				
GRAIN	518.57								
GRASS							92.00		
GROWTHFORM		4.00							
HDTREECAN	17.00								
HERBCAN							91.00		
HERONRY						64.37		64.37	
HUMAN	222.86	100.00	50.00	10.00	100.00	250.00		100.00	
HUMANTYPE	1.00	1.00	0.50	0.75	1.00	1.00	1.00	1.00	
MAXSALIN									
MAXTURBID				50.00	50.00				
MINDISOXY				3.00	3.00				
MORPHPOOLS					1.00				
NESTBOX	0.00	0.00		0.00	0.00	0.00		0.00	
NESTDIST		6.12	6.12	6.12	6.12	6.12		6.12	

[14]Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

Table 42. (cont.). Baseline variable values for the Brushy Lake Site HEP assessment[15]

Variable Codes	DF	MARSH	LACUST	CHANNEL	DITCH	PFO	PRAIRIE	RIPARIAN	STREAMS
NUMSUBSTR					2.00				
ORIGINSUB					2.00				
PERCHDIST							3.00		
PHRANGE				7.23	7.23				
POOLDEPTH									
REGIME	4.00	3.00	1.00	2.00	3.00	4.00		5.00	
RIFFLEPOOL					3.00				
SHORECOV			25.00	14.00	65.00				
SINUOSITY					2.00				
SHRUBCAN	5.71					0.33	5.00	0.00	
SUBMERGCAN		50.00	0.00	5.00	10.00	10.33		2.00	
SUBSTRATE					3.00				
SUBSTRFINE					3.00				
SUITABLTMP				18.87	18.87				
TEMPEPILIM									
TEMPLITTRL				18.87	18.87				
TEMPSPAWN				18.87	18.87				
TREECAN	94.29					60.00		60.00	
TREECAV	1.66	0.00		0.20	0.20	0.67		1.00	
TREEDBH	49.54								
TRSHRCAN	100.00	15.00	14.00	10.00	70.00	60.33		60.00	
TYPEADJRIP					3.00				
TYPESTRM					6.00				
TYPESUBSTR					11.00				
VELOCITY		0.00	0.00	8.00	0.00	0.00		0.00	
VELOCITY - QHEI					4.00				
WATERDEEP		42.60	70.60	46.00	40.00	38.33		14.20	
WATERPREY		1.00	0.50	0.75	0.25				
WATERTEMP		2.00	2.00	2.00	2.00	2.00		2.00	
WIDTHRIPAR					29.00				
YRSURFWAT	40.00	75.00	100.00	90.00	75.00	40.00		15.00	
POTENESTS	0.15	0.00		0.02	0.02	0.06		0.09	
HUMANSQ	1.00								
HUMANTYPE									
HUMANWD	1.00	1.00		0.20	1.00	1.00		1.00	
HUMANST		1.00	0.50	0.10	1.00	1.00		1.00	
HUMANTYPE									
HUMANMW		1.00							
HUMANEM							1.00		
HUMANMK	1.00	1.00	1.00	0.40	1.00	1.00		1.00	

[15]Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

Table 43. Baseline variable values for the Brushy Lake Site HGM assessment[16]

Variable Codes	Herbaceous Emergent Wetland (MARSH)
COMP	1.84
CONNECT	64.67
CWD	
CORE	28.68
DUR	75.00
ERODE	4.00
FREQ	6.50
GVC	19.69
HUMAN50	1.00
LITTER	14.59
LOG	
MAST	
SLOPE	1.50
SNAG	
SOIL	0.00
SSD	
TBA	
TCOMP	
TDENS	
TEX	8.00
TRACT (ha)	130.98

B.3. HEP Baseline Evaluation

Of the 10 HSI models used to evaluate ecosystem restoration benefits for alternatives in the ESL-ER study, nine [e.g., black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, wood duck and the Qualitative Habitat Evaluation Index, (QHEI)] were used to assess the site for existing conditions and proposed future alternatives. High quality baseline conditions existed for the eastern meadowlark (HSI = 0.94). Moderate baseline conditions were found for the black crappie (HSI = 0.54), fox squirrel (HSI = 0.62),great blue heron (HSI = 0.51) and QHEI (HSI = 0.64). Low baseline conditions existed for the remaining models (HSI <0.4)).

[16] Note that not all variables were associated with every PWAA in existence; thus missing values are an indication of non-association.

Based on these index scores and the existing cover types acreages, Habitat Units (HUs) were generated by multiplication. Low HU values were the result of the moderate and low HSI values. Baseline HUs for Brushy Lake can be found in Figure 38 and Figure 39.

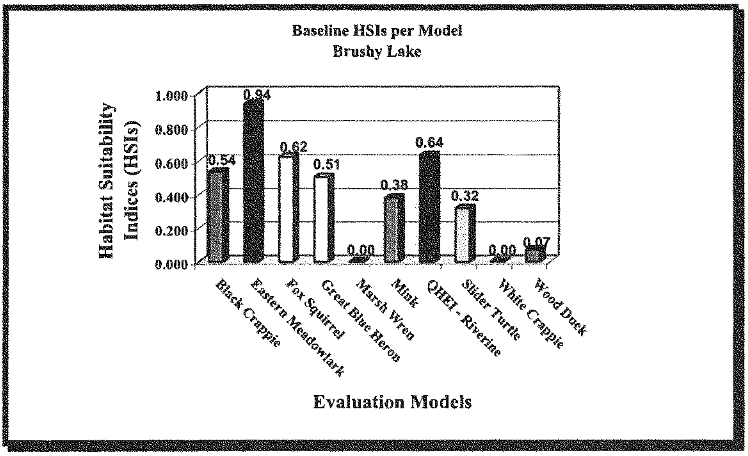

Figure 38. Baseline HSIs for the Brushy Lake Site

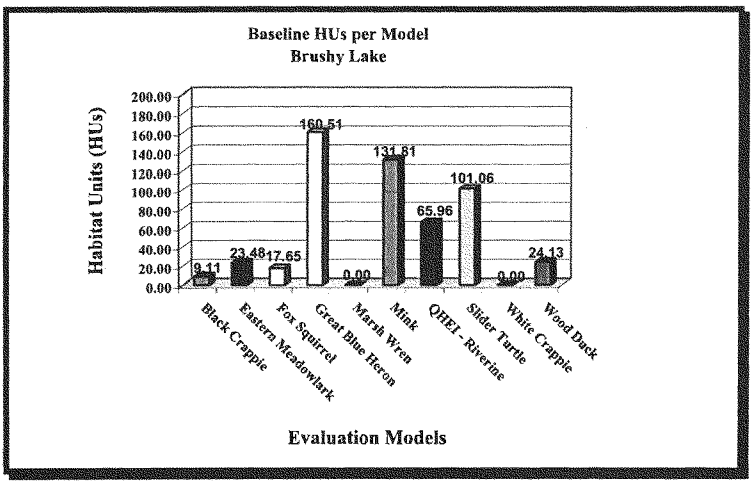

Figure 39. Baseline HUs for the Brushy Lake Site

B.4. HGM Baseline Evaluation

All six functional indices within the connected depression HGM wetland subclass model were used to evaluate ecosystem benefits for alternatives at this site[17]. These functional indices included:

(1) Function 1: Floodwater Detention,
(2) Function 3: Internal Nutrient Cycling,
(3) Function 4: Organic Carbon Export,
(4) Function 5: Remove and Sequester Elements and Compounds,
(5) Function 6: Maintain Characteristic Plant Community, and
(6) Function 7: Wildlife Habitat Maintenance.

Moderately functional baseline conditions were found for all functions (FCIs > 0.5 and ≤ 0.75) (Figure 40).

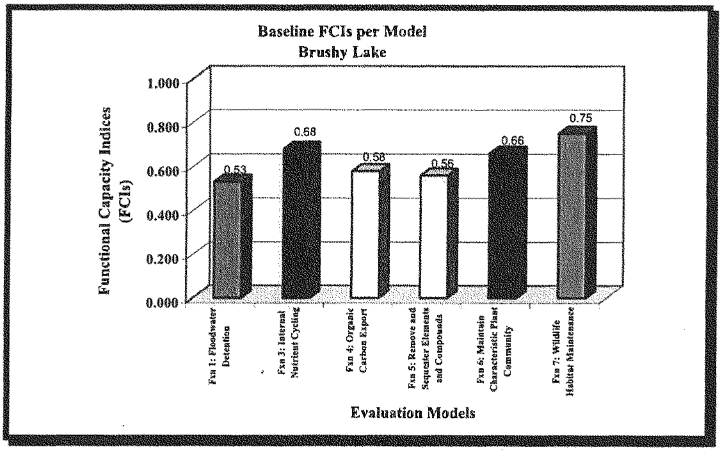

Figure 40. Baseline FCIs for the Brushy Lake Site

Based on these index scores and the existing partial wetland assessment area acreages (PWAA's), Functional Capacity Units (FCUs) were generated by multiplication. Low FCU scores can be attributed to lack of suitable wetland quantities. Baseline FCUs for Brushy Lake can be found in Figure 41.

[17] Function 2 is not associated with the connected depression HGM wetland subclass model. For more details refer to appendix B.

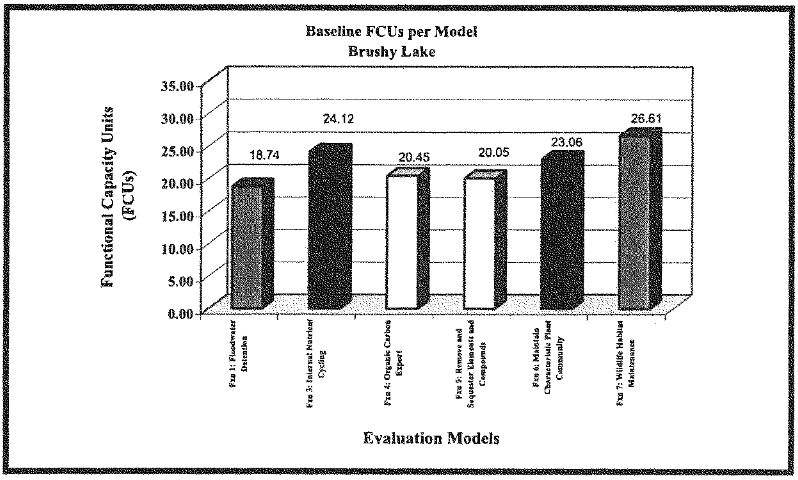

Figure 41. Baseline FCUs for the Brushy Lake Site

C. FUTURE CONDITIONS

C.1. Without Project Conditions

Based on the general Without Project trends described earlier in Chapter II, the ESL-ER Biological Team developed a series of incremental habitat quality and quantity projections to describe future conditions at the site given its location within the Cahokia Watershed boundaries. The single dominating factor of these projections was the anticipated increase in urban encroachment in the watershed over the next 50 years. For example, more than 75 percent of the Uplands deciduous forest and 25 percent of the wetlands (marshes, shrublands, forests, lakes and streams) in the Bottoms are expected to be lost to urbanization in Cahokia watershed alone. Not only did the Team forecast these impacts in terms of acreage losses, but they also attempted to capture the impacts in terms of degrading water quality and vegetative composition/structure scores. Thus, turbidity is expected to increase and dissolved oxygen levels are expected to decrease. Shoreline and submerged cover will decline as pools are filled with sediment. Water depths will decrease and available prey populations will decline as a direct result. In addition, the Team assumed that the human interference factors (distance to nearest human activities and the type of human activities occurring nearby) would significantly degrade future habitat conditions. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Brushy Lake Alternatives - HEP.xls, Brushy Lake Alternatives - HGM.xls).

C.2. With Project Conditions

With the general trends of the Without Project condition (i.e., the No Action Alternative) in mind, the Biological Team developed acreage and variable projections for the 20 alternatives proposed by the District. When possible, the Team offered suggestions to enhance the alternatives given the goals and objectives developed earlier in the process. As a general rule, the Biological Team assumed that available agricultural croplands would be converted to productive wetland settings, and the existing Uplands deciduous forests and floodplain wetlands would be protected from urban development. Alternatives that incorporated the deployment of detention ponds in the Uplands were assumed to have higher habitat quality than those alternatives that opted for floodplain sediment retention. Regardless of the manner in which it was achieved, the Team assumed the reduction in sediment would result in the overall improvement of both water quality (i.e., reduced turbidity and increased dissolved oxygen levels) and vegetative growth and health (i.e., increased submerged and shoreline coverage). Wetland quality would be further improved by the construction of a new ditch to funnel water to the wetland during pulse flood flows. One significant design feature, the planting of 175-200+ acres of palustrine forest, was projected to greatly enhance the overall value of the site by providing new cover, food and water for the wildlife species of concern. The Biological Team attempted to capture the vegetative succession of these forested areas in increments over time (low quality early in the life of the project, and higher quality by TY30). By restoring existing wetlands, developing new wetlands and protecting these areas in perpetuity, the Biological Team assumed the habitat would be buffered from human disturbance factors, thereby improving the overall value of the wetlands in the urban setting. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Brushy Lake Alternatives - HEP.xls, Brushy Lake Alternatives - HGM.xls).

D. EVALUATION OF ALTERNATIVES

D.1. Overall Review of the HEP Results

The overall HEP gains and losses per alternative are summarized in Table 44.

Table 44. Net AAHUs for each HSI model per alternative for the Brushy Lake Site

	Alternative Description	Alternative Code	Sum of Net AAHUs	Net AAHUs: Black Crappie	Eastern Meadowlark	Fox Squirrel	Great Blue Heron	Marsh Wren	Mink	QHEI	Slider Turtle	White Crappie	Wood Duck
Uplands Detention	Alternative As: No prairie buffer strips	4A-1-0	955.32	19.23	0.00	6.99	297.29	21.66	156.99	24.78	147.67	NA	280.70
		4A-3-0	965.96	21.77	0.00	6.99	299.59	21.66	160.22	24.78	148.38	NA	282.57
No Uplands Detention	Alternative Bs: No prairie buffer strips	4B-1-0	896.27	17.27	0.00	0.00	287.00	45.59	165.89	0.00	135.86	NA	244.66
		4B-3-0	906.60	19.85	0.00	0.00	289.26	45.59	169.12	0.00	136.50	NA	246.28
	Alternative Cs: Prairie buffer strips used to filter excess sediment from forests	4C-1-0	892.72	17.26	7.72	0.00	271.02	46.05	158.72	0.00	134.87	NA	257.08
		4C-3-0	902.89	19.85	7.72	0.00	272.99	46.05	161.95	0.00	135.55	NA	258.78

All Detention Basins = degraded Marshlands
Prairie buffers surrounding marshlands are wetter prairies with less depth due to sedimentation trapping.
With detention basins, basins dredged every 3-5 years, no external dredging necessary. (outside detention basin, but still within project boundary).
Ditch Options Considered:
-1 Ditch Option: Straight channel/concrete sides/dirt bottoms
-2a Ditch Option: Straight, all concrete - Rectangular
-2b Ditch Option: Straight, all concrete - Trapezoidal
-3 Ditch Option: Straight, grassy-slopes, dirt bottom
-4 Ditch Option: Meandering, riparian corridor
Forested Corridor Options Considered:
-(0) = No FCORRIDOR
-(1) = 100-m forested corridor strips (HSI weight = 1.0)

Overall, the results show that the 4A-3-0 alternative (the Uplands detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor) produced the highest net AAHUs across the suite of species (~966 AAHUs). The least productive alternative was 4C-1-0 (the Floodplain detention alternative that conveys flood waters to the site via a straight, concrete-sided, dirt-bottomed ditch with no forested corridor) generating ~ 893 AAHUs across the species evaluated. No alternatives resulted in the loss of AAHUs for any model evaluated.

Overall, the District can expect to see the creation of approximately 337 acres of new habitat (predominantly newly planted palustrine forest) and the preservation and restoration of approximately 451 acres of existing habitat under the proposed scenarios. Based on the assessment, the black crappie, eastern meadowlark, great blue heron, marsh wren, wood duck and riverine communities (based on the QHEI results) achieved optimum or near-optimum conditions under the majority of proposed design scenarios (HSIs ≥ 0.5 were realized by TY51). The great blue heron's outputs were the highest among models evaluated for the majority of the alternatives, representing approximately 30 percent (on average) of the total net gains. The second highest outputs were attained in the wood duck's returns, whose AAHUs contributed an additional 25 percent (on average) to the total net gains at the site. Low HSI scores (< 0.5) in the evaluation of two wetlands-based species (i.e., mink and slider turtle) and the Uplands forest-based species (i.e., fox squirrel), can be directly attributed to less than optimal design of pond ecosystems, and the impact of construction in the Upland forests of the study area. For detailed information regarding these results, refer to the tables in the attached electronic files (Brushy Lake Overall Results - HEP.xls, Brushy Lake Baseline HSIs Summarized.xls, Brushy Lake Baseline HUs Summarized.xls).

D.2. Top Three Biological Winners Using HEP

The top three biologically productive solutions among the alternatives were:

#1 **4A-3-0** - The Uplands detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor produced 965.96 net AAHUs;

#2 **4A-1-0** - The Uplands detention alternative that conveys flood waters to the site via a straight, concrete-sided, dirt-bottomed ditch with no forested corridor produced 955.32 net AAHUs; and

#3 **4B-3-0** - The Floodplain detention alternative that conveys floodwaters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor produced 906.60 net AAHUs.

D.3. Individual HSI Model Results

Creating habitats under these winning scenarios, even though the quality of these areas was less than optimal for the species (i.e., HSIs > 0, but ≤ 1.0 by TY51), nevertheless resulted in favorable wetland returns for the proposed winning alternatives when evaluated as a whole. On a model-by-model basis, the following summations could be made:

Black Crappie: Near optimum conditions were achieved under the top three "winning" alternatives (i.e., 4A-3-0, 4A-1-0 and 4B-3-0) (**TY51 HSIs ≅ 0.73**), resulting in net gains of **21.77**, **19.23** and **19.85 AAHUs,** respectively.

Eastern Meadowlark: No net change in AAHUs developed for this species as a result of undertaking the top three winning solutions (i.e., 4A-3-0, 4A-1-0 and 4B-3-0) and the HSIs remained stable across the TYs (**HSIs = 0.94, net AAHUS = 0.00**).

Fox Squirrel: Although optimum conditions (HSI = 1.0) were not achieved under the top two "winning" alternatives (i.e., 4A-3-0 and 4A-1-0), the species still achieved high TY51 HSIs (**0.67**), resulting in minimal net gains of **6.99 AAHUs.** The #3 "winner" (i.e., 4B-3-0) resulted in lower returns for the species (**TY51 HSI ≅ 0.37, net AAHU gains = 0.00**).

Great Blue Heron: Near optimum conditions were achieved under the top three "winning" alternatives (i.e., 4A-3-0, 4A-1-0 and 4B-3-0) (**TY51 HSIs ≅ 0.69**), resulting in net gains of **299.59**, **297.29** and **289.26 AAHUs,** respectively.

Marsh Wren: Near optimum conditions were achieved under the top three "winning" alternatives (i.e., 4A-3-0, 4A-1-0 and 4B-3-0) (**TY51 HSIs ≅ 0.75**), resulting in net gains of **21.66**, **21.66** and **45.59 AAHUs,** respectively.

Mink: Although sub-optimum conditions (HSI < 0.50) were experienced under the top three "winning" alternatives (i.e., 4A-3-0, 4A-1-0 and 4B-3-0), they still managed to generate some significant returns for this species by TY51 (**TY51 HSI ≅ 0.40**), resulting in net gains of **160.22**, **156.99** and **169.12 AAHUs,** respectively.

QHEI - Riverine Community: Near optimum conditions were achieved under the top two "winning" alternatives (i.e., 4A-3-0 and 4A-1-0) (**TY51 HSIs = 0.85**), resulting in net gains of **24.78 AAHUs** under either alternative. Under the third alternative (i.e., 4B-3-0), no change from the Without

Project Condition, resulted in moderate HSI values (TY51 HSIs = 0.59), and no net gain (i.e., AAHUs = 0.00).

Slider Turtle: Although sub-optimum conditions (HSI < 0.50) were experienced under the top three "winning" alternatives (i.e., 4A-3-0, 4A-1-0 and 4B-3-0), they still managed to generate some significant returns for this species by TY51 (**TY51 HSI ≅ 0.35**), resulting in net gains of **148.38**, **147.67** and **136.50 AAHUs,** respectively.

White Crappie: This species was not applicable to this site.

Wood Duck: Although optimum conditions (HSI = 1.0) were not achieved under the top three "winning" alternatives (i.e., 4A-3-0, 4A-1-0 and 4B-3-0), the species still achieved moderate TY51 HSIs (**0.58**, **0.58** and **0.51** respectively), resulting in significant net gains of **282.57**, **280.70** and **246.28 AAHUs,** respectively.

The specific details of the EXHEP runs are reported in the attached electronic files (Attained Goals.xls). Each alternative is identified, the gains or losses in terms of acres and HSIs are recorded, and both cumulative and net AAHUs are documented. The variations among model outputs are illustrated in Figure 42.

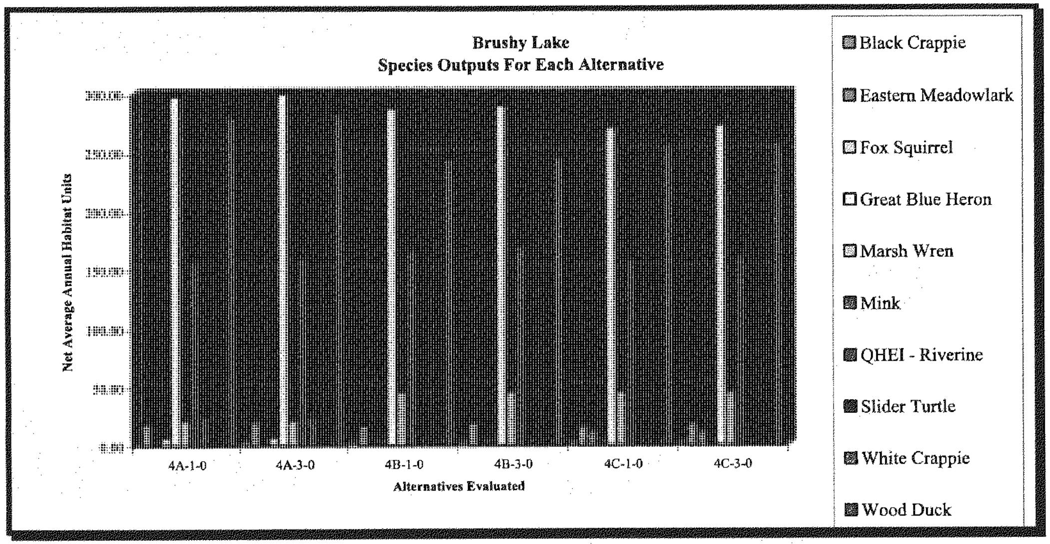

Figure 42. HSI Model outputs per alternative for the Brushy Lake Site

D.4. Overall Review of the HGM Results

The overall HGM gains and losses per alternative are summarized in Table 45. The results show that the four alternatives that promoted the capture of sediment in the floodplain in the Uplands (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0) produced the highest net AAFCUs across the suite of functions (net sum AAFCUs ≅ 208). The least productive alternatives were the Uplands detention solutions (4A-1-0 and 4A-3-0) generating ~ 56.47 AAFCUs across the functions evaluated. These same alternatives resulted in a loss of AAFCUs for the Nutrient Cycling function (Function 3, -2.8 AAFCUs lost).

Overall, the District can expect to see the creation of approximately 22 acres of existing connected depressional wetlands (predominantly newly planted palustrine forest) and the preservation and restoration of approximately 36 acres of existing connected depressional wetlands under the proposed scenarios. Based on the assessment, all functions achieved optimum or near-optimum conditions under the majority of proposed design scenarios (HSIs $\geq$ 0.5 were realized by TY51). Under the majority of alternatives, specifically those focused on detention of sediment in the Bottoms via on-site detention basins (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0), Functions 6 and 7 (i.e., Plant Community Maintenance and Wildlife Habitat Maintenance) generated the highest outputs among the models evaluated, together representing approximately 38 percent (on average) of the total net gains. Under the Uplands sediment detention scenarios (i.e., 4A-1-0 and 4A-3-0), Function 4 (Organic Carbon Export) and Function 5 (Remove and Sequester Elements and Compounds) generated the highest outputs among the models evaluated, together representing approximately 48 percent (on average) of the total net gains. For detailed information regarding these results, refer to the tables in the attached electronic files (Brushy Lake Overall Results - HGM.xls, Brushy Lake Baseline FCIs Summarized.xls, Brushy Lake Baseline FCUs Summarized.xls).

Table 45. Net AAFCUs for each FCI model per alternative for the Brushy Lake Site

	Alternative Description	Alternative Code	Sum of Net AAFCUs	Maximum Fxn AAFCUs	Minimum Fxn AAFCUs	Average of All Function AAFCUs	Net AAFCUs						
							Fxn 1 Floodwater Detention	Fxn 2 Surface Water Storage	Fxn 3 Nutrient Cycling	Fxn 4 Organic Carbon Export	Fxn 5 Remove & Sequester Elements & Compounds	Fxn 6 Plant Community Maintenance	Fxn 7 Wildlife Habitat Maintenance
Uplands Detention	Channel Option: -1: Straight channel/concrete sides/dirt bottoms -3: Straight, grassy-slopes, dirt bottom Forested Corridor Option: -0: No FCORRIDOR	4A-1-0	56.47	14.33	-2.80	9.41	12.33	NA	-2.80	12.63	14.33	9.22	10.75
		4A-3-0	56.47	14.33	-2.80	9.41	12.33	NA	-2.80	12.63	14.33	9.22	10.75
No Uplands Detention	Alternative Bs: No prairie buffer strips Alternative Cs: Prairie buffer strips used to filter excess sediment from forests Channel Option: -1: Straight channel/concrete sides/dirt bottoms -3: Straight, grassy-slopes, dirt bottom Forested Corridor Option: -0: No FCORRIDOR	4B-1-0	208.59	40.25	16.38	34.76	35.59	NA	16.38	38.16	39.02	39.19	40.25
		4B-3-0	208.59	40.25	16.38	34.76	35.59	NA	16.38	38.16	39.02	39.19	40.25
		4C-1-0	208.59	40.25	16.38	34.76	35.59	NA	16.38	38.16	39.02	39.19	40.25
		4C-3-0	208.59	40.25	16.38	34.76	35.59	NA	16.38	38.16	39.02	39.19	40.25

D.5. Top Three Biological Winners Using HGM

Four of the six alternatives evaluated with HGM generated the same results in terms of functionality. These four solutions are therefore considered "equal" in terms of biological productivity in this analysis. These winners are presented here in order of appearance:

#1 **4B-1-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, concrete-sided, dirt-bottomed ditch with no forested corridor produced 208.59 net AAFCUs;

#1 **4B-3-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt bottomed channel with no forested corridor produced 208.59 net AAFCUs;

#1 **4C-1-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, concrete-sided, dirt-bottomed ditch with no forested corridor, but deploys prairie buffer strips in the site to filter sediment out from the wetland produced 208.59 net AAFCUs; and

#1 **4C-3-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor, but deploys prairie buffer strips in the site to filter sediment out from the wetland produced 208.59 net AAFCUs.

D.6. Individual FCI Model Results

Creating wetlands under these winning scenarios, even though the quality of these areas was less than optimal for the functions (i.e., FCIs > 0, but ≤ 1.0 by TY51), nevertheless resulted in favorable wetland returns for the proposed winning alternatives when evaluated as a whole. On a model-by-model basis, the following summations could be made:

Function 1: Floodwater Detention: Although optimum conditions (FCI = 1.0) were not achieved under the "winning" alternatives (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0), the function still achieved high TY51 FCIs (**0.72**), resulting in net gains of **35.59 AAFCUs,** respectively.

Function 2: Surface Water Storage: This function was not applicable to the assessment of this subclass at this site.

Function 3: Internal Nutrient Cycling: Although optimum conditions (FCI = 1.0) were not achieved under the "winning" alternatives (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0), the function still achieved high TY51 FCIs

(0.55), resulting in net gains of **16.38 AAFCUs,** respectively.

Function 4: Organic Carbon Export: Although optimum conditions (FCI = 1.0) were not achieved under the "winning" alternatives (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0), the function still achieved high TY51 FCIs **(0.77)**, resulting in net gains of **38.16 AAFCUs,** respectively.

Function 5: Remove and Sequester Elements and Compounds: Although optimum conditions (FCI = 1.0) were not achieved under the "winning" alternatives (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0), the function still achieved high TY51 FCIs **(0.80)**, resulting in net gains of **39.02 AAFCUs,** respectively.

Function 6: Maintain Characteristic Plant Community: Although optimum conditions (FCI = 1.0) were not achieved under the "winning" alternatives (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0), the function still achieved high TY51 FCIs **(0.89)**, resulting in net gains of **39.19 AAFCUs,** respectively.

Function 7: Wildlife Habitat Maintenance: Although optimum conditions (FCI = 1.0) were not achieved under the "winning" alternatives (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0), the function still achieved high TY51 FCIs **(0.91)**, resulting in net gains of **40.25 AAFCUs,** respectively.

The specific details of the EXHGM runs are reported in the attached electronic files (Attained Goals.xls). Each alternative is identified, the gains or losses in terms of acres and FCIs are recorded, and both cumulative and net AAFCUs are documented. The variations among model outputs are illustrated in Figure 43.

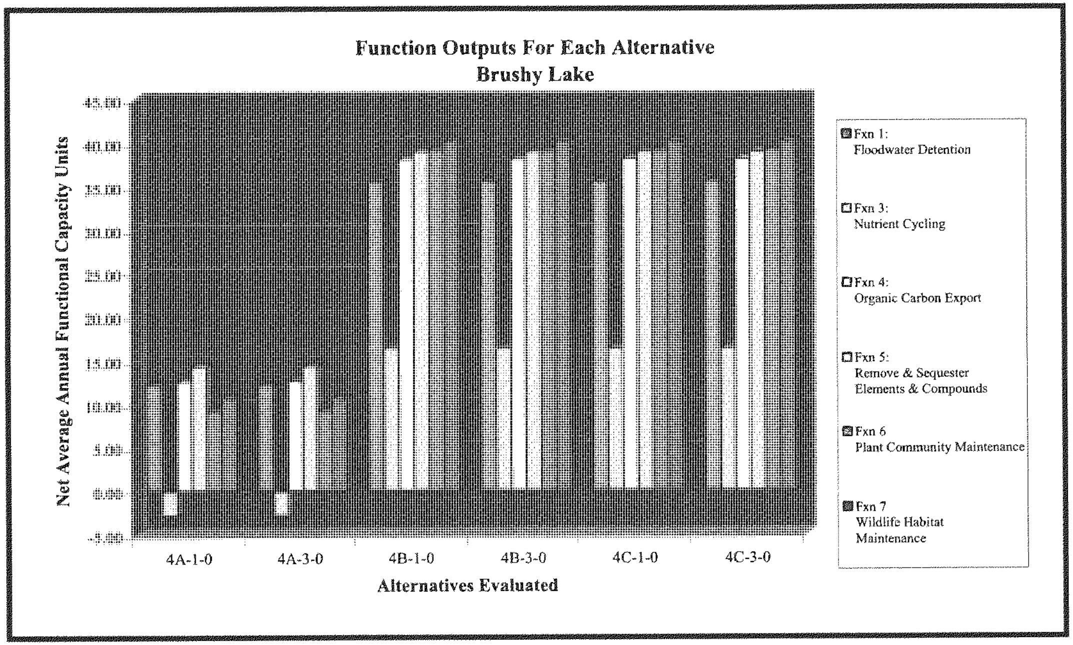

Figure 43. FCI Model outputs per alternative for the Brushy Lake Site

D.7. Comparison of the HEP and HGM Results

When reviewing the overall results of the HEP and HGM assessments, it should be noted that the techniques disagreed as to the identity of the most productive alternative – the top winning solution based on HEP was 4A-3-0, and HGM found that a suite of alternatives (i.e., 4B-1-0, 4B-3-0, 4C-1-0 and 4C-3-0) were equally productive (Table 46).

Table 46. Comparison of HEP versus HGM alternative rankings for the Brushy Lake Site

Alternative	Sum of Net AAHUs	Sum of Net AAFCUs	HEP Ranking	HGM Ranking
4A-3-0	966.0	56.5	1	2
4A-1-0	955.3	56.5	2	2
4B-3-0	906.6	208.6	3	1
4C-3-0	902.9	208.6	4	1
4B-1-0	896.3	208.6	5	1
4C-1-0	892.7	208.6	6	1
	#1 Ranked Alternative			
	#2 Ranked Alternative			
	#3 Ranked Alternative			

This comparison demonstrates a weakness of the HGM assessment – the technique was shown to be insensitive to the individual alternatives at the current assessment resolution. As indicated, both techniques found the 4B-3-0 alternative to be productive, yet the HEP technique appears to be able to distinguish between the 4B-3-0, 4C-3-0, 4B-1-0 and 4C-1-0 alternatives. While this simplistic comparison does not begin to address the subtle nuances of the separate HGM and HEP assessments, the basic review of the two results demonstrates the support an HGM analysis can lend to the overall HEP results. However, in the future application of the HGM model, it would be prudent to fine-tune the HGM connected depression subclass model used here to better reflect the District's design capabilities.

E. COST ANALYSIS

As described earlier in this report, two techniques were used to determine the winning solution in the cost evaluation process. First, the results of the habitat assessment were compared using Cost Effectiveness Analyses (CEA). When alternatives are compared using CEA, those alternatives that produce increased levels of output (AAHUs or AAFCUs) for the same or lesser costs were considered "effective" solutions and were retained. These alternatives are compared were, in turn, compared on the basis of cost efficiency [i.e., those alternatives that produce similar levels of output (AAHUs or AAFCUs) at a lesser expense]. The "efficient" solutions were submitted to Incremental Cost Analyses (ICA) (i.e., determining changes in costs for increasing levels of outputs). Once evaluated on the basis of incremental effectiveness, the "winning" solutions were revealed (those that are both cost effective and incrementally effective). The annualized costs and outputs, as well as the results of the CEA and ICA evaluations for the Brushy Lake Site, are presented below.

E.1. Project Costs

In Table 47, the total costs, annualized costs, and annualized biological returns (i.e., AAHUs and AAFCUs) are recorded for each alternative. The most expensive proposal, 4A-1-0, will cost more than $18.2M to implement. The least expensive proposal, 4B-3-0, will cost more than $6.8M to undertake.

Table 47. Total project costs and annualized costs per alternative for the Brushy Lake Site

	Alternative Description	Alternative Code	Total Alternative Costs ($M)	Total Annualized Costs	Net AAHUs	Cost Per AAHU	AAHU Per $1000.00	Net AAFCUs	Cost Per AAFCU	AAFCU Per $1000.00
Uplands Detention	Alternative As: No prairie buffer strips	4A-1-0	$18.2M	$1,215,900.00	955.32	$1,272.77	0.79	56.47	$21,532.02	0.046
		4A-3-0	$11.79M	$787,300.00	965.96	$815.04	1.23	56.47	$13,942.07	0.072
No Uplands Detention	Alternative Bs: No prairie buffer strips	4B-1-0	$13.24M	$884,400.00	896.27	$986.76	1.01	208.59	$4,239.96	0.236
		4B-3-0	$6.83M	$456,300.00	906.60	$503.31	1.99	208.59	$2,187.58	0.457
	Alternative Cs: Prairie buffer strips used to filter excess sediment from forests	4C-1-0	$13.3M	$888,200.00	892.72	$994.94	1.01	208.59	$4,258.18	0.235
		4C-3-0	$6.88M	$459,800.00	902.89	$509.26	1.96	208.59	$2,204.36	0.454

All Detention Basins = degraded Marshlands
Prairie buffers surrounding marshlands are wetter prairies with less depth due to sedimentation trapping.

With detention basins, basins dredged every 3-5 years, no external dredging necessary. (outside detention basin, but still within project boundary).
Ditch Options Considered:
- -1 Ditch Option: Straight channel/concrete sides/dirt bottoms
- -2a Ditch Option: Straight, all concrete - Rectangular
- -2b Ditch Option: Straight, all concrete - Trapezoidal
- -3 Ditch Option: Straight, grassy-slopes, dirt bottom
- -4 Ditch Option: Meandering, riparian corridor

Forested Corridor Options Considered:
- -(0) = No FCORRIDOR
- -(1) = 100-m forested corridor strips (HSI weight = 1.0)

E.2. Top Three Cost Effective Solutions Based on the HEP Results

The Brushy Lake CEA results based on the HEP assessment can be found in Table 48. The top three cost effective solutions in the analyses were: **4B-3-0, 4C-3-0** and **4A-3-0**. For the 4B-3-0 alternative, the District can expect to generate one AAHU for every $503.31 expended annually. For the 4C-3-0 alternative, the cost increased to $509.26 for each AAHU (an increase of $5.94). And, for the 4A-3-0 alternative, an AAHU could be gained at a cost of $815.04 – a cost $311.73 above the "winning" solution's cost. For detailed information regarding these cost analyses, refer to the tables in the attached electronic files (Brushy Lake HEP CEA.xls).

Table 48. Cost effective solutions for the alternatives on the Brushy Lake Site evaluated with HEP

CEA Ranking	ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU
1	1	3	4B-3-0	906.60	$456,300.00	$503.31
2	3	4	4C-3-0	902.89	$459,800.00	$509.26
3	2	1	4A-3-0	965.96	$787,300.00	$815.04
4	5	5	4B-1-0	896.27	$884,400.00	$986.76
5	6	6	4C-1-0	892.72	$888,200.00	$994.94
6	4	2	4A-1-0	955.32	$1,215,900.00	$1,272.77

#1 Ranked Alternative
#2 Ranked Alternative
#3 Ranked Alternative

E.3. Top Three Incrementally Effective Solutions Based on the HEP Results

The results of the ICA are displayed in Figure 44. At this site, the top three incrementally effective solutions evaluated with HEP included:

#1 **4B-3-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor produced 906.60 net AAHUs at a cost of $503.31 per AAHU;

#2 **4A-3-0** - The Uplands detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor produced 965.96 net AAHUs at a cost of $815.04 per AAHU; and

#3 **4C-3-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor, but deploys prairie buffer strips in the site to filter sediment out from the wetland produced 902.89 net AAHUs at a cost of $509.26 per AAHU.

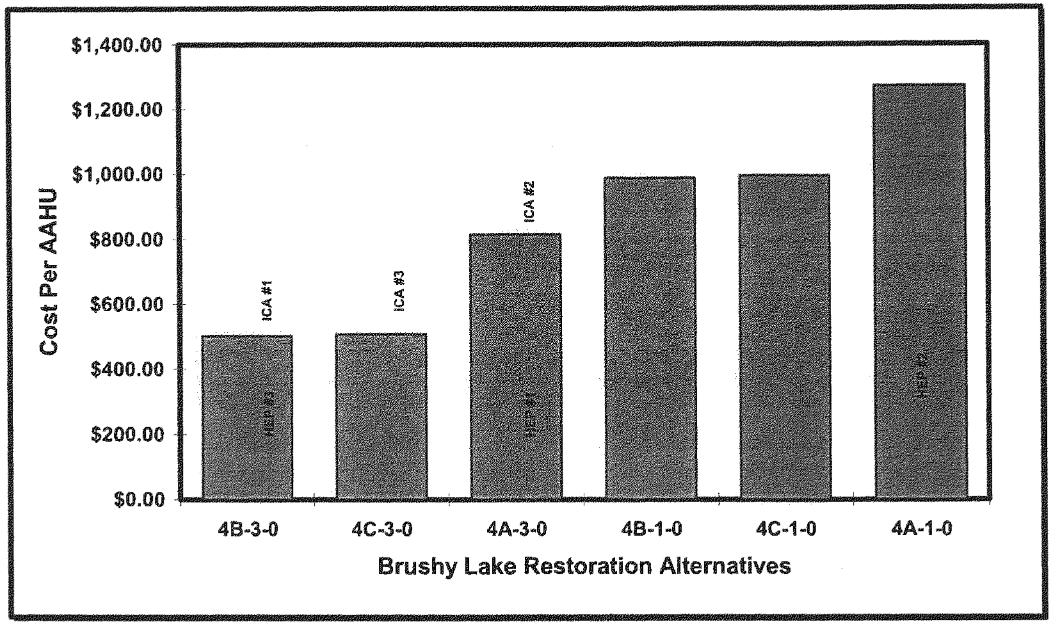

Figure 44. ICA results based on the HEP assessment of the alternatives for the Brushy Lake Site

In essence, only the top two alternatives (i.e. 4B-3-0 and 4A-3-0 were found to be "Best Buy" plans – that is they were the most biologically productive, incrementally effective plans (Figure 45 and Table 49).

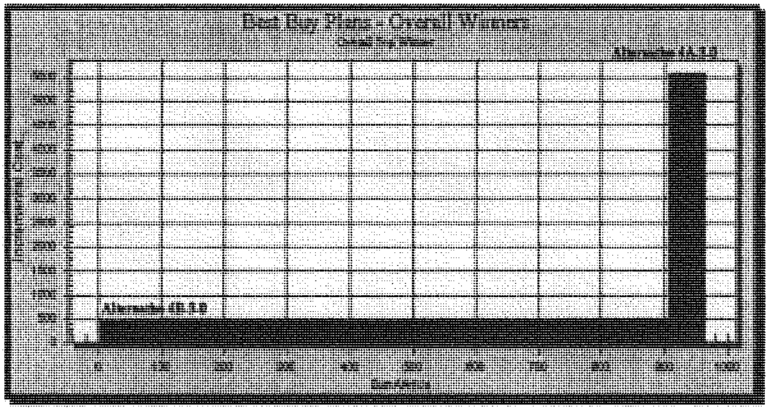

Figure 45. "Best Buy" options from the ICA analysis of the HEP results at the Brushy Site

Table 49. Incremental outputs for the "Best Buy" options resulting from the ICA analysis of the HEP results at the Brushy Site

Alternative	Incremental Output	Incremental Output/Unit Output
No Action	0.00	$0.00
4B-3-0	906.60	$503.31
4A-3-0	59.37	$5,575.63

E.4. Top Three Cost Effective Solutions Based on the HGM Results

The Brushy Lake CEA results based on the HGM assessment can be found in Table 50. The top three cost effective solutions in the analyses were **4B-3-0**, **4C-3-0** and **4B-1-0**. For the 4B-3-0 alternative, the District can expect to generate one AAHU for every $2,187.58 expended annually. For the 4C-3-0 alternative, the cost increased to $2,204.36 for each AAHU (an increase of $16.78). And, for the 4B-1-0 alternative, an AAHU could be gained at a cost of $4,239.96 – a cost $2,052.38 above the "winning" solution's cost. For detailed information regarding these cost analyses, refer to the tables in the attached electronic files (Brushy Lake HGM CEA.xls).

Table 50. Cost effective solutions for the alternatives on the Brushy Lake Site evaluated with HGM

HGM CEA Ranking	HGM ICA Ranking	HGM Ranking	Alternative	AAFCUs	Cost	Cost Per AAFCU
1	1	1	4B-3-0	208.59	$456,300.00	$2,187.58
2	2	1	4C-3-0	208.59	$459,800.00	$2,204.36
3	3	1	4B-1-0	208.59	$884,400.00	$4,239.96
4		1	4C-1-0	208.59	$888,200.00	$4,258.18
5		2	4A-3-0	56.47	$787,300.00	$13,942.07
6		2	4A-1-0	56.47	$1,215,900.00	$21,532.02

#1 Ranked Alternative
#2 Ranked Alternative
#3 Ranked Alternative

E.5. Top Three Incrementally Effective Solutions Based on the HGM Results

The results of the ICA are displayed in Figure 46. At this site, the top three incrementally effective solutions evaluated with HGM included:

#1 **4B-3-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor produced 208.59 net AAFCUs at a cost of $2,187.58 per AAFCU;

#2 **4C-3-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, grassy-slopes-sided, dirt-bottomed channel with no forested corridor, but deploys prairie buffer strips in the site to filter sediment out from the wetland produced 208.59 net AAFCUs at a cost of $2,204.36 per AAFCU; and

#3 **4B-1-0** - The Floodplain detention alternative that conveys flood waters to the site via a straight, concrete-sided, dirt bottomed ditch with no forested corridor produced 208.59 net AAFCUs at a cost of $4,239.96 per AAFCU.

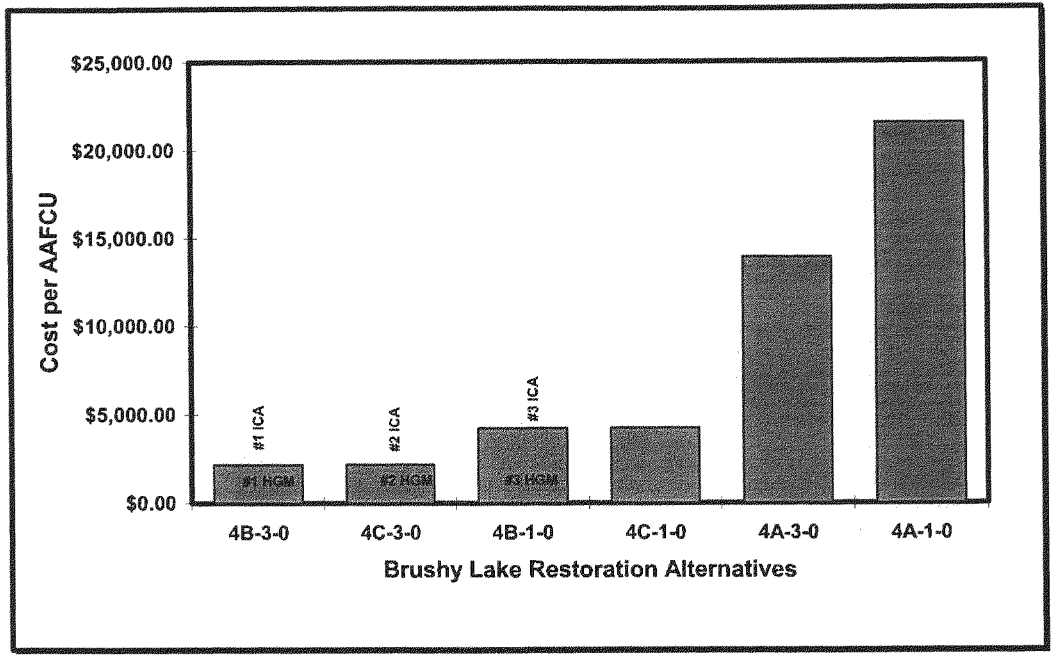

Figure 46. ICA results based on the HGM assessment of the alternatives for the Brushy Lake Site

In essence, only the top alternative [i.e., (4B-3-0)] was found to be "Best Buy" plans – that it was the most biologically productive, incrementally effective plans Figure 47 and Table 51.

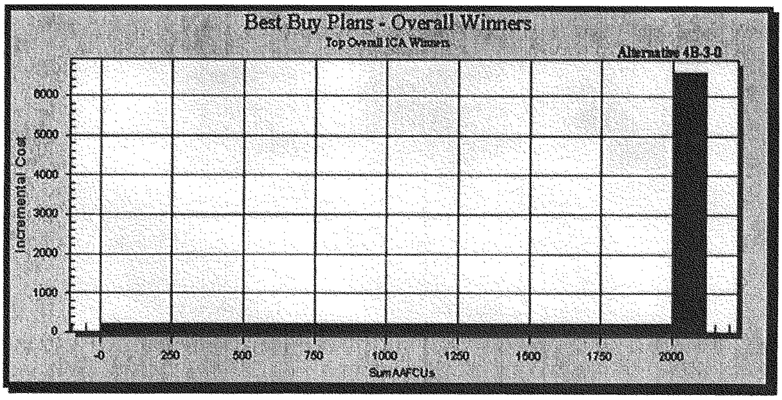

Figure 47. "Best Buy" options from the ICA analysis of the HGM results at the Brushy Lake Site

Table 51. Incremental outputs for the "Best Buy" options resulting from the ICA analysis of the HGM results at the Brushy Lake Site

Alternative	Incremental Output	Incremental Output/Unit Output
No Action	0.00	$0.00
4B-3-0	208.59	$2,187.58

E.6. Comparison of the ICA Results for the HEP and HGM Assessments

When the overall results of the ICA analyses are reviewed, it is important to note that both techniques (HEP and HGM) found the 4B-3-0 alternative to be the most incrementally effective alternative evaluated (Table 52).

Table 52. Comparison of incremental cost results for the HEP and HGM assessments at the Brushy Lake Site

Alternative	Sum of Net AAHUs	Cost Per AAHU	Sum of Net AAFCUs	Cost Per AAFCU	HEP ICA Ranking	HGM ICA Ranking
4B-3-0	906.6	$503.31	208.6	$2,187.58	1	1
4C-3-0	902.9	$509.26	56.5	$13,942.07	3	2
4A-3-0	966.0	$815.04	208.6	$2,204.36	2	
4B-1-0	896.3	$986.76	56.5	$21,532.02		3
4C-1-0	892.7	$994.94	208.6	$4,239.96		
4A-1-0	955.3	$1,272.77	208.6	$4,258.18		

Legend: (light shading) #1 Ranked Alternative; (white) #2 Ranked Alternative; (dark shading) #3 Ranked Alternative

However, the techniques did not agree on the second and third incrementally effective solutions. Again, this simplistic comparison does not begin to address the subtle nuances of the separate HGM and HEP assessments, yet the basic comparison suggests the HGM analysis can lend additional confirmation of the overall HEP results. Again, it is suggested that fine-tuning be completed prior to future applications of the existing HGM connected depression subclass model.

VI. SPRING LAKE

A. PROJECT DESCRIPTION

A.1. Location

Spring Lake, the largest restoration site under evaluation, spans two counties (i.e., Madison and St. Clair) and two watersheds (Cahokia and Harding). In addition to Harding Ditch, the floodplain component consists of three major areas:

1) **Cell 1**, a 368-acre area bounded by Forest Boulevard to the north, Interstate 255 to the east and Bunkum Road to the south;

2) **St. Clair Farms**, a 180-acre area bounded by Interstate 64 to the north, Harding Ditch and Interstate 255 to the east, St. Clair Avenue to the south; and

3) **Indian Lake**, a 619-acre area bounded by Interstates 55 and 70 to the north, Route 111 to the east, Collinsville Road to the south and Route 203 to the west.

The three floodplain areas lie in separate historic meander scars of the Mississippi River. Two centuries ago, the primary vegetation cover in these areas was thought to be marsh (Cell 1), prairie (St. Clair Farms) and forest (Indian Lake). The watersheds of Canteen Creek and Little Canteen Creek comprise the Uplands component of the site (Figure 48).

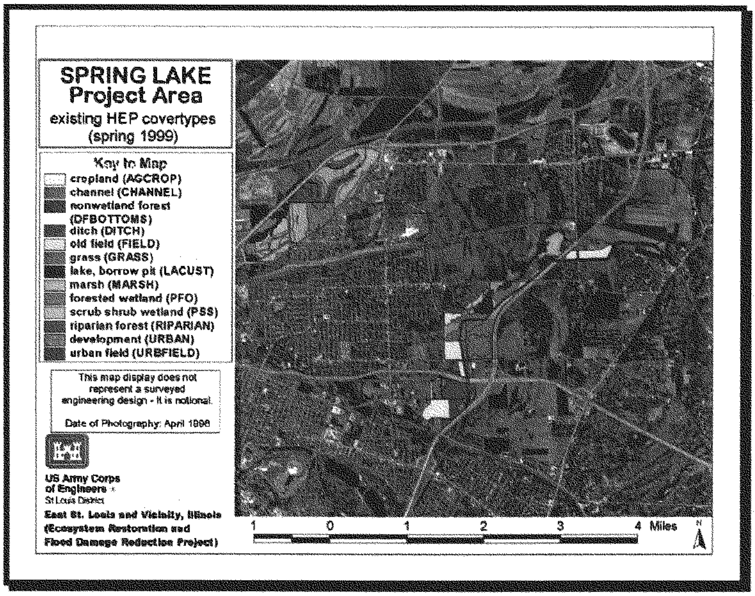

Figure 48. Spring Lake site map

A.2. Purpose

The proposed alternatives for this site were developed to address three restoration goals: (1) the creation of an area on the floodplain to support natural plant and animal communities and a flood regime similar to presettlement (ca. 1800) conditions; (2) the minimization of upland erosion and management of sedimentation in the Canteen and Little Canteen Creek watersheds; and (3) the reduction of flood damages within the Cahokia and Harding watersheds.

A.3. Measures Under Consideration

In order to address these goals, the District generated two lists of design measures that, when combined in series, served as unique alternatives for the assessment. The first list of features was considered essential to meet these goals and, therefore, formed the basis for each design. These commonly shared features included:

(1) The establishment of three floodplain areas, namely Cell 1

(370 acres), St. Clair Farms (180 acres) and Indian Lake (620 acres), as habitat areas that will utilize stormwater events from Canteen and Little Canteen Creeks with the construction of earthen hydraulic features around these areas, when necessary. At Indian Lake, remnants of Cahokia Creek would be reopened to create a flowing floodplain stream, and trees would be planted along both sides of the channel (where they currently do not exist), to create a continuous forested corridor 330 feet (100 meters) wide. Impaired drainage at the northern end would be improved and standing water removed, to allow the forest to become reestablished.

(2) The creation of a 330-foot-wide (100-meter-wide) wide forested corridor on both sides of Harding Ditch between Cell 1 and St. Clair Farms.

(3) The reestablishment of a forest in the dead timber area[18] north of Forest Boulevard, within the Cahokia Mounds State Historic Site.

(4) The construction of a new Canteen Creek relief channel to ensure that stormwater from the Canteen Creek watershed enters into the Harding Ditch system, and ultimately into the habitat areas. The channel would have concrete sides, a concrete bottom and earthen levees along both banks.

(5) The modification of Harding Ditch, from Route 157 to Cell 1, and from Cell 1 to St. Clair Farms, in order to ensure the transference of stormwater events from Canteen and Little Canteen Creeks to the habitat areas. The channels would have grassy sides, an earthen bottom and an earthen levee along both banks.

(6) The construction of a new "Fairmont City Ditch," from Cell 1 to Indian Lake, which will provide the hydraulic connection from Canteen Creek back to Cahokia Canal. The channel would have grassy sides, an earthen bottom and an earthen levee along both banks in low elevations.

In addition to these commonly shared features, the alternative design deployed various combinations of features from the following two options:

[18] The permanent standing water within a 35-acre tract of dead (drowned) timber would be drained and appropriate tree species planted under this option.

(1) Uplands versus Bottomlands, sediment detention. Sediment originating in the Uplands, and ultimately moving into the floodplain, would be detained either in the Uplands (by constructing 58 new tributary stream sediment detention basins - 37 in the Canteen Creek watershed and 21 in the Little Canteen Creek watershed), or in the Bottoms (in Harding Ditch, Canteen Creek and Cell 1).

(2) Presence or absence of a new "floodplain" along "Reach 3B" of Harding Ditch. By setting back the existing levees along a 2,000-foot-long reach of Harding Ditch, a "floodplain" area will be re-established.

(3) Vegetative cover across the habitat areas. A variety of habitat restoration options and hydrologic regime alternations are under consideration at the site. In Cell 1, a restoration marsh option that requires extensive excavation was compared to an option that produced a combination of marsh and forested habitat with minimal excavation required. In the St. Clair Farms area, an option that restores prairie and forested habitats to the site with no excavation activities was compared to the restoration of marsh habitat requiring minimal excavation. In "Reach 3B" of the Harding Ditch, a prairie restoration option implemented in the floodplain was evaluated. Throughout the evaluation of options, the habitat conditions in the Indian Lake area were held constant.

(4) A number of pool and riffle complexes will be deployed at this site (number to be determined during the design phase of the study)[19].

A.4. Alternatives Under Evaluation

Given the above mentioned design measures, the District generated no less than 126 unique alternatives for this site (Table 53). One hundred and twenty of these alternatives were dropped from consideration due to their excessive costs, design inconsistencies and/or biologically ineffective configurations. These alternatives have been illustrated in Figure 49 through Figure 51.

[19] A pilot study at Judy's Branch was constructed in 2000, and the District is currently monitoring the site (to continue for the 3 years). The results of the pilot project will assist the District in determining the number of riffle:pool complexes necessary on a site-by-site basis to meet the proposed beneficial productivity assumed herein. Section 9 of the main report discusses this pilot project (USACE 2002).

Table 53. Spring Lake alternative matrix

	Uplands ON Sediment Trapped in Uplands			**Uplands OFF** Floodplain will act as Natural Sediment Basin		
Channel Type & Corridor Type Options	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to Prairie	Cell 1: Minimal excavation Cell 2: Expected to Dry Out St. Clair Farms: Excavation necessary, Planted to MARSH	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to NEWFOREST	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to Prairie	Cell 1: Minimal excavation Cell 2: Expected to Dry Out St. Clair Farms: Excavation necessary, Planted to MARSH	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to NEWFOREST
Straight Channel with Concrete Sides	1A-1-X	1B-1-X	1C-1-X	1D-1-X	1E-1-X	1F-1-X
	1A-1-Y	1B-1-Y	1C-1-Y	1D-1-Y	1E-1-Y	1F-1-Y
	1A-1-Z	1B-1-Z	1C-1-Z	1D-1-Z	1E-1-Z	1F-1-Z
All Concrete Channel	1A-2a-X	1B-2a-X	1C-2a-X	1D-2a-X	1E-2a-X	1F-2a-X
	1A-2a-Y	1B-2a-Y	1C-2a-Y	1D-2a-Y	1E-2a-Y	1F-2a-Y
	1A-2a-Z	1B-2a-Z	1C-2a-Z	1D-2a-Z	1E-2a-Z	1F-2a-Z
	1A-2b-X	1B-2b-X	1C-2b-X	1D-2b-X	1E-2b-X	1F-2b-X
	1A-2b-Y	1B-2b-Y	1C-2b-Y	1D-2b-Y	1E-2b-Y	1F-2b-Y
	1A-2b-Z	1B-2b-Z	1C-2b-Z	1D-2b-Z	1E-2b-Z	1F-2b-Z
Straight Grass-lined Channel	**1A-3-X**	**1B-3-X**	**1C-3-X**	**1D-3-X**	**1E-3-X**	**1F-3-X**
	1A-3-Y	1B-3-Y	1C-3-Y	1D-3-Y	1E-3-Y	1F-3-Y
	1A-3-Z	1B-3-Z	1C-3-Z	1D-3-Z	1E-3-Z	1F-3-Z
Earthen Sides	1A-6-X	1B-6-X	1C-6-X	1D-6-X	1E-6-X	1F-6-X
	1A-6-Y	1B-6-Y	1C-6-Y	1D-6-Y	1E-6-Y	1F-6-Y
	1A-6-Z	1B-6-Z	1C-6-Z	1D-6-Z	1E-6-Z	1F-6-Z
Floodplain with Concrete Sides	1A-7-X	1B-7-X	1C-7-X	1D-7-X	1E-7-X	1F-7-X
	1A-7-Y	1B-7-Y	1C-7-Y	1D-7-Y	1E-7-Y	1F-7-Y
	1A-7-Z	1B-7-Z	1C-7-Z	1D-7-Z	1E-7-Z	1F-7-Z
Floodplain with Earthen Sides	1A-8-X	1B-8-X	1C-8-X	1D-8-X	1E-8-X	1F-8-X
	1A-8-Y	1B-8-Y	1C-8-Y	1D-8-Y	1E-8-Y	1F-8-Y
	1A-8-Z	1B-8-Z	1C-8-Z	1D-8-Z	1E-8-Z	1F-8-Z

(Shaded) Alternatives dropped from consideration due to low biological productivity, cost ineffectiveness, and/or design inefficiencies.

All Alternatives: Indian Lake: Re-establish Old Cahokia Reach, Send flood pulse into area, Drain out through Landsdowne Channel to promote tree growth, Expect Golf Course to naturally suceed NEWMARSH/NEWFOREST

Forested Corridor Options:

- -X = 100m forested corridor strips (HSI weight = 1.0)
- -Y = 75m forested corridor strips (HSI weight = 0.75)
- -Z = 50m forested corridor strips (HSI weight = 0.5)

Channel Options:

- -2b Ditch Option: Straight channel/concrete sides/concrete bottoms/Trapezoidal shaped
- -3 Ditch Option: Straight channel/grass-lined sides/dirt bottoms
- -6 Ditch Option: Straight channel/Earthen sides/dirt bottoms
- -7 Ditch Option: Straight Channel/grass-lined sides/dirt bottoms/Floodplain between setback levees and channel with PRAIRIE & RIPARIAN

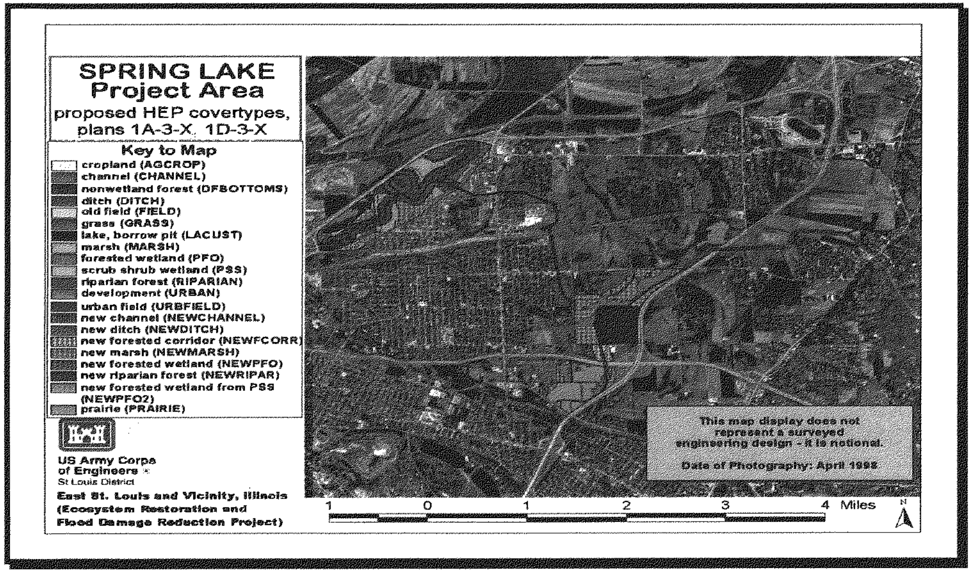

Figure 49. Proposed alternatives for the 1A-3-X and 1D-3-X alternatives at the Spring Lake Site (HEP cover types shown)

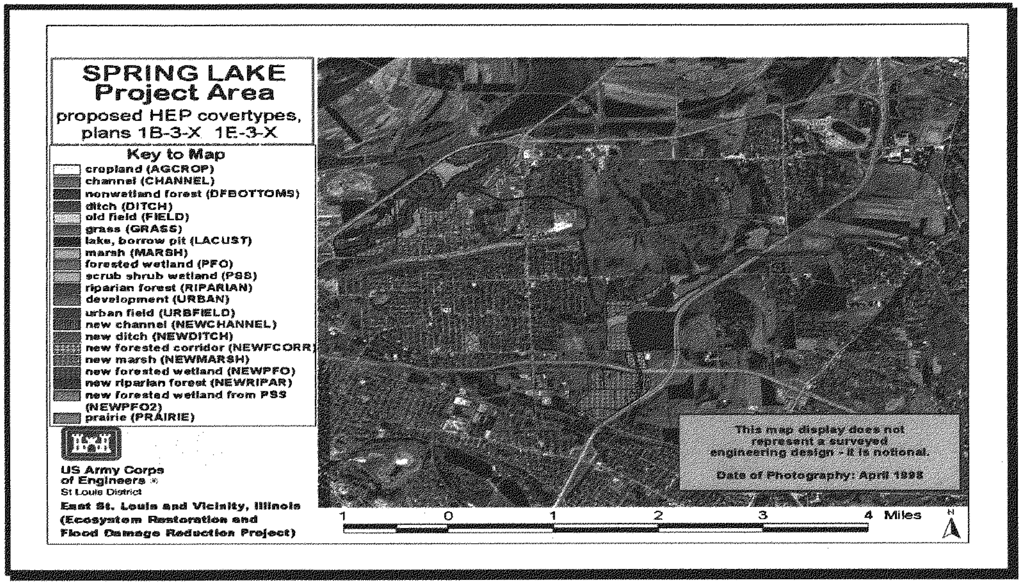

Figure 50. Proposed alternatives for the 1B-3-X and 1E-3-X alternatives at the Spring Lake Site (HEP cover types shown)

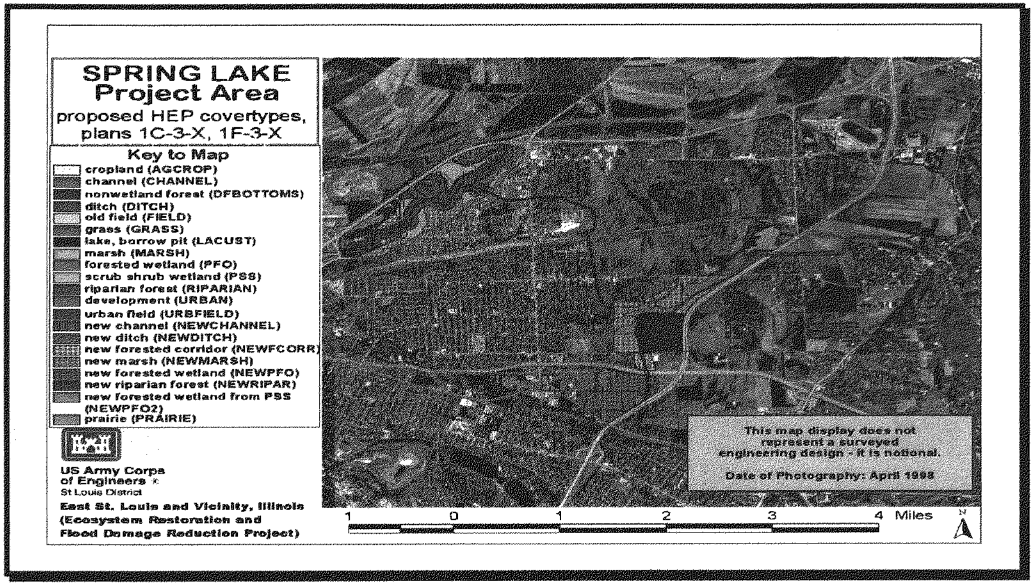

Figure 51. Proposed alternatives for the 1C-3-X and 1F-3-X alternatives at the Spring Lake Site (HEP cover types shown

B. BASELINE CONDITIONS

B.1. Baseline Acres and Cover Types

Currently, the study area encompasses approximately 2,052 acres, predominantly covered in agricultural croplands and forests. Although the District identified 27 distinct cover types across the entire ESL-ER study area, 15 were in evidence at the Spring Lake Site (i.e., deciduous forest in the Uplands, marshes, lakes, channels/rivers, palustrine forests, palustrine scrub-shrub wetlands, urbanized areas in general, agricultural croplands, old fields/haylands/pastures, riparian corridors, grass-sloped sides of ditches, deciduous forest in the Bottoms; urbanized fields/haylands/pasture, man-made ditches, and streams connecting the site to the upper watershed). Of the 15, 12 (i.e., DF, MARSH, LACUST, CHANNEL, PFO, PSS, FIELD, RIPPARIAN, DFBOTTOMS, URBFIELD, DITCH, and STREAMS) were associated with the various HSI models selected, and were therefore used to evaluate baseline conditions. The cover types and their respective baseline acreages can be found in Table 54.

Table 54. Baseline acres and cover types for the Spring Lake Site

No.	Code	Description	Baseline Acres
1	DF	Deciduous Forests	251.00
2	MARSH	Marshes (Herbaceous Emergent Wetlands)	402.77
3	LACUST	Lacustrine	91.28
4	CHANNEL	Channels and Rivers	19.25
5	PFO	Palustrine Forested Wetlands	84.43
6	PSS	Palustrine Scrub-Shrub Wetlands	81.34
7	URBAN	Urban Development, Roads	221.44
8	AGCROP	Agricultural Croplands	186.86
9	FIELD	Old Fields, Haylands and Pastures	12.15
10	PRAIRIE	Prairies (Wet & Dry)	0.00
11	PBUFFER	Prairie Buffer Strips	0.00
12	RIPARIAN	Riparian Corridors	58.00
13	FCORRIDOR	Forested Corridors	0.00
14	UNDREDGED	Undredged Prairies - Exterior	0.00
15	DETENTION	Detention Basins (with Degraded Marsh Inside)	0.00
16	NEWPFO	Newly Planted Forested Wetlands	0.00
17	GRASS	Grass-sloped Sides of Ditches	66.59
18	NEWCHANNEL	Newly Developed Riverine Channels	0.00
19	NEWMARSH	Newly Planted Marshes (HEW)	0.00
20	NEWFCORR	Newly Planted Forested Corridors	0.00
21	DFBOTTOMS	Deciduous Forests in the Bottoms	39.74
22	URBFIELD	Urbanized Old Fields, Haylands and Pastures	92.10
23	NEWRIPAR	Newly Developed Riparian Corridors	0.00
24	NEWPFO2	Newly Planted PFO from PSS	0.00
25	DITCH	Man-made Ditches, Channels	7.75
26	NEWDITCH	Newly Developed Man-made Ditches and Channels	0.00
27	STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed	437.39
		TOTALS:	2052.09

B.2. Baseline Variable Values for Each Cover Type

Field data was collected in the spring of 1999 through the summer of 2003 to determine existing conditions for this site. Data for each variable per cover type was recorded and the variable means/modes were calculated to generate baseline HSIs per model (Figure 50). For detailed information regarding the field data collected by the Biological Team, refer to the tables in the attached electronic files (HEP Field Data.xls, St. Louis Baseline Acres.xls, St. Louis Baseline Means.xls, Watershed Statistics.xls).

Table 55. Baseline variable values for the Spring Lake Site HEP assessment[20]

Variable Codes	DF	MARSH	LACUST	CHANNEL	DITCH	PFO	PSS	FIELD	DFBOTTOMS	RIPARIAN	URBFIELD	STREAMS
AMTINSTRM					85.00							
AMTSILT					2.00							
AVGHTHERB								10.00			10.00	
BROODCOVER		39.53		20.00	5.00	33.19	15.47			12.00		
CHANNELIZE					1.00							
DEPTHPOOLS					0.57							
DEPTHRIFFL					4.00							
DISTURB100		0.97	1.00	1.00	0.05	1.00	1.00		1.00	1.00		
DISTURB250						0.51			0.74	1.00		
EMBEDED					2.00							
EMERGCAN	0.00	35.73				9.57	26.79		2.24	5.33		
EROSNPOTNT					2.00							
EROSNBANK					2.00							
FISHCOVER												
GRADIENT					8.00							
GRAIN	632.97								736.89			
GRASS								10.00			25.00	
GROWTHFORM		1.00					3.00					
HDTREECAN	15.85								4.47			
HERBCAN								15.00			40.00	
HERONRY						35.14			43.17	42.00		
HUMAN	230.45	97.31	167.65	250.00	5.00	127.73	169.90		184.22	250.00		
HUMANTYPE	1.00	0.50	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	0.50	
MAXSALIN												
MAXTURBID				50.00	50.00							
MINDISOXY				4.00	4.00							
MORPHPOOLS					1.00							
NESTBOX	0.00	0.00		0.00	0.00	0.00	0.00		0.00	0.00		
NESTDIST		43.79	6.81	6.93	8.00	7.40	7.25		8.44	8.00		
NUMSUBSTR					2.00							
ORIGINSUB					2.00							
PERCHDIST								99.28			10.00	
PHRANGE				7.23	7.23							
POOLDEPTH												
REGIME	5.00	3.00	1.00	2.00	2.00	4.00	3.00		7.00	7.00		
RIFFLEPOOL					3.00							

[20] Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

Table 55. (cont.) Baseline variable values for the Spring Lake Site HEP assessment[21]

Variable Codes	DF	MARSH	LACUST	CHANNEL	DITCH	PFO	PSS	FIELD	DFBOTTOMS	RIPARIAN	URBFIELD	STREAMS
SHORECOV			41.93	65.00	14.00							
SINUOSITY					2.00							
SHRUBCAN	10.00					15.51	7.53	0.00	20.53	17.50	15.00	
SUBMERGCAN		19.76	17.34	15.00	5.00	11.26	26.79			6.27		
SUBSTRATE					3.00							
SUBSTRFINE					3.00							
SUITABLTMP				18.87	18.87							
TEMPEPILIM												
TEMPLITTRL				18.87	18.87							
TEMPSPAWN				18.87	18.87							
TREECAN	90.00					79.60	13.50		61.05	70.00		
TREECAV	1.37	0.05		0.20	0.00	0.91	0.83		0.45	1.60		
TREEDBH	44.20											
TRSHRCAN	100.00	4.39	26.83	70.00	2.00	95.11	21.03		81.58	87.50		
TYPEADJRIP					3.00							
TYPESTRM					6.00							
TYPESUBSTR					11.00							
VELOCITY		0.06	0.00	0.00	5.00	0.00	0.00					
VELOCITY - QHEI					4.00							
WATERDEEP		19.69	44.22	46.00	20.00	21.23	15.12			3.00		
WATERPREY		0.65	0.40	0.75	0.50		0.45					
WATERTEMP		3.00	2.00	2.00	2.00	2.00	2.00			2.00		
WIDTHRIPAR					29.00							
YRSURFWAT	15.00	75.00	100.00	90.00	90.00	40.00	75.00		5.00	5.00		
POTENESTS	0.12	0.00		0.02	0.00	0.08	0.07		0.04	0.14		
HUMANSQ	1.00											
HUMANTYPE												
HUMANWD	1.00	1.00		1.00	0.10	1.00	1.00		1.00	1.00		
HUMANTYPE												
HUMANST		0.97	1.00	1.00	0.05	1.00	1.00		1.00	1.00		
HUMANTYPE												
HUMANMW		1.00					1.00					
HUMANMK	1.00	1.00	1.00	1.00	0.20	1.00	1.00		1.00	1.00		
HUMANEM								1.00			0.67	

[21] Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

B.3. Baseline Evaluation

Of the 10 HSI models used to evaluate ecosystem restoration benefits for alternatives in the ESL-ER study, nine [e.g., black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, wood duck, and Qualitative Habitat Evaluation Index (QHEI)] were used to assess the site for existing conditions and proposed future alternatives. Moderately to moderately high baseline conditions existed for the black crappie (HSI = 0.56), fox squirrel (0.54), great blue heron (HSI = 0.59) marsh wren (HSI = 0.70), and mink (HSI = 0.62) and QHEI (HSI = 0.64). Eastern meadowlark and wood duck showed low HSIs at the onset of the study (HSIs = 0.06 and 0.06, respectively) (Figure 52).

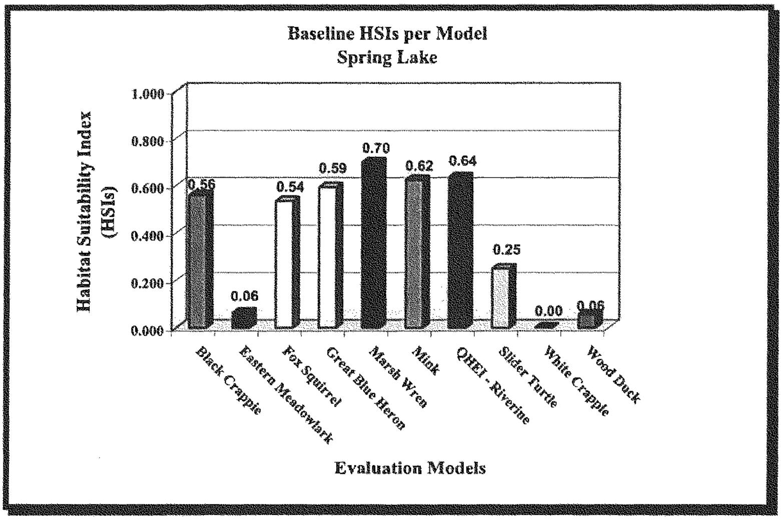

Figure 52. Baseline HSIs for the Spring Lake Site

Based on these index scores and the existing cover type acreages, Habitat Units (HUs) were generated by multiplication. Low HU values were the result of the moderate and low HSI values. Baseline HUs for Spring Lake can be found in Figure 53.

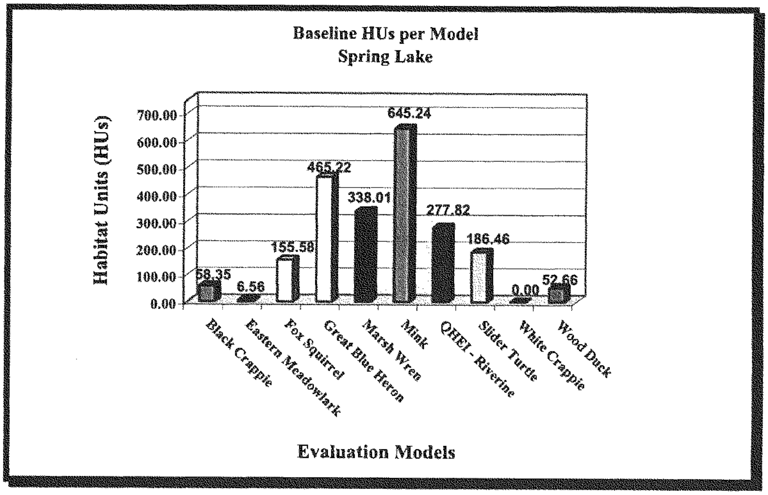

Figure 53. Baseline HUs for the Spring Lake Site

C. PROJECT ALTERNATIVES

C.1. Without Project Conditions

Based on the general Without Project trends described earlier in Chapter II, the ESL-ER Biological Team developed a series of incremental habitat quality and quantity projections to describe future conditions at the site given its location within the Cahokia watershed boundaries. The single dominating factor of these projections was the anticipated increase in urban encroachment in the watershed over the next 50 years. For example, more than 75 percent of the Uplands deciduous forest in the Cahokia watershed, 80 percent of the Uplands deciduous forest in the Harding watershed and 25 percent of the wetlands (marshes, shrublands, forests, lakes and streams) in the Bottoms are expected to be lost to urbanization. Not only did the Team forecast these impacts in terms of acreage losses, but they also attempted to capture the impacts in terms of degrading water quality and vegetative composition/structure scores. Thus, turbidity is expected to increase and dissolved oxygen levels are expected to decrease. Shoreline and submerged cover will decline as pools are filled with sediment. Water depths will decrease and available prey populations will decline as a direct result. In addition, the Team assumed that the human interference factors (distance to nearest human activities and the type of human activities occurring nearby) would significantly degrade future habitat conditions. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Spring Lake Alternatives.xls).

C.2. With Project Conditions

With the general trends of the Without Project condition (i.e., the No Action Alternative) in mind, the Biological Team developed acreage and variable projections for the 20 alternatives proposed by the District. When possible, the Team offered suggestions to enhance the alternatives given the goals and objectives developed earlier in the process. As a general rule, the Biological Team assumed that available agricultural croplands would be converted to productive wetland settings, and the existing Uplands deciduous forests and floodplain wetlands would be protected from urban development. Alternatives that incorporated the deployment of detention ponds in the Uplands were assumed to have higher habitat quality than those alternatives that opted for floodplain sediment retention. Regardless of the manner in which it was achieved, the Team assumed the reduction in sediment would result in the overall improvement of both water quality (i.e., reduced turbidity and increased dissolved oxygen levels) and vegetative growth and health (i.e., increased submerged and shoreline coverage. Several significant design measures, namely the creation of a 75 to120-acre lake, the restoration of 150-200 acres, of prairie, and the creation of 200-300 acres of marsh, will greatly enhance the overall value of the habitat for all evaluation species. The Biological Team attempted to capture the vegetative succession of these areas in increments over time (low quality early in the life of the project, and higher quality by TY30). By restoring existing wetlands, developing new wetlands and protecting these areas in perpetuity, the Biological Team assumed the habitat would be buffered from human disturbance factors, thereby improving the overall value of the wetlands in the urban setting. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Spring Lake Alternatives.xls).

D. EVALUATION OF ALTERNATIVES

D.1. Overall Review of the HEP Results

The overall gains and losses per alternative are summarized in Table 56.

Table 56. Net AAHUs for each HSI model per alternative for the Spring Lake Site

				Net AAHUs									
Alternative Description		Alternative Code	Sum of Net AAHUs	Black Crappie	Eastern Meadowlark	Fox Squirrel	Great Blue Heron	Marsh Wren	Mink	OHEI - Riverine	Slider Turtle	White Crappie	Wood Duck
Uplands Detention	A: Cell 1-Extensive Excavation, St. Clair-PRAIRIE	1A-3-X	**2284.21**	44.87	124.70	74.90	432.13	157.48	331.56	104.39	230.19	NA	783.98
	B: Cell 1-Minimal Excavation, St. Clair-MARSH	1B-3-X	**2803.01**	44.87	**-0.73**	74.90	565.65	277.94	490.54	104.39	339.81	NA	905.63
	C: Cell 1-Extensive Excavation, St. Clair-NEWFOREST	1C-3-X	**2451.61**	44.87	**-0.73**	74.90	549.59	157.48	403.84	104.39	285.02	NA	832.24
No Uplands Detention	D: Cell 1-Extensive Excavation, St. Clair-PRAIRIE	1D-3-X	**1992.88**	45.71	97.77	37.41	399.79	147.91	208.55	0.00	220.66	NA	835.07
	E: Cell 1-Minimal Excavation, St. Clair-MARSH	1E-3-X	**2496.37**	45.71	**-0.73**	37.42	496.59	262.10	367.56	0.00	300.63	NA	987.09
	F: Cell 1-Extensive Excavation, St. Clair-NEWFOREST	1F-3-X	**2174.53**	45.71	**-0.73**	37.42	520.84	147.91	280.86	0.00	273.19	NA	869.32

All Alternatives: Indian Lake: Re-establish Old Cahokia Reach, Send
Forested Corridor Options:
-X = 100m forested corridor strips (HSI weight = 1.0)
Channel Options:
-3 Ditch Option: Straight channel/grass-lined sides/dirt bottoms

Overall, the results show that the 1B-3-X alternative (the Uplands detention alternative that restores Cell 1 and St. Clair Farms to marsh with minimal excavation, while creating a 100-m forested corridor along the straight grass-lined, dirt-bottomed channel) produced the highest net AAHUs across the suite of species (~2,803 AAHUs). The least productive alternative was 1D-3-X (the Floodplain detention alternative that restores Cell 1 to marshes and forests with extensive excavation, while converting St. Clair Farms to a prairie, and creating a 100-m forested corridor along the straight grass-lined, dirt-bottomed channel) generating ~ 1,993 AAHUs across the species evaluated. All alternatives that deployed the straight, grass-lined, dirt-bottomed channels, but opted for floodplain detention and/or the conversion of St. Clair Farms to non-prairie conditions (i.e., 1B-3-X, 1C-3-X, 1E-3-X and 1F-3-X), resulted in the loss of AAHUs for the eastern meadowlark.

Overall, the District can expect to see the creation of approximately 638 acres of new habitat (predominantly newly planted palustrine forest, marshes, lakes and prairies) and the preservation and restoration of approximately 1,238 acres of existing habitat under the proposed scenarios. Based on the assessment, the black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, wood duck and riverine communities (based on QHEI results) achieved optimum or near-optimum conditions under the majority of proposed design scenarios (HSIs $\geq$ 0.6 were realized by TY51). The wood duck's outputs were the highest among models evaluated for the majority of the alternatives, representing approximately 35 percent (on average) of the total net gains. The second highest outputs were attained in the great blue heron's returns, whose AAHUs contributed an additional 20 percent (on average) to the total net gains at the site. Low HSI scores (< 0.5) in the evaluation of the slider turtle, under all alternatives the fox squirrel under 3 of the 6 alternatives, and the eastern meadowlark (in 4 out of 6 alternatives) can be directly attributed to less than optimal design of pond ecosystems, the impact of construction in the Upland forests of the study area, and the lack of the prairie restoration/creation concepts under the specific alternation designs. For detailed information regarding these results, refer to the tables in the attached electronic files (Spring Lake Overall Results.xls, Spring Lake Baseline HSIs Summarized.xls, Spring Lake Baseline HUs Summarized.xls).

D.2. Top Three Biological Winners Using HEP

The top three biologically productive solutions among the alternatives were:

#1 **1B-3-X** - The Uplands detention alternative that restores Cell 1 and St. Clair Farms to marsh with minimal excavation, while creating a 100-m forested corridor along the straight, grass-lined, dirt-bottomed channel produced 2,803.01 net AAHUs; and

#2 **1E-3-X** - The Floodplain detention alternative that restores Cell 1 to marshes and forests with minimal excavation, while converting St. Clair

Farms to a marsh, and creating a 100-m forested corridor along the straight, grass-lined, dirt-bottomed channel produced 2,496.37 net AAHUs.

#3 **1C-3-X** –The Uplands detention alternative that restores St. Clair Farms to forest with extensive excavation, while creating a 100-m forested corridor along the grass-lined, dirt-bottomed, channel produced 2,451.61 net AAHUs.

D.3. Individual HEP Model Results

Creating habitats under these winning scenarios, even though the quality of these areas was less than optimal for the species (i.e., HSIs > 0, but ≤ 1.0 by TY51), nevertheless resulted in favorable wetland returns for the proposed winning alternatives when evaluated as a whole. On a model-by-model basis, the following summations could be made:

Black Crappie: Near optimum conditions were achieved under the top three "winning" alternatives (i.e., 1B-3-X, 1E-3-X and 1C-3-X) (**TY51 HSIs ≅ 0.84**), resulting in net gains of **44.87, 45.71 and 44.87 AAHUs**, respectively.

Eastern Meadowlark: The loss of habitat coverage in the top three "winning" alternatives (i.e., 1B-3-X, 1E-3-X and 1C-3-X), completely degraded the HSI values for the species (**TY51 HSI = 0.0**), resulting in a net loss of AAHUs (**-0.73 AAHUs**).

Fox Squirrel: Although optimum conditions (HSI = 1.0) were not achieved under the first and third "winning" alternatives (i.e., 1B-3-X and 1C-3-X), the species still achieved high TY51 HSIs (**0.63**), resulting in minimal net gains of **74.90 AAHUs**. The #2 "winner" (i.e., 1E-3-X) resulted in lower returns for the species (**TY51 HSI ≅ 0.40, net AAHU gains = 37.42**).

Great Blue Heron: Near optimum conditions were achieved under the top three "winning" alternatives (i.e., 1B-3-X, 1E-3-X and 1C-3-X) (**TY51 HSIs ≅ 0.73, 0.68 and 0.63** respectively), resulting in net gains of **565.65** and **496.59 and 549.59 AAHUs**, respectively.

Marsh Wren: Near optimum conditions were achieved under the top three "winning" alternatives (i.e., 1B-3-X, 1E-3-X and 1C-3-X) (**TY51 HSIs ≅ 0.93**), resulting in net gains of **277.94, 262.10** and **157.48 AAHUs**, respectively.

Mink: Although optimum conditions (HSI = 1.0) were not achieved under the top three "winning" alternatives (i.e., 1B-3-X, 1E-3-X and 1C-3-X), the species still achieved moderate TY51 HSIs (**0.74** and **0.66** and **0.69** respectively), resulting in significant net gains of **490.54**, and **367.56** and **403.84 AAHUs**, respectively.

QHEI - Riverine Community: Near optimum conditions were achieved under the first and third "winning" alternatives (i.e., 1B-3-X and 1C-3-X) (**TY51 HSIs = 0.85**), resulting in net gains of **104.39 AAHUs** under either alternative. Under the second alternative (i.e., 1E-3-X), no change from the Without Project Condition resulted in moderate HSI values (**TY51 HSIs = 0.55**), and no net gain in AAHUs (**0.00 AAHUs**).

Slider Turtle: Although sub-optimum conditions (HSI < 0.50) were experienced under the top three "winning" alternatives (i.e., 1B-3-X, 1E-3-X and 1C-3-X), the alternatives still managed to generate significant returns for this species by TY51 (**TY51 HSI ≅ 0.38-0.42**), resulting in net gains of **339.81, 300.63** and **285.02 AAHUs**, respectively.

White Crappie: This species was not applicable to this site.

Wood Duck: Near optimum conditions were achieved under the top three "winning" alternatives (i.e., 1B-3-X, 1E-3-X and 1C-3-X) (**TY51 HSIs ≅ 0.72-0.87**), resulting in significant net gains of **905.63, 987.09 and 832.24 AAHUs**, respectively.

The specific details of the EXHEP runs are reported in the attached electronic files (Attained Goals.xls). Each alternative is identified, the gains or losses in terms of acres and HSIs are recorded, and both cumulative and net AAHUs are documented. The variations among model outputs are illustrated in Figure 54.

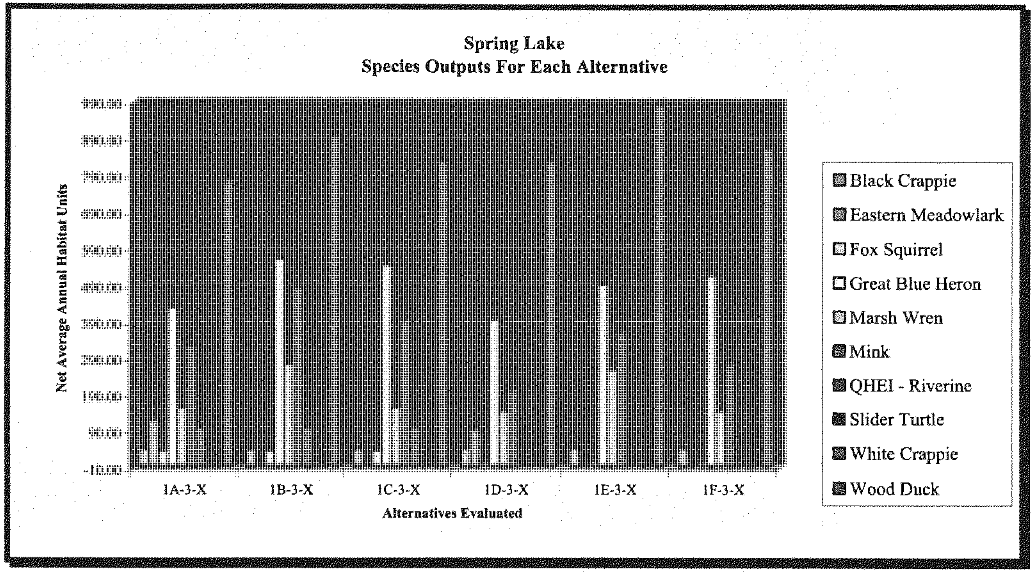

Figure 54. HSI Model outputs per alternative for the Spring Lake Site

E. COST ANALYSIS

As described earlier in this report, two techniques were used to determine the winning solution in the cost evaluation process. First, the results of the habitat assessment were compared using Cost Effectiveness Analyses (CEA). When alternatives are compared using CEA, those alternatives that produce increased levels of output (AAHUs or AAFCUs) for the same or lesser costs were considered "effective" solutions and were retained. These alternatives were, in turn, compared on the basis of cost efficiency [i.e., those alternatives that produce similar levels of output (AAHUs or AAFCUs) at a lesser expense]. The "efficient" solutions were submitted to Incremental Cost Analyses (ICA) (i.e., determining changes in costs for increasing levels of outputs). Once evaluated on the basis of incremental effectiveness, the "winning" solutions were revealed (those that are both cost effective and incrementally effective). The annualized costs and outputs, as well as the results of the CEA and ICA evaluations for the Spring Lake Site, are presented.

E.1. Project Costs

In Table 57, the total costs, annualized costs and annualized biological returns (i.e., AAHUs) are recorded for each alternative. The most expensive proposal, 1A-3-X, will cost more than $74.7M to implement. The least expensive proposal, 1F-3-X, will cost more than $47.2M to undertake.

Table 57. Total project costs and annualized costs per alternative for the Spring Lake Site

	Alternative Description	Alternative Code	Total Alternative Costs	Total Annualized Costs	Net AAHUs	Cost Per AAHU	AAHU Per $1000.00
Uplands Detention	A: Cell 1-Extensive Excavation, St. Clair-PRAIRIE	1A-3-X	$74.65M	$4,985,891.00	2284.21	$2,182.76	0.4581
	B: Cell 1-Minimal Excavation, St. Clair-MARSH	1B-3-X	$74.49M	$4,975,075.00	2803.01	$1,774.91	0.5634
	C: Cell 1-Extensive Excavation, St. Clair-NEWFOREST	1C-3-X	$74.44M	$4,971,933.00	2451.61	$2,028.03	0.4931
	D: Cell 1-Extensive Excavation, St. Clair-PRAIRIE	1D-3-X	$47.43M	$3,167,487.00	1992.88	$1,589.40	0.6292
	E: Cell 1-Minimal Excavation, St. Clair-MARSH	1E-3-X	$47.26M	$3,156,737.00	2496.37	$1,264.53	0.7908
	F: Cell 1-Extensive Excavation, St. Clair-NEWFOREST	1F-3-X	$47.22M	$3,153,528.00	2174.53	$1,450.21	0.6896

All Alternatives: Indian Lake: Re-establish Old Cahokia Reach, Send flood pulse into area, Drain out through Landsdowne Channel to promote tree growth, Expect Golf Course to naturally suceed NEWMARSH/NEWFOREST

Forested Corridor Options:

-X = 100m forested corridor strips (HSI weight = 1.0)

Channel Options:

-3 Ditch Option: Straight channel/grass-lined sides/dirt bottoms

-8 Ditch Option: Straight Channel/grass-lined sides/dirt bottoms/Floodplain between setback levees and channel with PRAIRIE & RIPARIAN

E.2. Top Three Cost Effective Solutions Based on the HEP Results

The CEA results based on the HEP assessment for the Spring Lake alternatives can be found in Table 58. The top three cost effective solutions in the analyses were: **1E-3-X, 1F-3-X** and **1D-3-X**. For the 1E-3-X alternative, the District can expect to generate one AAHU for every $1,264.53 expended annually. For the 1F-3-X alternative, the cost increased to $1,450.21 for each AAHU (an increase of $185.68). And, for the 1D-3-X alternative, an AAHU could be gained at a cost of $1,589.40 – a cost $324.87 above the "winning" solution's cost. For detailed information regarding these cost analyses, refer to the tables in the attached electronic files (Spring Lake HEP CEA.xls).

Table 58. Cost effective solutions for the alternatives on the Spring Lake Site evaluated with HEP

CEA Ranking	ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU
1	1	2	1E-3-X	2496.37	$ 3,156,737.00	$ 1,264.53
2	3	5	1F-3-X	2174.53	$ 3,153,528.00	$ 1,450.21
3	5	6	1D-3-X	1992.88	$ 3,167,487.00	$ 1,589.40
4	2	1	1B-3-X	2803.01	$ 4,975,075.00	$ 1,774.91
5	4	3	1C-3-X	2451.61	$ 4,971,933.00	$ 2,028.03
6	6	4	1A-3-X	2284.21	$ 4,985,891.00	$ 2,182.76
	#1 Ranked Alternative					
	#2 Ranked Alternative					
	#3 Ranked Alternative					

E.3. Top Three Incrementally Effective Solutions Based on the HEP Results

The results of the ICA are displayed in. At this site, the top three, incrementally effective solutions evaluated included:

#1 **1E-3-X** – The Floodplain detention alternative that restores Cell 1 to marshes and forests with minimal excavation, while converting St. Clair Farms to a marsh, and creating a 100-m forested corridor along the straight, grass-lined, dirt-bottomed channel produced 2,496.37 net AAHUs at a cost of $1,264.53 per AAHU;

#2 **1B-3-X** – The Uplands detention alternative that restores Cell 1 and St.

Clair Farms to marsh with minimal excavation, while creating a 100-m forested corridor along the straight, grass-lined, dirt-bottomed channel produced 2,803.31net AAHUs at a cost of $1,774.91 per AAHU; and

#3 **1F-3-X** – The Floodplain detention alternative that restores Cell 1 to marshes and forests using extensive excavation, while converting St. Clair Farms to a forest, and creating a 100-m forested corridor along the straight grass-lined, dirt-bottomed channel produced 2,174.53 net AAHUs at a cost of $1,450.21 per AAHU.

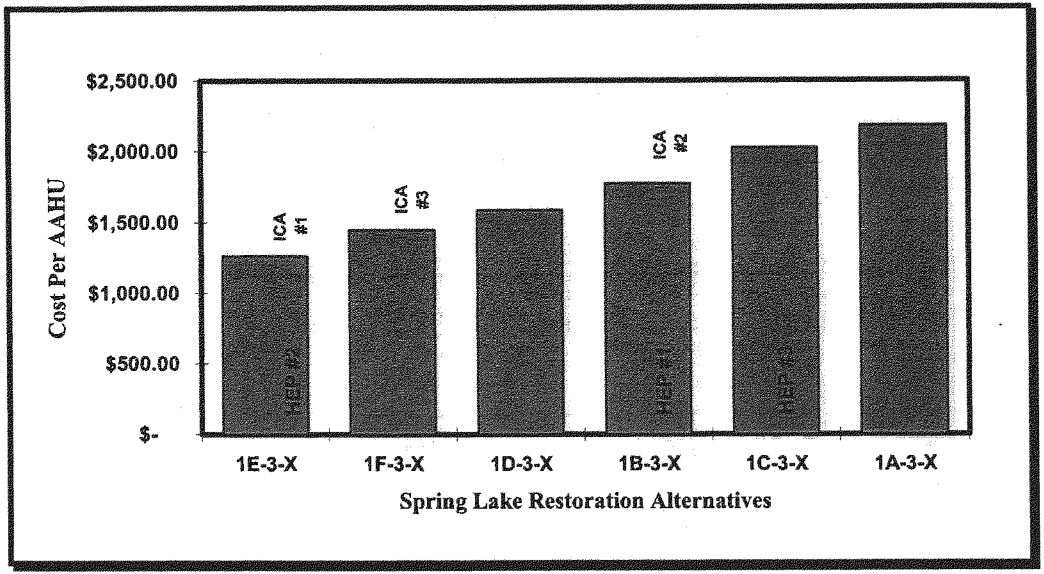

Figure 55. ICA results based on the HEP assessment of the alternatives for the Spring Lake Site

In essence, only the top two alternatives [i.e., 1E-3-X and 1B-3-X] were found to be "Best Buy" plans – that is they were the most biologically productive, incrementally effective plans (Figure 56 and Table 59).

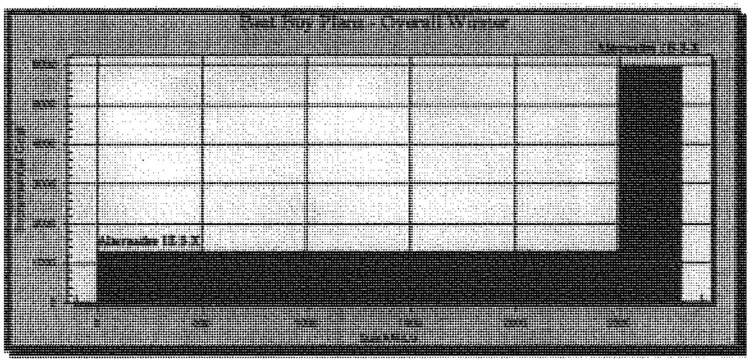

Figure 56. "Best Buy" options from the ICA analysis of the HEP results at the Spring Lake Site

Table 59. Incremental outputs for the "Best Buy" options resulting from the ICA analysis of the HEP results at the Spring Lake Site

Alternative	Incremental Output	Incremental Output/Unit Output
No Action	0.00	$0.00
1E-3-X	2496.37	$1,264.53
1B-8-X	306.64	$5,929.87

VII. WEDGEWOOD

A. PROJECT DESCRIPTION

A.1. Location

The project area is located in St. Clair County, Illinois, in the Harding watershed. The floodplain component is in East St. Louis, lies south of Interstate 64 and Metrolink, (immediately west of Harding Ditch), and straddles Interstate 255 and Summit Avenue. The area of the floodplain component is located in the southern portion of historic Cold Prairie and interfaces with adjacent forests. The watershed of Schoenberger Creek comprises the Uplands component of the site (Figure 57).

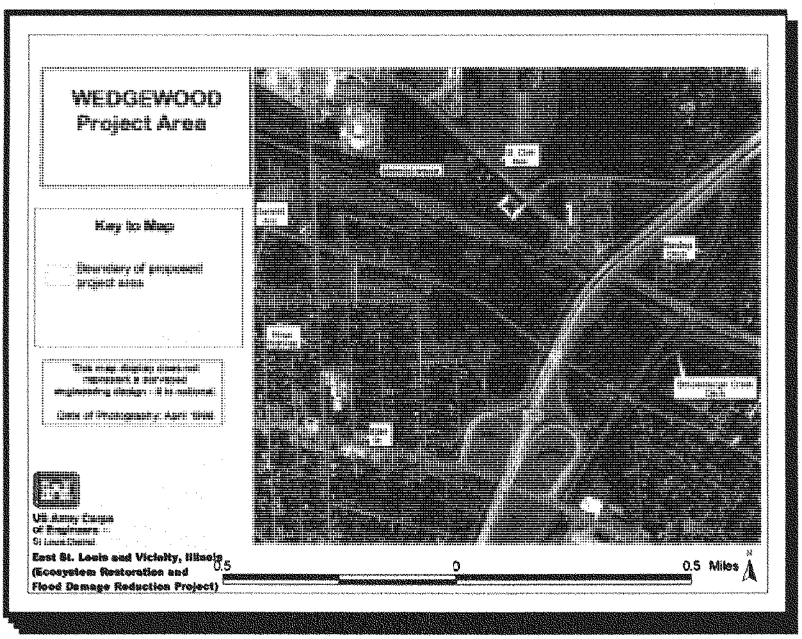

Figure 57. Wedgewood site map

A.2. Purpose

The proposed alternatives for this site were developed to address three restoration goals: (1) the creation of an area on the floodplain to support natural plant and animal communities and a flood regime similar to presettlement (ca. 1800) conditions;(2) the minimization of upland erosion and management of sedimentation in the Schoenberger Creek watershed; and (3) the reduction of flood damages within the Harding watershed.

A.3. Measures Under Consideration

In order to address these goals, the District generated two lists of design measures that, when combined in series, served as unique alternatives for the assessment. The first list of features was considered essential to meet these goals and, therefore, formed the basis for each design. These commonly shared features included:

1) The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Schoenberger Creek.

2) The modification of the existing levee, along the west side of Harding Ditch, to ensure delivery of stormwater events from Schoenberger Creek into the new habitat area.

3) The enclosure of Summit Avenue in the new habitat area, extending from Kings Highway on the west, to Harding Ditch on the east, to form a contiguous habitat area.

In addition to these commonly shared features, the alternatives deployed various combinations of features from the following two options:

(1) Uplands versus Bottomlands sediment detention, sediment originating in the Uplands, and ultimately moving into the floodplain, would be detained either in the Uplands (by constructing 24 new tributary stream sediment detention basins in the Schoenberger Creek watershed), or in the Bottoms (in the existing Schoenberger Creek leading to Harding Ditch and in a sediment detention basin within the new habitat area itself).

(2) Vegetative cover across the habitat area. A variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site, supported by excavation activities.

(3) A number of pool and riffle complexes will be deployed at this site (number to be determined during the design phase of the study)[22].

A.4. Alternatives Under Evaluation

Given the above mentioned design measures, the District generated six unique alternatives for this site (Table 60). Two of these alternatives were dropped from consideration due to their excessive costs, design inconsistencies and/or biologically ineffective configurations. These alternatives have been illustrated in Figure 58 through Figure 61.

Table 60. Wedgewood alternative matrix

	Uplands ON (no Detention basin)			Uplands OFF (Dentention basin needed)		
Options	Prairie Only	Marsh Only	Newly Planted Forested Wetlands Only	Prairie with Marsh Detention Basin	Marsh with Marsh Detention Basin	Newly Planted Forested Wetland with Marsh Detention Basin
Small Site (112.9 ac) w/o NEWFCORR	9AB-1-(0)	9B-1-(0)	9C-1-(0)	9D-1-(0)	9E-1-(0)	9F-1-(0)

[shaded] Alternatives dropped from consideration due to low biological productivity, cost ineffectiveness, and/or design inefficiencies.

9E & 9F ruled out because of cost of maintenance and re-vegetation is too high.
All Detention Basins = degraded Marshlands
All outside buffer strips = drier prairies. Where outside = outside the original 112.9 acres project boundary (does not refer to buffers surrounding detention basins).
Prairie buffer filter strips surrounding marshlands are wetter prairies with less depth due to sedimentation trapping. - Only used for 9D-9F Alternatives
With detention basins, basins dredged every 3-5 years, external to basins dredged every 50 years for Uplands off.

[22]A pilot study at Judy's Branch was constructed in 2000, and the District will monitor the site over the next 3 years. The results of the pilot project will assist the District in determining the number of riffle:pool complexes necessary on a site-by-site basis to meet the proposed beneficial productivity assumed herein. Section 9 of the main report discusses this pilot project in greater detail (USACE 2002).

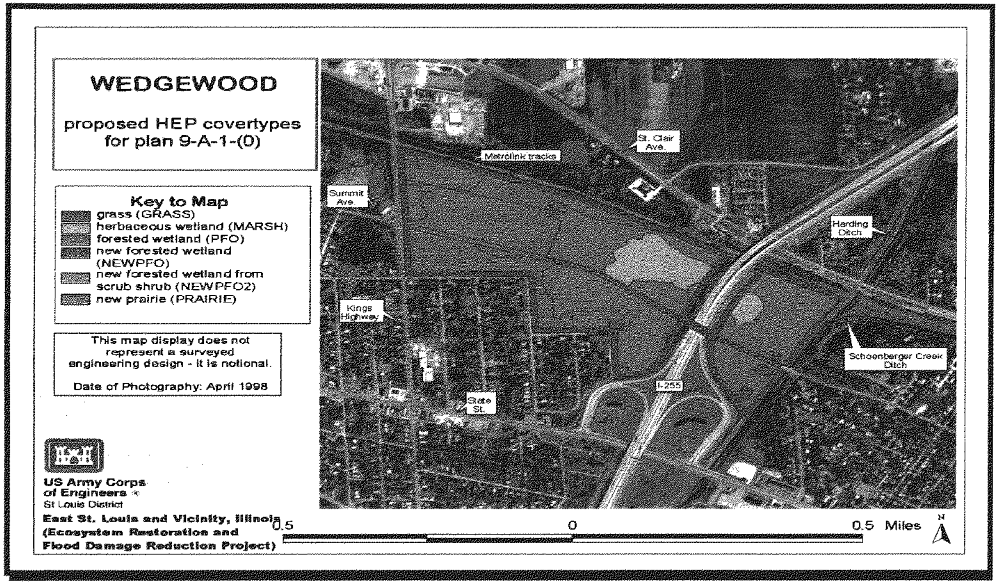

Figure 58. Proposed design for the 9-A-1(0) alternative at the Wedgewood Site (HEP cover types shown)

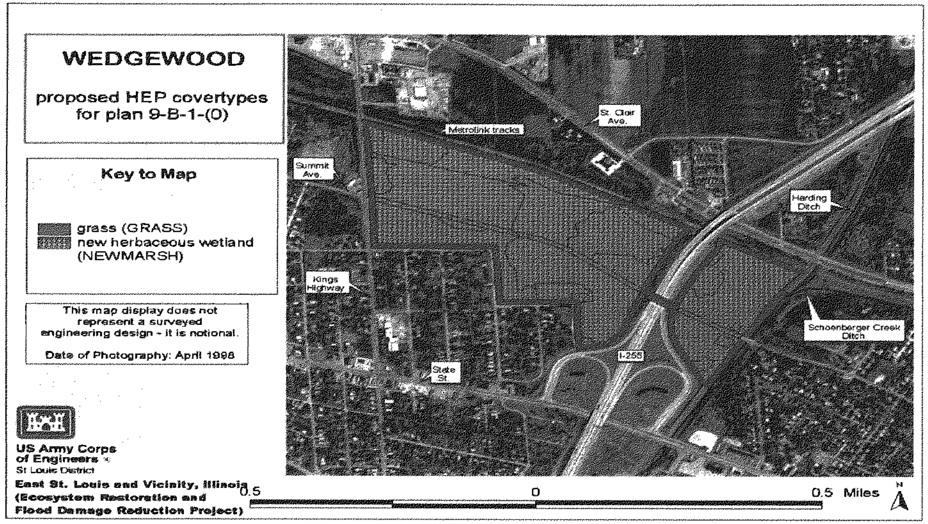

Figure 59. Proposed design for the 9-B-1-(0) alternative at the Wedgewood Site (HEP cover types shown)

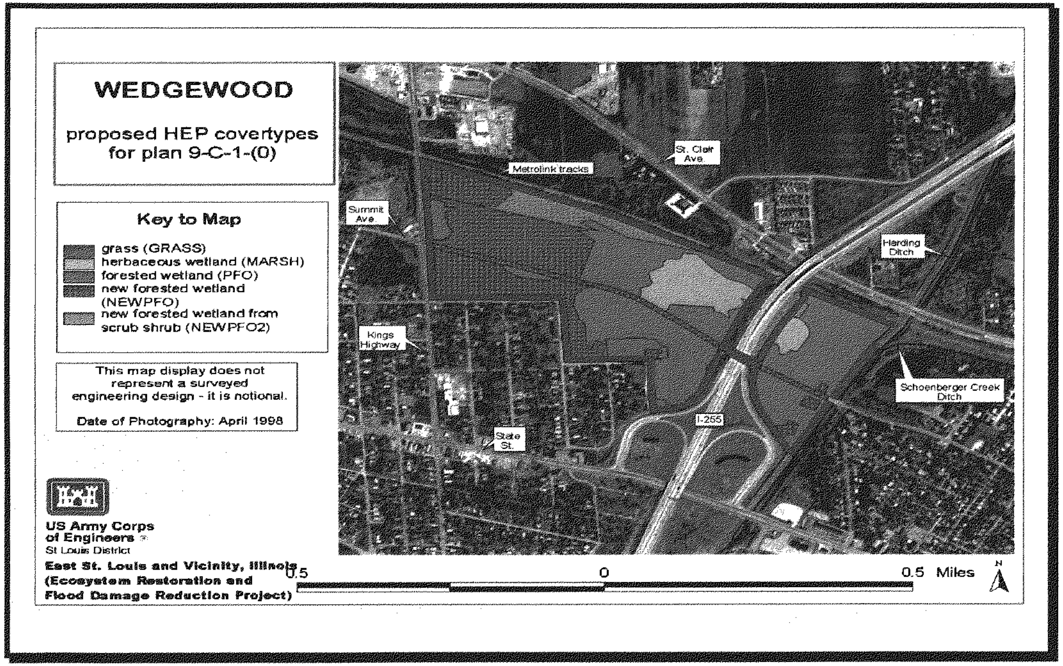

Figure 60. Proposed design for the 9-C-1-(0) alternative at the Wedgewood Site (HEP cover types shown)

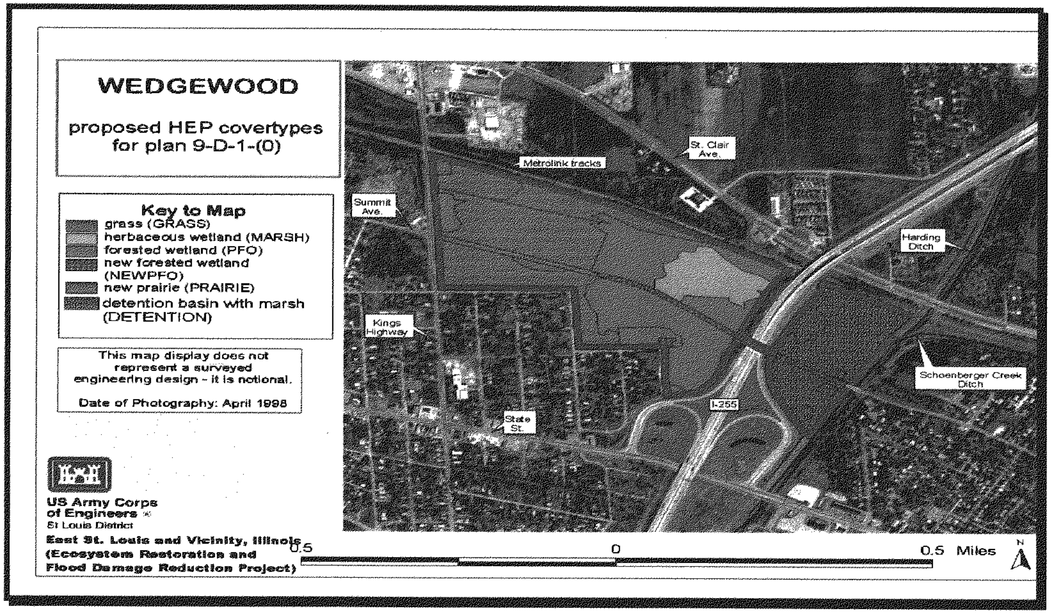

Figure 61. Proposed design for the 9-D-1-(0) alternative at the Wedgewood Site (HEP cover types shown)

B. BASELINE CONDITIONS

B.1. Baseline Acres and Cover Types

Currently, the study area encompasses approximately 330 acres, predominantly covered in forested wetlands and old fields. Although the District identified 27 distinct cover types across the entire ESL-ER study area, only eight were in evidence at the Wedgewood Site (i.e., deciduous forest in the Uplands, marshes, palustrine forested wetlands, palustrine scrub-shrub wetlands, urban areas, grass-sloped sides of ditches, old fields/pastures/haylands, and streams connecting the site to the upper watershed). Of the eight, six (i.e., DF, MARSH, PFO, PSS, URBFIELD, and STREAMS) were associated with the various HSI models selected and were therefore used to evaluate baseline conditions. The cover types and their respective baseline acreages can be found in Table 61.

Table 61. Baseline acres and cover types for the Wedgewood Site

No.	Code	Description	Baseline Acres
1	DF	Deciduous Forests	45.83
2	MARSH	Marshes (Herbaceous Emergent Wetlands)	11.22
3	LACUST	Lacustrine	0.00
4	CHANNEL	Channels and Rivers	0.00
5	PFO	Palustrine Forested Wetlands	58.59
6	PSS	Palustrine Scrub-Shrub Wetlands	10.04
7	URBAN	Urban Development, Roads	5.66
8	AGCROP	Agricultural Croplands	0.00
9	FIELD	Old Fields, Haylands and Pastures	0.00
10	PRAIRIE	Prairies (Wet & Dry)	0.00
11	PBUFFER	Prairie Buffer Strips	0.00
12	RIPARIAN	Riparian Corridors	0.00
13	FCORRIDOR	Forested Corridors	0.00
14	UNDREDGED	Undredged Prairies - Exterior	0.00
15	DETENTION	Detention Basins (with Degraded Marsh Inside)	0.00
16	NEWPFO	Newly Planted Forested Wetlands	0.00
17	GRASS	Grass-sloped Sides of Ditches	2.31
18	NEWCHANNEL	Newly Developed Riverine Channels	0.00
19	NEWMARSH	Newly Planted Marshes (HEW)	0.00
20	NEWFCORR	Newly Planted Forested Corridors	0.00
21	DFBOTTOMS	Deciduous Forests in the Bottoms	0.00
22	URBFIELD	Urbanized Old Fields, Haylands and Pastures	36.41
23	NEWRIPAR	Newly Developed Riparian Corridors	0.00
24	NEWPFO2	Newly Planted PFO from PSS	0.00
25	DITCH	Man-made Ditches, Channels	0.00
26	NEWDITCH	Newly Developed Man-made Ditches and Channels	0.00
27	STREAMS	Existing Streams Connecting the Floodplain Channels and Ditches to the Upper Watershed	160.19
		TOTALS:	330.25

B.2. Baseline Variable Values for Each Cover Type

Field data was collected in the spring of 1999 through the summer of 2003 to determine existing conditions for this site. Data for each variable per cover type was recorded and the variable means/modes were calculated to generate baseline HSIs per model (Table 62). For detailed information regarding the field data collected by the Biological Team, refer to the tables in the attached electronic files (HEP Field Data.xls, St. Louis Baseline Acres.xls, St. Louis Baseline Means.xls, Watershed Statistics.xls).

Table 62. Baseline variable values for the Wedgewood Site HEP assessment[23]

Variable Codes	DF	MARSH	PFO	PSS	URBFIELD	STREAMS
AMTINSTRM					85.00	
AMTSILT					2.00	
AVGHTHERB					10.00	
BROODCOVER		39.53	33.19	15.47		
CHANNELIZE					1.00	
DEPTHPOOLS					0.57	
DEPTHRIFFL					4.00	
DISTURB100		0.97	1.00	1.00		
DISTURB250		0.00	0.51	0.00		
EMBEDED					2.00	
EMERGCAN	0.00	35.73	9.57	26.79		
EROSNPOTNT					2.00	
EROSNBANK					2.00	
FISHCOVER						
GRADIENT					8.00	
GRAIN	632.97	0.00	0.00	0.00		
GRASS					25.00	
GROWTHFORM	0.00	1.00	0.00	3.00		
HDTREECAN	15.85	0.00	0.00	0.00		
HERBCAN					40.00	
HERONRY	0.00	0.00	35.14	0.00		
HUMAN	230.45	97.31	127.73	169.90		
HUMANTYPE	1.00	1.00	1.00	1.00	0.50	
MAXSALIN	0.00	0.00	0.00	0.00		
MAXTURBID	0.00	0.00	0.00	0.00		
MINDISOXY	0.00	0.00	0.00	0.00		
MORPHPOOLS					1.00	
NESTBOX	0.00	0.00	0.00	0.00		
NESTDIST	0.00	43.79	7.40	7.25		
NUMSUBSTR					2.00	
ORIGINSUB					2.00	
PERCHDIST					10.00	
PHRANGE	0.00	0.00	0.00	0.00		
POOLDEPTH						
REGIME	5.00	3.00	4.00	3.00		
RIFFLEPOOL					3.00	

[23] Blank spaces indicate the "non-association" of the cover type and the variable. In other words, these variables are not applicable to these cover types.

Table 62. (cont). Baseline variable values for the Wedgewood Site HEP assessment

Variable Codes	DF	MARSH	PFO	PSS	URBFIELD	STREAMS
SHORECOV	0.00	0.00	0.00	0.00		
SINUOSITY					2.00	
SHRUBCAN	10.00	0.00	15.51	7.53	15.00	
SUBMERGCAN	0.00	19.76	11.26	26.79		
SUBSTRATE					3.00	
SUBSTRFINE					3.00	
SUITABLTMP	0.00	0.00	0.00	0.00		
TEMPEPILIM	0.00	0.00	0.00	0.00		
TEMPLITTRL	0.00	0.00	0.00	0.00		
TEMPSPAWN	0.00	0.00	0.00	0.00		
TREECAN	90.00	0.00	79.60	13.50		
TREECAV	1.37	0.05	0.91	0.83		
TREEDBH	44.20	0.00	0.00	0.00		
TRSHRCAN	100.00	4.39	95.11	21.03		
TYPEADJRIP					3.00	
TYPESTRM					6.00	
TYPESUBSTR					11.00	
VELOCITY		0.06	0.00	0.00		
VELOCITY - QHEI					4.00	
WATERDEEP		19.69	21.23	15.12		
WATERPREY		0.65	0.00	0.45		
WATERTEMP		3.00	2.00	2.00		
WIDTHRIPAR					29.00	
YRSURFWAT	15.00	75.00	40.00	75.00		
POTENESTS	0.12	0.00	0.08	0.07		
HUMANSQ	1.00					
HUMANTYPE	0.10					
HUMANWD	1.00	1.00	1.00	1.00		
HUMANTYPE	0.10					
HUMANST		0.97	1.00	1.00		
HUMANTYPE						
HUMANMK	1.00	1.00	1.00	1.00		
HUMANTYPE	[redacted]	[redacted]	[redacted]		[redacted]	
HUMANMW		1.00				

B.3. Baseline Evaluation

Of the nine HSI models used to evaluate ecosystem restoration benefits for the alternatives in the ESL-ER study, eight [e.g., eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle and wood duck and the Qualitative Habitat Evaluation Index (QHEI)]. were used to assess the site for existing conditions and proposed future alternatives. Moderate conditions were found for the fox squirrel (HSI = 0.57), marsh wren (HSI = 0.66) and QHEI (HSI = 0.64). The remainder of the models scored lower at the onset of the study (HSIs < 0.45) (Figure 62).

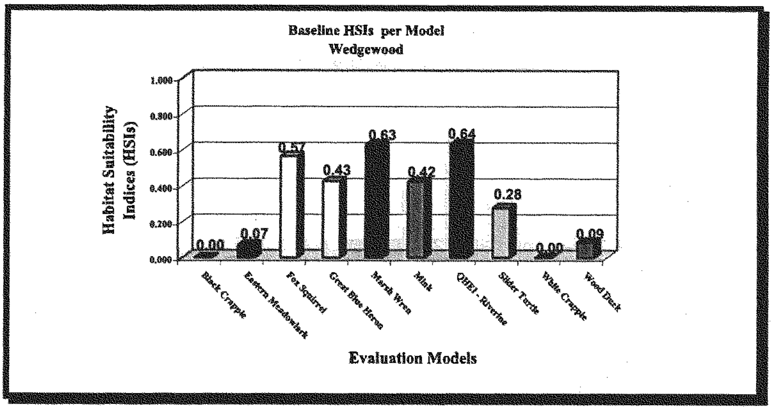

Figure 62. Baseline HSIs for the Wedgewood Site

Based on these index scores and the existing cover type acreages, Habitat Units (HUs) were generated by multiplication. Low HU values were the result of the moderate and low HSI values. Baseline HUs for Wedgewood can be found in Figure 63.

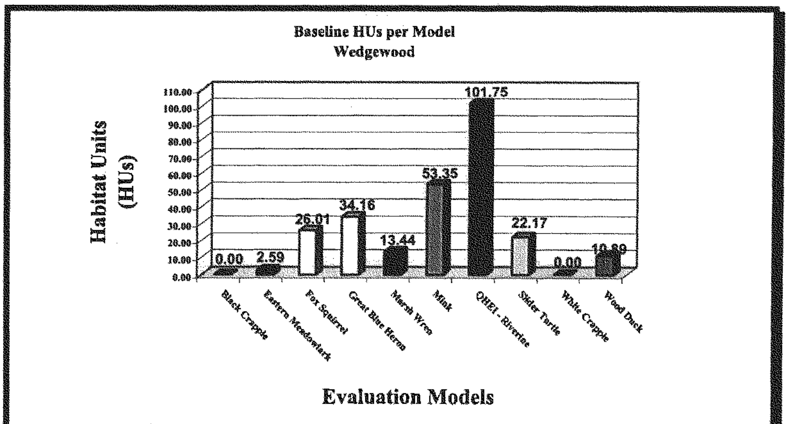

Figure 63. Baseline HUs for the Wedgewood Site

C. PROJECT ALTERNATIVES

C.1. Without Project Conditions

Based on the general Without Project trends described earlier in Chapter II, the ESL-ER Biological Team developed a series of incremental habitat quality and quantity projections to describe future conditions at the site given its location within the Cahokia watershed boundaries. The single dominating factor of these projections was the anticipated increase in urban encroachment in the watershed over the next 50 years. For example, more than 80 percent of the Uplands deciduous forest and 25 percent of the wetlands (marshes, shrublands, forests, lakes and streams) in the Bottoms are expected to be lost to urbanization in Harding watershed alone. Not only did the Team forecast these impacts in terms of acreage losses, but they also attempted to capture the impacts in terms of degrading water quality and vegetative composition/structure scores. Thus, turbidity is expected to increase and dissolved oxygen levels are expected to decrease. Shoreline and submerged cover will decline as pools are filled with sediment. Water depths will decrease and available prey populations will decline as a direct result. In addition, the Team assumed that the human interference factors (distance to nearest human activities and the type of human activities occurring nearby) would significantly degrade future habitat conditions. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Wedgewood Alternatives.xls).

C.2. With Project Condition

With the general trends of the Without Project condition (i.e., the No Action Alternative) in mind, the Biological Team developed acreage and variable projections for the 20 alternatives proposed by the District. When possible, the Team offered suggestions to enhance the alternatives given the goals and objectives developed earlier in the process. As a general rule, the Biological Team assumed that available agricultural croplands would be converted to productive wetland settings, and the existing Uplands deciduous forests and floodplain wetlands would be protected from urban development. Alternatives that incorporated the deployment of detention ponds in the Uplands were assumed to have higher habitat quality than those alternatives that opted for floodplain sediment retention. Regardless of the manner in which it was achieved, the Team assumed the reduction in sediment would result in the overall improvement of both water quality (i.e., reduced turbidity and increased dissolved oxygen levels) and vegetative growth and health (i.e., increased submerged and shoreline coverage). Two significant design measures, the development of approximately 30 acres of prairie and the creation of more than 100 acres of marsh, were projected to greatly enhance the overall value of the site by providing new cover, food and water for the wildlife species of concern. The Biological Team attempted to capture the vegetative succession of these forested areas in increments over time (low quality early in the life of the project, and higher quality by

TY30). By restoring existing wetlands, developing new wetlands and protecting these areas in perpetuity, the Biological Team assumed the habitat would be buffered from human disturbance factors, thereby improving the overall value of the wetlands in the urban setting. For detailed information regarding the Biological Team's acreage and variable projections, refer to the tables in the attached electronic files (Wedgewood Alternatives.xls).

D. EVALUATION OF ALTERNATIVES

D.1. Overall Review of the HEP Results

The overall gains and losses per alternative are summarized in Table 63.

Table 63. Net AAHUs for each HSI model per alternative for the Wedgewood Site

Alternative Description		Alternative Code	Sum of Net AAHUs	Net AAHUs									
				Black Crappie	Eastern Meadowlark	Fox Squirrel	Great Blue Heron	Marsh Wren	Mink	QHEI	Slider Turtle	White Crappie	Wood Duck
Uplands Detention	Prairie Restoration = A Marsh Restoration = B Forested Wetland Restoration = C	9A-1-(0)	126.12	NA	32.12	5.58	6.22	1.34	2.94	38.23	-2.64	NA	42.33
		9B-1-(0)	365.51	NA	-0.29	5.58	57.70	90.60	65.63	38.23	19.28	NA	88.77
		9C-1-(0)	193.14	NA	-0.29	5.58	38.43	1.69	22.23	38.23	10.48	NA	76.78
No Uplands Detention	Prairie Restoration with Marshy Detention Basin = D	9D-1-(0)	68.93	NA	25.16	0.06	12.08	15.77	-4.96	0.00	-2.86	NA	23.69

Overall, the results show that the 9B-1-(0) alternative (the Uplands detention alternative that restores the site to marsh without the 100-m forested corridor) produced the highest net AAHUs across the suite of species (~365.51 AAHUs). The least productive alternative was 9D-1-(0) (the Floodplain detention alternative that restores the area to prairie with a marshy detention basin and no 100-m forested corridor) generating ~68.93 AAHUs across the species evaluated. All alternatives resulted in the loss of AAHUs for one or more species that can be directly attributed to a decline in projected habitat quality, even though habitat acreage is expected to increase. Slider turtle lost 2.64 AAHUs under the 9A-1-(0) alternative. Eastern meadowlark lost 0.29 AAHUs under both the 9B-1-(0) and 9C-1-(0) alternatives. Both the mink and slider turtle lost AAHUs under the 9D-1-(0) alternative (i.e., mink AAHUs = -4.96 and slider turtle AAHUs = -2.86).

Overall, the District can expect to see no net increase in habitat, but approximately 228 acres of existing habitat will be restored and preserved under the proposed scenarios. However, the assessment found the majority of the species achieved optimum or near optimum conditions under the suite of proposed design scenarios (HSIs $\geq$ 0.6 were realized by TY51). The wood duck's outputs were the highest among models evaluated for the majority of the alternatives, representing approximately 35 percent (on average) of the total net gains. The second highest outputs were attained in the eastern meadowlark's returns, whose AAHUs contributed an additional 30 percent (on average) to the total net gains at the site. Low HSI scores (< 0.5) in the evaluation of one wetlands-based species (i.e., slider turtle), the fox squirrel, the eastern meadowlark and the wood duck can be directly attributed to less than optimal design of pond ecosystems and the impact of construction in the Upland forests of the study area and the lack of any prairie restoration/creation features under various alternative designs. For detailed information regarding these results, refer to the tables in the attached electronic files (Wedgewood Overall Results.xls, Wedgewood Baseline HSIs Summarized.xls, Wedgewood Baseline HUs Summarized.xls).

D.2. Top Three Biological Winners Using HEP

The top three biologically productive solutions among the alternatives were:

#1 **9B-1-(0)** - the Uplands detention alternative that restores the site to marsh without the 100-m forested corridor produced 365.51 net AAHUs;

#2 **9C-1-(0)** - the Uplands detention alternative that restores the site to forested wetlands without the 100-m forested corridor produced 193.14 net AAHUs; and

#3 **9A-1-(0)** - the Uplands detention alternative that restores the site to prairie without the 100-m forested corridor produced 126.12 net AAHUs.

D.3. Individual HEP Model Results

Creating habitats under these winning scenarios, even though the quality of these areas was less than optimal for the species (i.e., HSIs > 0, but ≤ 1.0 by TY51), nevertheless resulted in favorable wetland returns for the proposed winning alternatives when evaluated as a whole. On a model-by-model basis, the following summations could be made:

Black Crappie: This species was not applicable to this site.

Eastern Meadowlark: Negative impacts were assessed as a result of undertaking the top two winning solutions [i.e., 9B-1-(0) and 9C-1-(0)] for this species (**TY51 HSIs = 0.00, net AAHUS = -0.29**). However, near optimum conditions were achieved under the third "winning" alternative [i.e., 9A-1-(0)] (**TY51 HSIs ≅ 0.94**), generating significant returns for the species (**AAHUs = 32.12**).

Fox Squirrel: Although optimum conditions (HSI = 1.0) were not achieved under the top three "winning" alternatives [i.e., 9B-1-(0), 9C-1-(0) and 9A-1-(0)], the species still achieved high TY51 HSIs (**0.63**), resulting in minimal net gains of **5.58 AAHUs**.

Great Blue Heron: Near optimum conditions were achieved under the number one "winning" alternative [i.e., 9B-1-(0)] (**TY51 HSI ≅ 0.93**), resulting in a net gain of **57.70 AAHUs**. The remaining options [i.e., 9C-1-(0) and 9A-1-(0)], generated moderate scores (**TY51 HSIs ≅ 0.68** and **0.58**, respectively) and moderate net returns (**AAHUs = 38.43** and **6.22**, respectively).

Marsh Wren: Near optimum conditions were achieved under the top three "winning" alternatives [i.e., 9B-1-(0), 9C-1-(0) and 9A-1-(0)] (**TY51 HSIs ≅ 0.98**). The number one "winning" alternative [9B-1-(0)] generated significant returns (**AAHUs = 90.60**), yet the resulting net gains were less than optimum for the second and third "winning" solutions due to significant habitat losses (**AAHUs = 1.69** and **1.34 AAHUs**, respectively).

Mink: Although optimum conditions (HSI = 1.0) were not achieved under the top three "winning" alternatives [i.e., 9B-1-(0), 9C-1-(0) and 9A-1-(0)], the species still achieved moderate TY51 HSIs (**0.89**, **0.58** and **0.60** respectively), resulting in significant net gains of **65.63**, **22.23** and **2.94 AAHUs**, respectively.

QHEI - Riverine Community: Near optimum conditions were achieved under the "winning" alternatives [i.e., 9B-1-(0), 9C-1-(0) and 9A-1-(0)] (all

TY51 HSIs = 0.85), resulting in a net gain of **38.23 AAHUs** under each alternative.

Slider Turtle: Although sub-optimum conditions (HSI < 0.50) were experienced under the top two "winning" alternatives [i.e., 9B-1-(0) and 9C-1-(0)], they still managed to generate small returns for this species by TY51 (**TY51 HSI ≅ 0.39** and **0.31**, respectively), resulting in net gains of **19.28** and **10.48 AAHUs**, respectively. The third "winner" (9A-1-(0) resulted in a net loss for the species (i.e., **TY51 HSI = 0.29, AAHUs = -2.64**).

White Crappie: This species was not applicable to this site.

Wood Duck: Near optimum conditions were achieved under the top three "winning" alternatives [i.e., 9B-1-(0), 9C-1-(0) and 9A-1-(0)] (**TY51 HSIs ≅ 0.78, 0.76** and **0.63**, respectively), resulting in significant net gains of **88.77, 76.78** and **42.33 AAHUs**, respectively.

The specific details of the EXHEP runs are reported in the attached electronic files (Attained Goals.xls). Each alternative is identified, the gains or losses in terms of acres and HSIs are recorded, and both cumulative and net AAHUs are documented. The variations among model outputs are illustrated in Figure 64.

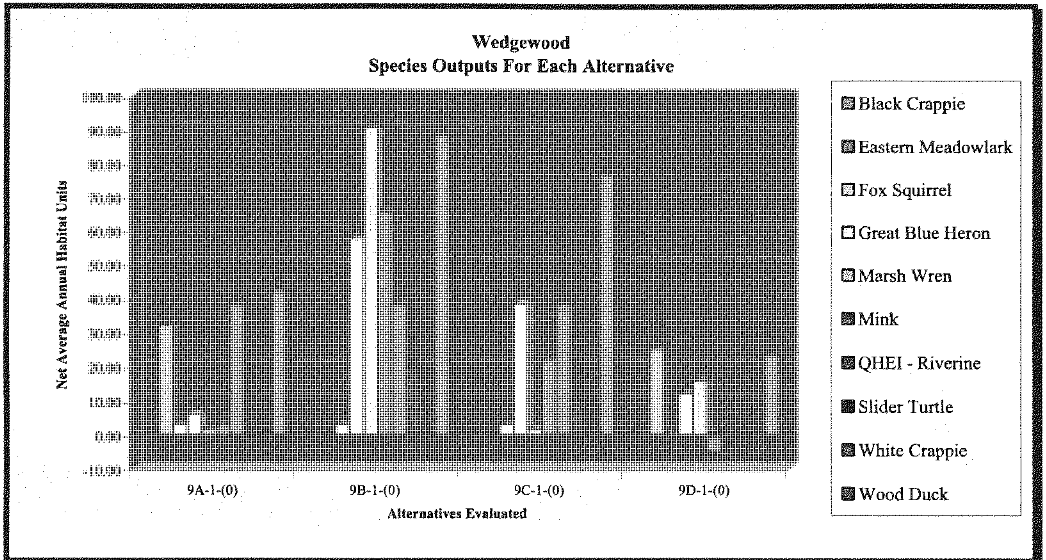

Figure 64. HSI model outputs per alternative for the Wedgewood Site

E. COST ANALYSIS

As described earlier in this report, two techniques were used to determine the winning solution in the cost evaluation process. First, the results of the habitat assessment were compared using Cost Effectiveness Analyses (CEA). When alternatives are compared using CEA, those alternatives that produce increased levels of output (AAHUs or AAFCUs) for the same or lesser costs were considered "effective" solutions and were retained. These alternatives were, in turn, compared on the basis of cost efficiency [i.e., those alternatives that produce similar levels of output (AAHUs or AAFCUs) at a lesser expense]. The "efficient" solutions were submitted to Incremental Cost Analyses (ICA) (i.e., determining changes in costs for increasing levels of outputs). Once evaluated on the basis of incremental effectiveness, the "winning" solutions were revealed (those that are both cost effective and incrementally effective). The annualized costs and outputs, as well as the results of the CEA and ICA evaluations for the Wedgewood Site, are presented.

E.1. Project Costs

In, the total costs, annualized costs and annualized biological returns (i.e., AAHUs) are recorded for each alternative. The most expensive proposal, 9B-1-(0), will cost more than $16.7M to implement. The least expensive proposal, 9D-1-(0), will cost more than $5.8M to undertake.

Table 64. Total project costs and annualized costs per alternative for the Wedgewood Site

Alternative Description		Alternative Code	Total Alternative Costs	Total Annualized Costs	Net AAHUs	Cost Per AAHU	AAHU Per $1000.00
Uplands Detention	Prairie Restoration = A Marsh Restoration = B Forested Wetland Restoration = C	9A-1-(0)	$16.43M	$1,097,100.00	126.12	$8,698.71	0.11
		9B-1-(0)	$16.69M	$1,115,000.00	365.51	$3,050.54	0.33
		9C-1-(0)	$16.38M	$1,093,700.00	193.14	$5,662.59	0.18
No Uplands Detention	Prairie Restoration with Marshy Detention Basin = D	9D-1-(0)	$5.82M	$388,538.00	68.93	$5,637.02	0.18

E.2. Top Three Cost Effective Solutions Based on the HEP Results

The CEA results based on the HEP assessment for the Wedgewood alternatives can be found in Table 65. The top three cost effective solutions in the analyses were: **9B-1-(0)**, **9D-1-(0)** and **9C-1-(0)** respectively. For the 9B-1-(0) alternative, the District can expect to generate one AAHU for every $3,050.54 expended annually. For the 9D-1-(0) alternative, the cost increased to $5,637.02 for each AAHU (an increase of $2,586.47). And, for the 9C-1-(0) alternative, an AAHU could be gained at a cost of $5,662.59 – a cost $2,612.05 above the "winning" solution's cost. For detailed information regarding these cost analyses, refer to the tables in the attached electronic files (Wedgewood HEP CEA.xls).

Table 65. Cost effective solutions for the alternatives on the Wedgewood Site evaluated with HEP

CEA Ranking	ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU
1	1	1	9B-1-(0)	365.51	$1,115,000.00	$3,050.54
2	2	4	9D-1-(0)	68.93	$388,538.00	$5,637.02
3	3	2	9C-1-(0)	193.14	$1,093,700.00	$5,662.59
4	4	3	9A-1-(0)	126.12	$1,097,100.00	$8,698.71

#1 Ranked Alternative
#2 Ranked Alternative
#3 Ranked Alternative

E.3. Top Three Incrementally Effective Solutions Based on the HEP Results

The results of the ICA are displayed in Figure 65. At this site, the top three incrementally effective solutions evaluated included:

#1 **9B-1-(0)** – the Uplands detention alternative that restores the site to marsh without the 100-m forested corridor produced 365.51 net AAHUs at a cost of $3,050.54 per AAHU;

#2 **9D-1-(0)** – the Floodplain detention alternative that restores prairie and deploys a marshy detention basin without the 100-m forested corridor produced 68.93 net AAHUs at a cost of $5,637.02 per AAHU; and

#3 **9C-1-(0)** – the Uplands detention alternative that restores the site to forested wetlands without the 100-m forested corridor produced 193.14 net AAHUs at a cost of $5,662.59 per AAHU.

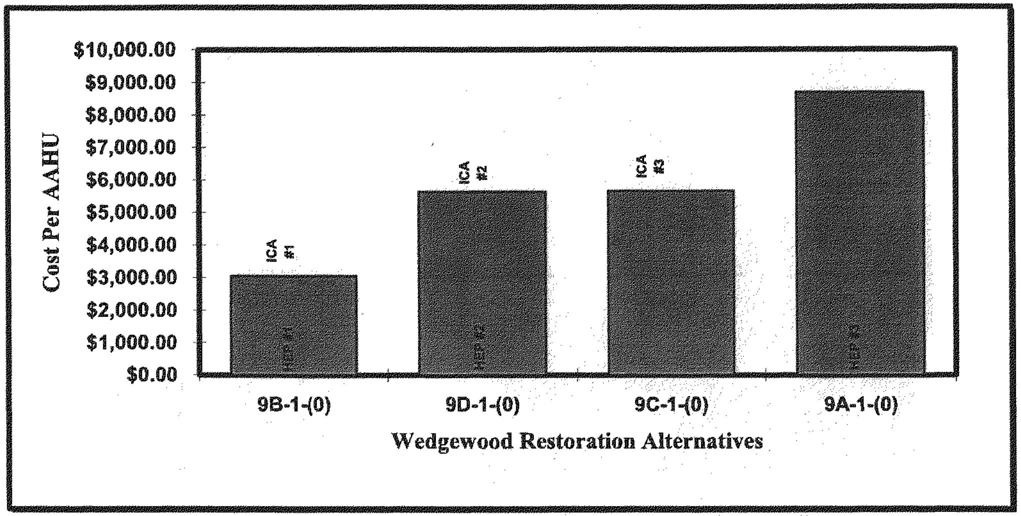

Figure 65. ICA results based on the HEP assessment of the alternatives for the Wedgewood Site

In essence, only one alternative [i.e., 9B-1-(0)] was found to be "Best Buy" plans – that is it was the most biologically productive, incrementally effective plan (Figure 66 and Table 66).

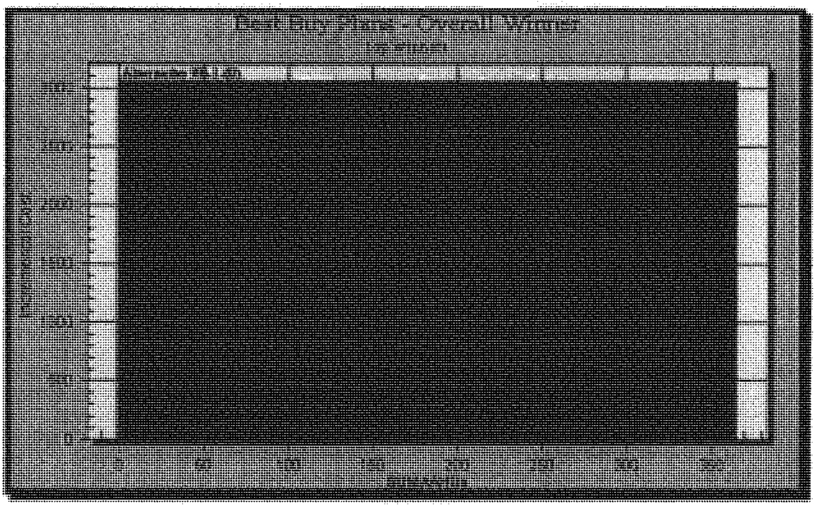

Figure 66. "Best Buy" options from the ICA analysis of the HEP results at the Wedgewood Site

Table 66. Incremental outputs for the "Best Buy" options resulting from the ICA analysis of the HEP results at the Wedgewood Site

Alternative	Incremental Output	Incremental Output/Unit Output
No Action	0.00	$0.00
9B-1-(0)	365.51	$3,050.55

VIII. MULLENS SLOUGH

A. PROJECT DESCRIPTION

A.1. Location

The project area is located in St. Clair County, in the southeast corner of the American Bottoms, near Centreville, Illinois (Powdermill watershed). The floodplain component lies between the Bluffs and Canal No.1/Harding Ditch. The "lake-like" body of water within the site's boundaries is referred to as Mullens Slough. Much of the project area lies in an old meander scar of the Mississippi River in the floodplain. The historic Pittsburg (Big Lake) occupied this area - Mullens Slough now lies within the extinct lake's footprint. It is interesting to note that prairie once extended south and west of this historic backwater lake. The Powdermill and "Bluff 6" watersheds compose the Uplands component of the site (Figure 67).

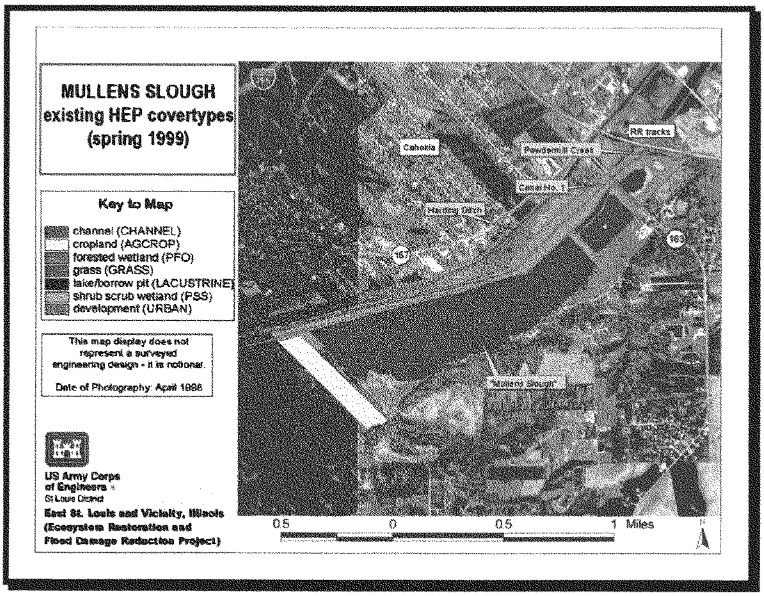

Figure 67. Mullens Slough site map

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

JAN 15 2009

HOUSE DOCUMENT NUMBER 111-17

2009 JAN 26 PM 3:49

Honorable Nancy Pelosi
Speaker of the House
of Representatives
U.S. Capitol Building, Room H-232
Washington, D.C. 20515-0001

Dear Madam Speaker:

In response to Section 310 of the Water Resources Development Act (WRDA) of 2000 for East St. Louis and Vicinity, Illinois, the U.S. Army Corps of Engineers conducted a feasibility study to evaluate problems and opportunities in the study area and completed a feasibility report to document its findings. The recommendations are described in the report of the Chief of Engineers dated December 22, 2004, which includes other pertinent reports and comments. The views of the State of Illinois and the Environmental Protection Agency, as well as the Departments of the Interior and Agriculture are set forth in the enclosed communications. Congress authorized the project in Section 1001(18) of WRDA 2007.

The project recommended in the report of the Chief of Engineers has an ecosystem restoration purpose. The recommended project would provide ecosystem restoration benefits in the vicinity of East St. Louis, Illinois. The recommended plan would restore approximately 1,700 acres of bottomland forest habitat, 1,100 acres of prairie wetland habitat, 840 acres of marsh and shrub swamp habitat, 460 acres of lake habitat, and 380 acres of riparian forest. In addition, the recommended plan also includes restoration of 10.4 miles of floodplain stream, installation of 650 wood duck boxes and 870 prairie bird perches, improvement of 20 acres of lacustrine over wintering and shoreline habitat, construction of 130 tributary sediment detention basins and riffle and pool complexes in 178 miles of streams, 15.5 miles of earthen embankments, and associated water control features (i.e., culverts, flap gates, and new channels). The project includes outdoor recreation as an economically justified project purpose, based on the inclusion of a bike trail at the Old Cahokia Creek action area. The project does not require mitigation for fish and wildlife or cultural resources. The recommend plan is the national ecosystem restoration plan.

At October 2008 price levels, the Corps of Engineers estimates the total first cost of the project to be $221,170,000. The total first cost includes approximately $220,820,000 for ecosystem restoration and approximately $350,000 for recreation. To assure that expected outcomes of the ecosystem restoration project feature are realized, the total first cost includes about $2,570,000 for monitoring and adaptive management. Consistent with the cost-sharing provisions of WRDA of 1986, as amended by Section 210 of WRDA 1996, the Federal share of the ecosystem restoration cost would be approximately $143,530,000 and the non-Federal share would be approximately $77,290,000. Based on the cost-sharing requirements of WRDA 1986, the recreation costs, estimated to be $350,000, would be shared 50 percent Federal and 50 percent non-Federal. Thus the overall Federal share of the estimated total first cost of the project would be $143,705,000 and the estimated non-Federal share would be $77,465,000. The total annual operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) cost for the authorized project, which is the responsibility of the non-Federal sponsor, is estimated to be $125,000 for ecosystem restoration and $1,200 for recreation. Total average annual costs, including initial construction and OMRR&R, are estimated at $11,533,000, based on and interest rate of 4.625 percent and a 50-year period of analysis.

The cost of the recommended plan is justified by the restoration of about 8,300 average annual habitat units. The project would provide both feeding and resting resources for the Federally-threatened bald eagle and would protect and propagate the decurrent false aster. Over 50 migratory bird species covered by international treaties and the state-threatened Illinois chorus frog would also benefit from the project. The plan connects five habitat areas and enlarges three isolated habitats to improve overall resource sustainability. The recommended ecosystem restoration project features are justified on restoration of these habitats which are considered especially valuable due to scarcity and dependence of certain species on these resources.

The average annual recreation benefits are estimated at $26,000 and average annual costs are estimated at $19,000, resulting in a recreation benefit cost ration of 1.4. The recommended plan also provides incidental flood damage reduction benefits estimated at $1,490,000 annually.

Army review of the recommendations contained in the report of the Chief of Engineers determined that the Corps did not demonstrate that the proposed plan represents an efficient way to target Federal and non-Federal resources for aquatic ecosystem restoration. To put this proposed project on par with similar Administration supported aquatic ecosystem restoration projects, those project elements that are not cost effective in providing significant fish and wildlife benefits at the least cost would need to be removed from the project, or provided by other Federal, state, or local agencies without cost to the project as part of a locally preferred plan.

The Office of Management and Budget (OMB) advises that there is no objection to the submission of the report to Congress. However, construction funding would not be considered by the Administration for the project recommended in the report of the Chief of Engineers because the project is not consistent with the policy and programs of the President. A copy of its letter is enclosed. I am providing a copy of this transmittal and the OMB letter, dated January 12, 2009, to the House Subcommittees on Energy and Water Development, and Water Resources and Environment.

Very truly yours,

John Paul Woodley, Jr.

John Paul Woodley, Jr.
Assistant Secretary of the Army
(Civil Works)

Enclosures

3 Enclosures

1. OMB Letter, Jan 12, 2009
2. Report of the Chief of Engineers, Dec 22, 2004
3. East St. Louis and Vicinity, Illinois - Ecosystem Restoration and Flood Damage Reduction Project, November 2003

01/14/2009 11:50 FAX 202 395 4817 OMB WATER & POWER BRANCH → MARK MUGGLER 002

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

January 12, 2009

The Honorable John Paul Woodley, Jr.
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington D.C. 20310-0108

Dear Mr. Woodley:

As required by Executive Order 12322, the Office of Management and Budget has completed its review of your recommendation concerning the feasibility report of the Army Corps of Engineers East St. Louis and Vicinity, General Reevaluation Report.

We agree with your recommendation that this project is not consistent with the policy and programs of the President, because the Corps of Engineers' report does not demonstrate that the proposed plan represents an efficient way to target Federal and non-Federal resources for aquatic ecosystem restoration.

The Office of Management and Budget does not object to you submitting the report to Congress.

Sincerely,

Richard A. Mertens
Deputy Associate Director
Energy, Science and Water

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-MVD (1105-2-10a) 22 DEC 2004

SUBJECT: East St. Louis and Vicinity, Illinois

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on ecosystem restoration and recreation in the vicinity of East St. Louis, Illinois. It is accompanied by the report of the district and division engineers. These reports constitute a general reevaluation of the flood damage reduction project authorized in Section 204 of the Flood Control Act of 1965, and modified by Section 137 of the Water Resources Development Act (WRDA) of 1976 and Section 310 of WRDA of 2000, for East St. Louis and Vicinity, Illinois. Preconstruction engineering and design activities for this project will be continued under authority of Section 310 of WRDA 2000.

2. The reporting officers recommend further modification to the authorized project. The recommended plan is an extensive restoration of the ecosystem in the vicinity of East St. Louis, Illinois, on the Mississippi River. The recommended plan will restore approximately 1,700 acres of bottomland forest habitat, 1,100 acres of prairie wetland habitat, 840 acres of marsh and shrub swamp habitat, 460 acres of lake habitat, and 380 acres of riparian forest. In addition, the recommended plan also includes restoration of 10.4 miles of floodplain stream, installation of 650 wood duck boxes and 870 prairie bird perches, improvement of 20 acres of lacustrine over wintering and shoreline habitat, construction of 130 tributary sediment detention basins and riffle and pool complexes in 178 miles of streams, 15.5 miles of earthen embankments, and associated water control features (i.e., culverts, flap gates, and new channels). All project features are located within the State of Illinois. Because the recommended plan would not have any significant adverse effects, no mitigation measures (beyond management practices and avoidance) or compensation measures are required. The recommended plan is the national ecosystem restoration plan.

3. Based on October 2004 price levels, the total first cost of the recommended plan is estimated at $191,158,000. The total first cost of the project includes approximately $190,854,000 for ecosystem restoration and approximately $304,000 for recreation. In accordance with the cost sharing provisions of WRDA of 1986, as amended by Section 210 of WRDA 1996, ecosystem restoration features would be cost shared 65 percent Federal and 35 percent non-Federal. Thus the Federal cost of the ecosystem restoration features is estimated at $123,655,000 and the non-Federal cost is estimated at $67,199,000. The estimated total first cost also includes a separable

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SUBJECT: East St. Louis and Vicinity, Illinois

recreational trail. This feature is estimated at $304,000; and based on the cost sharing requirements of WRDA of 1986, the costs would be shared 50 percent Federal and 50 percent non-Federal. To assure that expected outputs of the ecosystem restoration project feature are realized, the project also includes about $2,221,000 for monitoring and adaptive management. Thus the overall Federal share of the estimated total first cost of the project would be $123,807,000 and the non-Federal share would be $67,351,000. Average annual recreation benefits are estimated at $25,000 and average annual costs are estimated at $18,000, for a recreation benefit-to-cost ratio of 1.4 to 1. The average annual cost for ecosystem restoration is approximately $11,066,000. The total annual operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs of the recommended project are estimated at $109,000 per year. This includes $108,000 for ecosystem restoration OMRR&R and $1,000 for recreation OMRR&R. Total average annual costs, including initial construction and OMRR&R, are estimated at $11,193,000, based on an interest rate of 5.375 percent and a 50-year period of analysis.

4. During the reevaluation of this authorized project, it became apparent that problems and opportunities in the project area had changed significantly since authorization. While interior flooding problems still exist, other more significant problems and changes (e.g., the environmental degradation of significant resources in the study area, urbanization, changes in the transportation infrastructure, etc.) were identified. While the authorized project was designed to eliminate interior flooding from a 50-year storm event, the plan recommended herein is designed to reconnect watershed functionality by using stormwater for the restoration of significant ecosystem resources. The recommended plan also provides incidental flood damage reduction benefits estimated at $1,445,000 annually.

5. To ensure that an effective environmental restoration plan was recommended, cost effectiveness and incremental analysis techniques were used to evaluate alternative restoration plans. The recommended plan provides both feeding and resting resources for the federally-threatened bald eagle and will protect and propagate the decurrent false aster. The project contributes to the life cycle requirements of more than 50 migratory bird species covered by international treaties and the state-threatened Illinois chorus frog. The palustrine wetland resources to be restored are considered scarce with over 85 percent of the wetlands in Illinois and other midwestern states lost since the 1780's, and the decline is continuing. The plan connects 5 habitat areas and enlarges 3 isolated habitats to improve overall resource sustainability. The project produces approximately 8,332 average annual habitat units. The recommended ecosystem restoration project features are justified on restoration of habitats considered especially valuable due to scarcity and dependence of certain species on these resources.

6. Washington level review indicates that the plan recommended by the reporting officers is environmentally justified, technically sound, cost effective and socially acceptable. The plan conforms with essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and complies with other administration and legislative policies and guidelines. Also, the views of interested parties, including Federal, State and local agencies have been considered.

CECW-MVD
SUBJECT: East St. Louis and Vicinity, Illinois

7. I concur in the findings, conclusions, and recommendation of the reporting officers. Accordingly, I recommend implementation of the modifications to the authorized project in accordance with the reporting officers' plan with such modifications as in the discretion of the Chief of Engineers may be advisable. The recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and State laws and policies, including Public Law 99-662, as amended by Section 210 of Public Law 104-303, and in accordance with the following requirements which the non-Federal sponsor must agree to prior to project implementation:

a. Provide 35 percent of the total project costs allocated to ecosystem restoration as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to ecosystem restoration in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds needed to cover the non-Federal share of design costs allocated by the Government to ecosystem restoration;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the ecosystem restoration features;

(4) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the ecosystem restoration features;

(5) Provide during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of total project costs allocated to ecosystem restoration;

b. Provide 50 percent of total project costs allocated to recreation as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to recreation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to recreation;

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SUBJECT: East St. Louis and Vicinity, Illinois

(3) Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;

(4) Provide, during construction, any additional funds necessary to make its total contribution for recreation equal to 50 percent of total recreation costs;

c. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost-sharing provisions of the agreement;

d. Provide, during construction, 100 percent of total project costs allocated to recreation that exceed an amount equal to 10 percent of the Federal share of costs allocated to ecosystem restoration;

e. Operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

f. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

g. Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

h. Hold and save the Government free from all damages arising from the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

i. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents and other evidence are required, to the

CECW-MVD
SUBJECT: East St. Louis and Vicinity, Illinois

extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

j. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project. However for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

k. Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA- regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

l. Agree, as between the Federal Government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERLA;

m. Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration benefits, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or addition of facilities that might reduce the benefits of the project;

n. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

o. Do not use Federal funds from other Federal programs, including any non-Federal contribution required as a matching share, to meet any of the non-Federal obligations for the project unless the Federal granting agency providing the Federal portion of such funds verifies in writing that the expenditure of such funds for such purpose is authorized;

CECW-MVD
SUBJECT: East St. Louis and Vicinity, Illinois

p. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army;" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

q. Provide and maintain recreation features, such as access roads, parking areas and other public use facilities, open and available to all on equal terms.

8. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to the Congress, the non-Federal sponsor, the State of Illinois, interested Federal agencies, and other parties will be advised of any significant modifications and will be afforded the opportunity to comment further.

CARL A. STROCK
Lieutenant General, U.S. Army
Chief of Engineers

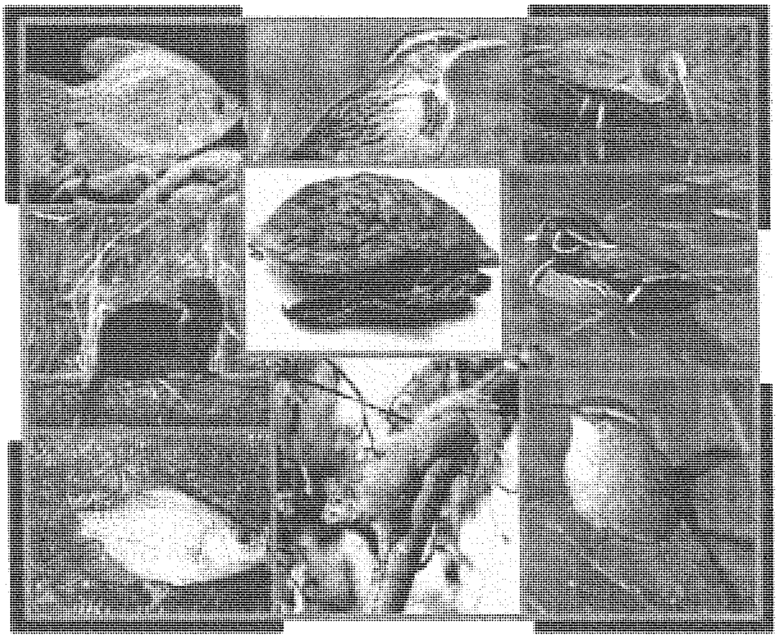
NOTICE

EAST ST LOUIS, IL

Since Congress has authorized the project, the Army Corps of Engineers does not request that the report be printed. If there are any questions about this, please call Mr. Lucyshyn at Corps Headquarters. You can reach Mr. Lucyshyn at (202) 761-4515.

East St. Louis and Vicinity, Illinois Ecosystem Restoration And Flood Damage Reduction Project

General Reevaluation Final Report with Integrated Environmental Impact Statement



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US Army Corps
of Engineers ®
St Louis District

November 2003

**US Army Corps
of Engineers
Saint Louis District**

ADDENDUM

TO THE

GENERAL REEVALUATION REPORT

AND THE

POST-AUTHORIZATION CHANGE REPORT

East St. Louis and Vicinity, Illinois

Ecosystem Restoration and Flood Damage Reduction Project

Dated November 2003

Revised October 2004

ADDENDUM

General Reevaluation Report

East St. Louis and Vicinity, Illinois
Ecosystem Restoration and Flood Damage Reduction Project
Madison and St. Clair County, Illinois

1. Purpose of Addendum

The purpose of this Addendum is to summarize changes made to the General Reevaluation Report for the East St. Louis and Vicinity, Illinois Project dated November 2003. It is intended to be part of the final report and be an integral part of the project process. Since the submission of the report in November, the Washington Level review resulted in several changes to the report. These items include the addition of information supporting selection of the recommended plan, changes resulting from Council review, Real Estate Review and general editorial comments. This Addendum further includes the Final Coordination Act Report as received from the U.S. Fish and Wildlife Service and dated 12 May 2004.

The General Reevaluation Report, as supplemented by this Addendum, is intended to serve as the basis for project authorization and, ultimately the Project cooperation Agreement (PCA). Information contained in this Addendum makes no change to the recommendations contained in the November 2003 report, which has completed State, Agency and NEPA Compliance Review. Details and supporting documentation pertaining to these changes are available in the files of the Planning and Project Management Division of the St. Louis District Corps of Engineers.

This Addendum includes project costs updated to the October 2004 price level and discounted at the FY 2005 rate of 5.375%.

2. Updated Project Costs

Construction Project October 2004 Price Level

Feature	Costs
Lands and Damages	28,292,000
Relocations	6,257,000
Fish and Wildlife Facilities	117,089,000
Recreation Facilities	261,000
Engineering and Design	24,844,000
Construction Management	12,194,000
Monitoring and Adaptive Management	2,221,000
Total	191,158,000

Project Cost Share

First Cost (rounded)	Non-Federal Share (rounded) 65% for ecosystem features and 50% for recreation features	Federal Share (rounded) 65% for ecosystem features and 50% for recreation features
$191,158,000	$67,351,000	$123,807,000

Ecosystem Restoration Project Costs annualized at the Federal Discount Rate for FY 2005 (5.375%) for the 50 year period of analysis equal $11,066,000.

Recreation Costs annualized at the Federal Discount Rate for FY 2005 (5.375%) totals $18,000 providing a Benefit to Cost Ratio of 1.3 to 1.

Total Project Costs annualized at the Federal Discount Rate for FY 2005 (5.375%) for the 50 year period of analysis equal $11,315,000.

Total Project OMRR&R annualized costs at the Federal Discount Rate for FY 2005 (5.375%) total $109,000. $1,000 of this is for annual OMRR&R for the recreation facilities.

Monitoring and Adaptive Management is described in Section 9.11 of the General Reevaluation Report and costs are estimated to be $2,221,000 (1.1% of total project costs).

Incidental Flood Damage Reduction Benefits are estimated to be $1,445,000 (October 04 price level).

3. Summary of Report Changes

Executive Summary

(1) Addenda to Section 1- page II-1 - Change the second sentence of paragraph 3 on this page to read:

> "Section 310 of this Public Law contains the following wording: "The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

(2) Addenda to Section 6- page II-6 - Change the first sentence of paragraph 4 on this page to read:

> "The ecosystem restoration measures, a separable element of the existing authorized East St. Louis and Vicinity project, were formulated in accordance with ER1105-2-100 (3-5c):......."

Section 6 - Plan Formulation and Evaluation

(1) Addenda to page 6-6 - Change Section 6.1.2 Evaluation Methodology by inserting the following after the sixth sentence:

> "The Habitat Evaluation Procedures (HEP) methodology was chosen by the interagency biology team to assess project-induced changes. Although models used in the HEP methodology are often species-based and limited in their overall review of potential changes to ecosystem dynamics and

functionality, HEP was utilized to assess ecosystem health by using a combination of appropriate keystone species or guild-based species models to assess change. Thus, the selection of species from multiple faunal groups better describes the complex functions of an ecosystem, capturing both structure and process.

The model selection process focused on the study's performance measures (i.e., success criteria), community incidence, and architecture and model parameters directly contributing to the ecosystem function. In addition, model selection was based on sensitivity of the species or community to the proposed changes considered to address the planning objectives of the study. Seven distinct communities were identified (i.e., marshes, wetland forests, deciduous forests, shrublands, lakes, channels, and prairies). In addition, the team compiled lists of known regional species of plants and animals. These lists were used to narrow the choices of available Habitat Suitability Index (HSI) models, and focus the selection on critical community dynamics across the ecosystem.

Because of the relatively large area under evaluation, and the diversity of habitat desired to be restored, nine species models were selected for use in analyzing proposed changes to the ecosystem. These species included the Great Blue Heron, Marsh Wren, Mink, Slider Turtle, Wood Duck, Fox Squirrel, White Crappie, Black Crappie, Eastern Meadowlark. The justification for these model selections ranged from faunal group representation (i.e., two mammals, two fishes, one amphibian, two waterfowl, etc.) to public awareness issues including the public's interest in game species populations (e.g., the wood duck, fox squirrel, and mink). Furthermore, these models were selected on the basis of their representation of ongoing critical ecosystem processes. For example, the great blue heron HSI model, as well as both the black and white crappie HSI models, all contained variables measuring water quality conditions (i.e., dissolved oxygen, water temperature, and pH) and sedimentation deposition reduction efforts (i.e., turbidity and overall water clarity). The marsh wren and mink models were selected because they captured functions such as surface water storage monitoring (i.e., water regime, water depth) and species diversity changes (i.e., dominant growth forms, and both tree and shrub canopy coverage). Of course, the primary function the selected HSI models evaluated was the maintenance of plant and wildlife communities across the East St. Louis ecosystem. Appendix A describes this process in detail."

Addenda to Section 6.11.3 page 6-112 - add the following after the second paragraph on this page:

"The Old Cahokia Creek restoration on the Mississippi River floodplain which consists of reopening about 3.5 miles of a historic stream, and creating a 328-foot (100-meter) wide forested corridor along both sides of the channel is important as an increment of the overall restoration plan for a number of reasons. First, it restores habitat diversity to the Mississippi River's floodplain. Like all floodplain streams in the project area, this historic creek was eliminated in the early 1800's in an effort to provide floodplain flood protection. This restoration of habitat diversity as indicated would support the Habitat Needs Assessment of the Upper Mississippi River System – Habitat Rehabilitation and Enhancement Program, which calls for the replacement of ecologically important habitats lost to development within a nationally important ecosystem. Second, this restoration area's footprint would protect and expand two areas of important habitat on the Mississippi River floodplain designated for the Illinois chorus frog, a state threatened species in Illinois. Third, the restoration of Old Cahokia Creek is important to the overall function and sustainability of the Recommended Plan. This restoration improves the ecological functioning of a proposed chain of hydrologically linked habitat restoration areas. Old Cahokia Creek is expected to improve the quality of surface water moving downstream by removing sediment and pollutants. Net primary productivity at Old Cahokia Creek is expected to result in the export of organic carbon in the form of dead and live plant material. The Judy's-Burdicks restoration area, about one mile downstream along Cahokia Canal, would receive cleaner storm water as well as exported carbon. At Judy's-Burdicks, cleaner storm water is expected to improve the sustainability of characteristic plant communities. Likewise, received carbon is expected to help fuel primary productivity and the microbial and detrital food webs at the second restoration area. In turn, this cycle would be repeated at the third restoration area (Brushy Lake), about one mile downstream of Judy's-Burdicks. Assessment tools used in this study were not able to evaluate the benefits created by the synergy of linking these sites. An additional benefits of the Old Cahokia Creek restoration is the provision of migratory or breeding habitat for a number of bird species that the federal government has designated as a concern because of declining or low population levels. They include the mallard, wood duck, American woodcock, black-crowned and yellow-crowned night-herons, and Louisiana waterthrush. Restoration would support these species' conservation plans.

Habitat benefits quantified for Old Cahokia Creek are relatively expensive to achieve when compared to the restoration of wetland resources recommended at other action areas on the floodplain but it is a fact that the cost of providing aquatic habitat is historically higher than the cost of restoring other habitats based on the construction methods (dredging and excavation) that is typically required. However, when the restoration of Old Cahokia Creek aquatic resources is compared to the costs of other like projects in this region and across the country, they are low by comparison. The average annual habitat unit (AAHU) cost of $2,600 for the restoration of the Old Cahokia Creek on the floodplain compares favorably to the cost of other Corps' aquatic restoration programs, such as those under the Upper Mississippi River System's Environmental Management Program (EMP). The EMP does not require the purchase of land and averages between about $2,500 and $3,000 per AAHU. "

(3) Addenda to Section 6.12.2 beginning on page 6-138 - add the following after Table 6-9.

"During plan formulation, a cost effectiveness/incremental cost analysis (CE/ICA) was performed at the action area level. The interagency biological team then used the Best Buy results of this CE/ICA analysis to select the alternative at each site that in their professional judgment best achieved study planning objectives and targets. This process resulted in the Recommended Plan. Although the Recommended Plan was selected only from Best Buy alternatives generated by IWR-Plan, action area Best Buy alternatives were never analyzed together using IWR-Plan. In order to address policy review comments on the final report related to the assembly of the Recommended Plan, a CE/ICA was performed using IWR-Plan at the project level. This analysis was performed using the Best Buy alternatives from each of the 8 action areas identified in Tables 6-6 and 6-7.

The following chart identifies the cross walk between IWR-Plan input from Tables 6-6 and 6-7

A1 - Dobrey Best Buy Least Cost
A2 - Dobrey Best Buy Highest Output
B1 – Elm Best Buy Least Cost and Highest Output
C1 - Cahokia Best Buy Least Cost (No tributary stream restoration)
C2 - Cahokia Best Buy Highest Output (Includes tributary stream restoration)
D1 - Brushy Best Buy Least Cost (No tributary stream restoration)
D2 - Brushy Best Buy Highest Output (Includes tributary stream restoration)
E1- Judy's Burdick Best Buy Least Cost (No tributary stream restoration)
E2 - Judy's/Burdick Best Buy Highest Output (Includes tributary stream restoration)
F1 - Cahokia Mounds Best Buy Least Cost
F2 - Cahokia Mounds Best Buy Highest Output
G1 - Spring Lake Best Buy Least Cost and Highest Output
H1 - Mullens Slough Best Buy Least Cost (No tributary stream restoration)
H2 - Mullens Slough Best Buy Highest Output (Includes tributary stream restoration)

The following charts generated by the IWR-Plan program provide the results of this analysis in a graphic presentation. Chart 1 displays all possible plan combinations with cost effective and Best Buy plans identified as black circles or red triangles.

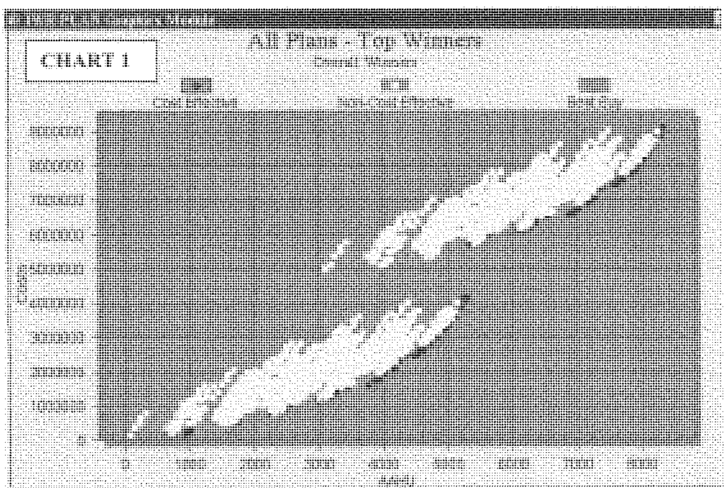
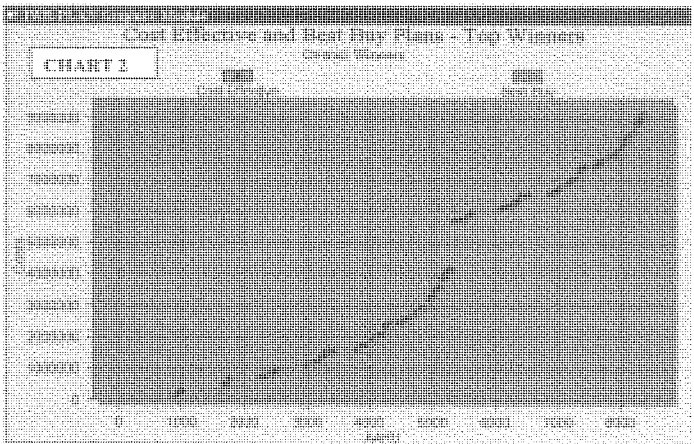


Chart 2 produced by IWR-Plan shows the plans remaining from all possible combinations after those that are not cost effective have been screened out.



IWR Chart 3 shows Best Buy plans represented in a bar chart format to show plans relative to one another in output and incremental cost. Chart 3 shows fourteen plans and the No Action Plan that are identified as Best Buys (Note: no bar is assigned to the "No Action Plan" in this depiction, and the Best Buy Highest Output Plan is represented by the bar at the far right of the graph labeled Plan Combination 15).

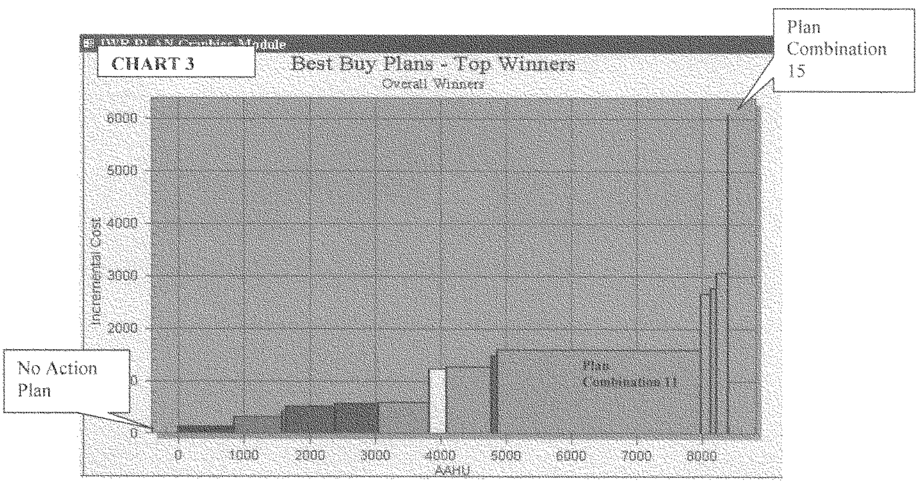


Chart 4 identifies the alternative combinations generated by IWR-Plan (color-coded to match the Best Buy bar chart depicted above) in tabular form. Plan 11 of the IWR-Plan generated combinations represents a logical break point in cost versus production of outputs of all plans compared. As can be seen, Plan 11 produces a significantly increased incremental level of output. The 3,105 AAHU is a 64% increase in incremental output for less than an 8% increase in incremental cost per output.

CHART 4

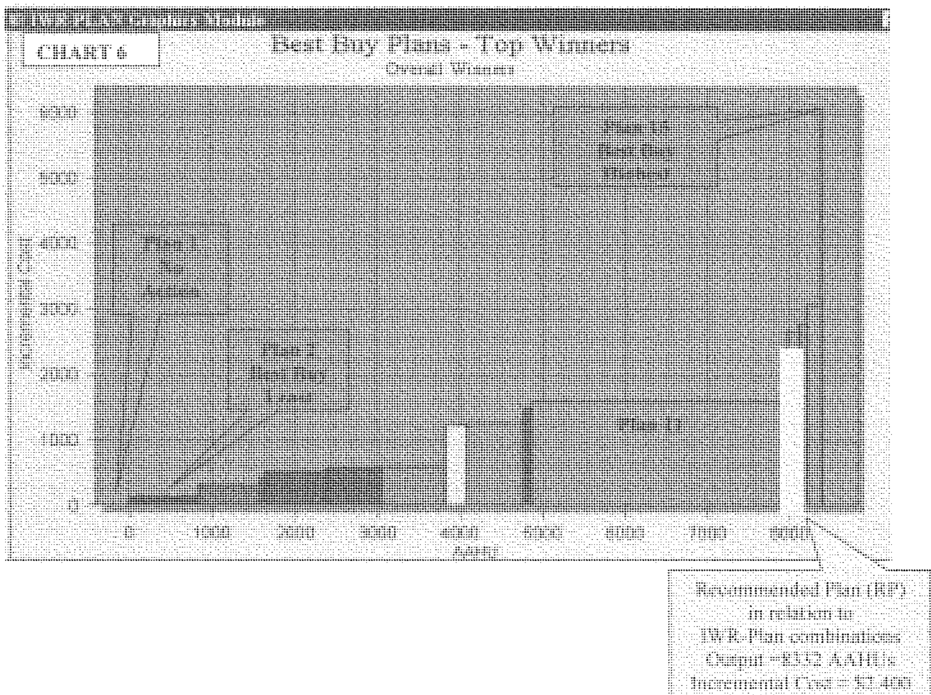
Counter	Plan Code	AAHU	Costs ($)	Avg. Cost $ / AAHU	Inc. Cost ($)	Inc. Output (AAHU)	Incremental Cost Per Output
1	A0 B0 C0 D0 E0 F0 G0 H0	0.00	0.00	0.00	0.00	0.00	0.00
2	A0 B0 C0 D0 E0 F1 G0 H0	849.00	113,200.00	133.33	113,200.00	849.00	133.33
3	A0 B0 C0 D0 E0 F1 G0 H1	1,579.00	347,900.00	220.33	234,700.00	730.00	321.51
4	A0 B0 C0 D0 E0 F2 G0 H1	1,645.00	376,400.00	228.81	28,500.00	66.00	431.82
5	A0 B1 C0 D0 E0 F2 G0 H1	2,390.00	765,900.00	320.46	389,500.00	745.00	522.82
6	A0 B1 C0 D0 E1 F2 G0 H1	3,045.00	1,145,400.00	376.16	379,500.00	655.00	579.39
7	A0 B1 C0 D1 E1 F2 G0 H1	3,287.00	1,605,200.00	419.44	459,800.00	782.00	587.98
8	A0 B1 C0 D2 E1 F2 G0 H1	4,092.00	1,932,700.00	472.31	327,500.00	265.00	1,235.85
9	A0 B1 C0 D2 E2 F2 G0 H1	4,787.00	2,808,900.00	586.78	876,200.00	695.00	1,260.72
10	A1 B1 C0 D2 E2 F2 G0 H1	4,873.00	2,937,000.00	602.71	128,100.00	86.00	1,489.54
11	A1 B1 C0 D2 E2 F2 G1 H1	7,978.00	7,912,075.00	991.74	4,975,075.00	3,105.00	1,602.28
12	A1 B1 C1 D2 E2 F2 G1 H1	8,119.00	8,289,075.00	1,020.95	377,000.00	141.00	2,673.76
13	A1 B1 C2 D2 E2 F2 G1 H1	8,216.00	8,559,075.00	1,041.76	270,000.00	97.00	2,783.51
14	A1 B1 C2 D2 E2 F2 G1 H2	8,398.00	9,118,775.00	1,085.83	559,700.00	182.00	3,075.28
15	A2 B1 C2 D2 E2 F2 G1 H2	8,399.00	9,124,875.00	1,086.42	6,100.00	1.00	6,100.00

The alternatives selected by the Biological Team as the Recommended Plan do not replicate any one of the IWR-Plan generated combinations. Chart 5 shows how the Recommended Plan compares with the array of CE/ICA cost effective plans produced by the IWR-Plan analysis. It was the determination of the interagency Biological Team that the outputs produced by the Best Buy Least Cost alternative F1 for the Cahokia Mounds prairie restoration met the planning criteria and the extra increment produced by alternative F2 at this site was not warranted based on its increased cost. For this reason the Recommended Plan falls between CE/ICA plans 13 and 14 when comparing RP Average Annual Habitat Unit (AAHU) production, first cost and average cost per AAHU. The incremental cost per output for the Recommended Plan falls however, between plans 11 and 12, because its incremental cost per output is less than that of the plan 12 combinations, with a cost of only approximately $2,400 for the increased incremental output. This places the RP for output production above plan 13 but below plan 12 for incremental cost per output produced making it a better buy plan than 12 or 13.

CHART 5

Counter	Plan Code	AAHU	Costs ($)	Avg. Cost $ / AAHU	Inc. Cost ($)	Inc. Output (AAHU)	Incremental Cost Per Output
1	A0 B0 C0 D0 E0 F0 G0 H0	0.00	0.00	0.00	0.00	0.00	0.00
2	A0 B0 C0 D0 E0 F1 G0 H0	849.00	113,200.00	133.33	113,200.00	849.00	133.33
3	A0 B0 C0 D0 E0 F1 G0 H1	1,579.00	347,900.00	220.33	234,700.00	730.00	321.51
4	A0 B0 C0 D0 E0 F2 G0 H1	1,645.00	376,400.00	228.81	28,500.00	66.00	431.82
5	A0 B1 C0 D0 E0 F2 G0 H1	2,390.00	765,900.00	320.46	389,500.00	745.00	522.82
6	A0 B1 C0 D0 E1 F2 G0 H1	3,045.00	1,145,400.00	376.16	379,500.00	655.00	579.39
7	A0 B1 C0 D1 E1 F2 G0 H1	3,287.00	1,605,200.00	419.44	459,800.00	782.00	587.98
8	A0 B1 C0 D2 E1 F2 G0 H1	4,092.00	1,932,700.00	472.31	327,500.00	265.00	1,235.85
9	A0 B1 C0 D2 E2 F2 G0 H1	4,787.00	2,808,900.00	586.78	876,200.00	695.00	1,260.72
10	A1 B1 C0 D2 E2 F2 G0 H1	4,873.00	2,937,000.00	602.71	128,100.00	86.00	1,489.54
11	A1 B1 C0 D2 E2 F2 G1 H1	7,978.00	7,912,075.00	991.74	4,975,075.00	3,105.00	1,602.28
12	A1 B1 C1 D2 E2 F2 G1 H1	8,119.00	8,289,075.00	1,020.95	377,000.00	141.00	2,673.76
13	A1 B1 C2 D2 E2 F2 G1 H1	8,216.00	8,559,075.00	1,041.76	270,000.00	97.00	2,783.51
RP *	A1 B1 C2 D2 E2 F1 G1 H2	8,332.00	8,833,775.00	1,060.00	274,700.00	116.00	2,368.10
14	A1 B1 C2 D2 E2 F2 G1 H2	8,398.00	9,118,775.00	1,085.83	559,700.00	182.00	3,075.28
15	A2 B1 C2 D2 E2 F2 G1 H2	8,399.00	9,124,875.00	1,086.42	6,100.00	1.00	6,100.00

Chart 6 is an illustration of the Recommended Plan overlaid onto the array of alternatives determined to be Best Buy plans using the IWR-Plan software. The Recommended Plan produces a slightly higher output than Plan 13, and carries an incremental cost slightly lower than Plan 12's. The additional increment of AAHU output for the additional cost of approximately $2,400 is related to the inclusion of both the Old Cahokia Creek action area and 16 miles of tributary stream aquatic restoration within the Mullen Slough action area. Both of these components are considered essential to the overall East St. Louis ecosystem restoration plan and have been justified as such.



The IWR-Plan CE/ICA analysis supports the Recommended Plan selection by the Interagency Team. This analysis confirms the importance of the tributary stream restoration with all but 16 miles of stream restoration being included in the Plan 11 combination. The selection of an the RP which produces higher outputs than the Plan 13 combination at an incremental output cost of less than Plan 12 is justified based on considerations of sustainability and connectivity. The use of the IWR-Plan to evaluate all action areas supports the selection of alternatives at each action area site as being appropriate and justified as an increment of the overall restoration plan."

(4) Addenda to page 6-139 - add the following as new Section 6.12.3 and renumber current Section 6.12.3 as Section 6.12.4

"6.12.3 Benefits of Tributary Stream Restoration

Tributary stream restoration is an essential component of the recommended plan because it restores habitat quality to the streams, provides for a comprehensive watershed approach to ecosystem restoration and allows the restored system to operate naturally, which assures its long term sustainability. The restoration of tributary streams may not appear to be justified based solely on HEP analysis outputs. However, the species models available did not assess and measure the benefits derived from restoring these finite stream resources. In addition to the professional judgments made by the interagency biological team during plan selection, the Qualitative Habitat Evaluation Index (QHEI) model was utilized in October 2003 in order to provide an additional measure of the value of tributary stream restoration. The results of this analysis are discussed in detail in Section 7 and Appendix A. The QHEI procedure was applied to evaluate tributary streams as habitat for fish communities and other aquatic species, such as invertebrates. Measurements of physical habitat parameters (i.e., hydrology and geomorphology) that are known to correlate to high biological diversity and biological integrity were used to generate a habitat suitability index on a scale from 0 (no value) to 1 (optimal). The results of this evaluation showed that with the Project, the stream quality increases by 35% and without the Project, stream quality decreases by an additional 14%.

The results of this QHEI evaluation further supports the professional judgment of the interagency biology team by indicating that under the future with Project condition, the combined effects of tributary stream restoration far exceeds that expected under the future without Project condition increasing quality an overall 55%. Additionally, available tools do not readily measure the benefits created by the synergy of linking otherwise isolated sites in this highly disturbed urban area. Tributary stream restoration measures restore habitat quality by accomplishing the following: reducing sediment release, transport and accumulation; reducing nutrient delivery to waters and restored floodplain areas; reducing turbidity while increasing dissolved oxygen; protecting and preserving streams from further headcutting; improving spawning habitat for fish; and creating conditions beneficial to benthic organisms that will increase the sustainability and productivity of the system. Installation of tributary stream restoration measures further improves the quality and manageability of flood pulses that are delivered to restored habitat areas, ensures essential riparian linkages are maintained and allows for the linkage of aquatic resources on the floodplain by supporting the hydrologic integrity of the overall restored system.

These positive effects are difficult to quantify in straight output terms and as a general rule, restoration of aquatic habitats such as streams and lakes is more costly than that of wetland or terrestrial habitats per unit of environmental output achieved because of the construction costs of producing such habitats. As a result, aquatic restoration is automatically placed at a disadvantage when compared dollar for dollar to outputs generated from the restoration of other habitat types. The added increment of cost for the recommended plan that includes 79 miles of tributary stream restoration is between $1,230 and $3,000 per average annual habitat unit (AAHU) depending on the watershed involved for an overall average of $1640 per AAHU. When compared to other like projects in this region and across the country, this incremental cost is low. An average cost for producing aquatic resources in the Environmental Management Program on the upper Mississippi River system that requires no purchase of land is approximately $2,500 to $3,000 per AAHU. As can be seen, the additional cost of restoring the 79 miles of tributary stream in the project area is reasonable when compared to the results achieved and to the typical costs for such restoration activities. The CE/ICA analysis conducted as a result of Policy Compliance Review and included in Section 6.12.2 supports the inclusion of tributary stream restoration as a justified increment of the overall restoration plan."

Section 8 - Recommended Plan, and Section 12 – Commander's Recommendation

Addenda to Section 8.16 pages 8-63 to 8-65, and pages 12-1 and 12-2 - items a-o should be changed to include the following IAW the latest guidance on the sponsor requirements:

"a. Provide 35 percent of the total project costs allocated to ecosystem restoration as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to ecosystem restoration in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds needed to cover the non-Federal share of design costs allocated by the Government to ecosystem restoration;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the ecosystem restoration features;

(4) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the ecosystem restoration features;

(5) Provide during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of total project costs allocated to ecosystem restoration;

b. Provide 50 percent of total project costs allocated to recreation as further specified below:

(1) Provide 25 percent of design costs allocated by the Government to recreation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to recreation;

(3) Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;

(4) Provide, during construction, any additional funds necessary to make its total contribution for recreation equal to 50 percent of total recreation costs;

c. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost-sharing provisions of the agreement;

d. Provide, during construction, 100 percent of total project costs allocated to recreation that exceed an amount equal to 10 percent of the Federal share of costs allocated to ecosystem restoration;

e. Operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

f. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

g. Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

h. Hold and save the Government free from all damages arising from the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

i. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents and other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

j. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project. However for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

k. Assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA-regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

l. Agree, as between the Federal Government and the Non-Federal Sponsor, that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERLA;

m. Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration benefits, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or addition of facilities that might reduce the benefits of the project;

n. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

o. Do not use Federal funds from other Federal programs, including any non-Federal contribution required as a matching share, to meet any of the non-Federal obligations for the project unless the Federal granting agency providing the Federal portion of such funds verifies in writing that the expenditure of such funds for such purpose is authorized;

p. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army;" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

q. Provide and maintain recreation features, such as access roads, parking areas and other public use facilities, open and available to all on equal terms."

Section 11 - Environmental Statutes and Requirements

Addenda to page 11-4 - Delete the last sentence of Section 11.4 second paragraph.

Appendix B

(1) Addenda to page B-3 - Add the following:

"B.26 COORDINATION ACT REPORT B-181"

(2) Addenda to page B-106 - Change the third sentence of paragraph 4 to read:

"Section 310 of this Public Law contains the following wording: "The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

(3) Addenda to page B-181- add the following:

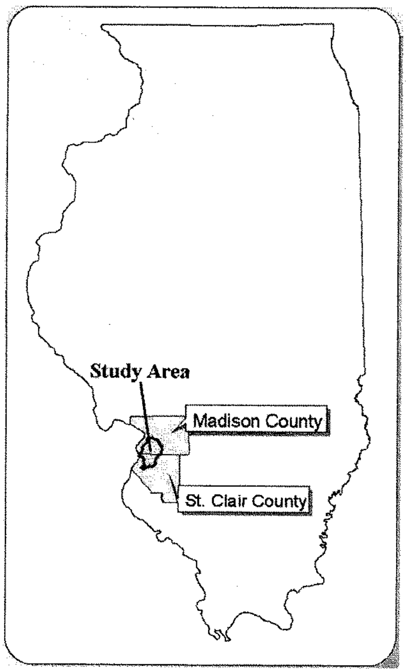
"Section B.26 - COORDINATION ACT REPORT"

EAST ST. LOUIS AND VICINITY, ILLINOIS ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION PROJECT

FINAL GENERAL REEVALUATION STUDY

SUMMARY REPORT

October 2003



EAST ST. LOUIS AND VICINITY, ILLINOIS ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION PROJECT FINAL GENERAL REEVALUATION STUDY

SUMMARY REPORT

OVERVIEW

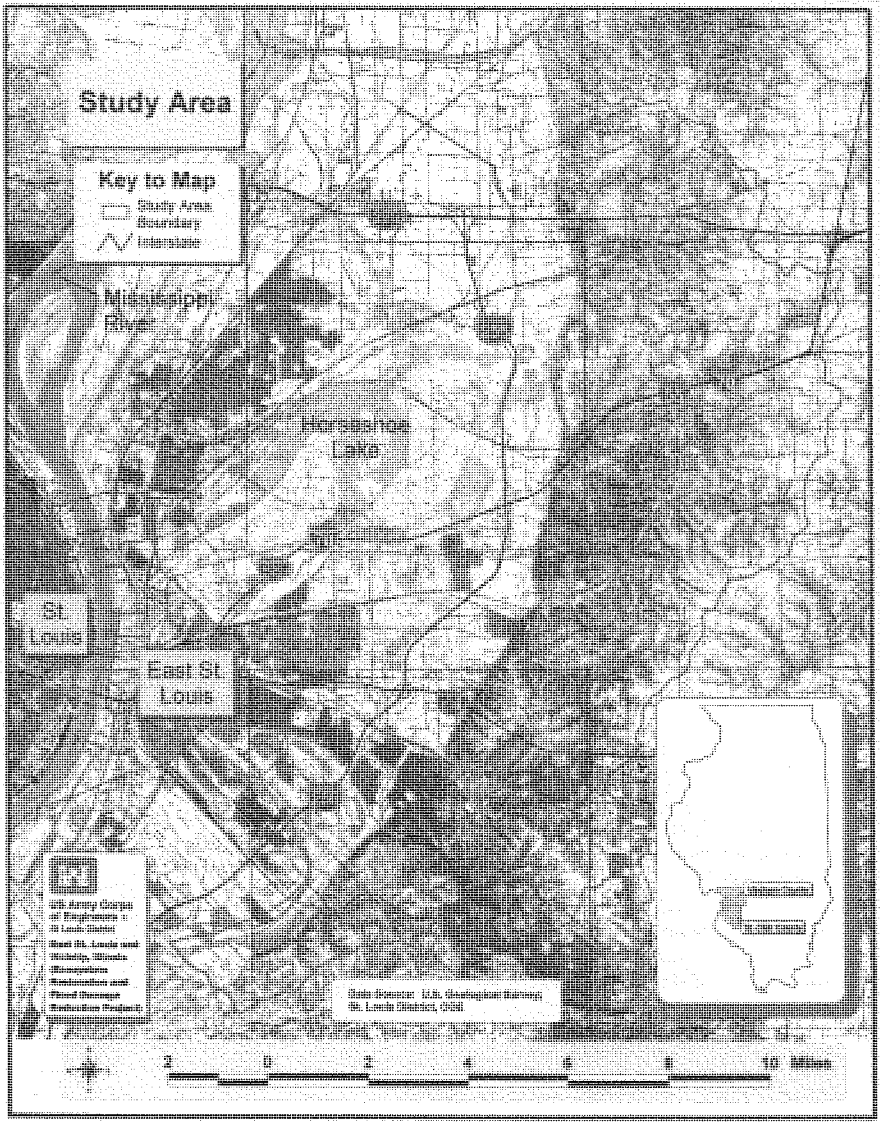
This report presents a summary of the East St. Louis and Vicinity, Illinois, Ecosystem Restoration and Flood Damage Reduction Project General Reevaluation Report with Integrated Environmental Impact Statement. As such, this Summary Report includes material also contained in the above referenced General Reevaluation Report (GRR) but in a much more abbreviated form. For complete details, the reader is urged to reference the above GRR.

The East St. Louis and Vicinity, Illinois Project is located in Madison and St. Clair Counties, Illinois, along the left bank of the Mississippi River between river miles 175 and 195 above the Ohio River. It includes a portion of the bottomlands between the bluffs on the east and the Mississippi River and Chain of Rocks Canal on the west. It extends from the Prairie Du Pont canal on the south to the Cahokia Creek diversion channel on the north.

The study area to be re-evaluated envelops about 166 square miles or 105,000 acres in the MetroEast area. About half of the study area occurs on the floodplain of the Mississippi River, and the remainder consists of small tributary watersheds that drain into the bottoms. The floodplain area includes approximately 55,000 of the 86,000 acres that are protected by an urban levee system along the Mississippi River, Chain of Rocks Canal, Prairie du Pont canal, and Cahokia Creek diversion channel. The upland area includes watersheds of seven named and several unnamed tributary streams draining a total of about 50,000 acres. Tributary streams typically end at the bluff-floodplain border, and continue as a ditch and canal system on the floodplain to carry water as directly as possible to the river. Larger streams to the north and south of these watersheds were diverted many years ago to the Mississippi River between flank levees to reduce drainage into the bottomlands.

Even though the study area is protected from Mississippi River overflow by an urban design levee, the bottomland inside or interior to this levee can experience flooding after significant rainfall. The ditches and canals of the interior flood control system were constructed in the early 1900's, and have not been modified to handle the increased runoff caused by urbanization, and more intense summer rainstorms due to a localized climatic change called the St. Louis effect. As a result, moderate storms over the tributary watersheds are capable of overtopping the ditch and canal system, and damaging adjacent farmland and urbanized areas. Additionally, low lying areas in the mid-region of the floodplain that typically do not flood from overtopping events will pond stormwater that cannot gravity flow into the interior flood control system when its ditches and canals are full of flow from tributary streams. This inability to get water into the interior flood control system also causes flood damages across the study area.

Figure 1 The study area



In 1965 a flood protection project was authorized for East St. Louis and Vicinity, Illinois, to provide protection in the bottoms from flooding caused by local storm events. In 1976 Blue Waters Ditch, a segment of the authorized project was reevaluated, and in 1989 new and improved drainage channels and a pump station were constructed to eliminate flooding from about 700 acres of the original 136,000-acre Project area. In 1984 a reevaluation of the recommendations contained in the 1965 report for the Cahokia Canal and Harding Ditch drainage areas found them not to be economically justified.

In the mid 1990's when interior flooding again became a major issue in the area, it was realized that the un-constructed portions of the authorized project would still not be economically justified. However, by 1998 the Corps was participating with Region 5 of the U. S. Environmental Protection Agency and interested local parties in the MetroEast area on issues related to urban sprawl, smart growth and watershed planning. During this timeframe a second re-evaluation of the un-constructed portions of the 1965 authorized project was initiated. It was determined at the outset that a completely fresh look of the existing problems and opportunities needed to be made, as there had been substantial changes in the existing conditions since the 1965 report was prepared.

In 2000, the project for flood protection was modified to include ecosystem restoration as a project purpose. The purpose of ecosystem restoration activities in the Civil Works program is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. The intent of restoration is to partially or fully reestablish the attributes of a naturalistic, functioning, and self-regulating system. Restoration opportunities most appropriate for Corps involvement are associated with wetlands, riparian and other floodplain and aquatic systems.

When Europeans began settling the study area about two hundred years ago, the Mississippi River floodplain and adjacent tributary watersheds supported a high level of biodiversity. On the floodplain, backwater lakes, sloughs, and marshes punctuated broad expanses of forest and prairie. Streams beginning in upland forests and prairies meandered across the floodplain to discharge into the Mississippi. Forest typically comprised the riparian corridors along rivers and streams. Wetlands consisted of shallow ponds, forested wetlands, wet prairies, and marsh. Seasonal flooding from the Mississippi River and tributary streams inundated the floodplain to various degrees from year to year. The dynamic process of flooding was accompanied by other periodic natural disturbances, such as wildfire and drought. These disturbances were important because they maintained biological diversity, growth and productivity. Wetlands performed various functions, such as temporary storage of surface water, maintenance of habitat for numerous plant and animal species, and export of organic carbon.

Under current conditions, the study area lies within the largest concentration of industrial, commercial, and residential land use on the Mississippi River floodplain north of New Orleans. Development has greatly affected historic ecosystem structure, function, and dynamic processes. By area, about half of all lakes and ponds are gone, about two-thirds of forests, wetlands, and floodplain streams no longer exist, and virtually all historic prairie has disappeared. Remaining resources are fragmented and degraded. Many wetlands have become isolated from historic sources of flooding because riverine overflow has been engineered out of today's environment. Due to their isolation, wetlands no longer temporarily store much surface water.

The lack of significant periodic flood disturbances or flood pulses jeopardizes the sustainability of floodplain resources and the maintenance of characteristic plant and animal communities. Development in tributary watersheds has also degraded tributary streams, where channel and bank instability diminish in-stream habitat quality and give rise to excessive levels of sediment transported by storm water to the floodplain.

Despite these changes, remaining aquatic resources in the study area are significant at the national and regional scale. Such resources include the 2,000-acre Horseshoe Lake, about 6,000 acres of wetlands in the lake's vicinity, and over 200 miles of tributary streams. Sources of significance are technical and institutional, and include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Clean Water Action Plan, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and several international bird conservation initiatives supported by the Federal government to protect a variety of bird species of concern. Technical significance is based on the ecological concepts of connectivity and status and trends.

The recommended plan would restore significant ecosystem structure, dynamic processes, and function to aquatic resources in the study area at a watershed level. About 4,700 acres of forests, prairies, marshes, scrub-shrub wetlands, and lakes and ponds would be restored at eight proposed floodplain habitat restoration sites. Restoration activities would improve about 2,300 acres of existing, degraded habitats, and recreate about 2,400 acres of wetlands and floodplain habitats at sites where they formerly occurred that are now agricultural. About 11 miles of floodplain streams would be restored within the floodplain habitat areas, and about 178 miles of streams in the tributary watersheds would be restored. Introducing storm water from tributary watersheds into the proposed habitat restoration areas, thereby mimicking the historic flood pulse, would restore the dynamic process of flooding. The plan would make significant contributions to the national and regional plans and programs outlined above. By restoring ecosystem functions at a watershed level, existing problems and opportunities including those identified by the public could best be addressed.

The MetroEast Sanitary District has been the local sponsor for this General Reevaluation Study. As a reevaluation of an authorized project, the Planning, Engineering and Design costs were shared on a 25% non-Federal and 75% Federal basis.

STUDY AUTHORITY

The East St. Louis and Vicinity, Illinois Flood Protection Project was specifically authorized (and modified) through Congressional actions in 1965 under Section 204 of the Flood Control Act of 1965, (Public Law 89-298) and subsequently under the Water Resources Development Act of 1976 (Public Law 94-587). Section 204 of the Flood Control Act of 27 October 1965 (Public Law 89-298) provides that:

"The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein. The necessary plans, specifications, and preliminary work may be prosecuted on any project authorized in this title with funds from appropriations hereafter made for flood control so as to be ready for rapid inauguration of a construction program. The projects authorized in this title shall be initiated as expeditiously and prosecuted as vigorously as may be consistent with budgetary requirements. Penstocks and other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this Act for construction by the Department of the Army on the recommendation of the Chief of Engineers and the Federal Power Commission."

UPPER MISSISSIPPI RIVER BASIN

"The project for flood protection at East St. Louis and Vicinity, Illinois, (East Side Levee and Sanitary District), is hereby authorized substantially, as recommended by the Chief of Engineers, in House Document Numbered 329, Eighty-eighth Congress, at an estimated cost of $6,180,000."

The Water Resources Act of 1976 (Public Law 94-587) provides that:

"An Act"

"Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,"

"Sec. 137. The project for flood control in East St. Louis and Vicinity, Illinois, authorized by Section 204 of the Flood Control Act, approved October 27, 1965, is hereby modified to authorize the Secretary of the Army, acting through the Chief of Engineers, to construct the Blue Waters Ditch segment of the overall project independently of the other project segments. Prior to initiation of construction of the Blue Waters Ditch segment, appropriate non-Federal interests shall agree, in accordance with the provisions of section 221 of the Flood Control Act of 1970, to furnish non-Federal cooperation for such segment."

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Blue Waters Ditch in 1976. The results showed that the Blue Waters Ditch portion of the authorized project was still economically justified with a benefit to cost ratio of 1.35 to 1. Blue Waters Ditch was completed in 1989 and includes 4.4 miles of new/improved drainage channels and a 600 c.f.s. pump station, which eliminates flooding from an estimated 700 acres of approximately 136,000 acres of the original project area.

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Cahokia Canal and Harding Ditch Areas in 1984. This evaluation found the recommendations contained in the authorized project to not be economically justified under the existing interest rate at that time of 8 1/8 percent.
Major interior flooding in the study area resulted in four disaster declarations during the period 1993 to 1996. As a result, the 104th Congress, 2d Session provided funding via House Report 104-782, Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1997, to initiate a reevaluation of the authorized project.

PURPOSE AND SCOPE OF STUDY

In broad terms, the purpose of this Study is to re-examine the Cahokia Canal and Harding Ditch areas of the authorized East St. Louis and Vicinity, Illinois Project under current conditions, existing authorities, and Executive Branch priorities with a view towards looking for new solutions to old problems. The principal goal is to identify potential improvements to the natural system for ecosystem restoration and to address related land and water resources problems and opportunities.

The Study follows the Corps' methodology for the reevaluation of a feasibility report. In general, the previous study information was examined and updated to current and future without project conditions. Additionally, an analysis of the pre-levee condition (ca. 1800) was made in order for a full array of ecosystem alternatives to be understood and explored that might best achieve study objectives.

Through a series of public and agency involvement activities, objectives for the ecosystem restoration project were identified and existing baseline data gathered for use in the formulation of alternatives and their analyses. As an outgrowth of utilizing existing Corps' policy guidance and extensive coordination among project partners, environmental restoration benefits were utilized to measure, evaluate and compare alternative plans through the application of an incremental cost analysis methodology. The Waterways Experiment Station's (WES) Integrated Bio-Economic Planning System (IBEPS) was used in conjunction with the Institute for Water Resources' (IWR) method of cost effectiveness analysis for environmental planning. In addition to Corps' expertise, the Study Team included biologists from partnering agencies. They included representatives from: the U.S. Environmental Protection Agency, Region 5; the U.S. Fish and Wildlife Service, Region 3; the Natural Resources Conservation Service, Illinois; and the Illinois Department of Natural Resources. The Study Team was augmented throughout the reevaluation process by technical experts from respective resource agencies as needs arose.

Since a feasibility report normally does not include a significant level of detail and thus, includes an inherent level of uncertainty, the GRR documents the resultant uncertainties involved with plan selection and with the future tasks that will be needed to minimize these uncertainties. Engineering and real estate cost estimates have been based upon the analyses and assumptions made during the process of formulating and developing components of the recommended plan. Uncertainties in design details could impact future alternative analyses and subsequent design and cost estimates. As a result, the Study Team decided, in consultation with the Environmental Protection Agency and the U.S. Fish and Wildlife Service, that a Programmatic Environmental Impact Statement would be most appropriate for this report because of the size of the study area and complexity of ecosystem features. However, after review of the draft report, these agencies agreed that the level of information provided was able to satisfy the requirements for preparation of an Environmental Impact Statement. It was determined following this review that the project should follow a tiered evaluation approach to accomplish future NEPA requirements.

In order to clarify a potential area of confusion, the term "Study" in this report refers to the General Reevaluation Study as addressed in the more detailed "East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project General Reevaluation Report with Integrated Environmental Impact Statement" mentioned above. The term "Project" refers to the congressionally authorized but un-constructed segments of the East St. Louis and Vicinity, Illinois Flood Protection Project (as amended) known as the Cahokia Canal and Harding Ditch Drainage Areas upon which the General Reevaluation Study is based.

RELATED PROJECTS AND STUDIES

Existing Authorized Project. The East St. Louis main line flood protection system, authorized by the Flood Control Act of 1936, has been essentially complete for many years. Its features are approximately 19.8 miles of levee/floodwall improvements including: 6.1 miles of reconstructed riverfront levee, 4.8 miles of upper flank levee; 4.9 miles of lower flank levee; 0.9 miles of new riverfront levee; and 3.1 miles of riverfront floodwall. Complementary appurtenant works consist of gravity drainage structures at highway crossings, alterations and reconstruction of existing pumping plants, construction of new pumping plants, servicing of access roads on the levee crown, seepage corrective measures, and alterations to railroad tracks and bridges at levee crossings. The project levee grade (52 feet on the Market Street gage) affords protection against a flood with a 500-year return period.

Prior Corps' Studies. In 1957, the Corps was authorized to study the engineering and economic feasibility of improvements to the interior flooding problem in the study area. Completion of the study and a recommended plan were documented in a Survey Report published in 1962. The Survey Report plan recommended 14 separate features: improvement of four channel systems; the construction of five bottomland detention areas; the construction of one upland reservoir on Little Canteen Creek; the use of two existing lakes for storage; the construction of one new channel; and, the construction of a new pump station for the Blue Waters Ditch area. The modification of the interior flood control system based on the 1962 Survey Report was authorized by the Flood Control Act of 1965 and had four major components: Blue Waters Ditch, Cahokia Low Water Dam, Harding Ditch drainage area, and the Cahokia Canal drainage area.

The Water Resources Development Act (WRDA) of 1976 modified the 1965 Act by authorizing construction of the Blue Waters Ditch segment of the overall project independently of the other project segments. The Blue Waters segment was constructed in the 1980s.

Major repair work was done on the Cahokia Low Water Dam after the 1993 flood. The success of the repair will likely preclude the need to replace the low water dam as was originally authorized. The Harding Ditch and Cahokia Canal segments, the subject of this reevaluation study, were studied in the 1980s and resulted in a revised unpublished draft report in 1985. The conclusion stated in the document was that there is no economic justification for these two segments. The recommendation in the report was for those segments to be reclassified as inactive. However, due to severe flooding in 1995 through 1997 on the Harding Ditch and Cahokia Canal segments, a new Congressional appropriation in 1997 initiated a re-start of a general reevaluation of the interior area.

Other Related Projects. Due to intense local interest, the State of Illinois became involved in the flooding problems of the Dobrey Slough area. Flooding in the Dobrey Slough area was a problem from both surface water and from a rising groundwater table. In 1974, the State provided a solution for the more frequent surface water flooding through the installation of a small pump station that discharged into the Nameoki Ditch system.

Next, during a Mississippi River flood event, which occurred in October 1986, a roller gate failed at the East St. Louis Pumping Station, resulting in river water backing into East St. Louis. This caused 1200 persons to be evacuated from their homes, and flood damages estimated at $35 million. This disaster helped focus attention on the need for rehabilitation of the very deteriorated flood protection system, and led to the authorization of the Corps' "East St. Louis Flood Protection Rehabilitation Project." The majority of the rehabilitation took place along the mainline Mississippi River protection, but channel rehabilitation in the bottoms was also an authorized purpose. Much of the work has been completed, however, relief well rehabilitation is currently under contract and cleanout of the upper portion of Canteen Creek is about to get underway. A supplemental report with additional rehabilitation items has been prepared.

Finally, after a large rainfall event in May 1995, significant interior flooding occurred throughout the bottoms area. This disaster reiterated the need to rehabilitate the deteriorated condition of the interior flood protection channels that were choked with vegetative growth and sediment. FEMA funded a $5 million cleanout of many of the major ditches in the bottoms. $4 million more has spent on rehabilitation of many of the major ditches under the Corps Rehabilitation Project.

Related Studies and Reports by Others. In 1950, the Illinois Department of Public Works and Buildings' Division of Waterways issued a report entitled, "Proposed Hillside Diversion Project, Madison and St. Clair Counties, Illinois." The report included a recommendation for a project that included a bluff-line diversion channel, floodway enlargements, pumping station improvements, and run-off impoundments within the bottoms area of their study area.

In 1970, the Illinois Department of Transportation's Division of Water Resource Management completed a draft report entitled, "Flood Control Project For East St. Louis and Vicinity, Illinois," which incorporated the most desirable features of the 1950 report and added to this earlier plan, a reservoir on Prairie Du Pont Creek at the bluff line and the proposed deepening and widening of the Prairie Du Pont Diversion Channel.

In November 1972, the Illinois Department of Transportation issued a report entitled "Request for Public Law 99 Assistance, Dobrey Slough Flood Water Conduit". This report proposed a floodwater conduit to reduce flooding in the Dobrey Slough area.

In August 1975, the Southwestern Illinois Metropolitan and Regional Planning Commission issued a report entitled "Plan for Major Drainage: The American Bottoms and Hillside Drainage Area Planning Basin". The report proposed alternatives for reducing stormwater flooding in both the Cahokia Canal and Harding Ditch watersheds.

In December 1978, the Illinois State Water Survey issued a report on the analysis of the inflow hydrology of Horseshoe Lake. The report describes the drainage history of the lake, its hydrologic modeling, inflow frequency analysis, and hydrologic budget.

In August 1986, Hurst-Rosche Engineers, Inc. completed a report commissioned by the Metro-East Sanitary District (MESD) to identify the scope of rehabilitation and improvements needed to restore the flood control facilities under MESD operational control. The MESD's commissioning of the report was prompted by the failure of the roller gate at the East St. Louis Pumping Station in October 1986. The Hurst-Rosche report was used as a starting point to get the Corps' involved in the rehabilitation of the project.

Between 1990 and 1995 the Natural Resource Conservation Service (NRCS) in Madison and St. Clair Counties completed 6 planning studies that were designed to address flooding and sedimentation caused by erosion in the project area. However, no projects resulted from these studies:

Little Canteen Creek/Harding Watershed, May 24, 1995
Big Canteen Creek Hydrologic Unit Resource Plan February 9, 1995
Schoolhouse Branch Watershed Resource Inventory and Alternative Evaluation, September 15, 1995
Long Lake Watershed Resource Inventory and Alternative Evaluation, July 25, 1995
Judy's/Burdick Branch Watershed Resource Inventory and Alternative Evaluation, September 1, 1995

RESOURCE SIGNIFICANCE IN STUDY AREA

Aquatic resources of national and regional significance are found in the Project area. They include aquatic features such as 2,000-acre Horseshoe Lake, over 6,000 acres of various wetlands on the Mississippi River's floodplain, and over 200 miles of streams in small tributary watersheds. The national and regional level of significance attributed to these resources comes from institutional and technical sources. Sources of significance for the Project area's aquatic resources are described below.

North American Waterfowl Management Plan. Because the study area's aquatic resources are within a waterfowl habitat area of major concern designated under the North American Waterfowl Management Plan, and within a joint venture area approved under the Plan, their institutional significance is recognized from both a national and international perspective. Additionally, the study area's aquatic resources exist within a priority or focus area designated in the Upper Mississippi River/Great Lakes Region Joint Venture Implementation Plan, which recognizes their institutional significance from a regional perspective. Based on technical recognition, Horseshoe Lake and surrounding wetlands are significant from a state perspective because they are important resources for migratory waterfowl in terms of connectivity. At the landscape level, the lake and its surrounding wetlands serve as an important link in a chain of habitats used by migratory waterfowl along the Mississippi flyway. Based on public recognition, Horseshoe Lake is locally significant because of the hunting opportunities it offers to the public, and because the Illinois Chapter of Ducks Unlimited, Inc., supports wetland enhancement opportunities at the lake.

Upper Mississippi River System Environmental Management Program. Because the study area's aquatic resources on the Mississippi River's floodplain are located within the floodplain of the Upper Mississippi River System, they can be recognized as part of a nationally significant ecosystem. Also, because these resources are within an area of the UMRS targeted for habitat restoration under the Upper Mississippi River Environmental Management Program, its natural resources can be recognized as institutionally significant from a regional perspective. In addition, floodplain prairies, hardwood forests, marshes, and deep backwaters within the study area can be recognized as technically significant from a regional perspective based on status and trends as described in the UMRS-EMP's recent Habitat Needs Assessment.

Clean Water Action Plan. The small watersheds within the Study area are designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan and are recognized as institutionally significant from a national perspective.

Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Because the study area is located on the floodplain of the Mississippi River north of the Ohio River, it occurs in an area highlighted by the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force as potentially important to contributing to the Action Plan's goals of reducing nitrogen loads to the Gulf of Mexico and improving waters within the river's basin. As such, the study area and its aquatic resources can be recognized as institutionally significant from a regional perspective.

Given the potential to implement one of the Action Plan's recommended actions in the study area, namely the restoration of floodplain wetlands, further significance is associated with the study area and its aquatic resources.

Conservation Initiatives for Bird Species of Concern. Aquatic resources within the Study area serve as migratory, wintering, or breeding habitat for 34 bird species of concern. The cause of concern is the species' declining population levels. The Study area's aquatic resources also support two Federally threatened species (a bird and a plant). The listing of certain migratory birds as species of concern by the U.S. Fish and Wildlife Service illustrates that the Federal government recognizes them as highly significant. Their institutional significance is further supported by various international agreements the Federal government has entered into with Canada, Mexico, and other countries to foster continental and regional bird conservation strategies. Technical significance is supported because aquatic habitats in the study area and along the Mississippi River also serve as habitat for these 34 bird species of concern as well as the two federally threatened species.

PRE-DEVELOPMENT STUDY AREA CONDITIONS

This section provides an overall characterization of the conditions that existed in the Project area about two hundred years ago (ca. 1800), prior to construction of the Mississippi River levee system and prior to drainage and development activities in the East St. Louis floodplain. The Project Team determined that it was important to understand how the ecosystem of the Project area functioned prior to recent human development in order to realize how the functioning of the natural ecosystem has been impacted by human activity. This information provides a key to guide potential ecosystem restoration.

Topography. Erosional and depositional forces have shaped the natural topography of the Project area over the last 7,000 years. The area has three main topographic areas: the relatively level alluvial flood plain of the Mississippi River; the upland bluff area of steep erodible slopes and narrow valleys; and the rolling hills of the uplands.

The Project area is primarily located within a portion of the Mississippi River floodplain known locally as the "American Bottom", and includes western portions of Madison and St. Clair Counties. The American Bottom extends beyond the Project area boundaries going farther north up to Alton and south into Monroe County near Dupo. The American Bottom covers approximately 175 square miles (112,000 acres). The area is approximately 30 miles long and 11 miles wide at its widest point. The topography in the floodplain is nearly level bottomland. The floodplain generally slopes to the south and drops in elevation approximately 0.5-foot per mile mirroring the Mississippi River surface profile. The floodplain typically exhibits river meander scars, abandoned channel oxbow lakes, low-relief ridges, and swales. The average elevation to the north near Alton is 415 feet above the National Geodetic Vertical Datum (NGVD) and to the south near Dupo is 405 feet NGVD. In the northern portion, there are terraces located along the foot of the bluff between East Alton and Roxana. The terraces are approximately 25 to 35 feet above the floodplain with elevations between 440 and 450 feet NGVD. The Project area north of Horseshoe Lake is typically higher than the adjacent floodplain with elevations between 420 and 435 feet NGVD.

The topography near the Illinois bluff on the eastern edge of the floodplain is generally higher than the adjacent floodplain with elevations between 435 and 465 feet NGVD. The bluff rises steeply between 150 to 200 feet above the floodplain. The bluff has a rather rugged topography with the drainage channels forming valleys with steep slopes. Beyond the bluff line the topography consists of rolling hills and valleys with elevations ranging between 500 and 600 feet NGVD.

System Hydrology/Watershed Characteristics. Two major rivers, the Mississippi and Missouri, carried drainage from major portions of the North American continent past St. Louis. The drainage area of the Mississippi River at St. Louis is nearly 700,000 square miles, and that of the Missouri River is about 530,000 square miles. Flooding from the Mississippi and Missouri Rivers frequently inundated large areas of the American Bottom.

Over 500 square miles of tributary or bluff watersheds drained into the study area in pre-settlement times (Figure 2, Table 1). Cahokia Creek was the major tributary watershed. Tributary streams emptied onto the bottoms. Drainage generally flowed toward the Mississippi River and was intercepted by swales, creeks, and major channels. The naturally flat topography in the bottoms was a major factor for the existence of wide meandering creeks and overland flows across the Project area. Abandoned river channels and swales held water that formed large lakes and wetlands. The natural channels had very little slope and were not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River.

Three distinct natural watersheds were present on the floodplain of the Mississippi River in the American Bottom. The Cahokia Creek watershed was larger than either the Wood River or Prairie du Pont watersheds. Figure 3 displays these three watersheds, along with streams and floodplain lakes.

Sediments were transported during predevelopment times into and out of the Mississippi River floodplain. Flows from the tributary streams carried eroded sediments from the uplands and bluffs onto the American Bottom. Where each tributary discharged onto the floodplain, a colluvial fan consisting of heavier sediments formed. Finer grained sediments were carried further out into the floodplain, and eventually dropped out in the meandering channels or on adjacent lands during overland (out-of banks) flows. Flood events from the Mississippi and Missouri Rivers also deposited alluvial materials on the floodplain. Large high-velocity flood events from these major rivers also periodically scoured out portions of the floodplain. A dynamic balance existed between aggradation (filling) due to sediment deposition and degradation (deepening) due to scouring. Although some low areas represented by lakes, sloughs, or wetlands filled up over time with sediments, new ones were created concurrently at other locations.

Figure 2 Historic Tributary Watersheds of the American Bottom

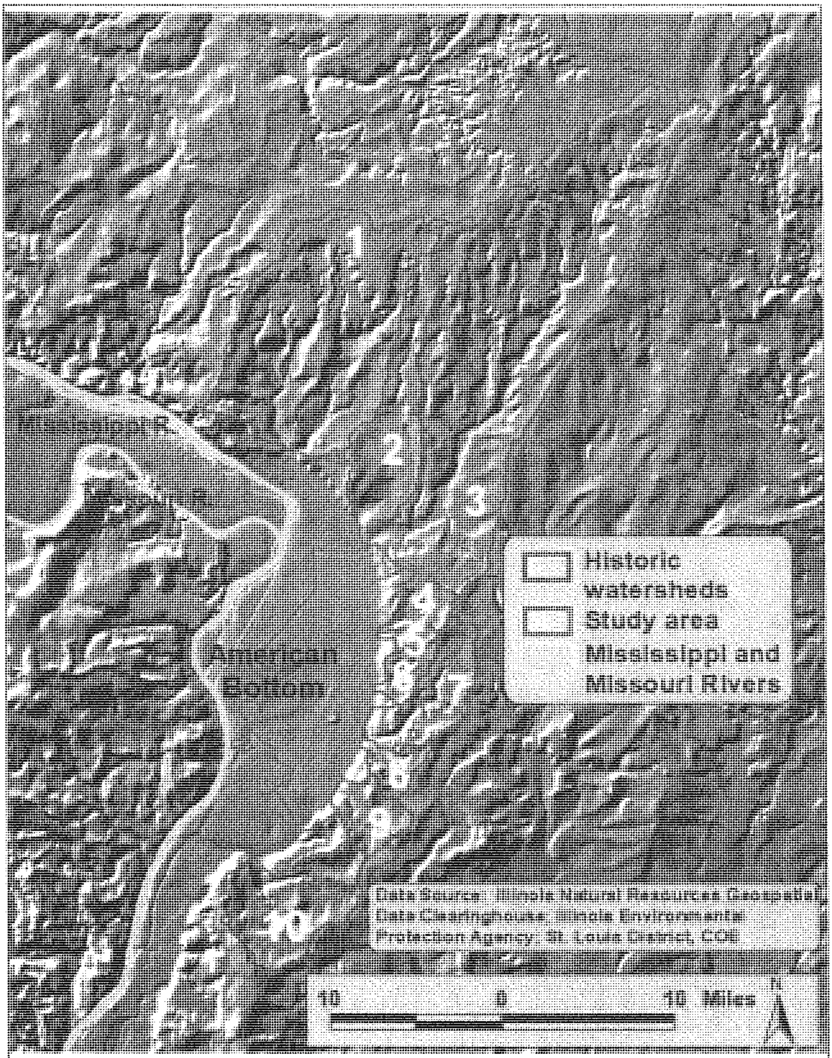
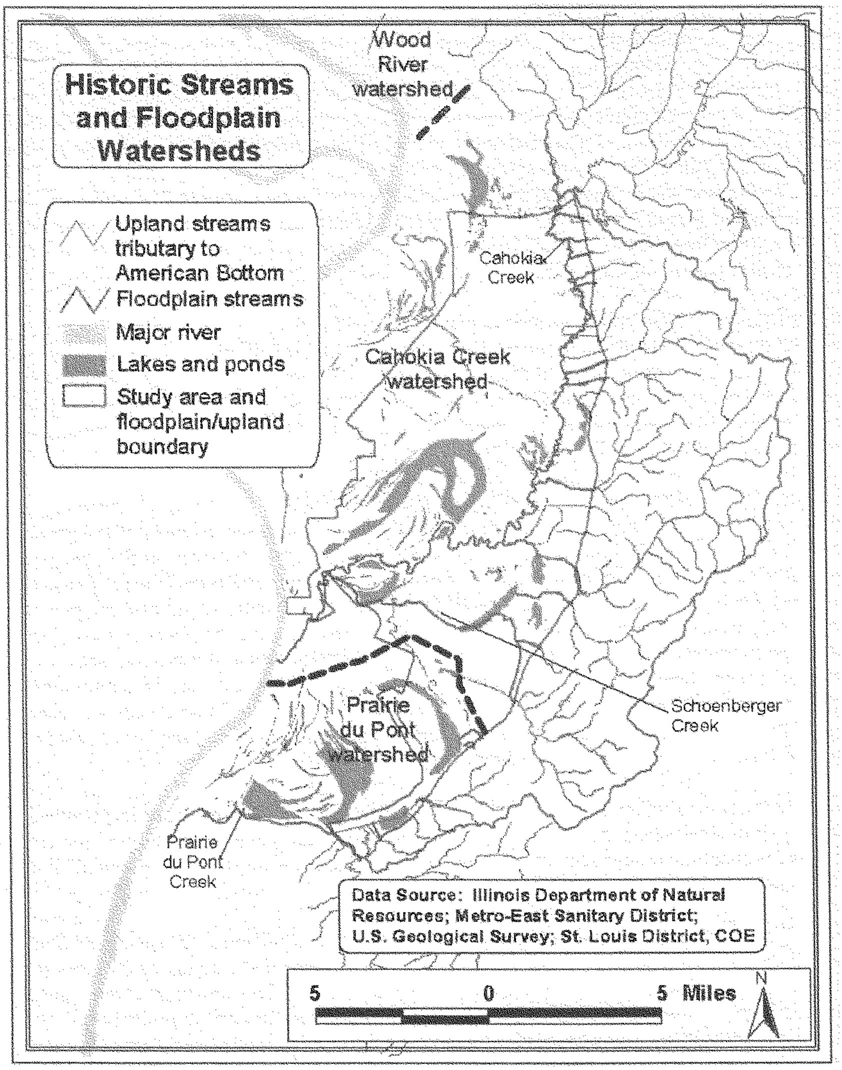


Table 1 Tributary Watersheds that Historically Drained into the American Bottom

Watershed number (Figure 2)	Name of Watershed	Area (sq. miles)	Percent of all watersheds
1	Wood River	121.4	23.8
2	Indian Creek	40.2	7.9
3	Cahokia Creek	217.0	42.6
	Bluff 1	4.5	0.9
4	Judy's Branch	8.5	1.7
5	Burdick Branch	2.9	0.6
	Bluff 2	1.0	0.2
6	Schoolhouse Branch	7.1	1.4
	Bluff 3	1.6	0.3
	Bluff 3/4	<0.1	<0.1
7	Canteen Creek	22.7	4.5
8	Little Canteen Creek	7.9	1.6
	Bluff 4	1.5	0.3
9	Schoenberger Creek	12.1	2.4
	Bluff 5	1.5	0.3
(10)	Powdermill Creek	1.3	0.3
(10)	Bluff 6	1.8	0.4
10	Prairie du Pont Creek (including Hickman Creek)	56.2	9.0
Total		509.4	100.0

Figure 3 Historic Streams and Floodplain Watersheds



Geomorphology. Locally, the Mississippi River is quite old, and probably was established during the Mesozoic Era, and at the very latest during the Tertiary Period of the Cenozoic Era. The Mississippi River maintained its course at the eastern edge of the Ozark Plateaus (uplift) and eroded a broad bedrock valley bottom ranging in elevations between 290 and 310 feet NGVD with an average elevation of 300 feet NGVD, some 300 feet below the surrounding uplands. The eastern bluff has exposed bedrock outcroppings consisting of hard limestone deposits and softer deposits of shale, coal, and some sandstone. The limestones were formed during the Mississippian Period and are located north of Alton, Illinois, and south of Dupo, Illinois. Between Alton and Dupo, soft Pennsylvanian Period shales, coals, and some sandstones extend westward into St. Louis, Missouri, much like a tongue. It is this tongue of weaker shales and coals that enabled the young Mississippi River to cut a wider floodplain (11 miles wide at its widest point), which it was unable to do either upstream and downstream through harder limestone deposits.

Physiography. The Project area is located in part in two geological provinces, Ozark Plateau on the west, and Central Lowlands on the east. The uplands are in the Springfield Till Plain of the Central Lowlands. The Springfield Till Plain was formed by Illinoisan glacial drift that formed a nearly level surface, except where stream dissection has taken place. Narrow flat-topped divides, V-shaped valleys, and slopes of up to 35 percent characterize the bluff. The area has a mean slope of eight degrees and an average local relief of 132 feet.

Stratigraphy. The geologic history of the Project area is divided into three main periods: (1) bedrock formations formed during the Paleozoic Era; (2) deposition of the unconsolidated glacial materials occurring during the Pleistocene Series; and (3) erosion and deposition of the unconsolidated materials occurring, and modern soils formed during the Recent Epoch. During the Paleozoic Era, the Project area, as well as most of the Midwest, was intermittently submerged beneath the sea. Responding to continental tectonic activity with continental plate movements in the nearby Ozark Plateaus and the more distant Appalachian Mountains to the east, the seas alternately advanced, depositing sedimentary rocks, and retreated from the area. This migration of seas brought periods of marine deposition, followed by times of erosion. These events are recorded in some 1,500 to 3,000 feet of sedimentary rocks, mostly limestone, shale and sandstone, which underlie the glacial and Recent Epoch aged sediments.

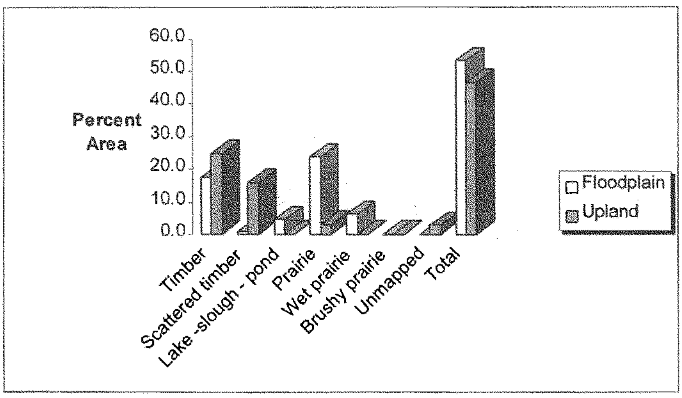
The upland areas of the Project area are covered with glacial till and outwash of sands, gravels, and silts that vary in thickness from zero to over one hundred feet. The Banner Formation of the Kansan Stage probably overlies much of the bedrock of the Project area. The extent and thickness of this formation is unknown.

The Recent Epoch generally is accepted to begin at the end of the last ice age, Wisconsinan Stage. It defines all deposits younger than the top of the Wisconsinan Stage and extends 7,000 years B.P. to the present. The upper portions of the surficial soils within the Project area were formed during the Holocene Stage. However, the lower portion of some of the surficial soil deposits were aggrading during the Wisconsinan Stage since as soon as the glaciers melted away, an assortment of soils were being deposited. In many areas the soils were intermixed, overlapped, and intertongued. The boundaries between Wisconsinan Stage and Recent Epoch deposits are blurred.

Ecological Conditions. Before Europeans settled the study area about 200 years ago, the Study area's ecosystem was vibrant and diverse. Water played a significant role in sustaining the ecosystem and its resources. Mississippi River floods, overflows from tributary streams, rainfall and local runoff all provided periodic disturbances in the form of flooding at various times of the year. These actions, coupled with the occurrence of fire, provided the natural system with the maintenance necessary to ensure its biological integrity. The historic dynamics that contributed to the functioning of the predevelopment ecosystem provide an insight into ways in which improvements can be made to reintroduce missing components, improve habitat quality and ecological function, and recreate a sustainable ecosystem.

Prairie and forest were the dominant forms of land cover during predevelopment times. Land cover of the historic ecosystem has been reconstructed using notes taken by General Land Office surveyors that worked in the area in the early 1800s to establish the public land survey system on the ground. Figure 4 is a map showing six types of land cover in the Project area. They include timber, scattered timber, lake-slough-pond, prairie, wet prairie, and brushy prairie. Nearly 60 percent of the Project area was forested while about 33 percent consisted of different kinds of prairie (Table 2). Aquatic areas, including lakes, sloughs and ponds, covered about five percent of the Project area. About two-thirds of all forest in the Project area occurred in the uplands. Over 90 percent of all kinds of prairie were in the floodplain. All of the lakes, sloughs, and ponds were in the bottoms. A large floodplain lake (called Horseshoe Lake today) comprised most of this water. Additionally, nearly all of the scattered timber was in the uplands, and all the wet and brushy prairies were in the bottoms.

Table 2 Predevelopment Land Cover in the Project area



A better understanding of historic plant and animal communities has been obtained by determining the kinds of natural communities that most likely existed, using the classification system recently developed by the Illinois Natural Area Inventory. Historic community classes included forest, prairie, wetland, lake and pond, stream, cultural, and possibly savanna (Table 2). About 25 kinds of natural communities probably were present in the study area, excluding cultural ones. At least a dozen different natural communities occurred in both the Mississippi River floodplain and tributary watersheds (uplands). The wetland, lake and pond, and stream community classes represent aquatic resources that were present, along with those natural communities in the forest and prairie community classes that occurred on hydric or wetland soils. In addition to marshes, shrub swamps, and ponds, there were variants of forests and prairies that were wetlands, and they are marked in Table 3 with an asterisk. The various kinds of natural communities were associated with differences in geomorphology, topography, and soils. Many of them were influenced by periodic disturbances in the form of flooding and wildfire.

Figure 4 Predevelopment Land Cover of the Study Area

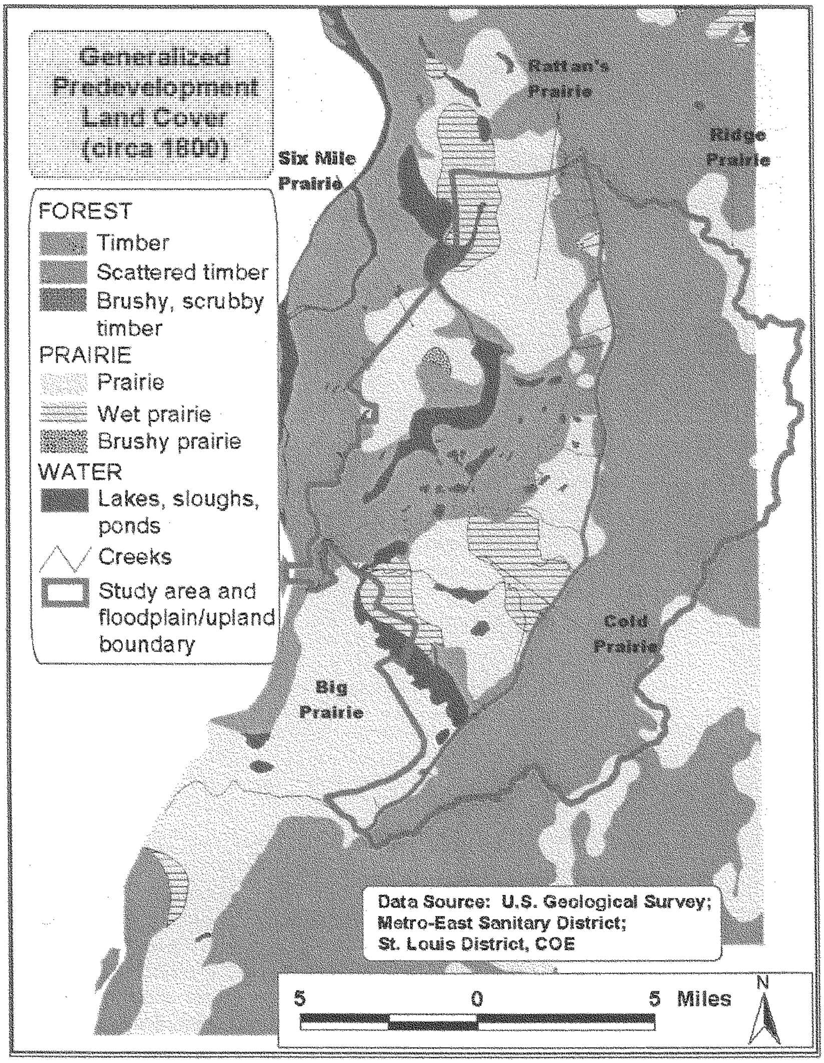


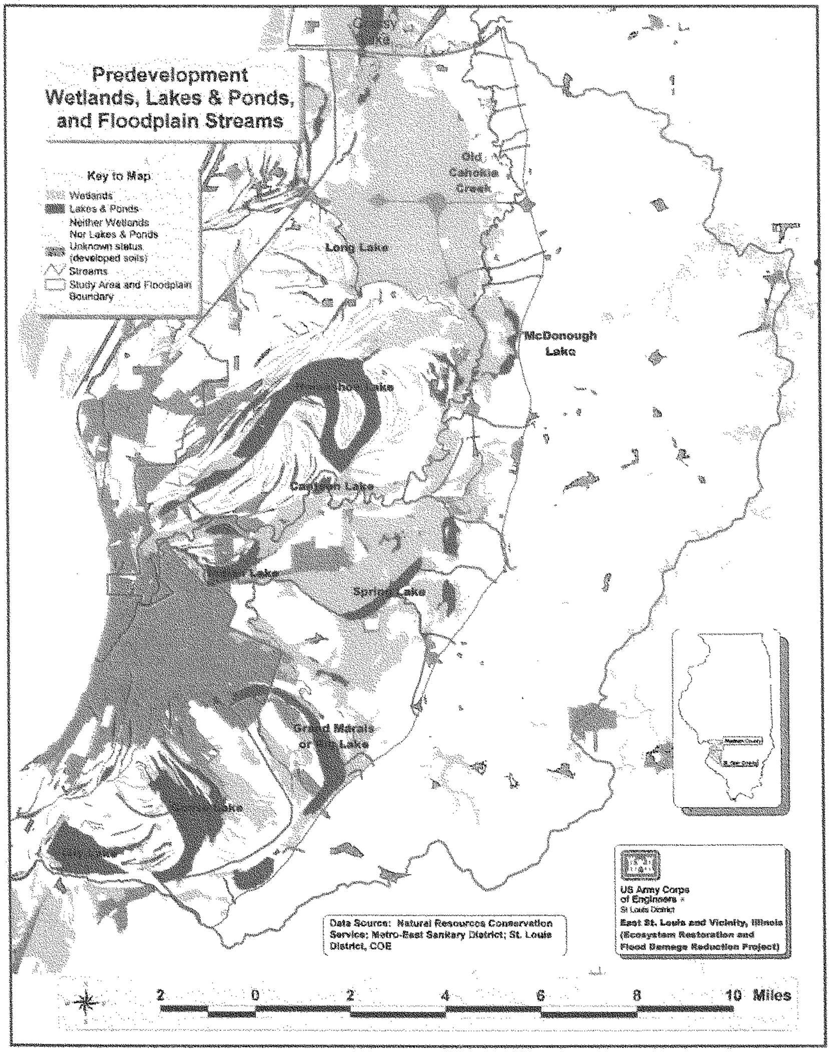
Table 3. Community Classes and Natural Communities of the Predevelopment Study Area (ca. 1800), using the Illinois Natural Areas Inventory Classification System. (1)

Community Class	**Natural Community (2)**	**Mississippi River floodplain**	**Adjacent tributary watersheds**
Forest	Dry upland forest		?
	Dry-mesic upland forest		√
	Mesic upland forest		√
	*Wet-mesic upland forest		√
	Mesic floodplain forest	√	√
	*Wet-mesic floodplain forest	√	√
	*Wet floodplain forest	√	?
	Mesic sand forest	√	
Prairie	Dry prairie		?
	Dry-mesic prairie		√
	Mesic prairie	√	√
	*Wet-mesic prairie	√	√
	*Wet prairie	√	?
	Mesic sand prairie	√	
	Loess hill prairie		√
Savanna	Dry-mesic savanna		?
	Mesic savanna		?
Wetland	*Marsh	√	
	*Shrub swamp	√	
Lake and Pond	*Pond	√	
	Lake	√	
Stream	High-gradient creek		√
	Medium-gradient creek		√
	Low-gradient creek	√	√
	Low-gradient river	√	
	Major river	√	
Cultural	Pastureland	?	?
	Successional land	?	?
	Developed land	?	?
	Cropland	?	?

(1) Questionable communities indicated by "?"
(2) Natural communities that are wetlands preceded by "*"

Wetlands were a significant component of the historic ecosystem. The spatial extent of presettlement wetlands is displayed in Figure 5. Wetland soils comprised nearly 23 percent of the Project area, as determined from digital modern soil surveys. About 95 percent of these wetland soils occurred in the floodplain. Two-thirds of the Project area was comprised of non-wetland soils, and nearly 66 percent of those occurred in the uplands. About 40 percent of the bottoms consisted of wetland soils, and another seven percent of water. In the uplands, nearly 95 percent consisted of nonwetland soils, roughly two percent of wetland soils, and about one percent of water.

Figure 5 Predevelopment Wetlands, Lakes & Ponds, and Floodplain Streams



Flora And Fauna. A high level of species diversity was characteristic of the Project area and its vicinity. The juxtaposition of two major landforms, floodplain and uplands, and the localized physical variations in each, created the setting for an abundance of life forms to exist.

"Mammals" included more than 45 species which lived in the area, including opossum, rabbit, and various shrews and moles, bats, rodents, carnivores, and ungulates (those with hoofs). They utilized all habitats, from forests, prairies, and herbaceous wetlands, to creeks and lakes. Other than a few bat species that migrated, they lived there year-round.

"Birds" included about 285 species that inhabited the Project area and environs. They belonged to many taxonomic groups, included the loons, grebes, pelicans and cormorants, egrets and herons, geese and ducks, hawks and falcons, gallinules, rails, shorebirds, gulls and terns, doves, parakeets, cuckoos, owls, nighthawks, swifts and hummingbirds, woodpeckers, and the diverse songbirds. Like mammals, they made use of all terrestrial, wetland, and aquatic habitats. Many bird species reproduced and stayed throughout the year. Others also raised young but then left before winter to migrate to warmer climates, returning the following year. Still other species passed through the area seasonally, on their way to distant breeding or wintering areas. The Mississippi River corridor was an important flyway for many migratory bird species.

"Fishes" included over 90 species that lived in the various creeks, rivers, ponds, and lakes in the Project area, including the Mississippi River. They were very diverse taxonomically, representing 24 families. Some species lived in the Mississippi River only, while others also used the adjacent standing waters on the floodplain. A few species were restricted to the small tributary streams. Many had broad ecological tolerances and inhabited tributary creeks, floodplain habitats, and the Mississippi River. During seasonal flooding, fishes were carried to aquatic areas on the floodplain, where some species spawned. Backwaters on the floodplain also served as winter refuges from cold, swift, main channel currents.

"Reptiles and Amphibians" included at least 65 species that occurred in the Project area. Reptiles consisted of various salamanders, toads, and frogs, and amphibians included a variety of turtles, lizards, and snakes. For these species as a whole, every habitat in the floodplain and uplands was exploited. Amphibians as a group needed some kind of aquatic habitat, such as a wetland, pond, lake, creek, or river, for breeding, yet the adults of many species also used nonaquatic areas, such as drier forests and prairies, for their other activities. Most turtles also required some type of aquatic habitat for survival. A number of lizards and snakes did not, and instead existed in terrestrial habitats such as forests and prairies. Some reptiles and amphibians made seasonal short-distance migrations between breeding habitats on the floodplain and drier habitats in the uplands.

"Plants" included a variety of vascular species that were found in the Project area. They included all the trees, shrubs, vines, forbs, grasses, and sedges. They formed the preponderance of vegetation that constituted the various natural communities described previously. Plants grew in all habitats, except for those places where either flowing or standing water prevented the establishment of either emergent or rooted floating water-tolerant species.

Ecosystem Disturbance Dynamics. A variety of natural disturbances, such as flooding, wildfire, drought and windstorms, occurred periodically during predevelopment times. Disturbances disrupt ecosystem, community, or population structure and change resources, substrate availability or the physical environment. Disturbances are important to some ecosystems, including those prone to flooding and fire because they are necessary in order to maintain biological growth and productivity. The flooding and wildfire disturbances that were common influences on the ecosystem around 1800 have been largely eliminated from today's environment.

Flooding Disturbances. Flooding varied on a continuum from small to very large, in terms of depth and duration. Because the watershed of the Mississippi River at St. Louis was so immense relative to the combined area of all the tributary watersheds that drained into the American Bottom, it was the primary source of flood pulses that inundated large portions of the floodplain. Flooding from the Mississippi River varied by season and from year to year. Floods could happen during any month, but they usually occurred in the spring (April-June) and fall (September-October). Springtime events were often higher and greater in duration. Low flow periods typically coincided with summer and winter. In many years, the Mississippi River rose and gently overflowed its banks, spreading out over the adjacent floodplain to a minor degree. On an infrequent basis it inundated much of the American Bottom.

Flood pulses are important to wetlands and other floodplain habitats for a variety of reasons. In riverine wetlands, they drive processes such as sediment deposition and nutrient transport. Flood pulses also serve as a temporary connection or link between the floodplain and river channel.

Wildfire Disturbances. Like flooding, wildfire also was a cyclical phenomenon during predevelopment times. Fires started naturally, as from lightning strikes, but they also were set by people, whether Native Americans or early settlers. When intentional, fire could be used to facilitate the hunting of wild animals, or to clear open areas under invasion from woody encroachment. Fires occurred any time of the year, depending on how dry conditions were, but were most prevalent in the fall and early winter.

Fire is important ecologically for maintaining the overall biological integrity of natural habitats adapted to it. In prairies and other herbaceous plant communities, fall or winter burning removed the build-up of dead aboveground plant parts such as leaves and stems, while underground root systems were protected and dormant until the next spring. Without periodic elimination of dead growth, the amount of each year's new growth would be reduced. Other effects of fire on prairie grasses include increased flowering, improved seed germination, and earlier emergence of new growth in the spring. Fire also suppressed the encroachment of trees into prairies. In forests, fire maintained plant species composition and diversity, and variably aged populations of trees. In all areas, nutrients bound in plant materials were released by fire to the soil as ash.

Ecosystem Function. The physical, chemical, and biological processes that occurred in the predevelopment ecosystem were necessary for self-maintenance, such as primary production, nutrient cycling, and decomposition. These processes reflected dynamics within the uplands, floodplain, and Mississippi River, and between these spatial entities. Seven functions described below serve as a foundation for understanding how wetlands were a vital component of the historic ecosystem. This knowledge can be applied in developing solutions to today's environmental and flooding problems and opportunities in the Project area.

Temporary Storage of Surface Water. In light of the flooding problems facing the Project area today, perhaps the most important wetland function intrinsic to the historic ecosystem was the ability to temporarily store floodwater. Due to properties such as width, slope, and roughness, riverine wetlands in the American Bottom routinely detained riverine overflow from the Mississippi River and adjacent tributary watersheds, and released it slowly back to the creeks and river. Aquatic areas (sloughs, lakes, ponds) associated with these riverine wetlands also received overbank floodwaters, and they performed this function. Likewise, nonwetland areas in the American Bottom that became inundated during the larger flood events also temporarily stored floodwater. Wetlands detaining overbank flows dissipate energy, and reduce the velocity of moving water. From a flood damage perspective, the capacity for erosion is reduced. Similarly, storage of riverine overflow in wetlands prolongs the passage of a flood event, and thereby reduces the peak discharge downstream.

Maintenance of Plant Community Characteristics. Another important wetland function was the maintenance of its own characteristic plant community, like that of forest, prairie, or marsh, which are distinct in terms of species composition and physical characteristics. Large areas of these various wetland plant communities existed in the American Bottom. They created much primary production in the form of plant biomass. The type of plant community affected other functions, such as wildlife habitat.

Provision of Wildlife Habitat. The various wetland plant communities served as habitat for many kinds of animals, ranging from macroinvertebrates to vertebrates. The composition and spatial complexity of the vegetation above ground affected the kinds of animals living there and their abundance. Forested wetlands exhibited vertical stratification (understory, subcanopy, overstory), and this structural complexity offered various opportunities for animals to find sites for shelter, nesting, breeding and foraging. Prairies and marshes had simpler structure, which offered opportunities for other species. At the landscape scale, the heterogeneity of wetland types in the American Bottom helped maintain higher levels of species diversity. The extensive spatial distribution of wetlands, and the linkages or connections that existed between different wetland types, facilitated the movement and dispersal of animals. Movements between wetlands, between wetlands and uplands, and between uplands (via relatively small, irregularly shaped wetlands) occurred, in addition to those between wetlands and aquatic areas. Nonwetland areas in the American Bottom also provided wildlife habitat.

Nutrient Cycling. Cycling of nutrients, a fundamental ecosystem function, consists of the abiotic and biotic processes that convert elements from one form to another; primarily recycling processes. In one process, nutrients are taken up from the soil in inorganic form by plants and transformed into organic forms during photosynthesis and growth. In another process, after the plant dies, these organic nutrients are converted back into inorganic form through microbial decomposition, for renewed uptake by plants. In ecological terms, the function is represented by net primary productivity and detritus turnover. Wetlands in the American Bottom performed this function. Nutrient cycling was also a fundamental process in nonwetland areas.

Removal of Elements and Compounds. Surface water can import natural nutrients (like nitrogen, phosphorus, or potassium), present-day contaminants (such as herbicides and pesticides), and other elements and compounds into wetlands. Once there, wetlands can permanently remove these materials from the water column, or immobilize them. The avenues by which they are removed or immobilized include sorption, sedimentation, denitrification, burial, decomposition to inactive forms, uptake and incorporation into long-standing woody and long-lived perennial herbaceous biomass, and similar process. Practical applications of this function are the current use of artificial or natural wetlands to "clean" partially treated wastewater or sewage effluent. As purifiers, wetlands improve the quality of water as it moves downstream. Wetlands in the American Bottom had performed this function, as did aquatic areas.

Particulate Retention. Floodplain wetlands naturally retain organic and inorganic particulates carried in by overbank floodwater. When moving floodwater enters a wetland, its velocity is reduced by the wetland's roughness and increased cross-sectional area. As velocity is reduced, the capacity of the water to carry suspended particulates is reduced, and particulates drop out of the water column and settle. Sedimentation is a common example of this physical process. Deposition of silt is often observed in wetlands after floodwaters recede. Sedimentation raises ground or substrate surface elevations, creates topographic variability, and augments nutrient levels; the accumulation of organic particulates supports decomposition, nutrient cycling, and detrital food webs. Wetlands and aquatic areas in the American Bottom naturally retained organic and inorganic particulates.

Organic Carbon Exportation. Organic carbon in the form of dead and live plant material is exported from wetlands by moving water. Carbon material is either dissolved or particulate. Dissolved forms include organic materials leached out of litter and surface soil during periods of surface inundation. Particulates include living biomass, leaf litter, and fine and coarse woody debris. Organic carbon is typically flushed out of riverine wetlands by overbank floodwater. Downstream aquatic areas usually receive this material. The microbial food web, which forms the base of the detrital food web in aquatic ecosystems, is fueled in large part by the energy in this organic carbon. Given their proximity to the Mississippi River and floodplain lakes and ponds, wetlands in the American Bottom would have been significant sources of organic carbon. Adjacent nonwetland areas on the floodplain would also have been sources of organic carbon, but their rates of carbon export are lower than those of wetlands.

EXISTING STUDY AREA CONDITIONS

Urbanization has had a profound impact on the Project area since pre-development days. The ecosystem has been significantly disturbed and the Project area's flooding patterns, which historically helped create, develop, and sustain habitat quality, have been significantly altered in order to minimize agricultural and structural damages.

Land Cover. The study area lies within the largest concentration of industrial, commercial, and residential land use on the Mississippi River floodplain north of New Orleans. As of the early 1990s, about 68 percent of the Project area consisted of urban/built-up, cropland, and grassland areas (Figure 6). The largely "natural" cover types - forested, wetland, and open water areas - made up the remaining 32 percent. Row crops comprised most cropland, and accounted for about 25 percent of the Project area. Figure 7 displays recent land cover.

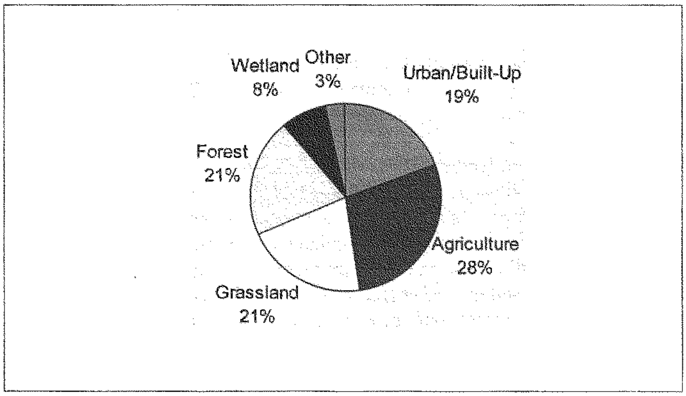
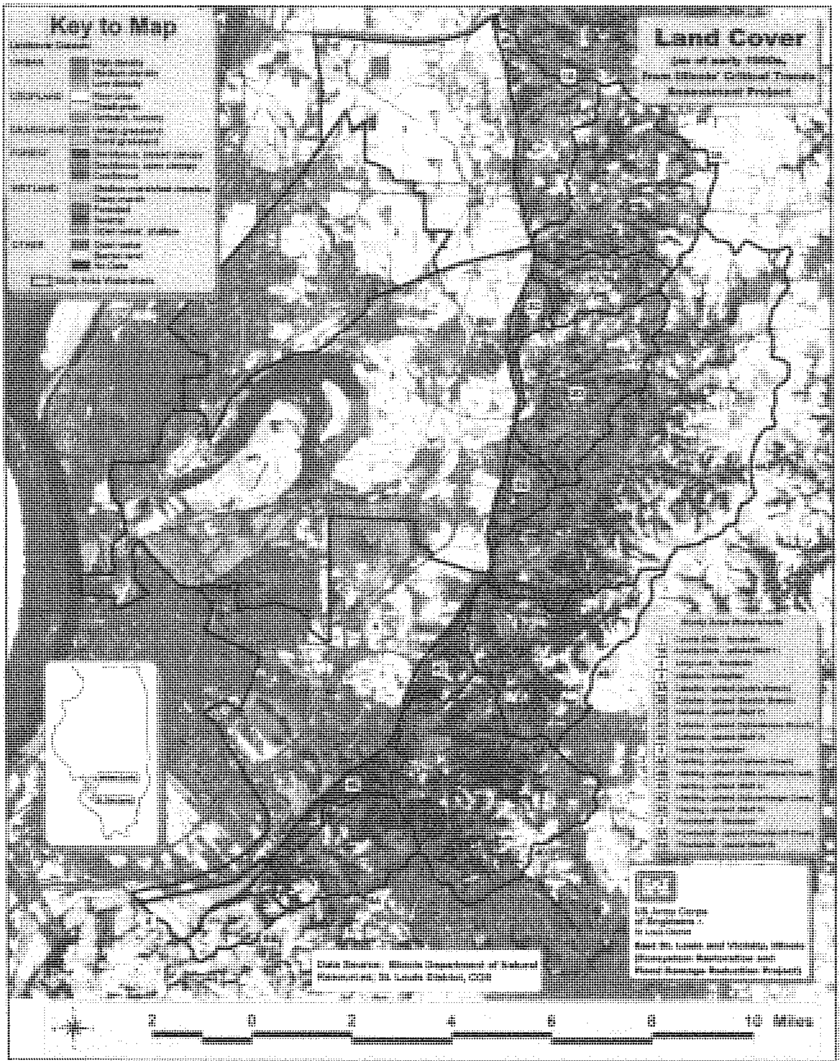


Figure 7 Land Cover Data for Project Area (early 1990s).



Topography. Existing topography has not substantially different from the pre-development period. Changes to topography on the floodplain since pre-settlement times are man made. The area is crisscrossed with railroad beds that form small levee systems across the surface of the area. Mine subsidence in the last 100 years has created some shallow surface depressions less than 5 feet deep east of the bluff line in the uplands.

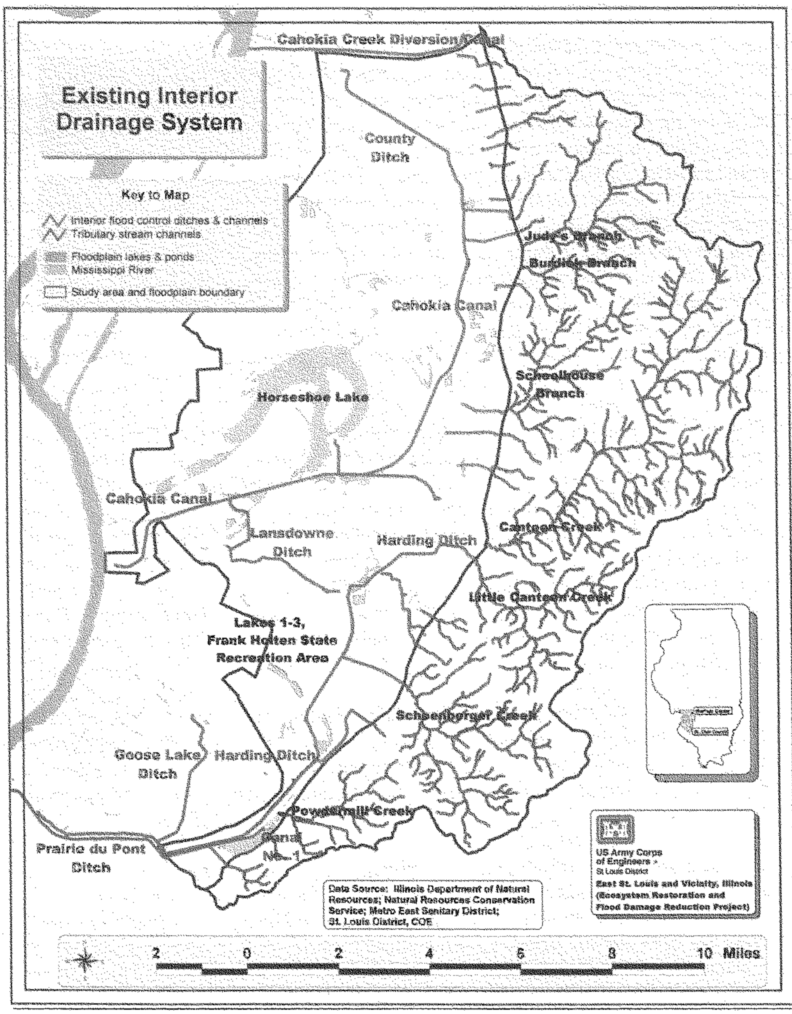
Drainage. By the 1800's, changes to topography from development of the railroad lines traversing the area had altered the natural drainage patterns of the area. Likewise, man-made levee systems designed to protect cropland from flooding changed the natural drainage. Later in the 1900's, as a result of increased development in the area, drainage districts were formed for the sole purpose of managing the drainage of the floodplain. By 1904, engineering plans were underway for the construction of a system of canals and drainage ditches designed to carry water as quickly and directly as possible to the River. The construction of this system eliminated the creek system that originally flowed across the Project area. By this time, a levee system had been constructed along the Mississippi River to protect the area from River flooding and in 1910, the tributary drainage area of Cahokia Creek was eliminated from the floodplain and diverted into a large diversion canal on the northern end of the Project area for the purpose of having the creek flow directly into the River. All flow was diverted into the Cahokia Creek Diversion Canal and levees were constructed along the northern boundary of the newly formed East Side Levee and Sanitary District. The Diversion Canal that is approximately 4.5 miles long flows directly west into the Mississippi River at Mile 195. The levee system continued to be improved and today an urban design (500-year) flood control system protects the Project area within the floodplain with large earthen levees and floodwalls. On the northern Project boundary, a levee is located on the left descending bank of the Cahokia Creek Diversion Canal and ties into the bluff west of Edwardsville. On the southern Project boundary, a levee is located on the right descending bank of the Prairie Du Pont Creek and ties into the bluff. While this mainline protection system has continually been improved over time, the original interior drainage canals and ditches remain as originally constructed in the early 1900's. The interior drainage system is shown in Figure 8.

The natural topography is still a major factor contributing to storm drainage and flooding problems within the Project area. The manmade drainage channels have very little slope and are not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River. Surface water moves slowly in the ditch system to the Mississippi River or remains in numerous natural depressions. Additionally, the carving up of the natural drainage areas by railroad and road embankments makes drainage of the floodplain areas even more difficult.

Surface drainage problems are made worse because groundwater has historically been very shallow in many areas within the floodplain. The combination of shallow groundwater and poor draining alluvial soils of alternating layers of clays, silts, and sands further promoted the need for the development of the extensive drainage system of levees and varying sizes of drainage ditches, channels, and canals. During the height of the industrial period to until the mid 20th century, the groundwater surface was generally lowered between 2 and 12 feet with localized reductions as a result of extensive ground water pumping in ten areas for industrial and municipal purposes.

When this pumping stopped, groundwater returned to its historical level and areas that were constructed with dry basements in the 1950's, suffer groundwater flooding today as a result of the cessation of groundwater pumping for industrial purposes.

Figure 8 Existing Interior Drainage System



Surficial Soils. The surficial alluvial soils that cover the American Bottom are related to their mode of river deposition. Glacial deposits from the Pleistocene Epoch underlie the alluvial soils. Five alluvial soil types are identified by their depositional fluvial geomorphic process: abandoned channel, backswamp, point bar, and chutes and bar deposits. The bluffs and uplands within the Project area are predominately glacial drift deposits and aeolian (wind deposited) loess deposits.

Geomorphology. The last major Mississippi River flood experienced by the American Bottom occurred in 1903. Construction of a levee system along the river following that flood event prevented Mississippi River overflow from inundating the American Bottom, and halted the historic depositional and scouring processes that periodically reworked the floodplain's surface. The deep loess mantle in the uplands is highly erodible, and development in the tributary watersheds has produced increased runoff, with higher peak flows due to the increased amount of impervious surfaces. As a result, the tributary stream channels have become unstable. These instabilities have adversely impacted floodplain drainage, as well as infrastructure and stream quality. Excessive levels of sediment are reaching the bottom. Sedimentation is occurring in the floodplain ditch and canal system, and in aquatic resources where storm water flows. For example, a delta of sediment has formed in Horseshoe Lake where storm water enters it from Cahokia Canal. With the scouring forces of the Mississippi River no longer present, sediments deposited by tributary streams cannot be carried out of the American Bottom. The result is a net gain of sediments accumulating in the bottoms.

Climate and Weather. Because of its central U.S. location, St. Louis feels the effects of warm moist air moving north from the Gulf of Mexico and the cold air masses moving south from Canada. The conflict along the frontal zones of these invading air masses provides a variety of weather conditions. Winters are brisk with temperatures dropping to zero or below generally only two or three days per year. Snowfall averages about 20 inches per season. Daily temperatures of 32 degrees or less occur less than 25 days per year, while temperatures of 90 degrees F or higher occur about 35-40 days a year. Temperatures exceeding 100 degrees F occur every other year generally, although some years may see 15 or more days with temperatures exceeding 100 degrees F. The prevailing wind direction is from the south for May through November and from the northwest for December through April.

Precipitation averages about 36 inches per year. The winter months are the driest while the months of May through July are the wettest. Rainfall can be severe at times with as much as eight inches of rain recorded in a 24-hour period in 1957. Thunderstorms occur between 40 and 50 days per year, with a few being severe, causing hail and damaging winds. Tornadoes have produced damage and loss of life in the St. Louis area.

An important condition affecting precipitation in the Project area of Madison and St. Clair counties in Illinois is the St. Louis urban effect. Studies by the Illinois State Water Survey have shown substantial increases in rainfall downwind of the City of St. Louis. The increases tend to be the largest in relatively heavy rainstorms and most pronounced in spring and summer when most of the large rainstorms occur. Frequency rainfall values for Madison and St. Clair Counties used in this Project have been adjusted to account for the St. Louis urban effect.

Air Quality. Air quality information was prepared under a cooperation agreement, by the USEPA Region 5. The Project area is located to the east of St. Louis, within the Metropolitan St. Louis Interstate Air Quality Control Region (AQCR). This AQCR covers part of Missouri and Illinois. Areas within the AQCR are further defined according to the attainment status of criteria pollutants. The Metropolitan St. Louis AQCR includes the Illinois counties of Madison, Monroe, and St. Clair, which are referred to as the Metro-East Nonattainment Area (IEPA, 1995). The Metro-East Nonattainment Area is a moderate nonattainment area for ozone. The Project area is in attainment for most of the criteria pollutants, sulfur dioxide, particulate matter, carbon monoxide, nitrogen dioxide, and lead. The area is "nonattainment" for the pollutant ozone and is classified as moderate. A portion of the area is also a "maintenance" area for particulate matter. The townships of Granite City and Nameoki are "maintenance" for PM10.

Noise. Noise is not considered to be an issue in the preparation of this General Re-evaluation Report.

Surface Water. Floodplain management has been a challenge for the inhabitants of the bottoms since the early 1900s when the push began in earnest to farm the rich land and develop for industry and commerce the area that sits on the river at the crossroads of the nation. With the diversion of Cahokia Creek and the construction of the Mississippi River levee system, the challenge of taking the remaining surface water from the bluffs to the river, while protecting the intermediate area from flooding, has yet to be met. As early as 1905, the problem of managing interior flooding was sited as being key to the future development of the area. By 1908, construction had begun on a canal system that was designed to manage this surface water as it traveled from the bluff to the river. The system instituted during this period is the same system that is in service today with only minor changes. Past urbanization of the area and climactic changes have increased significantly the peak volume this original system is now expected to contain.

The result is severe flooding across the bottoms when rainfall events of moderate intensity occur. At the bluff line a system of man made ditches and channels take the flows from tributary streams across the floodplain to the levee where the water enters the Mississippi River. When rainfall events exceed the capacity of this interior drainage system, whose size has not been altered since constructed, the water typically breaks out immediately downstream of the bluff line. They instead damage the urban and agricultural areas that hug the bluff line of the project area.

Floodplain Management. Floodplain management is divided among the four drainage districts on the floodplain that have responsibility for the operation and maintenance of the canal and ditch system as well as the pumping facilities associated with them. Additionally, the county for unincorporated areas and each municipality have responsibility for floodplain management within their area of responsibility. This management responsibility takes the form of ordinance enforcement and the issuance of permits for any disruptive activity (such as construction) that occurs within the drainage system, all within the context of the regulation of the federal flood insurance program.

The Federal and State Emergency Management Agencies also form a review and approval tier in the floodplain management process, as does the Corps of Engineers with its oversight responsibility for the Section 404 permit program. As in any urban setting where watersheds cross county and municipal boundaries, the effective management of the floodplain is a constant challenge. The formation of the Metro East Regional Stormwater Committee has been an attempt on the part of the floodplain communities to address these challenges. The Metro East Regional Storm Water Committee charter envisions a region in which properly managed storm water leads to a higher quality of life for the residents and better protection for the overall environment. With the implementation of Phase II Stormwater Regulations by the USEPA, both Madison and St. Clair Counties have pursued the establishment of ordnances and best management practices to address the problems associated with the increased stormwater runoff created by the addition of impermeable surfaces that come with urbanization.

Water Quality. The streams, lakes and river in the Project area have been assessed by the Illinois Environmental Projection Agency for a wide variety of water quality parameters over time. Because none of the streams, lakes or river segments is pristine, the causes of water quality impairment and the possible sources of impairment have been evaluated. Overall general causes of impairment in the Project area include the following: Priority Organic Contaminants; Metals Contaminants; Nutrient Enrichment (i.e., phosphorus, nitrogen, nitrates); Siltation; Organic Enrichment/Low Dissolved Oxygen; Habitat Alteration; Suspended Solids; Excessive Algae; and, Noxious Aquatic Plants. Detailed information concerning water quality conditions is in Appendix B of the main report.

The sources of impairment to water quality within the Project area vary widely from urban to industrial to agricultural. The following impairment sources are commonly found to be associated with most of the watersheds in the Project area: Agricultural Operations; Construction/Land Development/Commercialization/Urbanization; Urban/Stormwater Runoff; Hydrologic/Habitat Modification via Channelization; Land disposal/Septic Tanks and, Streambank Erosion.

Ecological and Natural Resources. Despite extensive local losses of various historic natural resources, and degradation of remaining resources, the Project area lies in a belt of existing "resource rich areas" strung along the Mississippi River in southwestern Illinois. "Resource rich areas" are relatively large areas in Illinois where current biologically significant resources are concentrated. Thirty such areas have been identified statewide. They were delineated and evaluated by the Illinois Natural History Survey as part of the Critical Trends Assessment Project and Ecosystems Program of the Illinois Department of Natural Resources. They often occur along the state's major streams and rivers. Two resource rich areas are found in the vicinity of the Project area. "Big Rivers" lies just north, and "Karst/Cave Area" overlaps partially with the Project area.

Forest. Estimates of forest losses in the Project area range from about 60 to 70 percent. This level of loss has occurred in both floodplain and upland areas. Similar losses of forest have occurred in Illinois at the state and county level. Loss of historic forest for the state is estimated to be about 63 percent, and about 58 percent and 67 percent for Madison and St. Clair Counties. All wet-mesic upland forest that occurred on the flat drainage divide in the headwater reaches of the Project area's tributary watersheds during pre-development times appears to be gone.

Prairie. The most striking loss in the Project area is the virtual disappearance of prairie. Roughly 35,000 acres of historic prairie have been reduced to about 33 acres, which are confined to the floodplain. This equates to an overall loss of about 99.9 percent. At least half of Madison and St. Clair Counties was once prairie and countywide losses are also at the same level. Of the eight types of prairie natural communities that were present historically, six have disappeared – two from the floodplain and four from the uplands.

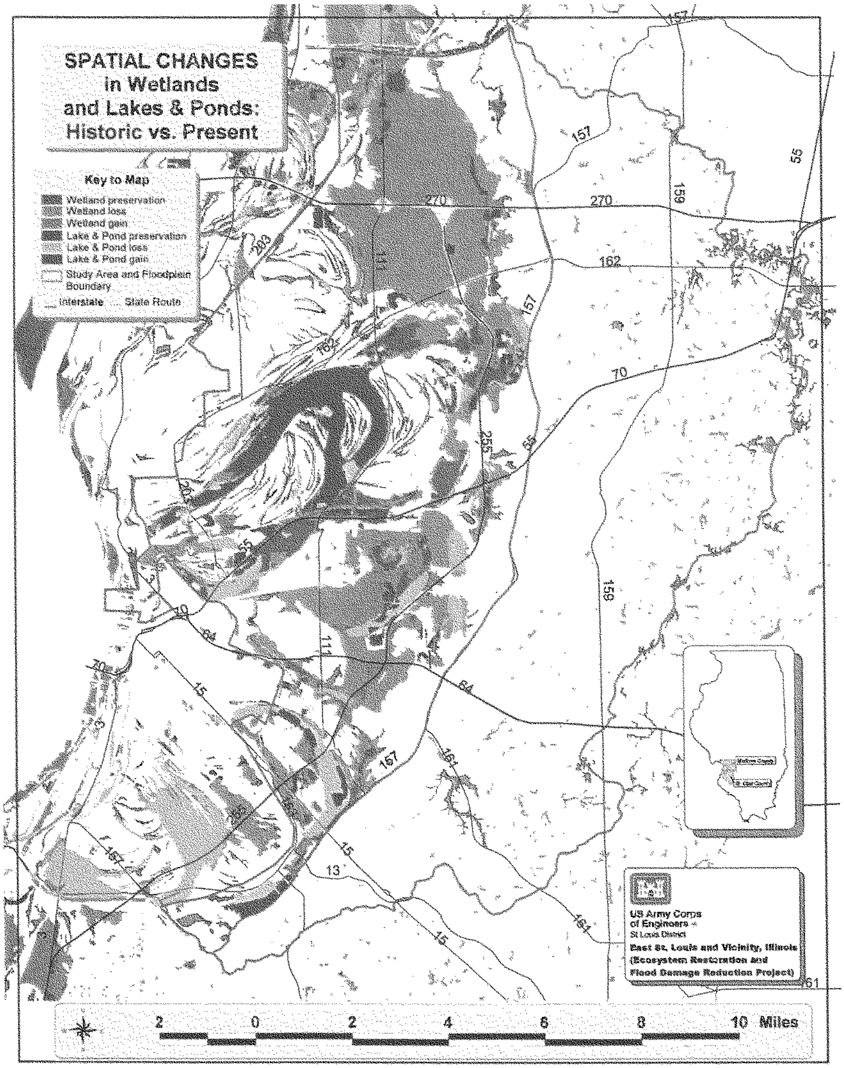
Savanna. Savanna is not currently known from the Project area. It is mentioned because it may have been present in predevelopment times in the uplands. If any remnants survived, they would have since changed into forest. Because periodic wildfires enabled this type of vegetation to persist in historical times, the suppression of wildfire that came with settlement caused vegetational changes in savanna. Tree density became greater and open savanna converted to closed forest. Other factors have led to the loss of savanna in addition to fire absence and destruction. These include fragmentation, degradation of the ground cover from intense grazing, and invasion by exotic plant species.

Wetland. Estimates of wetland losses in the Project area range from about 65 to 85 percent. For Madison and St. Clair Counties, estimates of wetland losses are 61 and 63 percent, respectively. Wetland diversity has declined because of the loss of three of ten historic wetland natural communities: wet-mesic upland forest and wet-mesic prairie in the uplands, and wet prairie in the floodplain. Wetland losses are displayed in Figure 9. Flooding from tributary streams caused by "out of bank" flows do not provide a beneficial disturbance to remaining wetland or other habitat resources, as they are too far removed from the bluff line to receive these flows.

Lake and Pond. Estimates of lake and pond loss range from about 35 to 50 percent in the Project area. Because lakes and ponds still occur in the Project area today, diversity of natural communities within this class has not been reduced. Losses of lakes and ponds due to development are shown in Figure 9.

Stream. The overall loss of all floodplain streams by length in the Project area is estimated to be about 66 percent. About 62 percent of the historic channel of Cahokia Creek in the Project area has been filled in for development or modified into ditches. The isolated remnants no longer convey flowing waters.

Figure 9 Losses of lakes and ponds due to development



Existing Species.

Plants. Roughly 1,000 plant species consisting of various trees, shrubs, vines, grasses, sedges, forbs, and ferns occur, or are likely to occur, in the Project area. About 18 percent of the Project area's flora, consisting of 173 species, is not native to Illinois. Exotic species occur in all kinds of natural communities, but, excluding cultural areas, are most prevalent in remnant prairies and savannas.

Invertebrates. Roughly 350 relatively common macroinvertebrate species consisting primarily of beetles, worms, water bugs, midges, caddisflies, mayflies, damselflies, dragonflies, damselflies, leeches, mosquitoes, clams, crayfish, mussels, and snails occur, or are likely to occur, in the Project area.

Fishes. The existing fish fauna is much reduced from what it was historically, and today has little relationship to the original fauna. Native species are wide-ranging, and are characteristic of habitats that have been heavily modified and subjected to considerable environmental fluctuations, such as in water temperature, flow, turbidity, and dissolved oxygen. Thirty-six species of fish have been collected since 1984 during fish surveys of channels and lakes within the Project area. Thirty-three species inhabit floodplain channels, and twenty-one species occur in lakes. None of the 36 species are federally or state protected. Three species, the gold fish, common carp, and grass carp, are exotic or non-native.

Reptiles and Amphibians. A total of 65 species of reptiles and amphibians occur or may occur in the Project area. Various kinds of salamanders and toads and frogs comprise the 22 amphibian species, of which 12 have documented occurrences. Forty-three species of reptiles include a number of turtles, lizards, and snakes; twenty-four of these species have been documented from the area. All species are native. None have been introduced. Reptiles and amphibians are found in all communities of the Project area. In cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, they are less diverse than in forest, prairie, wetland, creek and river, and lake and pond habitats. The alligator snapping turtle has become locally extinct. One species of frog and three species of snakes are either state or federally protected species.

Birds. Numerous species of birds occur regularly or occasionally in the Project area. There are 126 species that occur regularly. Birds are the most diverse group of vertebrates living in the Project area and consist of species from over 40 families. Herons, waterfowl, sandpipers, woodpeckers, flycatchers, swallows, warblers, sparrows, and blackbirds are bird families that are represented by numerous species. When bird species that occasionally use the Project area are added to those that are regular inhabitants, the total number of species increases to 288. Of the 288 species, one dove, one starling, one finch, and two sparrows are exotic or non-native.

Mammals. There are 41 mammal species that occur or are likely to occur in the Project area. The most diverse groups include the shrews and moles, bats, rodents, and carnivores. The remaining groups of mammals are represented by single species of opossum, rabbit, and deer. Twenty-five of the species have documented occurrences in the Project area.

Two species of bats are federally protected. Two species are not native, the Norway rat and house mouse. Mammals are found in all habitats of the Project area. Many species inhabit forest, including both upland forests as well as floodplain forests. Most species use a variety of habitats. About half use forests and prairies as well as nonwoody wetlands, such as marshes. Only two species are restricted to prairies and grasslands. Mammals found in cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, are rather diverse. Since settlement, a number of species have been extirpated from Illinois or on a regional basis within the state. Most of them are carnivores, and/or they require large home ranges.

Endangered and Threatened Species. Ten federally listed and 47 state-listed endangered and threatened species do occur or may occur within the Project area.

Federally-Listed Species. The U. S. Fish and Wildlife Service identified eight federally-listed species, and one candidate species for listing, that may be present in the Project area in a letter dated March 10, 1999 (see Appendix G of the main report). The piping plover (*Charadrius melodus*) has been added to this list by the Corps because it has been recently sighted within the Project area. In its letter, the USFWS indicated that no designated critical habitat exists within the Project area for any of these species. Similarly, there is no designated critical habitat for the piping plover. The potential or documented occurrences of federally-listed species in the Project area are discussed in a biological assessment included in Appendix B of the main report. In Illinois, these ten federally-listed species are also state-listed species. The bald eagle and decurrent false aster are known to occur in the project area.

State-Listed Species. The potential or documented occurrences of state-endangered species in the Project area are discussed in a biological assessment included in Appendix B of the main report.

Natural Areas, Natural Preserves and Endangered Species Sites. The Project area includes ten examples of natural areas, nature preserves, or endangered species sites.

Natural Areas – Bohm Woods (5 acres, dry mesic and mesic upland forest); Poag Railroad Prairie (33 acres, mesic sand and wet mesic prairie); Levee Lake (230 acres, pond shrub swamp, and marsh)

Nature Preserves – William & Emma Bohm Memorial (7 acres, dry mesic and mesic upland forest)

Endangered Species Sites – Chouteau Catchfly Site (2 acres, royal catchfly); Poag Railroad Prairie (33 acres, spring ladies' tresses); Precision Habitat (475 acres, Illinois chorus frog); Eagle Park Marsh (105 acres, common moorhen, pied-billed grebe, yellow-headed blackbird); Fairmont City Site (38 acres, decurrent false aster); East St. Louis (Alorton) Heron Colony (2 acres, snowy egret, little blue heron, black crowned night-heron).

Cultural Resources. The American Bottom portion of the Project area is arguably the richest, most complex, archaeological region in all of North America. Native American occupation of the Project area began at least 12,000 years ago and continued up until the early nineteenth century when the last groups of Native Americans were displaced from the area by ever-increasing numbers of Euro-American settlers. The crown jewel of this archaeological legacy is the Cahokia Mounds World Heritage Site, located near the center of the Project area. Eight centuries ago this site covered 5 square miles of the Mississippi River floodplain and was, in turn, surrounded by hundreds of supporting communities. These settlements ranged in size from large towns and villages to individual farmsteads. Even today, more than six centuries after the last of these prehistoric residents of the Central Mississippi River valley mysteriously abandoned the area, fragments of their discarded tools are commonly observed throughout the Project area by the trained eye of archaeologists.

The cultural value of these prehistoric remains to the Nation was recognized but not well protected until well into the twentieth century. By then, the remains of many of these sites had been significantly damaged, or destroyed. The preponderance of professional archaeological investigations conducted within the project area during the late twentieth century was administered by the Illinois Department of Transportation. For the most part these investigations were associated with interstate highway construction - the largest of those being Interstate 255. The right-of-way for this highway traverses the entire length of the American Bottom portion of the East St. Louis Ecosystem Restoration Project area. Scores of archaeological remains, some deeply buried and dating back more than 4000 years, were identified and excavated in advance of construction related to that project.

Only a small portion of the American Bottom has been systematically surveyed for the presence of archaeological remains. Therefore, it is impossible to reliably estimate the number of archaeological sites that have been lost as a result of commercial and residential development. However, it is safe to assume that the number is large. The scientific value (and corresponding loss to the Nation) of the information once contained in these destroyed archaeological sites is incalculable. Present-day land use within the areas being considered for potential ecosystem restoration includes agricultural fields, former residential and commercial tracts, lakes / sloughs, and public land. The preservation and enhancement of significant archaeological remains within these contexts is a priority of this Project.

Outdoor Recreational Resources. The voters of Madison and St. Clair Counties approved a metropolitan park and recreation district in November of 2000. The objectives of this park district, which will be supported by tax revenues, are to preserve natural lands adjacent to waterways, filter pollutants and protect wildlife habitat, provide safe places for families and children to play by repairing worn equipment and improving maintenance in existing parks, create trails and paths for walking, biking and other compatible uses, create new parks in newer communities, and, provide expanded disabled and public access to recreational areas. Within the Project area, the State of Illinois owns and maintains Horseshoe Lake State Recreation Area, Cahokia Mounds State Historic and World Heritage Site, and Frank Holten State Park. The two parks are managed for both recreational activities and as wildlife management areas. Horseshoe Lake provides seasonal duck hunting opportunities within sight of the Arch.

While there are fishing opportunities, they are limited for consumption purposes because of existing contamination. Likewise, the interior drainage canal and borrow sites along the I-55/I-70 highway route provide informal fishing opportunities. Frank Holten provides a more urban recreational experience with the inclusion of an 18-hole golf course while Horseshoe Lake provides both primitive and supported overnight campsite facilities. Within the local communities there are small city parks as well as school and neighborhood recreational areas that support those living in the immediate vicinity with basic recreational facilities.

Aesthetics. The Project area's aesthetic (visual) characteristics run the gamut from less attractive, heavily urbanized/heavy industrial sites to natural areas with pristine-like qualities. The landscape exhibits a wide variety of visual stimuli, including upland and bottomland forests, lakes, rivers, canals, marshes, ponds, small and large cities, farmland, and parks. The topographic features include remarkably flat expanses of bottomlands as well as bluff areas in the uplands. Man-made features abound in the form of flood control structures, interstates, highways, roads, utility structures, communication facilities, buildings, signs, billboards, and many other things normally associated with a heavily urbanized area. Unique to this area is the ancient man-made Cahokia Mounds World Heritage Site, and Monks Mound, its primary feature, can be seen from a distance. Also prominent is the highly visible St. Louis Gateway Arch located just across the Mississippi River.

Hazardous, Toxic and Radioactive Waste. Over 80 hazardous waste sites have been identified in the vicinity of the Project area through the Superfund program. Many of the sites are related to former industrial or landfill operations. These sites fall into four Superfund categories. First, there are 29 CERCLIS sites at which clean up is being considered, and they are listed in the U.S. EPA's Comprehensive Environmental Response, Compensation, and Liability Information System. Secondly, two sites are on EPA's National Priorities List, and involve long-term remedial response actions. Thirdly, two sites have been proposed for inclusion on the NPL. Lastly, 49 sites have been archived. Archived sites include those for which an assessment has been completed and EPA has determined no steps will be taken to designate the site as a priority by listing it on the NPL, and no further remedial action is planned under the Superfund Program. Thirteen hazardous waste sites occur within the Project area. Of these, six occur in Madison County and seven in St. Clair County. Nine are CERCLIS sites, and four are archived sites. None of the sites in the Project area are NPL sites or proposed for listing on the NPL. Most sites are outside the Project area to the southwest, in the vicinity of East St. Louis and Sauget.

FUTURE WITHOUT PROJECT STUDY AREA CONDITIONS

The future without project condition describes selected characteristics within the Project area over the next 50 years if no action is taken. The Federal regulations implementing the National Environmental Policy Act of 1969 require that the no action plan be considered as an alternative in assessing the potential effects of all Federal actions.

Climate and Weather. No significant climatological changes are expected to occur over the 50-year planning period used for this Project.

Ecological Resources.

Forest. The amount of forest in the Project area has declined significantly since presettlement times. This trend is expected to continue. Given the projections for greater population growth in the Bluff Corridor, the rate of forest loss in tributary watersheds is expected to substantially exceed that on the floodplain in the American Bottom Corridor.

Forest in Tributary Watersheds. Future rates of upland forest loss are expected to vary by major watershed. The two central watersheds, Cahokia and Harding, are expected to show considerably greater rates of loss than the two peripheral watersheds to the north and south. The two central watersheds, Cahokia and Harding, are expected to show considerably greater rates of loss than the two peripheral watersheds to the north and south. Remaining forest is expected to be concentrated on the steepest slopes of upland ravines and along narrow creek bottoms.

Ecological Problems of Forest in Tributary Watersheds. Upland forests in the Project area are expected to exhibit further loss of ecological integrity due to additional fragmentation, habitat degradation, introduction of exotic species, and a continued absence of fire.

Wildlife Habitat of Forest in Tributary Watersheds. Wildlife species diversity in shrinking areas of upland forest is expected to decrease and remaining species are expected to consist mainly of those adapted to human disturbances and suburban/urban conditions. Compared to mammals, reptiles and amphibians, the decline in bird species diversity is expected to be high, especially among breeding species.

Forest in the Bottoms. The rate of loss for forested wetlands in the bottoms over the 50-year project life was assumed to be 25 percent on privately owned lands and no loss on publicly owned lands. Forecasted rates of loss for forested wetlands and forested non-wetlands in the bottoms do not reflect any future implementation of tree preservation or "green space" requirements on development by local government.

Ecological Problems of Forest in the Bottoms. Additional fragmentation and habitat degradation caused by sedimentation and the introduction of exotic species are expected to lead to further loss of ecological integrity in bottomland forests. In addition, forested wetlands will continue to exhibit hydrological regimes that depart from natural conditions either because changes in hydrology have resulted in stabilized water levels, or timing of floods have shifted, either of which may depart too drastically from any natural cycle to permit an adapted forest community to remain or develop on a site.

Wildlife Habitat of Forest in the Bottoms. Wildlife species diversity of bottomland forests is expected to decline with decreasing area of forest. However, because most forested non-wetland is already extremely fragmented, this effect should be most noticeable in forested wetlands.

Prairie. Given that most prairies in the Project area are on public lands (and consist of restorations), the amount of prairie in the future is expected to remain relatively constant. There are no known plans for future restorations of prairie on public lands.

Ecological Problems of Prairie. The only known remnant of natural prairie in the Project area is expected to experience further fragmentation. Continuing invasion by exotic species and habitat degradation related to railroad maintenance is expected. Unless additional plant species are added, most existing areas of prairie restorations will continue to show little floristic similarity to historic prairies because of their low plant species diversity.

Wildlife Habitat of Prairie. Existing restorations will continue to be too small to attract many species of area sensitive grassland-adapted animals, including breeding birds. Although these areas of prairie may not decline in extent, anticipated development in their vicinity is expected to cause a small decline in diversity of species using them as habitat.

Wetlands. Wetlands occurring on private lands are expected to decline in area by 25 percent over the 50-year project life whereas no loss is anticipated for those found in public areas. This assumption applies equally to all kinds of wetlands - forested wetlands, marshes, and scrub-shrub.

Ecological Problems of Wetland. Continuing problems in marshes and scrub-shrub swamps include altered hydrologic regimes, addition of sediments and agricultural chemicals or urban runoff, encroachment by exotic plant species, and disturbance-tolerant native plant species dominating the local plant community. Continuing ecological problems associated with forested wetlands are discussed above and those associated with ponds are given below.

Wildlife Habitat of Wetland. Wildlife species diversity of marshes and scrub-shrub swamps is expected to decline to a small degree because of decreasing area of these habitats as well as increasing development surrounding wetlands. A decline of wetlands in the Project area, either forested or herbaceous, is expected to adversely affect numerous listed birds and some other species. Fewer nesting or feeding opportunities would be available to as many as twenty-one listed bird species known or likely to occur in the Project area. Among other listed species, the Illinois chorus frog, Indiana bat, and decurrent false aster would also be potentially adversely affected.

Functional Capacity of Wetlands. Sources of hydrology driving existing wetland functions are not expected to change in the future. Overbank flooding from the Mississippi River will continue to be excluded from the Project area and overflow from tributary streams will remain confined to floodplain channels of the interior flood control system under normal circumstances. On occasions when storms in tributary watersheds overtop the floodplain flood control system, overflow into adjacent wetlands is expected to continue occurring in a random manner with respect to location and season. Consequently, flooding in wetlands historically adapted to riverine overflows is expected to continue to come primarily from direct rainfall and local runoff.

Lake and Pond. Future development in the Project area was not assumed to affect lakes and ponds directly. However, lakes and ponds receiving regular inputs of stormwater from the interior flood control system were assumed to decrease in surface area by 1.5 percent every 10 years, or a total of 7.5 percent during the 50-year project life. Reduction in area was expected because of the accumulation of sediment carried by stormwater originating from tributary streams. Lakes and ponds remaining constant in area were assumed to be those that are relatively isolated from stormwater carried by the interior flood control system.

Examples of waterbodies experiencing future losses in surface area include Horseshoe Lake and Grand Marais Lake (lake 3) at Frank Holten State Recreation Area.

Ecological Problems of Lake and Pond. Ongoing siltation and habitat degradation will continue to cause problems at lakes and ponds. Not only does siltation cause loss of surface area, but it also causes a gradual decrease in average water depth. Since many natural lakes are only several feet deep, decreasing water depths may at some point threaten fish populations during periods of drought when water levels are low. Local watersheds carrying runoff into lakes and ponds are expected to become less agricultural and more urbanized. Major pollutants in storm water are expected to shift from agricultural chemicals to transportation related pollutants such as oil, antifreeze, and gasoline. An overall lack of natural aquatic and emergent plant growth in these water bodies, the presence of fish species such as carp that uproot such plants, summer algal blooms that can cause fish mortality, and a general lack of habitat structure are problems that will continue to affect lakes and ponds.

Wildlife Habitat of Lake and Pond. Expected reductions in surface area of some lakes and ponds and continuing ecological problems probably will lead to small reductions in diversity of animal species using these communities as habitat. Increasing urbanization surrounding lakes and ponds is anticipated to also contribute to this effect.

Streams. The area or extent of floodplain streams has been assumed to remain constant in the future. Periodic maintenance of the floodplain's interior flood control system, including cleanout of ditches and canals that carry storm water, is expected to maintain existing channel dimensions. Future development in the tributary watersheds is expected to directly affect headwater reaches of many tributaries, but not downstream reaches. In order to maximize the amount of developable land in the uplands, headwater streams are expected to be lost by either channelization or replacement by underground pipe over which fill material would be placed. Additional channelization of floodplain streams is unlikely in the future.

Ecological Problems of Streams. Floodplain channels will continue to be affected by the lack of riparian vegetation, transport of sediment into channels, inflows of agricultural and urban runoff, and encroachment by exotic plant species, such as Japanese hops. In the uplands, additional urbanization is expected to continue encroaching upon streams and their adjacent floodplains. Existing instability of stream banks and channel bottoms is expected to continue and become more widespread as additional stream reaches are indirectly impacted by adjacent development. Sediments and polluted runoff entering tributary streams are expected to continue.

Wildlife Habitat of Streams. Expected adverse changes in physical and chemical characteristics of streams are expected to be greater in tributary watersheds than on the floodplain. Consequently, the capacity of tributary streams to serve as habitat for fish and other wildlife is expected to decline to a greater degree than that of floodplain channels.

Cultural. Due to anticipated development, new cultural habitats consisting of residential, commercial, and industrial areas will arise from future losses of forests, prairies, and various wetlands. Similarly, these kinds of cultural habitats will come from future losses of agricultural land. To conduct the habitat assessment for this Project, the interagency biology team assumed that 75 percent of existing floodplain agricultural areas would be developed in 50 years. Therefore, the ongoing shift in cultural habitats, from agricultural to suburban and urban, is expected to continue.

Wildlife Habitat of Cultural Areas. Over the next 50 years, wildlife species using cultural habitats in the Project area are expected to gradually shift in composition from a mixture of agricultural and suburban-urban species to mainly suburban-urban species. The overall number of species is expected to decline.

Water Quality. The surface water quality within the project area has a wide variety of impairments with causes originating from agricultural uses, urban-runoff, stream bank erosion, point source discharges (industrial and public/private treatment works) and land development. New stormwater ordnances and attention by the counties to EPA Phase II regulations can address future problems. However, the degradation that has begun from past practices in the tributary streams will not be fixed without direct intervention. If action is not taken in tributary streams they will continue to experience increasing destabilization of stream banks and put heavier sediment loads into the system and further degrade their quality. The general trend in population and commercialization/industrialization is increasing within the project area. Based upon the increasing trend the surface water quality would most likely have additional impairment loads placed upon it over time. The surface water quality would degrade with an increased impairment load. Downstream receiving water would then have an increased impairment load which decreases water quality within those regions. The degrading water quality condition, with time, within the project area would result in a decreased amount of possible designated uses.

Physical Facilities and Operations. The current capacity of the interior ditching system in the Bottoms area has been re-established through the recent channel cleanouts that were performed using either Corps of Engineers' Rehabilitation funding or FEMA funding. These cleanouts occurred after the 1995 through 1997 flooding. Under the future without project condition, continued sedimentation in the Bottom's channels and degradation of the bluff stream channels is expected. Any loss of channel capacity as a result of inadequate maintenance will reduce future flood protection. Degradation of bluff stream channels will continue to adversely impact existing infrastructure. It is assumed that the channel cross-sections attained after the recent Corps of Engineers' and FEMA cleanouts will be maintained by MESD or other responsible parties thereby continuing an expensive operation and maintenance program in the future.

Outdoor Recreational Resources. Greenways offer opportunities to creatively preserve open space in rapidly developing areas, protect important natural resources such as wetlands and wildlife corridors, and provide opportunities for outdoor activities such as bicycling and walking. Greenways and trails have been one of the top public concerns identified through the Statewide Comprehensive Outdoor Recreation Plan (SCORP) Public Participation program for years. Southwestern Illinois offers tremendous greenway opportunities.

Currently, the Metro East region has three of the 16 National Millennium Trails designated in 1999 and there are three major greenway systems proposed for the region. The Millennium Trails program is an initiative of the White House Millennium Council in partnership with the U.S. Department of Transportation and the Rails-to-Trails Conservancy.

Millennium Trails will recognize, promote and support trails as a means to preserve open spaces, interpret history and culture, and enhance recreation and tourism. The majority of the systems are located in Madison County where they are expected to be expanded to form a comprehensive regional network.

As urban growth continues, the demand for open space preservation and the development of outdoor recreational opportunities is expected to increase.

PROBLEMS AND OPPORTUNITIES

The identification of problems and opportunities and the development of clear operational objectives was the initial challenge in the formulation process for the Project team. The identification of problems and opportunities began with the assessment of the information compiled for the preparation of the pre-development, existing, and future without project conditions in addition to the input received during the public involvement process.

During the identification and validation process of problems facing the Study area, it became clear that there was a logical connection between these problems and the degradation of the natural ecosystem from a variety of causes. In every instance, there appeared to be a compelling reason to address Project area problems as environmental opportunities. As the Project team delved into the history of the area and the operation of the natural system during pre-settlement times, the picture that evolved provided a focus for the plan formulation process.

Ecological Resources. A recent report on trends in Illinois' environmental and ecological conditions concluded that the condition of natural ecosystems in Illinois is rapidly declining as a result of fragmentation and continual stress. Over the last two centuries, the historic natural ecosystem of the Project area has been reduced to a fraction of what it once was. Ecological problems that are identified and addressed include loss of biodiversity, fragmentation of natural systems, loss of historic ecosystem disturbances, loss of habitat quality, and degradation of water quality.

Loss of Biodiversity. Much of the historical biodiversity of the Project area, consisting of numerous natural communities and their constituent plant and animal species, has been lost due to intensive economic development. The loss of much of the natural heritage within the Project area is illustrative of a larger pattern in Illinois that indicates a trend toward simpler natural systems. The once complex historical natural environment has been replaced with one that is fairly simple biologically. Spatial losses in the Project area due to habitat destruction are significant. Only about 30 percent of the Project area, collectively, now consists of remnant forests, prairies, wetlands, lakes and ponds, and streams. Built-up areas, agriculture, and non-native grassland represent the remaining 70 percent, which supports low levels of biodiversity as compared to natural habitats.

Losses also consist of declines in the diversity of natural communities. Some types of forest, prairie, and stream natural communities have disappeared entirely. The case of prairie losses is the most extreme. About 99.9% of the historic prairie is gone. Once extending over roughly 35,000 acres and consisting of seven distinct communities, only about 35 acres comprising two communities remain. Widespread natural disturbances, such as flooding and wildfire, added a temporal dimension to the spatial complexity of the historic ecosystem that is gone today. Biodiversity losses also include the loss of some native plant and animal species that once inhabited the Project area as a result of the presence of introduced or exotic species that can out-compete native plants and animals. This shift in species composition illustrates another broader pattern in Illinois that is a trend toward non-native species. Continuing urbanization is expected to be the chief cause of future losses of biodiversity, especially to forests in the uplands.

Opportunities exist within the Project area to restore some of the lost and diminished components of the historic ecosystem. These include floodplain prairies, forests, marshes, and streams. Economic and agricultural activities prevent the re-creation of an entire stream traversing the floodplain, but there are locations where partial restorations could occur. Likewise, undeveloped areas exist where natural areas such as forests and prairies could be restored. Restoration of such features would replicate, albeit on a much reduced scale, the historic natural ecosystem.

Fragmentation of Natural Systems. As a result of development, natural areas within the Project area have become highly fragmented and remnants are generally too small to support all plant and animal species characteristic of functional ecosystems. The fragmented character of natural areas within the Project area is illustrative of a broader pattern in Illinois, which exhibits a trend toward fragmented natural systems. Fragmentation is the transformation of continuous areas of natural ecosystems into smaller and smaller pieces as a result of development. Along with habitat destruction, fragmentation is considered by many ecologists to be among the chief causes of loss of biodiversity worldwide. Requirements for the establishment and maintenance of self-sustaining and functional natural ecosystems in Illinois have yet to be defined.

Opportunities exist within the Project area to restore some forested areas and to create prairie restorations that are large enough to support animals sensitive to habitat fragmentation, including birds.

Loss of Historic Ecosystem Disturbances. Remaining natural areas cannot be expected to retain much similarity to their former structure and function if periodic ecosystem disturbances are not introduced to mimic historic flooding and wildfire. Natural flooding and wildfire sustained the historic natural ecosystem. With the elimination of these natural forces, today's remaining natural areas cannot maintain much similarity with their former historic condition without intervention. Fragmentation of natural areas and the loss of linkages between wetlands, streams, and rivers in the Project area have reduced the ability of many wetlands to perform historic functions, such as to temporarily store overland flows of water, or to remove natural nutrients and other elements and compounds from floodwaters.

The elimination of disturbance factors such as flooding and fire from much of today's environment has also diminished the ability of wetlands to serve as support systems for some plant and animal species. For example, the decurrent false aster, a federally threatened species, is an herbaceous plant that historically occurred in open habitats on the floodplain of the Illinois and Mississippi Rivers, such as wet prairies, shallow marshes, and the shores of rivers, creeks, and lakes. It is found within the Project area today in old or mowed fields, marshes, and at the edges of active fields, farm facilities, golf courses, and a railroad. The plant requires high levels of light to survive. Riverine flooding apparently benefits this species by disbursing seeds to new areas for colonization and suppressing the encroachment of woody vegetation that would create shady conditions. Likewise, wildfire would also have maintained open habitats in areas such as wet prairies and marshes.

Opportunities exist within the Project area to re-establish lost linkages between wetlands and tributary streams and re-introduce periodic flooding to existing floodplain natural areas. Such flooding could mimic the predevelopment flood pulse. Although the Mississippi River is no longer a feasible source, storm water from tributary watersheds could serve as the basis for the desired flood pulse. Prescribed fire is currently used to maintain some small prairie restoration areas within the Project area. Its use could be expanded into other natural areas to provide the same ecological benefits.

Loss of Habitat Quality. Many areas of fish and wildlife habitat in the urbanizing Project area are poor to fair in quality as a result of human activities and influences. Habitat quality in the Project area ranges from poor to good, and most habitats rank as poor to fair. This assessment is based on data gathered for this Project in the spring of 1999 by an interagency group of biologists studying 228 individual sites in floodplain (terrestrial, wetland, aquatic) and tributary stream (terrestrial) habitats. These quality ratings represent the ability of sampled habitats to fulfill the food, cover, or reproductive needs of eight fish and wildlife species occurring in the Project area. These species, which include the black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, and wood duck, were selected to serve as representatives of a broad number of other species that are present or desirable and that also use forest, marsh, prairie, lake, stream, and cultural habitats. These animals, and the current quality of habitats they use, serve in this Project as the benchmark against which the expected effects of alternative solutions for ecosystem restoration can be compared. Further details about the habitat assessment method are found in Appendix A of the main report.

Opportunities exist within the Project area to make numerous improvements to habitat quality. Native plant communities can be restored in existing forests by introducing historically occurring tree species that are now lacking or underrepresented. Oaks can be planted in developed areas to benefit birds. Lakes and ponds can be improved for fishes by creating deep-water areas to serve as overwintering habitat. Emergent vegetation can be increased along the margins of these water bodies to benefit resident fishes, birds that feed in such areas, and enhance the production of macroinvertebrates that serve as food sources for such animals. Buffer zones of natural vegetation can be added around the perimeter of natural areas to minimize human disturbances. Wetlands can be improved by restoring native grassland around them or by adding wooded buffers. Invasions of exotic plant species in the Project area can be controlled or eliminated.

Existing narrow riparian zones along streams can be widened to benefit greater numbers of species. Connections or linkages consisting of natural vegetation can be established between various habitats to provide corridors for animal movements. Levels of sediment and chemicals carried by runoff into natural areas can be reduced.

Degradation of Surface Water Quality. The surface water quality within the Project area has a wide variety of impairments with causes originating from agricultural uses, tributary stream bank erosion, urban-runoff, point source discharges (industrial and public/private treatment works) and land development. In particular, sediment makes a significant contribution to the degradation of water quality that adversely impacts aquatic habitats, such as streams and lakes. Likewise, water quality is adversely impacted by non-point source water pollution that enters the tributary streams, the interior drainage system, and then on to the Mississippi River. Water passing over the land, either from rain, car washing, watering of crops, or lawns, picks up an array of contaminants including oil from roadways, agricultural chemicals from farmland, and nutrients and toxic materials from urban and suburban areas. This runoff is defined by the Water Resource Advisory Council as non-point source water pollution and finds its way into waterways either directly or through storm drain collection systems.

The general trend in population/urbanization/ industrialization and tributary stream degradation for the Project area and vicinity is increasing. Based upon this increasing trend, it is concluded that increased degradation of water quality will continue to be a problem. The adverse effects of this degraded water quality are not limited to large lakes or rivers but can be found in local streams and ponds and natural areas.

Opportunities exist within the Project area to improve surface water quality for the benefit of restoring and protecting important aquatic habitat. Measures implemented in the tributary streams could reduce impairments with upland origins and reduce sediment loads by stabilizing degraded streams before they reach the bottoms via tributary streams. Natural areas such as existing or constructed wetlands could be protected from the debilitating affects of degraded water quality while serving as an additional filtration systems to improve water quality before it is released into the Mississippi River.

Erosion and Sedimentation. Erosional processes occurring in the Project area related to rain events, increased peak flows due to storm water runoff, and head cutting and rotational bank slumping in tributary streams. These processes are causing excessive sedimentation in the bottoms and degradation of tributary stream resources. Community leaders and the local people who participated in the public involvement program ranked sedimentation and erosion problems on a par with flooding problems. Urban sprawl and the loss of greenspace and open space were believed to contribute to both the flooding and sedimentation problems. Federal and State resource agencies that participated in the study expressed concern about the adverse environmental effects of the sediment and erosion problems.

In general, the runoff from the hillside creeks enters the canals in the Bottoms area at a high velocity capable of transporting heavy loads of sediment out of the bluffs. However, when these high velocity flows reach the Bottoms, the velocity of the water drops substantially because the gradient flattens and the water in the canal is no longer able to transport the sediment load. This sediment is then transported through follow-on storm events through the drainage canal system eventually finding its way to the Mississippi River or remaining captured in the canal system reducing its capacity. Approximately 202,700 tons of sediment per year are being generated from gross erosion from the uplands. Very little sediment is found to originate from the bottomland sources because of the flat topography and sluggish runoff velocities.

Sedimentation creates several serious problems in the bottomlands of the Project area. As sediment collects in the already undersized drainage channels, the flow area is reduced even further so that a given amount of runoff is more likely to overflow the channel or break through the spoilbank levees. Sediment has also degraded the environmental quality of numerous wetland and aquatic areas in the bottomlands, including Horseshoe Lake and the lake resources at Frank Holten State Park. Sedimentation of Horseshoe Lake has dramatically impacted its fisheries quality. It is now approximately two feet deep on average and provides less than desired habitat for aquatic resources. Sediment also has degraded the quality of tributary streams in the Project area. Aquatic habitat no longer supports the variety of species that were present during pre-settlement times. Urban development has increased the volume, duration, and frequency of stormwater entering the stream system and has affected the stability and habitat functions of streams. This degradation once begun will continue to adversely impact stream functions. Sediment left behind in drainage canals also contributes to loss of flood conveyance capacity. Following the severe flooding experienced by the area between 1996 and 2001, approximately $10,000,000 in federal, state and local funds have been expended in removing sedimentation from the interior drainage system. This is a continuing effort and expense.

Opportunities exist within the Project area to reduce sedimentation. Measures sited within the tributary watersheds would be located closest to the "problem" and address both the problem of sediment transfer to the floodplain and degradation of stream quality and function. Measures could also be implemented in the Bottoms to detain sediment.

Tributary Steam Channel Instability. Tributary stream channels in the Project area have responded to growing development in their watersheds with bank instability and head cutting. Increasing areas of developed, impermeable land surfaces in tributary watersheds has allowed greater amounts of storm water to pass through stream systems per unit time. These increased flows have lead to channel instability by creating unstable bank lines. In addition, base flows in some watersheds have increased due to the addition of effluent from septic systems in some subdivisions. Increased base flow can also lead to channel bottom instability and headcutting. Head cutting in tributary streams and tributaries has contributed to some dramatic losses and destabilization of banks throughout the system. This situation not only contributes large volumes of sediment to the system that ultimately reaches the floodplain, but it also degrades stream quality, threatens bluff infrastructure, existing developments, and habitat quality.

In spite of actions being taken today to manage stormwater runoff and future problems associated with urbanization, the destabilization process that has begun in the streams will continue to worsen if not addressed. For this reason, solving these tributary stream problems on a systematic watershed basis became an important facet of the overall Project focus.

An opportunity exists within the Project area to address the instability of tributary streams. For the purposes of this Project, this opportunity could beneficially address the sediment problem in a way that could provide increased and sustainable environmental viability for the tributary streams while protecting the restored floodplain habitat resources from unwanted sediment deposition. The NRCS was brought in to analyze the problems associated with sediment and to explore opportunities to address this problem. Appendix E of the main report includes the detailed findings and recommendations from these analyses. For purposes of this Project, the ability to find solutions for loss of sediment from the tributary streams was viewed as an environmental opportunity to improve water quality and aquatic habitat. Evaluation of potential measures to reduce sediment and stabilize and restore tributary streams became a focus of the plan formulation process.

Flooding and Flood Damages. Flooding that currently occurs when storm water overtops the existing water conveyance system in the bottoms will continue to cause significant flood damages. As discussed earlier, the Project area bottomlands are protected from direct flooding from the Mississippi River by a series of levees and floodwalls. However, the Project area has a history of serious interior flooding which is caused by storms producing interior flows that exceed the capacity of the canals in the bottomlands area.

At the bluff line the system of man-made ditches and channels take the flows from tributary streams across the floodplain to the levee where the water enters the Mississippi River. When rainfall events exceed the capacity of this interior drainage system, whose size has not been altered since constructed, the water typically breaks out immediately downstream of the bluff line. These "out of bank" flows do not provide a beneficial disturbance to wetland or other habitat resources as they are too far removed from the bluff line to receive these flows. They instead damage the urban and agricultural areas that hug the bluff line of the project area. Additionally, when the interior drainage system is full, floodplain areas cannot remove ponded water quickly enough, allowing these waters to damage urban areas away from the bluff line.

Interior flooding associated with large rainfall events producing widespread damages across the floodplain occurred in the Project area as a result of the storms of August 1915, July 1942, August 1946, July 1952, June 1957, May 1961, and May 1995. Perhaps the most damaging event occurred in August 1946 when approximately 19½ inches of rain fell over Madison and St. Clair Counties during an eight-day period. This storm produced an average depth of 15.1 inches over the entire Project area. Flood damage from this event was estimated to be $56,800,000 (2001 dollars) and the event was estimated to be rarer than the 100-year storm in terms of inches of rainfall. Flooding caused by a 14-inch rainfall over a two-day period in June 1957 caused approximately $25,000,000 (2001 dollars) in damages. This event and the 1995 event produced approximately a 100-year rainfall with average depths of over 8 inches across the Project area.

Unlike the other problems identified in this Study, the problem of interior flooding in the Study area has been the subject of numerous reports prepared by a number of different local, state and federal agencies. However, to date, no definitive solution has proved to be economically viable to address the situation and as a result, the cycle of flooding and disaster relief continues. Nevertheless, an opportunity exists to address flood damage reduction as part of the efforts to restore the historic flood pulse to the Project area. This opportunity to provide incidental flood damage reduction benefits occurs because of the multi-objective nature of the flood pulse restoration measures.

Cultural Resources. Literally hundreds of prehistoric and historic archeological resources are located throughout the Project area and are under constant threat from the pressures of development. The most well known site is the world-renowned Cahokia Mounds which is a World Heritage Site recognized by the United Nations. Despite the fact that more than 2,000 acres of the Cahokia Mounds site are publicly designated, more than one third of the site is still in private hands and is highly vulnerable to commercial or residential development.

The Project Team has concluded that if present growth rates throughout the Project area continue unabated during the twenty-first century, virtually all of the archaeological sites not currently in public ownership will be destroyed by commercial and residential development. If that is allowed to occur, the loss of the information contained in these sites will have a profound effect upon the ability of future generations to accurately interpret the prehistory of the Project area; one of the most significant prehistoric regions in all of North America.

An opportunity exists where feasible to incorporate the locations of archeological sites present in the Project area into the boundaries of the habitat areas developed for this Project. In this manner, the irreplaceable information contained within these sites will be protected and available for the benefit and enjoyment of future generations of all Americans.

Outdoor Recreation. The area is fortunate to have both the Horseshoe Lake and Frank Holten State Park systems and a start in implementing a "rails to trails" program. However, as the Project area continues to develop, there will be a growing need for additional outdoor recreation areas. As the surrounding land becomes increasingly urbanized, additional pressure is placed on the wildlife areas managed in the Horseshoe Lake State Park. Each of the counties have plans to enhance their outdoor recreational resources to attempt to keep pace with the growing population and ever expanding interest in outdoors activities.

Opportunities exist within the Project area to improve outdoor recreational opportunities through the restoration, protection and enhancement of existing ecosystem resources. Eco-education and related tourism is a new pastime of a society chiefly separated from natural areas and environmental resources. The opportunity also exists to adapt the existing flood protection system to meet outdoor recreational needs while the restoration and expansion of natural areas could create connectivity to augment and expand existing outdoor recreational opportunities.

Summary. The main problems within the Study area are the loss of ecological resources primarily caused by urbanization, sedimentation (which contributes to loss of water quality and aquatic environmental quality), and persistent recurring flooding. After looking at the cause and effect of these problems in depth, it becomes clear that they are inter-related and require an inter-related watershed based focus in the search for potential opportunities and resultant solutions. Natural ecosystem areas must be preserved now in order to protect them from loss on the floodplain. Likewise tributary streams must be restored now in order to protect them from being lost. Stormwater is the only viable floodplain hydrology source that remains to restore and revitalize the natural ecosystem. The beneficial uses of this water provide the possibility of identifying numerous environmental opportunities that could not otherwise be realized. An investigation of the pre-settlement hydrology of the area provides a picture of a vibrant natural ecosystem sustained by over-bank flooding coming from the Mississippi River as well as from the tributary watersheds. This investigation, coupled with an inventory of existing natural areas, provides a roadmap for restoration possibilities.

For the purposes of this Study, the interior flooding problems were viewed as an ecosystem service opportunity and the evaluation of the use of stormwater events to restore a flood pulse necessary to mimic pre-settlement ecosystem conditions as a foundation of the formulation process. The restoration of watershed functions appeared to be the best way to address the problems of the study area while capitalizing on the opportunities available. It is believed that through the identification of the ecosystem services gained from environmental restoration actions, the cost of ecological restoration activities can be competitive with other demands for limited public financial resources. By clearly demonstrating the many contributions to social well being that ecosystem restoration achieves, a restoration project can become the focal point of an area's master plan. From the onset of this Study, the potential mitigation of floods by the natural ecosystem has been highlighted as the most important service to provide social well-being for the Project area.

PLAN DEVELOPMENT

Planning Assumptions. The following assumptions were made in order to help guide the plan development effort:

The existing levee system and interior flood control system will remain functional and operational.

The existing pump station capacities are adequate and will not be impacted by Study recommendations.

Pre-development conditions can be used to guide the development of ecosystem restoration plans in order to address multiple problems.

Ecosystem restoration can provide incidental flood damage reduction and be competitive for scarce sponsor financial resources.

Watershed based solutions will be essential based on the Study area characteristics and the limited remaining resources.

Planning Constraints. Every planning process has constraints placed upon it. Below are those that were identified during this Study effort:

Limitations within the Corp of Engineers' program prevent the investigation of problems associated with combined sewers under the flood control and environmental restoration authority and thus presents a constraint to this study's ability to address problems of combined sewer overflow, as expressed by the citizens in areas like East St. Louis.

Limitations within the Corps of Engineers' program prevent the investigation of interior drainage problems impacting less than one square mile and thus presents a constraint to this study's ability to address floodplain flooding caused by the ponding of stormwater falling within many of the smaller drainage areas of the floodplain itself.

Limitations established by the existing flood protection system and drainage canal system.

Limitations of available land suitable for ecosystem restoration.

Planning Objectives. Specific objectives for this Study have been developed in response to the problems and opportunities identified during the scoping, public involvement, and early Project research efforts. The analysis of pre-settlement land cover and conditions in the Project area became the guide to establishing restoration planning targets for the Project. The comparison of historic land cover mapping with today's existing conditions also provided insight into restoration possibilities.

In general, planning objectives are specific operational statements that provide the direction for the development of specific alternative plans. The planning objectives for this Project are identified below, in no particular order of importance. Planning targets were developed for each objective based on an analysis of pre-settlement conditions and existing conditions in order to provide information to the team during the iterative evaluation and assessment process. These planning targets served as guideposts for developing alternative plans, and for comparing the desired restoration level to the level of restoration expected to be achieved through the implementation of any alternative plan formulated to address the corresponding planning objective.

Planning Objective 1 - Restore Natural Areas. Increase the overall spatial extent of under-represented natural communities by restoring and expanding existing natural areas wherever possible. Planning target: natural areas to be established by the Project should contain ten percent of the historic amount of Mississippi River floodplain forest in the Project area (1,880 acres), five percent of the historic amount of floodplain prairie in the Project area (1,612 acres), and 100 acres of created (new) floodplain marsh. Floodplain forest is to consist of one-third existing forest (627 acres) and two-thirds new forest (1,253 acres).

Planning Objective 2 - Restore Flood Pulse. Reintroduce a flood pulse into floodplain natural areas that mimics the historic hydrological condition. Planning target: the maximum flood pulse will not exceed the depth of the Mississippi River flood of 1844 at St. Louis, or 14 days in duration.

Planning Objective 3 – Restore Habitat Quality. Restore habitat quality in existing and re-created natural areas. Planning target: develop and maintain, at a minimum, moderate habitat quality for all evaluation species in existing and re-created natural areas.

Planning Objective 4 - Improve Water Quality. Improve the quality of surface waters. Planning target: reduce levels of sedimentation in as many surface tributaries as possible.

Planning Objective 5 - Reduce Erosion. Reduce erosion in the tributary watersheds. Planning target: Reduce the total amount of sediment reaching the bottoms by 70 percent.

Planning Objective 6 – Restore Tributary Streams. Improve the stability of tributary streams in order to restore stream quality and aquatic functions.

Planning Objective 7 - Restore Floodplain Streams. Restore floodplain streams and associated riparian corridors. Planning target: recreate flowing floodplain streams with associated riparian corridors for a distance equivalent to 10 percent of the floodplain length of historic Cahokia Creek (four miles) and establish three miles of riparian corridor linkages between existing or proposed natural areas.

Planning Objective 8 - Incidental Social Objectives. The interrelationship between problems and opportunities that was identified through the public involvement process dictated the need to identify and measure incidental Project contributions to the social well being of the area. As previously discussed, it was deemed important to quantify the ecosystem services that would be provided as a natural by-product of the restoration Project in order to ensure the public had a full appreciation of the many positive benefits to be realized from an ecosystem restoration project. Objectives designed to focus on these issues were developed to ensure that ecosystem services incidentally provided by the Project could be tracked and quantified.

Planning Objective 8a - Reduce Flood Damages in Urban and Agricultural Areas. Planning target. To the maximum extent possible within the planning target to restore a floodplain flood pulse.

Planning Objective 8b - Enhance Outdoor Recreation. Increase and enhance outdoor recreational opportunities within natural areas. Planning target: Provide passive outdoor recreational opportunities at as many sites as possible.

Planning Objective 8c - Protect Cultural Resources. Protect cultural and archeological resources and enhance their values. Planning target: Envelop known archaeological sites into Project lands rather than attempt to avoid them.

Measures to Address the Planning Objectives. The Project Team identified and developed a number of measures that could be implemented to address each planning objective:

Objective 1. Expand natural areas. Measures: 1-Obtain land (existing or new habitats); and, 2-Create habitats (forest, prairie, marsh).

Objective 2. Restore flood pulse. Measures: 1-Modify existing channels; 2-Construct new channels; 3-Divert surface flow into habitat areas; 4-Construct earthen berms to contain flood pulse in habitat areas; and, 5-Detain surface flow in habitat areas.

Objective 3. Maintain habitat quality. Measures: 1-Increase tree species diversity and abundance in existing upland and floodplain forests (implement tree stand improvements, or selective clearing and planting of underrepresented species, such as oaks); 2-Install nesting boxes in existing marshes and floodplain forest (i.e., wood duck); 3-Add flood pulse to existing floodplain wetlands, lakes, ponds, borrow pits; 4-Remove standing water from areas of "drowned" forest; 5-Create overwintering areas for fish in existing floodplain lakes and ponds; 6-Add woody debris in floodplain lakes and ponds; 7-Add shoreline plantings in existing floodplain channels, lakes, ponds, borrow pits; 8-Augment base flow in existing floodplain channels with new pump station; 9-Add riffle and pool complexes in tributary streams; and, 10-Protect natural areas by restricting them to compatible uses.

Objective 4. Improve water quality. Measures: 1-Construct buffer strips and tile outlet terraces to control erosion in upland agricultural areas; 2-Construct in-stream sediment detention basins in tributary streams or dry sediment detention basins on the floodplain in habitat areas to capture sediment; 3-Create riffle and pool complexes in tributary streams to restore in-stream habitat; 4-Construct in-channel grade control structures in tributary streams to prevent headcutting; and, 5-Plant grassy or prairie buffers in floodplain swales to capture sediment.

Objective 5. Reduce erosion. Measures: 1-Construct tributary stream sediment detention basins; and, 2-Construct terraces in the uplands; 3-Construct underground outlet & subsurface drains in the uplands; 4-Construct water and sediment control basins in the uplands; 5-Install critical area plantings in the uplands; 6-Construct diversions in the uplands; 7-Install filter strips in the uplands; 8-Install grass waterways in the uplands; 9-Stabilize banks of tributary streams; 10-Install grade control structures in tributary streams; 11-Create riffle and pool complexes in tributary streams; 12-Allow for natural deposition of sediment on alluvial fans; and, 13-Construct lowland dry sediment detention basins.

Objective 6. Restore tributary streams. Measures: 1-Stabilize banks of tributary streams; 2-Create riffle and pool complexes; 3-Construct in-channel grade control structures; and, 4-Implement bio-erosion control techniques.

Objective 7. Restore floodplain streams. Measures: 1-Obtain land; 2-Reconnect historic stream channel fragments; 3-Plant natural vegetation; 4-Create connectivity corridors between natural areas that are centered along existing streams, by planting natural vegetation; 5-Create connectivity corridors between natural areas that are centered along existing ditches, by modifying existing ditch system (set back one or both levees) and planting natural vegetation within levees; and, 6-Create connectivity corridors between natural areas that are centered along existing ditches, by planting natural vegetation outside levees.

Objective 8. Incidental Social Objectives

8a. Reduce flood damages. Measures: 8a-1-Modify existing channels; 8a-2-Construct new channels; 8a-3-Divert surface flow into temporary storage areas; 8a-4-Construct earthen berms; and, 8a-5-Detain surface flow in temporary storage areas.

8b. Enhance recreation. Measures: 8b-1-Construct trails; 8b-2-Provide interpretive areas; 8b-3-Provide signage; and, 8b-4-Provide access areas.

8c. Protect cultural resources. Measures: 8c-1-Obtain selected sites; 8c-2-Plant historic natural vegetation; 8c-3-Add historic flood pulse; and, 8c-4-Provide interpretive areas.

Identification of Potential Restoration Sites. The initial array of possible restoration sites for each watershed was next developed based upon insight provided by analysis of the pre-settlement land cover and hydrology, project restoration planning targets, public outreach, previous reports, identification of existing habitat sites and the knowledge of agency personnel. In this manner the Project Team developed a list of potential sites for the Project area which were organized and identified in relation to the five area watersheds: Long Lake; County Ditch; Cahokia Canal; Harding Ditch; and, Powdermill. The item in parentheses below is the potential restoration sites' unique identifier.

Long Lake. Borrow Pits near Long Lake, south (LO-23); Borrow pit between Rte 162 and Long Lake (LO-27); Wetland along railroad track Granite City (LO-28); Dobrey Slough (LO-29); Dobrey Slough Agricultural land east of tracks; Wetland near Horseshoe Lake, Route 162, west (LO-47); Wetland West side of Lake Road Route 162, east (LO-48); Long Lake; Mitchell Ditch; Dobrey Slough Canal (concept); and, Legacy Golf Course.

County Ditch. Wetland near Rte. 111 (CO-18); Wetland along Old Cahokia Creek, north (CO-20); Wetland along Old Cahokia Creek, south (CO-21); Wetland along County Ditch, north (CO-24); Wetland along County Ditch, south (CO-25); County Ditch; and, Bluff 1 Tributary Watershed.

Cahokia. McDonough Lake (CA-30); Wetland Edelhardt Meander Scar, Rte. 111 west (CA-31); Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32); Agricultural land Edelhardt Meander Scar, middle (CA-33); Wetland Edelhardt Meander Scar, east (CA-34); Arlington Subdivision Wetland Edelhardt Meander Scar, south (CA-35); Arlington Subdivision area Wetland Horseshoe Lake, delta at Cahokia Diversion Canal (CA-36); Wetland Horseshoe Lake, west fringe (CA-37); Wetland Horseshoe Lake, Rte. 203 east (CA-37.1);

Wetland Horseshoe Lake, east fringe (CA-38); Wetland Horseshoe Lake, northeast fringe (CA-38.1); Wetland Horseshoe Lake, Walker Island (CA-39); Wetland, Milam mitigation site, Horseshoe Lake (CA-40); Horseshoe Lake Wetland Brushy Lake (CA-41); Agricultural land, Brushy Lake North; Wetland Eagle Park west (CA-42); Wetland Eagle Park east (CA-43); Wetland Cakokia Canal borrow pits along I-55/70 (CA-44); Wetland at Indian Lake, Fairmont City (CA-45); Wetland East of Route 203, North of I-55/70 (CA-46); Wetland Lansdowne Ditch (CA-49); Lansdowne Ditch Wetland Canteen Creek (CA-54); State Park Place; Judy's Branch Watershed; Burdick Branch Watershed; Agricultural land Judy's/ Burdick; Schoolhouse Branch Watershed; Canteen Creek Watershed; National City Stockyard; Cahokia Canal; and, Bluff 3 Watershed.

Harding. Wetland Cahokia Mounds (HA-50); Cahokia Mounds State Historic Site; Wetland Spring Lake meander scar, north (HA-51); Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52); Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53); St. Clair Farms; Farmed wetland along Harding Ditch, Bunkum Rd. (HA-54); Wedgewood; Centerville; Wetland Crooked Lake (HA-55); Wetland East St. Louis (HA-59); Wetland Holten State Park, north (HA-60); Wetland Holten State Park, northwest (HA-60.1); Wetland, Holten State Park, south (HA-61); Lakes 1 and 2, Holten State Park Lake; ALCOA Site; Wetland Canal No. 1, north (HA-62); Wetland Mary Spencer (HA-63); Wetland near Mary Spencer (HA-64); Farmed wetland North of Sterling Place; City of Caseyville (HA-68.5); Farmed wetland by Crooked Lake (HA-68.1); Farmed wetland by Crooked Lake (HA-68.2); Farmed wetland along Harding Ditch, south (HA-68.3); Area along Harding Ditch, north near Centerville (HA-68.6); Area along Harding Ditch, south near Centerville (HA-68.7); Farmed wetland East of I-255 South of I-64 (HA-68.8); Little Canteen Creek Watershed; Schoenberger Creek Watershed; Bluff 2, Watershed; Bluff 4, Bluff 5 Watershed; and, Harding Ditch.

Powdermill. Wetland Mullen Slough (PO-66); Wetland Fishing Pond (PO-67); Wetland Canal No. 1 (PO/HA-67); Agricultural Land Mullens Slough; Powder Mill Creek Watershed; and, Bluff 6 Watershed.

Identification of Potential Measures. In the spring of 1999, numerous sites throughout the Project area were visited to establish baseline habitat conditions. In all, some 112 sites were evaluated using the HydroGeoMorphic Approach to assessing wetland functions (HGM), and 160 sites were evaluated using the Habitat Evaluation Procedures (HEP) as apart of the initial baseline assessment process. Floodplain sites and bluff sites were subjected to a baseline evaluation using HEP, and wetland sites were additionally assessed using HGM. Tributary streams were assessed at 17 sites using the Qualitative Habitat Evaluation Index (QHEI) method. The first-hand experience gained from the HEP/HGM analysis at each site assisted in the identification of potential measures at these sites.

A detailed discussion showing the full array of objectives and measures that could potentially be applicable to each of the sites identified in the five watersheds is beyond the scope of this Summary Report but is contained in the more detailed General Reevaluation Report.

Screening of Potential Restoration Sites. Following the assessment and evaluation of measures, the Team began the evaluation of restoration sites and restoration site combinations based on location, topography, area hydrology, soils, and existing conditions to contribute to Project planning objectives. This next iteration of assessment and evaluation addressed each restoration site's ability to stand alone or work effectively in combination with others to address the planning objectives. Based upon the large number of potential sites, the Team agreed that in order to formulate viable alternative plans, the focus had to be on the identification of a few areas that could contribute in a meaningful way to the planning objectives. It was infeasible to develop a large number of small fragmented sites across the Project area that contributed to only to a few objectives and still hope to achieve restoration planning targets. Therefore, thc Team determined that sites or combination of sites needed to meet multiple objectives to have a chance of making a meaningful change in the existing conditions of the Project area. Sites were evaluated based on their ability to contribute individually or in combination to multiple project objectives and also have the potential to meet planning targets. In this way, potential action areas were to be identified. The following identifies by watershed, the restoration areas that survived the screening process. This screening process is detailed in Section 6 of the main report.

Restoration Site Survivors:

Long Lake. Dobrey Slough (LO-29); Dobrey Slough Agricultural land east of tracks; Long Lake; and, Mitchell Ditch.

County Ditch. Wetland along Old Cahokia Creek, north (CO-20); Wetland along Old Cahokia Creek, south (CO-21); Wetland along County Ditch, north (CO-24); Wetland along County Ditch, south (CO-25); County Ditch; and, Bluff 1 Tributary Watershed.

Cahokia. McDonough Lake (CA-30); Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32); Agricultural land Edelhardt Meander Scar, middle (CA-33); Wetland Brushy Lake (CA-41); Agricultural land, Brushy Lake North; Wetland Cakokia Canal borrow pits along I-55/70 (CA-44); Wetland at Indian Lake, Fairmont City (CA-45); Lansdowne Ditch Wetland Canteen Creek (CA-54); State Park Place; Judy's Branch Watershed; Burdick Branch Watershed; Agricultural land Judy's/ Burdick; Schoolhouse Branch Watershed; Canteen Creek Watershed; National City Stockyard; Cahokia Canal; and, Bluff 3 Watershed.

Harding. Cahokia Mounds State Historic Site; Wetland Spring Lake meander scar, north (HA-51); Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52); Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53); St. Clair Farms; Farmed wetland along Harding Ditch, Bunkum Rd. (HA-54); Wedgewood; Wetland Crooked Lake (HA-55); Wetland Canal No. 1, north (HA-62); Farmed wetland North of Sterling Place; City of Caseyville (HA-68.5); Farmed wetland by Crooked Lake (HA-68.1); Farmed wetland by Crooked Lake (HA-68.2); Little Canteen Creek Watershed; Schoenberger Creek Watershed; Bluff 2, Watershed; Bluff 4, Bluff 5 Watershed; and, Harding Ditch.

Powdermill. Wetland Mullen Slough (PO-66); Wetland Fishing Pond (PO-67); Wetland Canal No. 1 (PO/HA-67); Agricultural Land Mullens Slough; Powder Mill Creek Watershed; and, Bluff 6 Watershed.

Identification of Potential Action Areas. Restoration sites screened and identified to be carried forward as having potential for meeting project objectives were put through further engineering and biological analysis in order to identify the relative effectiveness of restoration sites and site combinations. These analyses are detailed in the Hydraulic, Geotechnical, and Sediment Appendixes of the General Reevaluation Report. The purpose was to eventually assemble "action areas" using one or more of the restoration areas so as to take advantage of their inherent synergistic characteristics. The action areas then would become the focus and would be the areas within which specific plans would be developed.

At this point, restoration sites were assembled into potential action areas and screened for having the ability to achieve multiple project goals and objectives and to make a significant contribution to attaining planning targets. Habitat restoration and the ability to reasonably attain hydraulic reconnection for flood pulse restoration to enhance ecosystem functions were key to the assessment process. The potential action areas determined to have inadequate potential were not carried forward. Those that did were carried forward and are identified below along with their components. The action areas carried forward from this assessment next were to be put through the alternative plan development process. They are displayed in Figure 10.

Action Areas Surviving the Screening Process:

Dobrey Slough Action Area. Consists of the Dobrey Slough (LO-29) and Dobrey Slough Agricultural land east of tracks restoration areas.

Old Cahokia Creek Action Area. Consists of the Wetland along Old Cahokia Creek north (CO-20), Wetland along Old Cahokia Creek south (CO-21), Bluff 1, and Cahokia Canal restoration areas.

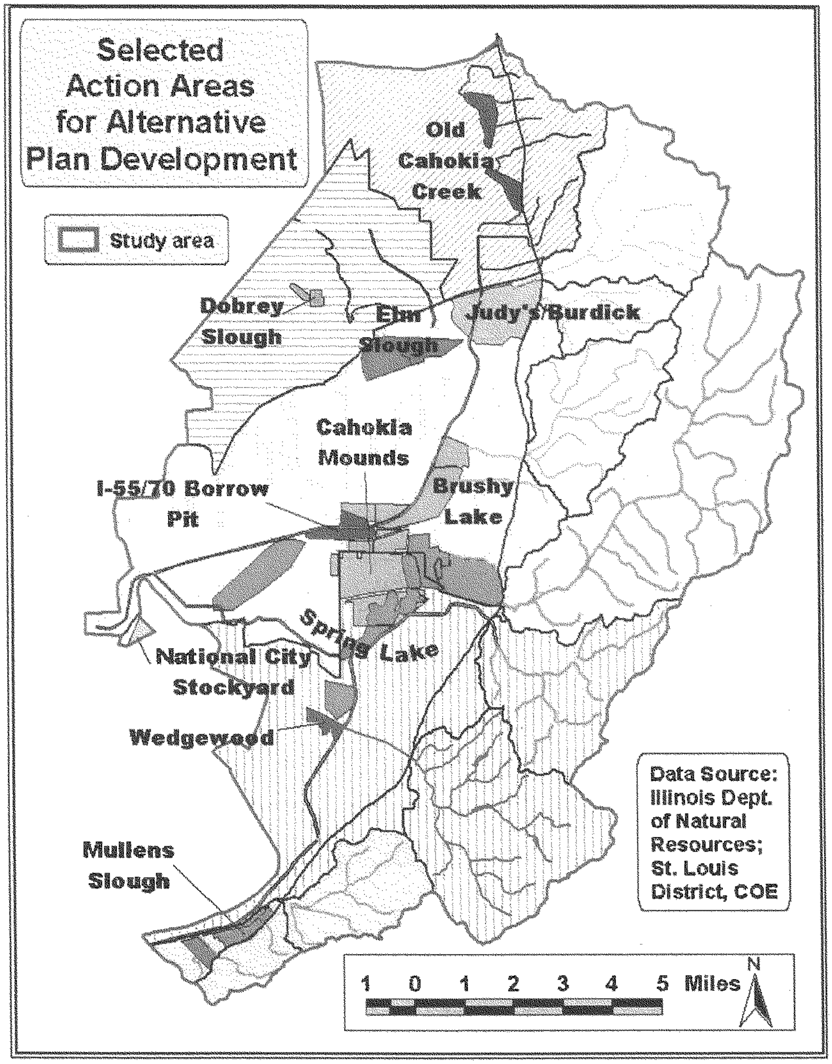
Elm Slough Action Area. Consists of the Long Lake, Mitchell Ditch, Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32), and Agricultural land Edelhardt Meander Scar, middle (CA-33) restoration areas.

Judy's/Burdick Branch Action Area. Consists of the Judy's Branch, Burdick Branch and Agricultural land Judy's/Burdick restoration areas.

Brushy Lake Action Area. Consists of the Wetland Brushy Lake (CA-41), Agricultural land Brushy Lake North, Bluff 3 Watershed, and Schoolhouse Branch restoration areas.

Cahokia Mounds Action Area. Consists of the Cahokia Mounds and CA-50 restoration sites.

Figure 10 Action Areas Selected for Alternative Plan Development



Spring Lake Action Area. Consists of the Canteen Creek, Harding Ditch, Little Canteen Creek, Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53), Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52), St. Clair Farms, Landsdowne Ditch, Wetland at Indian Lake, Fairmont City (CA-45) and, Wetland at Indian Lake restoration areas.

Wedgewood. Consists of the Harding Ditch, Schoenberger Creek and Wedgewood restoration areas.

Mullens Slough. Consists of the Wetland Mullens Slough (PO-66); Wetland Fishing Pond (PO-67); Wetland Canal No. 1 (PO/HA-67); Agricultural Land Mullens Slough; Powder Mill Creek Watershed; and, Bluff 6 Watershed restoration areas.

Alternative Plan Development. Preliminary alternative plans were next formulated for each action area. A variety of combinations of measures were developed at each site that could be evaluated for their effectiveness and cost efficiency in addressing planning objectives.

By this stage of the plan development process, the Team had determined the combination of species that would be used to predict habitat outputs for the various alternative plans. Appendix A of the main report provides detailed information regarding the rationale and selection process for these predictor species which are used to measure habitat outputs for the different combinations of measures in an alternative plan. The potential array of measures was developed based upon the analyses of pre-settlement land cover and hydrology, and project restoration planning targets. As described previously, the selected action areas were initially screened for their existing habitat, soils, hydraulic connectivity and spatial area. In this manner, the Team was able to develop a full array of ecosystem and social measures for efficiency and effectiveness competition at each action area. In the development of alternative plans for each action area, several conclusions from engineering and biological analysis were used to assist in guiding the process. It had been determined during the action area screening process that each of the designated project action areas could receive hydraulic input with the potential to provide disturbance depths having limited durations that would be considered beneficial for biological purposes (defined as meeting Objective 2, Flood Pulse Restoration) and could accept storm water for flood damage reduction purposes (Objective 8a, Reduce Flood Damages). Varying hydraulic events were analyzed at each site to determine the optimum for a site based upon planning targets and cost factors. A more detailed discussion of this analysis is contained in Appendix C of the main report.

Tributary stream sediment detention measures and creation of riffle and pool complexes recommended by NRCS were considered together within each watershed as an "all or nothing" unit for alternative development. This was necessitated by the inability to attribute improvements to the system in any smaller increments of action. This is in concert with the NRCS' study, which is further detailed in Appendix E of the main report. Based on the NRCS' analysis, land treatment measures were eliminated in alternative plans. These measures proved to be unreliable because of their voluntary nature, and uneconomical because of the rapid urbanization projections for the bluff, which meant these measures would be temporary in nature. This analysis is further discussed in Appendix E.

Tributary stream and lowland sediment detention measures were retained and analyzed during this iteration as a method for the removal of sediment and improvement of water quality for each action area that had a tributary stream connection. Appendices C and E of the main report provide more detail on tributary stream and lowland sediment detention measure analysis that determined the acceptability of measures designed to meet the Planning Target established for Objective 5 (Reduce Erosion) and Objective 4 (Improve Water Quality).

The measures at this stage of formulation had attained more specificity based upon additional hydraulic, geotechnical and sediment analyses performed. From these preliminary plans, cost curves were developed for measures that were required at multiple sites. These cost curves were utilized to identify those measures providing a similar benefit that proved less effective. This allowed for the initial reduction of alternative plans prior to running action area alternative plans through the HEP/ ICA analysis. The chart below shows the number of alternatives carried through to more detailed iterations of assessment and evaluation.

Watershed	Action Area	Alternative Counts		
		Conceived	Dropped	Evaluated
County Ditch	Old Cahokia Creek	24	12	12
Cahokia	Judy's-Burdick Branches	40	20	20
Cahokia	Brushy Lake	30	24	6
Cahokia	Elm Slough	6	1	5
Cahokia/Harding	Spring Lake	126	117	9
Harding	Wedgewood	6	2	4
Harding	Cahokia Mounds	12	6	6
Powdermill	Mullens Slough	6	0	6
Long Lake	Dobrey Slough	6	3	3
	Totals:	258	187	71

Alternative Plan Assessment. Planning level cost estimates were developed for each alternative plan within an action area. These estimates included lands, construction (including environmental treatments) and operation and maintenance costs and were annualized at the current interest rate over the 50-year project life. These estimates were to be used in the incremental cost analysis. Using this methodology, the predicted average annual habitat unit benefits (effectiveness) could be compared to the predicted annualized costs (efficiency) in order to generate a comparison of alternative plans for assessment and evaluation purposes. Appendix A of the main report describes these procedures in detail and provides data on results obtained. This process resulted in the final set of alternatives for each action are that was carried through the final incremental cost analysis process.

Final Array of Alternative Plans by Action Area. The screening process used on the alternative plans resulted in a final set of alternatives for each action area that were analyzed using the incremental cost effectiveness analysis process. The following is a recap of final alternatives that were competed through the incremental cost effectiveness analysis. Appendix A of the main report provides complete detail on this process.

Dobrey Slough. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages in the residential neighborhoods adjacent to Dobrey Slough, in the Long Lake watershed. A total of 3 different alternatives are being evaluated.

Common measures:

1. The establishment of a habitat area with the existing "slough" (marsh-based vegetation) serving as its core.

2. The restoration of existing marsh, and the creation of new marsh, inside the habitat area supported by utilization of the stormwater events delivered by local runoff. Excavation would be necessary to support the creation of the new marsh as well. In addition, modification of the existing drainage structures, located under the railroad embankment, will be necessary.

Variable measures:

1. The creation of a forested corridor, inside the habitat area, surrounding the existing marsh. Trees would be planted (where they currently do not occur) on the west side of the railroad embankment in undeveloped areas. The forested corridor would provide habitat, and serve as a filter strip to enhance water quality in the marsh. The width of the forested corridor was considered when developing alternatives. Three corridor size options [i.e., 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters)] were designed for this site. These corridor widths would be created on both sides of the channel/ditch.

Old Cahokia Creek. The purpose of this action area is to restore a portion of Cahokia Creek on the floodplain to a free-flowing stream, with an adjacent forested corridor supporting natural plant and animal communities, and a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the "Bluffl" watershed and to incidentally reduce flood damages in the bottoms in the County Ditch watershed, with a focus on Sand Road and vicinity. A total of 18 different alternatives are being evaluated.

Commonly shared measures:

1. The reopening of a portion of the Cahokia Creek channel on the floodplain. Segments of historic channel that were filled over the years would be reopened under these alternatives, and existing channel areas would be excavated to remove accumulated sediment to recreate a floodplain stream that once flowed from north to south.

2. The creation of a continuous forested corridor along the reopened channel. In all alternatives, trees would be planted on both sides of the creek where they currently do not occur.

3. The construction of an earthen hydraulic feature along the west side of the reopened channel. This feature, located along the west edge of the forest on the west side of the creek, would allow for a riverine overflow regime to be reestablished, while restricting overflow from the creek to the forested corridor and adjacent lands to the east.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 10 new tributary stream sediment detention basins in the "Bluff 1" watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 6 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.
2. Length of channel restoration – two lengths of channel restoration were considered. From the south end of the project area, the shorter channel option would extend north along the creek for a distance of approximately 2.9 miles. The longer channel option would extend the length of the diversion channel for a distance of approximately 4.2 miles.
3. Augmentation vs. no augmentation of stream flows – for the longer channel alternatives, a new pump station could be installed at the diversion channel, and would be used to augment low stream flows to enhance environmental returns.
4. Width of forested corridor – on each side of the creek, widths of approximately 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters) were considered.

Elm Slough. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages within the Long Lake watershed. Much of the project area is an old meander scar of the Mississippi River, and forest was the predominant type of vegetation two centuries ago. A total of 5 different alternatives are being evaluated.

Commonly shared measures:

1. The creation of a 670-acre forested habitat area to utilize stormwater events delivered by Long Lake and Mitchell Ditch. Trees would be planted in areas where they do not currently occur. The construction of earthen hydraulic features around the perimeter of the habitat area would also be included in this option, as well as the simulation of hydrologic conditions (in a large area of the newly planted wetland forest), similar to those of the existing wetland forest. Excavation of an area approximately 175 acre in size, will be necessary to temporarily store water.
2. The replacement of the two "funnel-shaped" waterways referred to as Mitchell Ditch and Long lake Ditch on the south side of Route 162. Stormwater from these two floodplain tributaries will be carried south into Elm Slough in a sheet-flow manner. Earthen hydraulic features constructed along the edges of these waterways will restrict stormwater to the habitat area. Culverts under Route 162, and the adjacent railroad embankments, will be modified as well.
3. Grassy vegetation will be planted inside the "funnel-shaped" drainage ways to act as filters that intercept sediment carried by stormwater.

Variable measures:

1. Replacement of under-represented tree species - two levels of management will be considered (i.e., simple vs. intensive activities). Simple improvements will focus on of selective thinning and planting of mast tree species in the existing forest. Intensive improvements will involve the removal of existing dead (drowned) timber, and the planting of appropriate tree species. The "No Action" management strategy defers improvements.

2. Presence or absence of a prairie-based vegetative buffer - the proposed buffer would be created at the location where sheet flows are anticipated to enter Elm Slough, in front of the main forested habitat area. The buffer will be designed to intercept sediment carried by flows from Long Lake and Mitchell Ditch.

Judy's-Burdick. The purpose of this action area is to create an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Judy's, Burdick, and "Bluff 1" watersheds and to incidentally reduce flood damages in the bottoms within the Cahokia watershed. The floodplain component lies at the southern end of historic Rattan's Prairie, a 15,000-acre wet prairie once located in the northeast part of the American Bottoms. A total of 16 different alternatives are being evaluated.

Commonly shared measures:

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Judy's and Burdick Branches combined.

2. The modification of the existing levee, along the south side of Burdick Branch, to ensure delivery of stormwater events from the Judy's and Burdick tributaries into the new habitat area.

3. The creation of a 330-foot (100-meter) wide prairie buffer surrounding the perimeter of the habitat area's earthen hydraulic feature.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 28 new tributary stream sediment detention basins- 23 in the Judy's Branch, 4 in the Burdick Branch and 3 in the "Bluff 1" watersheds and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 32 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.

2. Size of habitat area – given existing urban constraint, three options are being considered to provide a variety of habitat options and hydrologic regimes (the "small" option would restore 131 acres, the "medium" option would restore 230 acres and a "large" option would restore 350 acres). Under the small and medium size, options, a moderate-extensive excavation activity will support the development of a new marsh. For the larger option, prairie would be created with little or no excavation needed.

3. Restoration of the historic Cahokia Creek channel within the habitat area – a channel would be excavated to replace the historic channel that has degraded over time - in over time in an effort to recreate the floodplain stream similar to that which once flowed from north to south across the site.

4. Create a 330-foot (100-meter) wide forested corridor along the north side of Burdick Branch extending from Cahokia Canal to Route 157.

5. Restoration of Tributary Streams a series of riffle and pool complexes would be constructed in the streams to stabilize streams and improve habitat quality.

Brushy Lake. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to minimize restore stream resources in the Schoolhouse Branch and "Bluff 3" watersheds, and to incidentally reduce flood damages within the Cahokia watershed. Much of the floodplain component is an old meander scar of the Mississippi River. Two centuries ago, Cahokia Creek flowed through this area, and forest was the predominant type of vegetation. A total of 6 different alternatives are being evaluated.

Common measures:

1. The creation of a 710-acre forested habitat area on the floodplain to utilize stormwater events delivered by both Schoolhouse Branch and Snyder Creek that will include planting of trees where they do not currently exist.

2. The restoration of the historic Cahokia Creek channel within the habitat area. Segments of channel that have been filled, will be reopened, and existing remnants will be excavated to remove accumulated sediments. These actions will recreate a floodplain stream similar to that which once flowed from north to south across the site.

3. Modification of the existing channels and levees of Schoolhouse Branch and Snyder Ditch to ensure delivery of stormwater events from these two bluff tributaries into the new habitat area. The current channel conditions (i.e., grassy side-slopes and earthen bottom) will be utilized.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 15 new tributary stream sediment detention basins- 14 in the Schoolhouse Branch watershed and 1 in the "Bluff 3" watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 25 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.

2. Presence or absence of a prairie filter – under the Bottomland sediment detention option, a 330-foot (100 meter) wide vegetative buffer would be established in the habitat area outside the detention basin. The buffer would consist of prairie plantings to intercept sediment carried by stormwater overtopping the basin.

Spring Lake. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Canteen and Little Canteen Creek watersheds, and to incidentally reduce flood damages within the Cahokia and Harding watersheds. The three floodplain areas lie in separate historic meander scars of the Mississippi River.

Two centuries ago, the principal type of vegetation occurring in these areas appears to have been marsh (Cell 1), prairie (St. Clair Farms), and forest (Indian Lake). A total of 9 different alternatives are being evaluated.

Common measures:

1. The establishment of three floodplain areas, namely Cell 1 (370 acres), St. Clair Farms (180 acres) and Indian Lake (620 acres), as habitat areas that will utilize stormwater events from Canteen and Little Canteen Creeks with the construction of earthen hydraulic features around these areas, when necessary. At Indian Lake, remnants of Cahokia Creek would be reopened to create a flowing floodplain stream, and trees would be planted along both sides of the channel (where they currently do not exist), to create a continuous forested corridor 330 feet (100 meters) wide. Impaired drainage at the northern end would be improved and standing water removed, to allow the forest to become reestablished.
2. The creation of a 330-foot (100-meter) wide forested corridor on both sides of Harding Ditch between Cell 1 and St. Clair Farms.
3. The re-establishment of a forest in the dead timber area[1] north of Forest Boulevard, within the Cahokia Mounds State Historic Site. The permanent standing water within a 35-acre tract of dead (drowned) timber would be drained and appropriate tree species planted under this option.
4. The construction of a new Canteen Creek relief channel to ensure that stormwater from the Canteen Creek watershed enters into the Harding Ditch system, and ultimately into the habitat areas. The channel would have concrete sides, a concrete bottom and earthen levies along both banks.
5. The modification of Harding Ditch, from Route 157 to Cell 1, and from Cell 1 to St. Clair Farms, in order to ensure the transference of stormwater events from Canteen and Little Canteen Creeks to the habitat areas. The channels would have grassy sides, an earthen bottom and an earthen levee along both banks.
6. The construction of a new "Fairmont City Ditch," from Cell 1 to Indian Lake, which will provide the hydraulic connection from Canteen Creek back to Cahokia Canal. The channel would have grassy sides, an earthen bottom and an earthen levee along both banks in low elevations.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 58 new tributary stream sediment detention basins- 37 in the Canteen Creek watershed and 21 in the Little Canteen Creek watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 99 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.
2. Presence or absence of a new "floodplain" along "Reach 3B" of Harding Ditch. By setting back the existing levees along a 2,000-foot long reach of Harding Ditch, a "floodplain" area will be re-established.

3. Vegetative cover across the habitat areas – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site. In Cell 1, a restoration marsh option that requires extensive excavation was compared to an option that produced a combination of marsh and forested habitat with minimal excavation required. In the St. Clair Farms area, an option that restores prairie and forested habitats to the site with no excavation activities was compared to the restoration of marsh habitat requiring minimal excavation. In "Reach 3B" of the Harding Ditch, a prairie restoration option implemented in the floodplain was evaluated. Throughout the evaluation of options, the habitat conditions in the Indian Lake area were held constant.

4. Restoration of Tributary Streams - a series of riffle and pool complexes would be constructed in the streams to stabilize streams and improve habitat quality.

Wedgewood. The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Schoenberger Creek watershed and to incidentally reduce flood damages within the Harding watershed. The area of the floodplain component is located in the southern portion of historic Cold Prairie that interfaced with forest. A total of 4 different alternatives are being evaluated.

<u>Common measures:</u>

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Schoenberger Creek.
2. The modification of the existing levee, along the west side of Harding Ditch, to ensure delivery of stormwater events from Schoenberger Creek into the new habitat area.
3. The enclosure of Summit Avenue in the new habitat area, extending from Kings Highway on the west, to Harding Ditch on the east, to form a contiguous habitat area.

<u>Variable measures:</u>

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 24 new tributary stream sediment detention basins in the Schoenberger Creek watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 36 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches, and in the new habitat restoration area itself.
2. Vegetative cover across the habitat area – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site, wet supported by excavation activities.

Mullens Slough. The purpose of the restoration at the Mullen's Slough action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Powdermill and "Bluff 6" watersheds and to incidentally reduce flood damages within the Powdermill/Canal No. 1 watershed. In the floodplain, much of the project area lies in an old meander scar of the Mississippi River. The historic Pittsburg or Big Lake occupied this area, and Mullens Slough now lies within its footprint. Prairie once extended south and west of this historic backwater lake. A total of 6 different alternatives are being evaluated.

Common measures:

1. The establishment of a 310-acre floodplain habitat area to utilize stormwater events delivered by the Powdermill watershed.

2. The creation of overwintering fisheries habitat in Mullens Slough. To accomplish this, a series of deep pools (water depth greater than 8 feet) would be created (by excavation), to provide suitable conditions for winter survival.

3. The creation of islands in Mullens Slough. Material excavated to create overwintering habitat would, in turn, be placed in the slough to create a series of islands. These would be planted to prairie habitat.

4. The improvement of habitat structure in Mullens Slough. Woody debris would be added to the slough, and various aquatic plant species would be planted around its perimeter.

5. The restoration of historic floodplain prairie habitat. Within the new habitat area, prairie would be planted on a 31-acre floodplain area south of Mullens Slough.

6. The creation of a 17-acre marsh area (Cell 1). Stormwater from Powdermill Creek would be passed through this area on its way to Mullens Slough.

7. The improvement of tree species diversity in the existing forests along Canal No. 1 and Mullens Slough by selective thinning and planting of mast tree species.

Variable measures:

1. Tributary stream vs. Bottomlands sediment detention – sediment would be detained either by constructing 20 new tributary stream sediment detention basins),
Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 20 new tributary stream sediment detention basins - 14 in the Powdermill watershed and 6 in the "Bluff 6" watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 15 miles of tributary streams, or sediment would be detained in the Bottoms in a 17-acre detention basin (Cell 1) and in a second 23-acre detention basin (Cell 2), downstream of the habitat area itself.

2. Maintenance of prairie vegetation – three maintenance options were considered: Burning, Burning/Mowing, and Mowing.

Cahokia Mounds. The purpose of this action area is to restore an area on the floodplain that supports prairie plant and animal communities as similar to presettlement (ca. 1800) conditions as practicable. The project area lies within historic Cold Prairie, a 15,000-acre prairie once found in the southeast part of the American Bottoms. A total of 6 different action alternatives are being considered.

Variable measures:

1. Replacement of hay production areas with prairie plantings that would be completed within a 5 or 10- year time period. In terms of area, these rates corresponded to either ~105 or ~52.5 acres planted per year.

2. Three maintenance plans were designed to maintain the integrity of prairie plant communities by periodically removing dead plant materials.

a. Burning - the entire prairie would be burned every three years on a rotational cycle (a portion would be treated every year).

b. Burning and mowing - the entire prairie would be mowed once every two to three years, and burned once every ten years. Both treatments would be implemented on a rotational cycle.

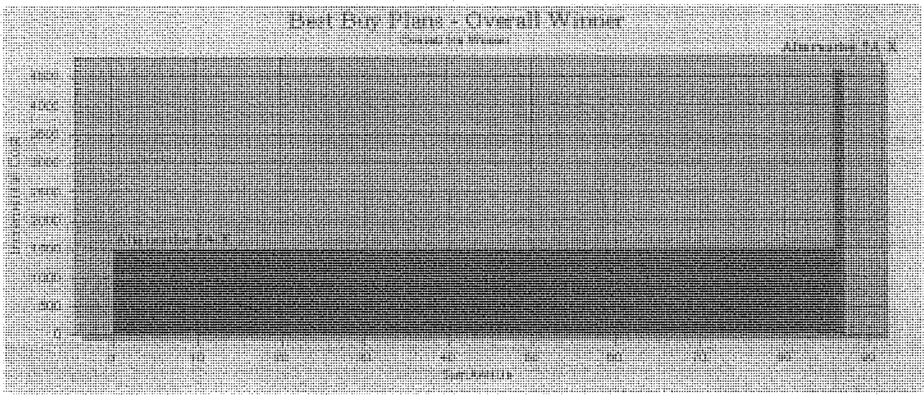
c. Mowing only - the entire prairie would be mowed once every three years on a rotational cycle.

Review and Evaluation of Incremental Cost Analysis (ICA). The ICA results for each action area's array of alternative plans provided comparable information that could be used in the evaluation and assessment process of selecting a preferred plan. Detailed information pertaining to this analysis and its results are contained in Appendix A and Section 6 of the main report. From this documentation, the Team used a two-phase recommended plan selection process. The Team evaluated incremental differences between plans in order to determine which alternative at each site achieved the best results in relation to planning objectives and restoration planning targets. Each action area was addressed and ICA results systematically reviewed and compared in order to select the alternatives that would form the preferred plan. Following the Team's assessment, the Local Sponsor representatives went through the full assessment and evaluation process to identify their preferred plan. The following presents information on the team assessments for each action area. The process utilized to assess ICA results was to look at each action sites results, make an evaluation of these results and recommend an alternative that would be carried into the Recommended Project Plan. In each case the analysis of the No Action Alternative found it to be unacceptable and therefore it was eliminated from consideration.

Dobrey Slough. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 5A-Y as the most cost effective and incrementally effective alternative (ICA winner). This plan includes a restored marsh buffered in part by a 75-meter wide forested corridor. Alternative 5A-X, with a 100-meter wide corridor, was labeled as the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 5A-Y (ICA winner) provides 86 AAHUs at an average cost of $1,491 per AAHU, whereas alternative 5A-X (HEP winner) produces an additional increment of 1 AAHU at an average cost of $4,611 per AAHU. Of the three evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.

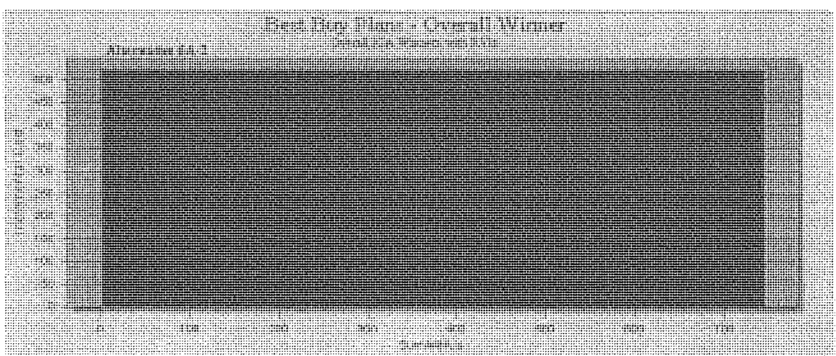
During the selection process it was determined that alternative 5A-Y met the planning objectives and was the most effective alternative based on cost and output. Alternative 5A-Y was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.



Elm Slough. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 6A-2 as the most cost effective and incrementally effective alternative (ICA winner), as well as the alternative producing the greatest number of habitat units (HEP winner). This alternative involves restoration of wetland forest in a floodplain habitat area by improving tree species diversity in existing wetland forest, restoring former wetland forest adjacent to existing wetland forest, and establishing prairie buffers between floodplain tributaries that are proposed to supply a restored flood pulse (Long Lake and Mitchell Ditch) to wetlands in the habitat restoration area. Alternative 6A-2 was carried forward as the preferred alternative.

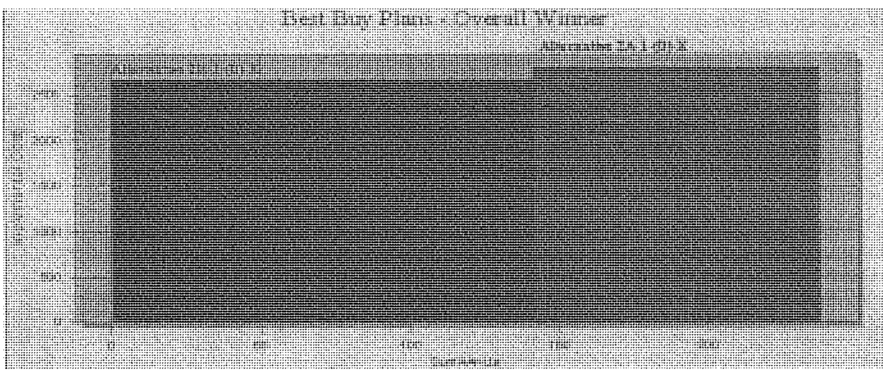
The following chart shows the best buy alternative and its increment of cost versus output difference.



Old Cahokia Creek. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 2B-1-(0)-X as the most cost effective and incrementally effective alternative (ICA winner). Alternative 2A-1-(0)-X was identified as the plan producing the greatest number of environmental outputs (HEP winner), and was second most cost effective. Under both alternatives, a floodplain habitat area of 314 acres would envelop 3.4 miles of restored floodplain stream and a 328-foot (100-meter) wide forested corridor along both sides of the restored creek channel. Under alternative 2A-1-(0)-X (HEP winner), restoration of floodplain aquatic habitat would be coupled with restoration of about seven miles of tributary streams in the Bluff 1 watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include ten sediment detention basins and creation of pool and riffle complexes.

During the selection process it was determined that Alternative 2A-1-(0)-X best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 2A-1-(0)-X was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.

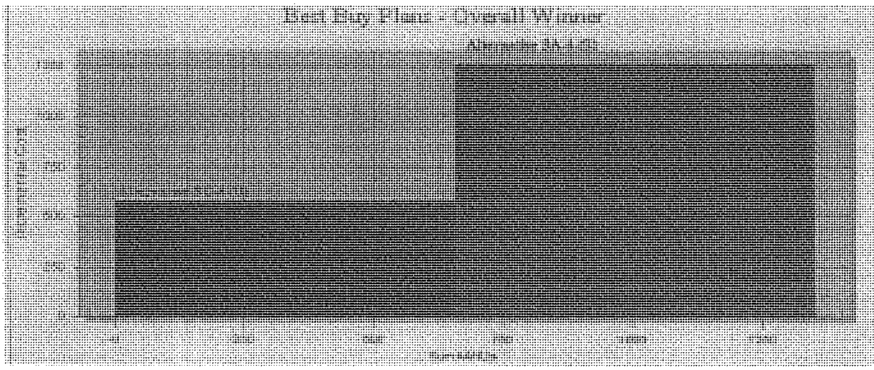


Judy's/Burdick Branch. The cost analysis process (as presented in Appendix A and Section 6.11 of the main report) identified alternative 3C-4-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 3A-4-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of wet prairie in a 507-acre habitat area would occur on the floodplain. Under alternative 3A-4-0 (HEP winner), the floodplain habitat area would include 0.8 miles of stream restoration, and would be coupled with restoration of about 32 miles of tributary streams in the Judy's and Burdick Branch watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 28 sediment detention basins and creation of pool and riffle complexes.

Alternative 3C-4-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

During the selection process it was determined that Alternative 3A-4(0) best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 3A-4(0) was carried forward as the preferred alternative.

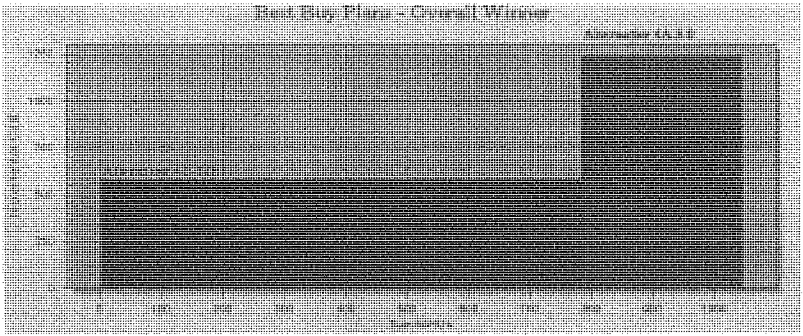
The following chart shows the best buy alternatives and their increment of cost versus output difference.



Brushy Lake. The cost analysis process (as presented in Appendix A) identified alternative 4C-3-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 4A-3-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of forested wetland in a 717-acre habitat area would occur on the floodplain. Under alternative 4A-3-0 (HEP winner), the floodplain habitat area would include 3.5 miles of stream restoration, and would be coupled with restoration of about 25 miles of tributary streams in the Schoolhouse watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 15 sediment detention basins and creation of pool and riffle complexes. Alternative 4C-3-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

During the selection process it was determined that Alternative 4A-3-0 best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 4A-3-0 was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.

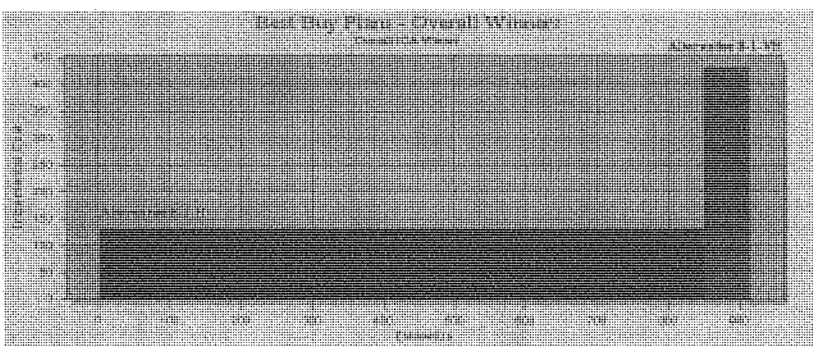


Cahokia Mounds. Of the six plans evaluated for Cahokia Mounds, the incremental cost analysis identified alternative 8-1-(H) as the most cost effective alternative (ICA winner). Alternative 8-1-VH was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs).

Both plans are considered to be least cost plans that produce alternative levels of environmental output.

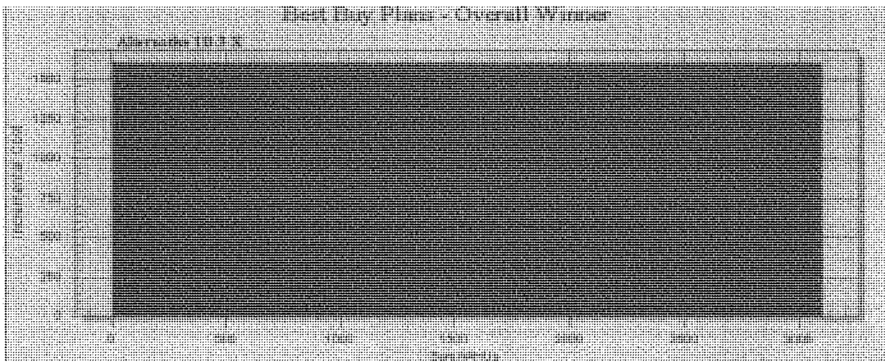
During the selection process it was determined that alternative 8-1-(H) met the planning objectives and was the most effective alternative based on cost and output. Alternative 8-1-(H) was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.



Spring Lake. The cost analysis process (as presented in Appendix A) identified alternative 1B-3-X as the most cost effective and incrementally effective alternative (ICA winner). Of the 6 evaluated alternatives, only 1B-3-X was determined to be a least cost plan, as shown in the bar chart below. It produces 3,105 AAHUs at an average cost of $1,602 per AAHU. A 1,364 acre floodplain habitat area consisting mainly of marsh and forested wetlands is to be established at three separate locations adjacent to Harding and Lansdowne Ditches. Under this alternative, the floodplain habitat area would include 3.1 miles of stream restoration, and would be coupled with restoration of about 99 miles of tributary streams in the Little Canteen and Canteen Creek watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 58 sediment detention basins and creation of pool and riffle complexes.

Alternative 1B-3-X was carried forward as the preferred alternative. The following chart shows the best buy alternative and its increment of cost versus output difference.



Wedgewood. As a result of comments received during public review of the draft report, which occurred between 28 February and 7 May 2003, this Action Area was eliminated and is not carried forward into the Recommended Plan. Additional information regarding this process is contained in Appendix G of the main report.

Mullens Slough. The cost analysis process (as presented in Appendix A) identified alternative 7B-2 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 7A-2 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was the second-most cost effective plan. Under both alternatives, a 312-acre floodplain area consisting of lake, prairie, and herbaceous wetland habitats is to be established adjacent to the confluence of Powdermill Creek and Canal No. 1. Under alternative 7A-2 (HEP winner), the floodplain habitat area would be coupled with restoration of about 16 miles of tributary streams in the Powdermill Creek watershed, which drains into the proposed habitat area.

Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 20 sediment detention basins and creation of pool and riffle complexes. Alternative 7B-2 (ICA winner) would include two floodplain sediment detention basins within the habitat area, and no tributary stream restoration.

During the selection process it was determined that Alternative 7A-2 best supports the planning objectives and produces significantly greater benefits for the project area. Alternative 7A-2 was carried forward as the preferred alternative.

The following chart shows the best buy alternatives and their increment of cost versus output difference.

Review and Evaluation of Plans. This section assesses the performance of the Biological (HEP), Incremental (ICA), and the Preferred plans with respect to the planning objectives described in Section 5. The summary of performance of each plan with respect to the planning objectives and targets is displayed below in Table 5. Table 6 provides an overview of the cost effectiveness of each plan. The No-Action Plan is displayed in Tables 5 and 6, and as it makes no contribution to any of the planning objectives it will not be further addressed in this context. Section 4 of the main report - Without Project Conditions addresses the effects of a No-Action Plan recommendation. The performance of the plans (Biological, Incremental, Preferred, and No Action) has also been assessed using results of incremental cost analyses that are presented in the Habitat Assessment of Appendix A and Section 6.12 of the main report and are displayed in Tables 7 through 9. The evaluation of plan performance against the objectives and a cost effectiveness analysis of the plans facilitate the selection of one of these plans as the Recommended Plan.

Table 5 Summary of the performance of each plan with respect to each of the planning objectives.

Objective	Target	Biological Plan	Incremental Plan	Preferred Plan	No-Action Plan
1 – Restore natural areas	Total area of habitat restored (acres)	4,885	4,440	4,830	0
2 – Restore flood pulse	% of action areas with depth of design flood < depth of 1844 flood	83	83	83	N/A
3 – Restore habitat quality	% of action areas with at least moderate habitat quality (average for 9 species)	75	60	76	N/A
4 – Improve water quality	Relative area affected	tributaries & floodplain	floodplain	tributaries & floodplain	N/A
5 – Reduce tributary erosion	% estimated sediment reduction	70	0	70	N/A
6 – Restore tributary streams	Total length of restored streams (miles)	178	99	178	N/A
7 – Restore floodplain streams	Total length of restored stream (miles)	10.8	9.7	10.8	N/A
8a – Reduce flood damages	Damages reduced by design event incidental to restoration of flood pulse (dollars)	$1,300,000	$1,300,000	$1,300,000	N/A
8b– Enhance outdoor recreation	Relative area affected	floodplain	floodplain	floodplain	N/A
8c – Protect cultural resources	Total area of known archaeological sites within action areas (acres)	999	990	989	N/A

Table 6 Summary of Cost Effectiveness Analysis of the Plans.

		Biological Plan	Incremental Plan	Preferred Plan	No Action Plan
Environmental output	Average annual habitat units generated by plan	8,399	7,093	8,332	0
Average cost of one unit of output	Average annual dollars per average annual habitat unit	$1,306	$995	$1,091	0
Total cost	Total dollars to implement plan	$136,570,000	$105,740,000	$136,120,000	0

The primary difference between the alternatives producing the higher habitat units (Biological Plan) and the alternatives that proved to be the least costly (ICA winners) is the measures used to restore tributary stream resources and reduce sediment. The Preferred Plan combines the alternatives producing the best results for this project as determined by the Biological Team and Sponsor Representative Team. In each instance where a higher cost alternative was selected the increment of cost for the higher producing habitat alternative was determined to provide additional value to the overall plan that justified the increased increment of cost.

The HEP Plan has the highest first cost of the plans compared but produces the highest habitat unit outputs. While the ICA plan produces the least habitat unit outputs its first cost is significantly les: than either the HEP or Preferred Plans. Rationale for alternatives selected for the Preferred Plan is addressed in detail in the General Reevaluation Report.

The Preferred Plan has a first cost slightly lower than the HEP Plan with lower habitat unit outputs and significantly higher first cost and habitat unit output as compared to the ICA Plan. The following tables display the cost effectiveness analysis for each of the plans for comparative purposes.

Table 7 Cost Analysis for Incremental Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2B-1-(0)-X	141	$377,000	$2,671	X		5.65
Brushy: 4C-3-0	782	$459,800	$588	X		6.95
Judy's: 3C-4-(0)	655	$379,500	$579	X		5.68
Cahokia: 8-1-(H)	849	$113,300	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7B-2	730	$234,700	$322	X		3.51
TOTAL	7093	$7,056,975	$995	8	2	$105.68

*After relative value indexing **Based on planning estimates

Table 8 Cost Analysis for Biological Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-X	87	$134,200	$1,539		X	2.0
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3-(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(VH)	915	$141,700	$155		X	2.05
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	8399	$9,124,875	$1,086	2	8	$136.57

* After relative value indexing **Based on planning estimates

Table 9 Cost Analysis for Preferred Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(H)	849	$113,200	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	8332	$9,090,275	$1,091	4	4	$136.12

*After relative value indexing **Based on planning estimates

Plan Development Conclusions. Of the three plans, the Preferred Plan is more effective in achieving the planning objectives. It is efficient because it consists of only "best buy" alternatives. The Preferred Plan is acceptable to state and federal resource agencies. It provides and accounts for all necessary investments needed to ensure the realization of the planned restoration outputs. Four state and federal agencies that partnered with the Corps during the study have indicated that the Preferred Plan best meets their desires and concerns. The plan is reasonable because non-Federal sponsors are willing to share study and project costs, and state and federal resource agencies support it. The Preferred Plan would provide significant restoration benefits to aquatic resources of national and regional institutional significance. The Preferred Plan provides a watershed level approach to addressing the problems and captializing on the opportunities of the project area. This plan re-establishes important linkages between tributary watersheds and floodplain ecosystems that best ensures future bio-diversity and sustainability. Based on these conclusions, the Preferred Plan is justified for selection as the Recommended Plan.

RECOMMENDED PLAN

Overview. The Recommended Plan consists of the alternative selected from each of the eight Project action areas as identified in Section 6. To recap, these Project action areas are: Old Cahokia Creek; Judy's and Burdick Branch; Brushy Lake; Spring Lake; Mullens Slough; Dobrey Slough; Elm Slough; and Cahokia Mounds Prairie. The alternative selected to be a part of the Recommended Plan from each of these areas was the one that best addressed study objectives and planning targets within each respective Project action area.

In general, the Recommended Plan consists of the following measures: the restoration of bottomland forest habitat (1,705 acres), prairie habitat (1,111 acres), marsh and shrub swamp habitat (843 acres), lake habitat (460 acres), upland forest (379 acres), floodplain stream restoration (10.4 miles or 161 acres), placement of wood duck boxes (651 boxes) and prairie bird perches (870 perches), creation of over wintering holes and shoreline plantings (20 acres), and construction of tributary stream detention basins (131), riffle and pool complexes in 178 miles of streams, earthen embankments (15.5 miles), and hydraulic control devices (culverts, flap gates, and new channels). Currently a total of 4,916 acres are included in the Project footprint, of which 4,468 acres are in the Mississippi River's floodplain and 448 acres are along streams in the tributary watersheds. The 178 miles of tributary stream restoration are not reflected in this Project area footprint.

Figure 11 displays the recommended plan. The eight proposed floodplain habitat restoration areas are outlined by various colors, the 178 miles of proposed tributary stream restoration are represented by various colors of line networks, and the 131 proposed sediment detention basins are shown as small circles along the tributary streams.

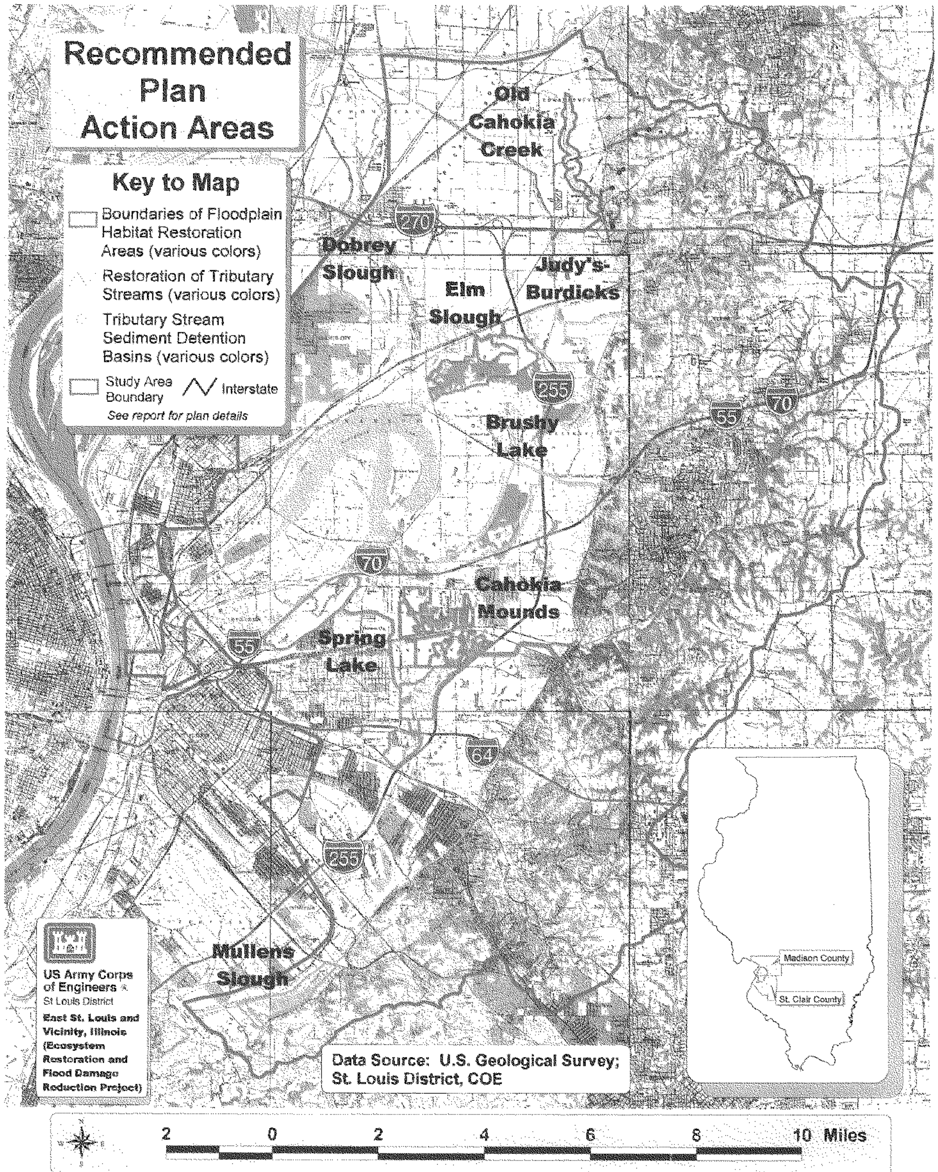


Figure 11 Recommended Plan

Features By Action Area.

Old Cahokia Creek. The Old Cahokia Creek action area consists of features to restore aquatic and terrestrial habitat in the floodplain and tributary stream watersheds. In the floodplain, about 3.4 miles of historic Cahokia Creek are to be restored to a flowing condition, and a 328-foot (100-meter) wide forested corridor is to be established along both sides of the restored creek channel. Together the restored creek and adjacent forest form a habitat area. About 6.6 miles of tributary streams in the Bluff 1 watershed are to be restored by constructing a series of riffle and pool complexes and building ten tributary stream sediment detention basins at scattered locations. The total footprint of all features is 314 acres, excluding restoration of tributary streams.

Judy's-Burdick Branch. The Judy's-Burdick action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary steams. A 507-acre floodplain habitat area of prairie is to be established at the confluence of Cahokia Canal, Judy's Branch, and Burdick Branch. About 32 miles of tributary streams in the Judy's, Burdick, and Bluff 1 watersheds are to be restored by constructing a series of riffle and pool complexes and building 28 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 600 acres, excluding restoration of tributary streams.

Dobrey Slough. The Dobrey Slough action area consists of features to preserve, restore, and enhance aquatic, wetland, and terrestrial habitats in the floodplain. A 75-acre habitat area consisting principally of marsh and forest is to be established north of Pontoon Road and east of Maryville Road.

Elm Slough. The Elm Slough action area consists of features to preserve, restore, and enhance aquatic, wetland and terrestrial habitats in the floodplain. A 670-acre habitat area consisting principally of forested and scrub-shrub wetland is to be established. Il Route 111 bounds the habitat area on the west, Il Route 162 on the north, and I-255 on the east.

Brushy Lake. The Brushy Lake action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary streams. A 717-acre forested floodplain habitat area is to be established at the confluence of Cahokia Canal and Schoolhouse Branch. About 25 miles of tributary streams in the Schoolhouse and Bluff 3 watersheds are to be restored by constructing a series of riffle and pool complexes and building 15 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 746 acres, excluding restoration of tributary streams.

Cahokia Mounds Prairie. The Cahokia Mounds action area consists of the restoration of 525 acres of floodplain prairie within the Cahokia Mounds State Historic Site. The action area is bounded by Collinsville Road on the north, Black Lane on the east, Forest Boulevard on the south, and railroad tracks on the west. Prairie plantings are to be established in eight separate tracts currently used as hay lease areas. Native plant species consisting of a variety of grasses and herbs and some sedges and shrubs are to be used. Flooding at this site was limited to rainfall and local run off in predevelopment times except when the Mississippi River was flooding the area, as was the case in 1844.

Under the recommended plan, no additional water would be brought to this site. While soils of the area are relict hydric soils, indicating that they historically supported a wetland plant community, additional investigation will be undertaken during design, such as the installation of piezometers at the site, to ensure there is currently sufficient hydrology at the site to support this prairie complex.

Spring Lake. The Spring Lake action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary streams. A 1,364-acre floodplain habitat area consisting mainly of marsh and forested wetlands is to be established at three separate locations adjacent to Harding and Lansdowne Ditches. About 99 miles of tributary streams in the Canteen Creek and Little Canteen Creek watersheds are to be restored by constructing a series of riffle and pool complexes and building 58 tributary stream sediment detention basins at scattered locations. Spring Lake is the largest of all action areas, and the total footprint for all features is 1,615 acres, excluding restoration of tributary streams.

Mullens Slough. The Mullens Slough action area consists of features to restore and enhance aquatic, wetland, and terrestrial habitats in the floodplain and tributary streams. A 312-acre floodplain habitat area consisting predominantly of a lake (known as Mullens Slough) is to be established adjacent to the confluence of Powdermill Creek and Canal No. 1. About 16 miles of tributary streams in the Powdermill Creek and Bluff 6 watersheds are to be restored by constructing a series of riffle and pool complexes and building 20 tributary stream sediment detention basins at scattered locations. The total footprint of all features is 371 acres, excluding restoration of tributary streams.

Operation and Maintenance. Each of the action areas will operate independently. None of the features of the Recommended Plan have any manual or automated operational components (such as slide gate and stop log closures or pumping stations). Also, no changes in the operation of the remaining flood control features such as canals and pumping plants will be necessary. Features of the Recommended Plan will require periodic inspection and maintenance to include: the removal of collected vegetative and woody debris at all control structures and upland dry detention basins; installation of sediment panels in upland dry detention basing; periodic erosion repair; periodic inspection to maintain smooth operation of all flap gates; and, and the mowing or burning, as necessary, of berms and prairie areas.

Real Estate. The Project will require the acquisition of approximately 5,398 acres of land. It will affect approximately 1,049 land parcels and 677 landowners. Eight areas in the floodplain and 131 upland sites are a part of this Project. Fee title is required on most of the land in the floodplain to allow the Sponsors to control the environmental restoration, habitat development and operation maintenance of the land. Permanent easement will be required to construct, to access, and to operate and maintain the 131 sediment detention basins. Flowage easement will be required for a ponding area at both Old Cahokia Creek and Judy's-Burdick Branch. Flowage easement will also be required for the 131 detention basins to allow water to temporarily pond during storm events. In summary, 4,468 acres in fee, 66 acres in permanent easement, and 864 acres in flowage easement will be acquired. Temporary Easements for access and construction are required and will be determined when the Engineering Design Reports are prepared for each Project action area. The temporary construction easements for this type of project are not considered out of the ordinary.

Adaptive Assessment and Monitoring. The Recommended Plan includes post-construction monitoring to determine if predicted environmental outputs will be achieved following construction, and to provide feedback for future ecosystem restoration projects. During the study's formulation process, it was uncertain whether specific proposed measures would achieve their restoration objectives. Consequently, the monitoring program reflects the incorporation of adaptive management. Adaptive management is a technique for addressing uncertainty in restoration projects. Under this approach, restoration measures are implemented and monitored, feedback is provided based on new insights gained from the response of the system and its resources, and adjustments are made to the Project as necessary and feasible. An example of this process is the Judy's Branch demonstration project that has been established on Judy's Branch, one of the tributary watersheds. To test whether tributary stream sediment detention basins and in-stream restoration measures will perform as expected, a demonstration project was initiated in early 2000 with the implementation of sediment monitoring by the USGS on Judy's Branch. This pilot project is described in greater detail in Appendix E of the main report. With the information gained from this monitoring process, preliminary plans for stream sediment detention and in-stream restoration measures will be developed and implemented in this tributary first. The performance of these measures will be analyzed over an approximate 3-year period to determine their effectiveness in restoring stream quality, stabilizing stream banks and slowing the transfer of sediment to the floodplain. Results from this pilot project will be used to make the adaptive changes required to achieve anticipated Project outputs.

Fish and Wildlife Mitigation. Since the purpose of ecosystem restoration is to provide environmental benefits, this Project was formulated and designed to avoid and/or minimize adverse effects to environmental resources.

Cultural Resources Mitigation. Prior to the discussion of any potential Project feature locations, the State of Illinois Historic Preservation Officer (SHPO) provided the design team with the locations of all previously recorded archaeological sites within the study area. The Team used this information throughout the plan formulation phase so as to avoid impacts to any known archaeological sites.

Outdoor Recreation. During the latter study stages, local interests made formal requests to the Team to investigate water and related land resources outdoor recreation opportunities, especially as they tie-in with the existing infrastructure and the potential to be derived from the Recommended Plan. The Recommended Plan currently contains a bike trail. However, there are many other outdoor recreation opportunities that could be pursued under separate action after authorization of this project. The opportunities are due, in part, to the scenic views of natural areas with interpretive potential and in their proximity for easy connection to the regional trail network that is being developed by local organizations and agencies. Trails also could be planned not only in the levied areas, but also along the streams and greenways. Ecosystem restoration measures of the Recommended Plan such as wetlands, would also lend themselves to outdoor recreational pursuits. The development of boardwalks at the wetlands would provide a close up view of wildlife. These boardwalks also would be useful for rest stops along the trail. Any recreation or interpretive opportunities will have to be consistent with the intent of the project and not interfere with the achievement of restoration objectives.

Economics. The total first cost is estimated to be $189,266,000. The average annual project implementation cost is $11,799,000. This average is computed using the current interest rate of 5.875% over the anticipated 50-year project life. Project benefits have been quantified by means of identifying habitat units incrementally compared to their cost of production. The Recommended Plan produces approximately 8,332 annualized habitat units at an average annual cost of $1,416.

In summary, this Project was formulated as a single purpose Ecosystem Restoration project in accordance with Corps' engineering regulations which states that: "Monetary gains (e.g., incidental recreation or flood damage reduction) and losses (e.g., flood damage reduction or hydropower) associated with the project shall also be identified." In an attempt to quantify these benefits, a risk-based analysis was performed. This analysis determined that $1,366,000 in average annual flood damage reduction is incidental to plans considered. Recreation benefits are also incidental to the Project. The Cahokia Creek Bike Trail has an estimated first cost of $258,000 with an annualized cost of $16,084 producing a benefit to cost ratio of 1 to 1.7, using the Facility Capacity Method.

Cost Sharing. The Corps of Engineers, on behalf of the Federal government, and the non-Federal Sponsors for the construction project, the Counties of Madison and St. Clair, Illinois, will share in the responsibilities for implementing the Recommended Plan. The Counties will participate in a third party agreement with the State of Illinois who will provide monetary support to the Counties for the implementation of the Project.

The Corps will be responsible for designing the Project and administering all government construction contracts to implement it. The Counties and the State will share in the design and construction costs. The Counties will furnish the necessary lands, easements, rights of way, relocation, and disposal areas as well as operate and maintain the completed Project. Rules that determine how project responsibilities are shared are established in Federal law and related Administration implementing policies.

RECOMMENDED PLAN'S EFFECT ON NATURAL RESOURCES OF SIGNIFICANCE

The Study area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area will contribute greatly to national, regional and local systems. Significant Study area characteristics and contributions include the following.

Aquatic resources of national and regional significance are found in the Project area. They include aquatic features such as 2,000-acre Horseshoe Lake, over 6,000 acres of various wetlands on the Mississippi River's floodplain, as well as over 200 miles of streams in small tributary watersheds.

North American Waterfowl Management Plan. The recommended plan will contribute to the North American Waterfowl Management Plan's goals for conservation and management of waterfowl species and habitat by protecting and restoring mid-migrational and breeding habitat along the Mississippi River flyway.

The proposed habitat restoration on the Mississippi River's floodplain will occur within one of the Plan's waterfowl habitat areas of major concern on the North American continent, and within a migratory focus area designated at the regional scale under the Upper Mississippi River/Great Lakes Region Joint Venture's Implementation Plan. This habitat restoration will contribute to the Joint Venture Implementation Plan's goal of increasing wetland habitats by about 36,000 acres in migratory focus areas along the Mississippi River in Illinois. The plan will contribute significantly by providing about 1,350 acres of new wetlands through reestablishment of historic vegetation and functions to former wetlands. It will also restore about 1,325 acres of existing wetlands by improving natural conditions and returning historic functions to degraded wetlands. About 30 species of migratory swans, geese, and ducks should benefit from the restoration of these 2,700 acres of affected wetlands.

The recommended plan will also provide additional benefits to migratory and resident waterfowl species at lake and pond habitats. Within the proposed habitat restoration areas, improving natural conditions and replacing historic functions will restore about 460 acres of lake and pond habitat, which is expected to provide more feeding opportunities for waterfowl by increasing production of aquatic organisms. In addition, indirect benefits to lake and pond habitat are expected outside the proposed restoration areas at the 2,000-acre Horseshoe Lake at Horseshoe Lake State Park. The proposed restoration of 178 miles of tributary streams is expected to reduce excessive sediment loads carried from the bluffs into Horseshoe Lake by the study area's interior drainage system during storm events, and similarly improve feeding opportunities for migratory and resident waterfowl.

Upper Mississippi River System Environmental Management Program. The recommended plan will contribute to the goal of the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program of increasing by about 100,000 acres the amount of prairie, marsh, and forest on the Mississippi River's floodplain within the river reach extending from St. Louis to Cairo. The plan will significantly increase the area of prairie, marsh, and forest in this river reach by about 2,365 acres. The plan is also expected to meet the need for three specific habitat improvements identified in the Habitat Needs Assessment. First, the plan is expected to restore existing degraded habitats by improving natural habitat conditions, thereby improving habitat quality. Second, the plan will restore a flood pulse to floodplain habitats, thereby returning the current hydrological regime to a closer approximation of pre-development conditions. Lastly, the plan will restore historically typical floodplain habitats that are now uncommon, such as floodplain prairies and streams, thereby increasing floodplain habitat diversity.

Clean Water Action Plan. The recommended plan will contribute toward the goals of the Clean Water Action Plan by restoring 178 miles of streams in five small watersheds identified as priority watersheds for restoration in Illinois. The plan's proposed restoration of tributary streams in these five watersheds is expected to correct silt and sedimentation problems that have degraded in-stream habitat.

Improving the quality of in-stream habitat should restore conditions that can support a diverse food web of animals by improving substrate quality, restoring channels and pool and riffle complexes, and encouraging recolonization by benthic invertebrates.

Restoration of riparian forest along tributary streams at the 131 proposed sediment detention basins is expected to improve degraded habitat conditions by reintroducing uncommon native tree species such as oaks. Under the plan, storm water carried by the tributary streams proposed for restoration is to serve as the source of the flood pulse to be reintroduced into the proposed habitat restoration areas on the Mississippi River's floodplain. An expected secondary effect of tributary stream restoration is improvement of conditions in the floodplain habitats, by reducing excessive sediment loads currently reaching the floodplain.

Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The plan's proposed restoration of wetlands on the Mississippi River's floodplain in Illinois supports the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The proposed restoration of about 2,700 acres of floodplain wetlands is expected to promote nitrogen retention within the study area's watersheds, reduce nitrogen loads of inflow from the interior drainage system to the Mississippi River, and contribute to the eventual improvement of the hypoxic condition in the northern Gulf of Mexico.

Conservation Initiatives for Bird Species of Concern. The recommended plan is expected to benefit 34 priority species of birds and two federally threatened species (one plant and one bird) through the restoration of about 4,300 acres of aquatic habitats on the Mississippi River's floodplain, 178 miles of tributary streams, and about 380 acres of riparian forest along the tributary streams. Migratory and breeding habitat for 10 priority species of ducks is expected to be provided by the proposed restoration of 2,700 acres of wetlands and 460 acres of lake habitat within eight proposed floodplain habitat restoration areas. The proposed plan will support the North American Waterbird Conservation Plan by providing migratory and breeding habitat for four heron and rail species of concern through the proposed wetland restoration, along with the proposed restoration of about 11 miles of floodplain streams. Feeding opportunities for two of these heron species are also expected to improve from the proposed restoration of 178 miles of tributary streams. The recommended plan will contribute to the U.S. Shorebird Conservation Plan by providing migratory habitat to eight sandpiper species of concern through the proposed floodplain wetland restoration. Horseshoe Lake at Horseshoe Lake State Park, recognized under the Shorebird Plan as an important stopover in Illinois for migratory shorebird species, is expected to indirectly benefit from the proposed plan through reduced levels of sedimentation, which is expected to provide improved feeding opportunities to shorebirds. The Neotropical Migratory Bird Conservation Program (Partners in Flight) and 11 landbird species of concern are expected to benefit from the recommended plan through the proposed restoration of forested wetlands, marshes, wet prairies, and floodplain and tributary streams, and restoration of riparian forest along tributary streams. Restoration of forested wetland habitat at the proposed Brushy Lake action area is expected to meet the size requirements for breeding habitat of some area-sensitive landbird species of concern, such as the Acadian flycatcher and Louisiana waterthrush. Similarly, area-sensitive grassland breeding species of concern like the grasshopper sparrow and sedge wren are expected to benefit from restoration of floodplain prairie at the Judy's-Burdick and Cahokia Mounds Prairie action areas.

The federally threatened bald eagle is expected to benefit from improved feeding opportunities through proposed restoration of 460 acres of lake habitats. The proposed plan will contribute to the recovery plan of the federally threatened decurrent false aster through restoration of about 1,500 acres of marsh and wet prairie habitats where it can be introduced.

IMPLEMENTATION PLAN

Implementation Process. As mentioned earlier, this Project originally was authorized to address flood damage reduction but as a result of the Water Resources Development Act of 2000, ecosystem restoration was added as a Project purpose thus permitting the formulation of alternatives for this Project using the Administration Policy Guidelines for an incrementally justified National Environmental Restoration Project. In accordance with the National Environmental Policy Act (NEPA) requirements, this report has been, and will continue to be coordinated with the public and appropriate resource agencies to seek their input. The Project Team has received public and review agency comments to the Draft Report, and this final report reflects the consideration and as appropriate incorporation of those comments. This final report is submitted to the Corps of Engineers' Mississippi Valley Division Headquarters for review and processing. After follow-on review at the Corps of Engineers' main headquarters in Washington D.C., the Chief of Engineers will release this report through the Assistant Secretary of the Army for Civil Works, who in-turn will refer it to Congress for authorization. Congressional authorization will permit a construction new start for the Project.

The Corps of Engineers will prepare the first set of plans and specifications as a part of the existing scope of the PED agreement. Based on consultation with the Sponsors, the first alternative to be undertaken outside the demonstration project will be the restoration of an area that does not have an upland component. In this manner, the analysis of stream restoration techniques can be completed on an alternative having those components prior to the completion of the design. Prior to the acquisition of Project lands and the subsequent initiation of the first item of construction, a Project Cooperation Agreement (PCA) will be executed for the entire Project effectively bringing the PED phase to a conclusion. Work under the PCA will begin with the Sponsors' acquisition of lands, easements, rights-of-way, relocations and necessary disposal areas (LERRD's) in advance of the advertisement and award of the first construction contract.

Implementation Reports. An Engineering Design Report (EDR) will be prepared to validate each recommended action plan. These reports will develop the detail for each alternative that was not accomplished during the restudy effort. Each EDR will detail the full spectrum of technical analyses required to support engineering considerations as well as assessing the validity of assumptions made during the ecosystem restoration evaluation. These EDR's will include comparisons to the original Habitat Evaluation Procedure outputs. If differences in the alternative design are required as a result of significant changes in the existing conditions that impact acreage, basic restoration concepts, or hydrology, the incremental cost analysis of outputs will be re-validated. Each EDR also will include a real estate report that verifies costs and estates required for the Project and an overall detailed cost estimate referred to as an "MCACES" estimate. Based upon these findings, an environmental assessment or supplemental environmental impact statement will be completed in accordance with NEPA requirements.

Following public review and comment, the EDR, will be approved within the Corps' chain of command. The design of alternative features will not begin until it is determined that the proposed action plan still supports original Project objectives and thus, continued action. Designs will be packaged in units appropriate to support efficient contract work on a specific alternative and sequenced as required to maintain Project progress in a logical manner.

As a result of these actions, the integrity of the Project objectives will be maintained. It will be unlikely that any of the restoration focus will be lost or diluted over time. The institution of this rigorous process as a part of Project implementation is deemed appropriate based on the uniqueness of this Project and its underlying concepts.

Project Management. The Project will be managed in accordance with all applicable laws, regulations, and policies. Information that outlines the philosophy of project management within the Corps of Engineers is contained in Engineering Regulation 5-7-1. There will be a lead Corps of Engineers person designated to manage the Project during its life cycle. This person will be responsible for managing the programmatic and the technical aspects of the Project as well as coordinating all issues related to the Project between the Sponsors, the stakeholders, and the public.

Implementation Schedule. A Project schedule has been developed based upon the assumption that a positive Chief of Engineers' report will be forwarded to the Assistant Secretary of the Army for Civil Works during calendar year 2003 and that Congressional authorization will occur in time to program construction new start funds for FY 2005. The Project schedule sequences the reporting, design, and construction activities as they move from the simple to the complex. In this manner, there will be ample time to complete sediment analyses and to review demonstration project results so that analytical data and practical lessons learned can be incorporated into action plan execution. Additionally, the schedule has been prepared in a manner to have new EDR's prepared simultaneously, with the designing and/or constructing of action areas covered in approved EDR's. This helps to ensure that project momentum is maintained and that the necessary experts remain engaged throughout the process. The development of this schedule assumes funding is available in the years required and that the real estate and relocations actions are completed on schedule. As mentioned, initiation and completion of EDRs are independent of one another for the various action plans. However, design and construction activities are dependent upon their respective EDR's approval. A copy of the proposed schedule is included in Appendix K of the main report. The Project schedule will be evaluated and updated continuously, based upon future funding levels and the results of the EDR studies.

The recommended schedule reflects the information currently available and the current departmental policies governing execution of projects. It does not reflect program and budgeting priorities inherent in either the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the schedule recommended in Appendix I of the main report may be modified before it is transmitted to higher authority for authorization and/or implementation funding. Under current plans, this schedule begins with PED activities in FY 2003 and concludes in FY 2005 with the advertisement and award of the first item of construction.

Funding. In order to support the planning and budget development process for the Project, Table 11 depicting the necessary funding stream required to support the Project schedule is presented below. This table identifies the resource requirements by year and details non-Federal requirements for Project implementation. This Table identifies both cash requirements and the requirements estimated by year for LERRD's.

Table 11 Project Funding Stream

FY	Phase	Total Project Implementation Cost	LERRDs	PED or Construction	%	Additional Non-Fed Cash	Federal Cash Schedule
Prior FY's	PED	2407.000	0.000	2407.000		601.750	1805.250
FY03	PED	800.000	0.000	800.000		200.000	600.000
FY04	PED	793.000	0.000	793.000		198.250	594.750
FY05	Constr	4865.430	3343.890	1521.540	0.011	371.993	1149.547
FY06	Constr	1348.910	130.470	1218.440	0.009	308.347	910.093
FY07	Constr	5276.770	2074.020	3202.750	0.020	799.843	2402.907
FY08	Constr	11589.600	4182.300	7407.300	0.048	1607.902	5799.398
FY09	Constr	12626.800	6880.120	5746.680	0.038	1259.200	4487.480
FY10	Constr	12242.210	6881.970	5360.240	0.035	1178.055	4182.185
FY11	Constr	18987.800	6230.540	12757.260	0.082	2731.302	10025.958
FY12	Constr	16344.350	1620.660	14723.690	0.094	3144.219	11579.471
FY13	Constr	18853.900	633.870	18220.030	0.116	3878.391	14341.639
FY14	Constr	22284.470	968.570	21315.900	0.136	3528.471	17787.429
FY15	Constr	16491.590	791.190	15700.400	0.100	3349.312	12351.088
FY16	Constr	14666.300	469.800	14196.500	0.091	3033.518	11162.982
FY17	Constr	13120.500	0.000	13120.500	0.084	2807.577	10312.923
FY18	Constr	11529.210	0.000	11529.210	0.074	2473.433	9055.777
FY19	Constr	8845.000	0.000	8845.000	0.057	1909.795	6935.205
FY20	Constr	193.260	0.000	193.260	0.003	93.077	100.183
Total		**193266.100**	**34207.400**	**159058.700**	**1.000**	**33474.435**	**125584.265**

*Displayed in $1,000s

Financial Analysis. Madison and St. Clair Counties are expected to serve as Sponsors and thus, share in the non-Federal costs of this Project. They are being joined in a separate third party agreement with the Illinois Department of Natural Resources, who is committing to provide a minimum cash contribution of $10,000,000.

The Sponsors' share of the Project cost is estimated to be $67,681,835 of which $1,000,000 has already been contributed during PED. The Illinois Department of Natural Resources has committed to providing funds totaling approximately $10,000,000. The estimated $34,207,400 in LERRD's costs will be borne by Madison and St. Clair Counties. The remainder of the Sponsors' share estimated to be $23,474,435 will be a divided among the State and the two counties. These figures include the restoration project costs that are shared at a 35% -65% rate and recreation features that are shared at a 50%-50% rate. Madison and St. Clair Counties and the State of Illinois have the capability of performing some of the required work themselves.

During the development and negotiation of the Project Cooperation Agreement (PCA) these possibilities will be further examined.

The Sponsors have the capability to finance this Project. Additionally, they have the financial resources to accomplish future OMRR&R requirements currently estimated to be $93,000 a year. They each have taxing authority and an annual budget that supports their estimated individual share of estimated Project costs.

CONCLUSIONS

This Report presents a summary of the work that the St. Louis District, Corps of Engineers and its partners have accomplished to advance the East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project. This work progressed from the identification of the Study Area's problems and opportunities to the development, assessment, and evaluation of alternative plans to address the problems and opportunities. Based upon rigorous evaluation and assessment, a Recommended Plan was selected.

The conclusions reached from this effort are that the implementation of the Recommended Plan will greatly improve and restore the ecosystem within the Study Area as well as provide the basis for the permanent preservation and protection of these invaluable ecosystem resources.

POST AUTHORIZATION CHANGE REPORT

A Post Authorization Change Report (PAC) has been prepared to accompany the General Re-evaluation Report based on the change in project outputs, the increase in cost estimate and period of apportionment. This report provides information identified in ER1105-2-100 comparing the authorized Project and recommended plan in detail. The conclusion of this report is that additional congressional authority is required to implement the plan recommended in the Final General Re-evaluation Report.

COMMANDER'S RECOMMENDATION

The Project area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area will contribute greatly to national, regional and local systems. The Study area's ecosystem significance relates directly to contributions towards the: North American Waterfowl Management Plan; Upper Mississippi River System Environmental Management Program; Clean Water Action Plan; Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; and, federal government's list of "Species of Concern".

I have carefully considered the significant factors related to the problems and associated opportunities identified within the Project Area, as well as the numerous alternative plans that were developed to address these problems and opportunities.

These factors include: the severity of the environmental, social and economic consequences of ecosystem degradation and its related land and water resources problems within this significant, internationally known and valued environmental/cultural resource area; the probability of more severe conditions in the future; the ability of each alternative plan to address the ecosystem restoration and related problems and opportunities; the costs of the plans and the relationship of the costs to their associated outputs; and the acceptability of the plans to the non-Federal interests and partner Resource agencies. In consideration of these important factors, I have determined that the following recommendation is in the public's interest.

I recommend that East St. Louis and Vicinity, Illinois project authorized by the Section 204 of the Flood Control Act of 1965 and amended by Section 310 of the Water Resources Development Act of 2000 be modified to implement the National Environmental Restoration Plan identified in this Report as the Recommended Plan, as a Federal project with further modifications as necessary, in the discretion of the Commander, USACE, that may be advisable in accordance with the cost sharing and financing arrangements satisfactory to the President and the Congress. Based on October 2003 price levels, the total cost of the recommended plan is currently estimated to be $193,266,100 including PED activities. The Federal and non-Federal shares are estimated at $125,584,265 and $67,681,835, respectively. These costs reflect a 65-35% cost share of the environmental features and a 50-50 cost share for the recreation features. The non-Federal operation, maintenance, repair, rehabilitation and replacement costs are estimated at $93,000 annually. This recommendation is made with the provision that prior to Project implementation, the non-Federal interests must:

a. Provide a minimum of 35 percent of project costs allocated to ecosystem restoration and 50 percent of the project costs allocated to recreation, as further specified below:

(1) Enter into an agreement to provide, prior to execution of the project cooperation agreement, 25 percent of design costs;

(2) Provide during construction, any additional funds needed to cover the non-Federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the Project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for construction, operation, and maintenance of the Project;

(5) Provide during construction, any additional costs as necessary to make the total non-Federal contributions equal to 35 percent of total project costs allocated to ecosystem restoration and 50 percent of the total project costs allocated to recreation.

b. Provide 35 percent of the cost for that portion of total cultural resource preservation mitigation and data recovery costs attributable to ecosystem restoration that are in excess of one percent of the total amount authorized to be appropriated for the Project;

c. Provide 50 percent of the cost for that portion of total cultural resource preservation mitigation and data recovery costs attributable to recreation that are in excess of one percent of the total amount authorized to be appropriated for the Project;

d. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government;

e. Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project;

f. Comply with Section 221 of Public Law 91-661, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence construction of any water resources project or separable element thereof until the non-federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

g. Hold and save the Government free from all damages arising for the construction, operation, maintenance repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

h. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extend and in such detail as will properly reflect total project costs;

i. Perform, or cause to be performed, any investigations for hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements of rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government;

j. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project;

k. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA;

l. Prevent future encroachments on project lands, easements, and rights-of-way, which might interfere with the proper functioning of the Project;

m. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), as amended by Public Law 102-240, Section 1055 (re: rural electrification), as amended by Public Law 105-117, Section 104 (re: Alien not lawfully present in United States), and the Uniform Regulation contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

n. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable federal labor standards requirements, including, but not limited to, the Davis-Bacon Act (40 U.S.C. 276a et. seq.), the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et. seq.) and the Copeland Anti-Kickback Act (40 U.S.C. 276c).

o. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

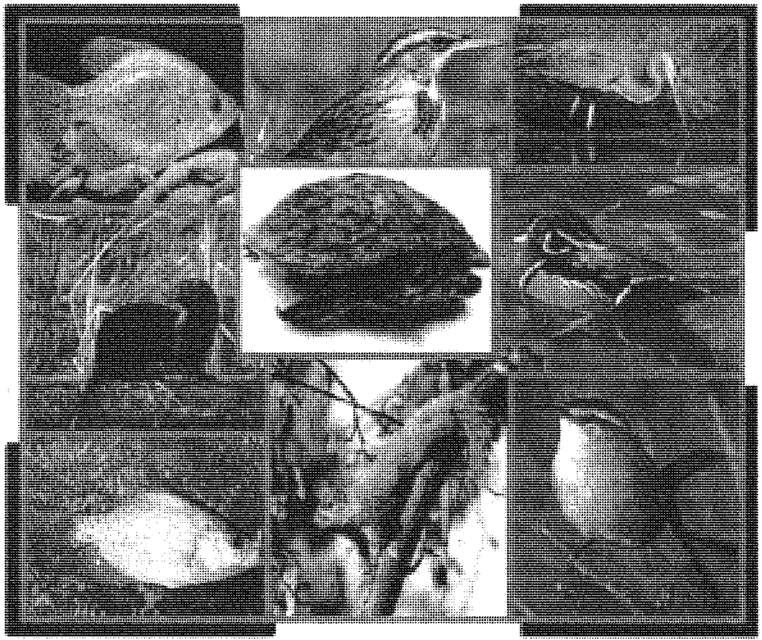
The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. Consequently, this recommendation may be modified before it is transmitted to Congress as proposals for authorization and implementation funding. However, prior to transmittal to Congress, the State of Illinois, Madison and St. Clair Counties, Illinois, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

C. Kevin Williams

C. KEVIN WILLIAMS
COL, EN
Commanding

East St. Louis and Vicinity, Illinois Ecosystem Restoration And Flood Damage Reduction Project

General Reevaluation Final Report with Integrated Environmental Impact Statement



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US Army Corps
of Engineers ®
St Louis District

November 2003

East St. Louis and Vicinity, Illinois
Ecosystem Restoration And Flood Damage Reduction Project

General Reevaluation Final Report with Integrated Environmental Impact Statement (EIS)

Lead Agency:

U.S. Army Corps of Engineers
St. Louis District
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Cooperating Agencies:

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EAST ST. LOUIS AND VICINITY, ILLINOIS, ECOSYSTEM RESTORATION AND FLOOD DAMAGE REDUCTION

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Note: The asterisk (*) denotes information required by the National Environmental Policy Act

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EXECUTIVE SUMMARY

1. AUTHORITY AND PURPOSE. The East St. Louis and Vicinity, Illinois Flood Protection Project was authorized through Congressional actions in 1965 under Section 204 of the Flood Control Act of 1965, (Public Law 89-298). Section 137 of the Water Resources Development Act of 1976 (Public Law 94-587) modified the Flood Control Act of 1965 by authorizing construction of the Blue Waters Ditch segment independently of the other authorized segments. A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Blue Waters Ditch in 1976. The Blue Waters Ditch portion of the authorized project was economically justified and subsequently constructed and completed in 1989.

Major flooding in the study area resulted in four disaster declarations during the period 1993 to 1996. As a result of these disasters, the 104th Congress, 2d Session added funding for a reevaluation of the authorized project be conducted via House Report 104-782, Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1997.

The Water Resource Development Act of 2000 (Public Law 106-541) again modified the project authorization. Section 304 of this Public Law contains the following wording: "The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

The purpose of this reevaluation was to re-examine the East St. Louis and Vicinity, Illinois Project under current conditions, existing authorities, and Executive Branch priorities with a view towards looking for new solutions to old problems. The principal goal was to identify potential improvements to the natural watershed system, that would restore biodiversity with the reintroduction of an historic flood pulse to select portion of the floodplain, to enhance habitat quality and sustainability while providing incidental ecosystem services, such as flood damage reduction.

2. LOCATION AND SIGNIFICANCE. The East St. Louis and Vicinity, Illinois Flood Protection Project is located in Madison and St. Clair Counties, Illinois, along the left bank of the Mississippi River between river miles 175 and 195 above the Ohio River (see Figure ES-1). Between these river miles the Project area includes approximately 55,000 of the 86,000 floodplain acres that are protected by a levee system along the Mississippi River, the Chain of Rocks Canal, the Prairie du Pont canal, and the Cahokia Creek diversion channel. An additional 51,000 acres of upland area are tributary and drain into the bottomlands. Flows from the uplands have been diverted between flank levees to reduce upland flow into the bottomlands. The uplands portion of the Project area contains the municipalities of Edwardsville, Maryville, Glen Carbon, Collinsville, Fairview Heights, Belleville, and Swansea while Pontoon Beach, Granite City, Venice, Madison, Brooklyn, East St. Louis, Fairmont City, Washington Park, Sauget, Centreville, East Carondelet, Caseyville, Alorton, Cahokia and Dupo are located in the Bottoms.

In terms of environmental and cultural significance, the Project area lies at the confluence of the Mississippi and Missouri Rivers, which as a river system is the fourth longest in the world and of national and international importance. The Mississippi flyway, one of four major flyways for migratory birds on the North American continent, is centered on the Mississippi River corridor. Many species of migratory waterfowl and songbirds are supported by aquatic, wetland, and terrestrial habitats within the Project area and adjacent river corridor.

The Study area is located within an extremely valuable and strategic ecosystem resource area. The Study area's resources contribute to the: North American Waterfowl Management Plan; Upper Mississippi River System Environmental Management Program; Clean Water Action Plan; Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; and, to the needs of some 34 "Species of Concern".

More than just unique for its physical features - this confluence has drawn people to it since man inhabited this country, becoming a crossroads in the middle of the continent. As far back as 12,000 years ago it was home to the ancient Cahokia civilization and contained great expanses or wetland, prairies and forests when European man arrived in the area in the 1700's. In 1982 a 2,000-acre portion of the Project area was designated by the United Nations as a World Heritage Site because of the areas significance. This designation places it in the company of such areas as the Grand Canon and the Mesa Verde. At the time of European settlement, this floodplain was essentially vacant, and supported great expanses of forests and prairies that were punctuated by scattered lakes and ponds, herbaceous wetlands, and meandering streams. Today the Project area provides essential habitat for waterfowl and migratory songbirds alike sitting at the heart of the major migratory flyways for both.

As a result of development over the last two centuries, the Project area now lies in the second largest concentration of residential, commercial, and industrial land use on the Mississippi River floodplain, after New Orleans. Yet open space still exists, including agricultural lands. About two-thirds of the world's supply of horseradish is grown locally on this Mississippi River floodplain and most horseradish fields are found in the Project area. This confluence area as indicated supports resources of national and regional importance.

3. NON-FEDERAL SPONSORSHIP AND STUDY PARTICPATION. The non-Federal sponsor for the re-evaluation study was the Metro East Sanitary District (MESD), who entered into a cost shared PED agreement in May 1998. The MESD was joined in this study cost share effort in a separate four party agreement with the State of Illinois' Department of Natural Resources (IDNR), Madison County, Illinois, and St. Clair County, Illinois. These entities served jointly on a Metro East Regional Stormwater Committee that solicits input and participation from the public and private sector in identifying problems and opportunities for meeting the challenges of stormwater management across their areas of responsibility. This Committee provided a monthly forum for sharing study progress, identifying additional study issues and receiving input across the spectrum of study concerns. Madison and St. Clair Counties, Illinois, have indicated their intent to serve as the non-Federal sponsor for the construction project and have received a pledge of backing from the Illinois Department of Natural Resources for cost share funding totaling some $10,000,000.

The Environmental Protection Agency (EPA) and the Natural Resource Conservation Service (NCRS) agreed to participate with the Corps as cooperating agencies on the Environmental Impact Statement (EIS) for the study. This effort is a natural extension of their on-going efforts in the Metro East area to improve the quality of life and protect valuable natural resources. Each agency provided a biologist to participate throughout the Habitat Evaluation Procedures analysis and also provided supporting technical expertise from their respective agencies. The EPA's Region 5 assisted in assessing water quality, air quality, hazardous and toxic waste plus environmental justice issues. The NRCS prepared extensive evaluations and analyses of sedimentation and stream erosion concerns in order to better define problems and opportunities. The IDNR provided a biologist to the study team and provided technical support from their Office of Water Resources for hydraulic/hydrologic issues. The U.S. Fish and Wildlife Service provided a biologist to the study team and ensured that their resource issues and concerns were addressed throughout the process. Because unique archeological resources occur in the study area, coordination was maintained with the Illinois State Historic Preservation Office during the formulation of alternative plans and subsequent plan evaluations.

4. PROBLEMS AND OBJECTIVES. The primary water and land resource problems identified are ecosystem degradation, sedimentation and recurring interior flooding. Ecosystem degradation is characterized in the study area by: the loss of biodiversity and the fragmentation of natural systems caused primarily by intensive urbanization over the years; the loss of historic ecosystem disturbances such as natural flooding and wildfires; the loss of habitat quality; and the degradation of tributary stream resources. Ecosystem degradation has occurred primarily because of the exclusion of Mississippi River overflows and upland stream flooding of the Project area, changes to the interior hydraulic system, and the significant pressures which urban development has placed upon the ecosystem. The elimination of effects from the Mississippi River and channelization of the floodplain streams has severed the natural connection between wetlands and river/stream hydrology.

Significant sedimentation is occurring as a result of erosional processes occurring in the tributary streams. Stream destabilization has occurred as a result of past urbanization that has increased the base flow rate within the streams. Urban sprawl and the loss of greenspace/open space are considered to be the major contributors to this problem. The runoff from the hillside creeks enters the canals on the floodplain at a high velocity capable of transporting heavy loads of sediment out of the bluffs. However, when these high velocity flows reach the bottoms, the velocity of the water drops substantially because the gradient flattens, and the water in the canal is no longer able to transport the sediment load. The desire to re-establish watershed functionality by reconnecting tributary streams and floodplain wetland resources makes the issue of sediment transport key. Currently sediment is either removed manually from the ditch/canal system, is deposited in connected water bodies such as Horseshoe Lake or is carried through a succession of storm events out to the Mississippi River.

Interior flooding currently occurs when bluff storm water entering the floodplain from streams overtops the floodplain canal system. This overtopping typically occurs close to the bluff line damaging surrounding structures and crops. This man made collector system will continue to contribute to significant flood damages if left alone. Interior flooding associated with large rainfall events produced widespread damages across the floodplain as a result of storms in 1915, 1942, 1946, 1952, 1957, 1961, and 1995. In 1993, 1994 and 1996 localized flooding caused major damages in specific areas.

Based upon the problems and opportunities identified for the study area, eight planning objectives were identified to guide the plan formulation effort: 1.) restore natural areas; 2.) restore the flood pulse; 3.) restore habitat quality; 4.) improve water quality; 5.) reduce erosion; 6.) restore tributary streams; 7.) restore floodplain streams; and 8.) address the incidental social objectives of reducing flood damages, enhancing outdoor recreation opportunities, and protecting cultural resources. The incidental social objectives were included to measure the ecosystem services provided by the restoration project.

5. DEVELOPMENT OF PLANS. Once the problems and planning objectives were identified and established, the next step in the formulation process was to develop plans to address the planning objectives. The study area has a number of remaining degraded wetland remnants that together create one the largest areas of urban wetlands in the state.

The period prior to the diversion of the natural stream system and construction of the levee along the Mississippi (ca.1800's) provided a picture of how the floodplain operated and natural communities prospered. Mapping of cover types reflecting historic vegetation and analysis of historic Mississippi River flood events became an essential ingredient in the formulation process. It was during this investigation that it became apparent that the re-creation of a floodplain flood pulse that mimics the pulse experienced on the undisturbed floodplain was essential for restoring a natural regimen that could sustain an ecosystem restoration plan for this floodplain area.

In order to ensure the broadest focus possible for the formulation of this restudy effort, the St. Louis District partnered with the U.S. Environmental Protection Agency Region 5, the Natural Resource Conservation Service in Illinois, the U.S. Fish and Wildlife Service Region 3, the Illinois Department of Natural Resources, and the U.S. Army Engineer Research and Development Center (previously Waterways Experiment Station).

The Project area was divided into five watersheds: Long Lake; County Ditch; Cahokia Canal; Harding Ditch; and Powdermill. An initial array of possible restoration sites was developed for each of the five watersheds, and these were selected based upon insight provided by the analysis of the pre-settlement land cover and hydrology, project restoration planning targets, public outreach, previous reports, identification of existing habitat sites, and the knowledge of agency personnel. After these sites were identified, baseline environmental conditions were established using Habitat Evaluation Procedure (HEP) on 89 floodplain and 71 tributary stream sites, Hydrogeomorphic Model (HGM) on 112 floodplain sites, and Qualitative Evaluation Habitat Index (QEHI) on 17 tributary stream sites within the Study area.

Restoration measures were developed for each site to meet the planning objectives. After a series of iterative evaluations and screenings, the initial array of sites was reduced to nine "clusters" of sites (Action Areas) that provided the best potential for meeting the planning objectives.

An array of alternatives was developed for each of the nine Action Areas, yielding a total of about 256 alternatives. These 256 alternatives were reduced to 71 through an iterative process of analysis and evaluation of measures designed to meet the planning objectives. Habitat benefits or environmental outputs for each of the 71 plans were estimated using HEP, and cost estimates for each plan were developed. An incremental cost analysis (ICA) was then performed on these 71 alternatives to compare the cost effectiveness and efficiency of the array of alternatives at each Action Area. Through a two-step review and evaluation process, one conducted by the biological team and one by the Sponsors' planning team, a preferred plan was identified.

The review and public comment period for the Draft Report that was conducted between 28 February and 7 May of 2003. As a result of this process the Wedgewood action area was eliminated from the preferred plan.

6. RECOMMENDED PLAN. In general, the Recommended Plan consists of the following measures: the restoration of bottomland forest habitat (1,705 acres), prairie habitat (1,111 acres), marsh and shrub swamp habitat (843 acres), lake habitat (460 acres), upland forest (379 acres), floodplain stream restoration (10.4 miles or 161 acres), placement of wood duck boxes (651 boxes) and prairie bird perches (870 perches), creation of over wintering holes and shoreline plantings (20 acres), and construction of tributary stream detention basins (131), riffle and pool complexes in 178 miles of streams, earthen embankments (15.5 miles), and hydraulic control devices (culverts, flap gates, and new channels).

Currently a total of 4,916 acres are included in the Project footprint, of which 4,468 acres are in the Mississippi River's floodplain and 448 acres are along streams in the tributary watersheds. The 178 miles of tributary stream restoration are not reflected in this Project area footprint. Specific sites, at which stream restoration measures would be implemented, other than the tributary sediment detention basins, have yet to be determined.

Figure ES-2 shows the location of the eight habitat areas and 178 miles of tributary stream restoration that comprise the Recommended Plan that includes: Old Cahokia Creek, Judy's-Burdicks, Elm Slough, Dobrey Slough, Brushy Lake, Cahokia Mounds, Spring Lake, and Mullens Slough.

The Recommended Plan will use storm water from upland watersheds to substitute for historic riverine overflow from the Mississippi River. The introduction of periodic "flood pulses" of storm water into the restored forests, prairies, and marshes of the floodplain Action Areas and the restoration of tributary streams will return the existing ecosystem to a more natural condition. A major source of historic surface hydrology will be restored to affected floodplain wetlands and aquatic areas. By receiving flood pulses, affected areas would once again be under the influence of a fundamental type of natural disturbance typical of floodplains.

The capacity of wetlands to temporarily store floodwater as they did historically would be restored. Storm water would then be released from these areas back into the interior flood control system and eventually to the Mississippi River. Restoring flooding to floodplain habitats and linking these areas to the interior flood control system would reintegrate the landscape and create a more naturally functioning watershed ecosystem.

The Recommended Plan re-establishes a surface hydrologic regime that was "engineered" out of the floodplain in the 1900's. The reconnection of the upland streams to the 4,916 acres of restored floodplain habitat areas will provide incidental flood damage reduction for the surrounding area as an ecosystem service.

The total project cost, including PED, is estimated to be $189,266,100. Project outputs have been captured by means of identifying habitat units and the dollar value of producing these units. Qualitative factors such as Habitat Suitability Index were utilized during plan assessment and evaluation to ensure that quantitative measures were maintaining qualitative standards. Cost data gathered after the selection of the Recommended Plan, which included the gross appraisal and other pertinent real estate and engineering information, was used to develop the baseline Project cost estimate. Average annual Project costs were computed to be approximately $11,798,851 using the current interest rate of 5.875% over the 50-year Project life. Annualized outputs for the Recommended Plan total some 8,332 habitat units. The Recommended Plan therefore produces these habitat units for an average annualized cost of approximately $1,416 per unit. Project benefits have been quantified by means of identifying habitat units incrementally compared to their cost of production.

This Project was formulated as a single purpose Ecosystem Restoration project, in accordance with ER1105-2-100 (3-5c.): "Monetary gains (e.g. incidental recreation or flood damage reduction) and losses (e.g., flood damage reduction or hydropower) associated with the project shall also be identified." In an attempt to quantify these benefits, a risk-based analysis was performed. This analysis determined that $1,366,000 in average annual flood damage reduction is incidental to plans considered. The Project includes a bike trail at the Old Cahokia Creek action area. This bike trail extends an existing trail and was justified using the Facility Capacity Method having an annualized cost of $16,084. At the current interest rate this trail has a benefit to cost ratio of 1.7 to 1.

7. IMPLEMENTATION. The non-Federal Sponsors for the construction project will be the Counties of Madison and St. Clair Illinois who have provided their letters of intent and have demonstrated the financial ability to cost share, operate, and maintain the project. The State of Illinois Department of Natural Resources has also provided their letter of intent to financially support the Project. A fifteen-year schedule (see Table ES-2 below) has been developed for project implementation beginning in FY05 with a construction new start. This schedule allows the flexibility needed to implement a project of this size and with the amount of land acquisition required.

The first set of plans and specifications will be undertaken during planning, engineering and design (PED), which are a part of the existing Design Agreement's scope. Prior to the acquisition of Project lands and the subsequent initiation of the first item of construction, a Project Cooperation Agreement (PCA) will be executed for the entire Project effectively bringing the PED phase to a conclusion.

Work under the PCA will begin with the Sponsors' acquisition of applicable lands, easements, rights-of-way, relocations and necessary disposal areas (LERRD's) in advance of the advertisement and award of the first construction contract. The Sponsors have sophisticated engineering staffs with construction capability. Their ability to contribute to project execution will be negotiated during the development of the Project Cooperation Agreement.

Table ES-2 Funding Stream Restoration Project.

		2	3	4	5	7	9
		Total Project		**PED or**		**Additional**	**Federal Cash**
FY	**Phase**	**Implementation Cost**	**LERRDs**	**Construction**	**%**	**Non-Fed Cash**	**Schedule**
Prior FY's	PED	2407.00	0.00	2407.00		601.75	1805.25
FY03	PED	800.00	0.00	800.00		200.00	600.00
FY04	PED	793.00	0.00	793.00		198.25	594.75
FY05	Constr	4865.43	3343.89	1521.54	0.01	371.99	1149.55
FY06	Constr	1348.91	130.47	1218.44	0.01	308.35	910.09
FY07	Constr	5018.77	2074.02	2944.75	0.02	670.84	2273.91
FY08	Constr	11589.60	4182.30	7407.30	0.05	1607.91	5799.39
FY09	Constr	12626.80	6880.12	5746.68	0.04	1259.20	4487.48
FY10	Constr	12242.21	6881.97	5360.24	0.04	1178.06	4182.18
FY11	Constr	18987.80	6230.54	12757.26	0.08	2731.31	10025.95
FY12	Constr	16344.35	1620.66	14723.69	0.09	3144.23	11579.46
FY13	Constr	18853.90	633.87	18220.03	0.12	3878.40	14341.63
FY14	Constr	22284.47	968.57	21315.90	0.14	4528.48	16787.42
FY15	Constr	16491.59	791.19	15700.40	0.10	3349.32	12351.08
FY16	Constr	14666.30	469.70	14196.60	0.09	3033.55	11163.05
FY17	Constr	13120.50	0.00	13120.50	0.08	2807.58	10312.92
FY18	Constr	11529.21	0.00	11529.21	0.07	2473.44	9055.77
FY19	Constr	8845.00	0.00	8845.00	0.06	1909.80	6935.20
FY20	Constr	193.26	0.00	193.26	0.00	93.08	100.18
Total		**193008.10**	**34207.30**	**158800.80**	**1.000**	**33345.54**	**124455.27**

*Displayed in $1,000s

This report consists of an Environmental Impact Statement (EIS) integrated with the general reevaluation report. Because implementation is expected to occur over a 15-year period, the Recommended Plan could be modified to reflect future changes at proposed Action Areas (such as new private development), or changes due to refinement of designs developed during the PED process.

Prior to implementation of any action area, follow-up NEPA compliance documentation will accompany the detailed design reports. This documentation will be prepared as either a Supplement to the EIS, or as a series of Environmental Assessments. Public involvement will continue during the preparation of future NEPA documentation.

8. PROJECT RECOMMENDATION. We have carefully considered the significant factors related to the problems and associated opportunities identified within the Project Area as well as the numerous alternative plans that were developed to address these problems and opportunities. These factors include: the severity of the environmental, social and economic consequences of ecosystem degradation and its related land and water resources problems within this significant, internationally known and valued, environmental/cultural resource area; the probability of worsening conditions in the future; the ability of each alternative plan to address the ecosystem restoration and related problems and opportunities; the costs of the plans and the relationship of the costs to their associated tangible and intangible outputs; and, the acceptability of the plans to the non-Federal interests. In consideration of these important factors, we have determined that the following recommendation is in the public's interest.

We recommend that East St. Louis and Vicinity, Illinois project authorized by the Section 204 of the Flood Control Act of 1965 and amended by Section 310 of the Water Resources Development Act of 2000 be modified to implement the National Environmental Restoration Plan identified in this Report as the Recommended Plan, as a Federal project with further modifications as necessary, in the discretion of the Commander, USACE, that may be advisable in accordance with the cost sharing and financing arrangements satisfactory to the President and the Congress. Based on October 2003 price levels, the total cost of the recommended plan is currently estimated to be $189,266,100.

The Sponsors' share of the Project cost is estimated to be $67,681,840 of which $1,000,000 has already been contributed during PED. The Illinois Department of Natural Resources has committed to providing funds totaling approximately $10,000,000. The estimated $34,207,400 in LERRD's costs will be borne by Madison and St. Clair Counties. The remainder of the Sponsors' share estimated to be $22,474,440 will be a divided among the State and the two counties. These figures include the restoration project costs that are shared at a 35% -65% rate and recreation features that are shared at a 50%-50% rate. Madison and St. Clair Counties and the State of Illinois have the capability of performing some of the required work themselves. During the development and negotiation of the Project Cooperation Agreement (PCA) these possibilities will be further examined.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding.

Figure ES-1. Project Area.

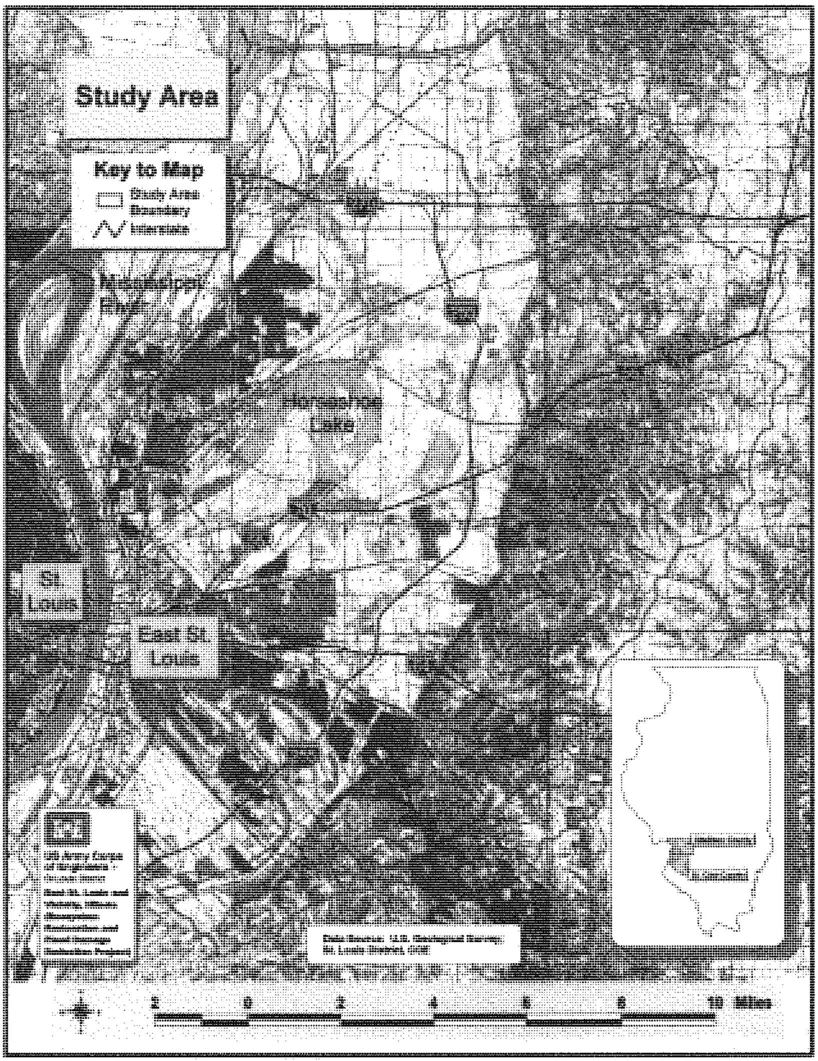

Figure ES-2. Action Areas comprising the Recommended Plan.

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1.1 PROJECT AUTHORITY

1.1.1 Background. The East St. Louis and Vicinity, Illinois Flood Protection Project was specifically authorized (and modified) through Congressional actions in 1965 under Section 204 of the Flood Control Act of 1965, (Public Law 89-298) and subsequently under the Water Resources Development Act of 1976 (Public Law 94-587). Section 204 of the Flood Control Act of 27 October 1965 (Public Law 89-298) provides that:

"The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein. The necessary plans, specifications, and preliminary work may be prosecuted on any project authorized in this title with funds from appropriations hereafter made for flood control so as to be ready for rapid inauguration of a construction program. The projects authorized in this title shall be initiated as expeditiously and prosecuted as vigorously as may be consistent with budgetary requirements. Penstocks and other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this Act for construction by the Department of the Army on the recommendation of the Chief of Engineers and the Federal Power Commission."

UPPER MISSISSIPPI RIVER BASIN

"The project for flood protection at East St. Louis and Vicinity, Illinois, (East Side Levee and Sanitary District), is hereby authorized substantially, as recommended by the Chief of Engineers, in House Document Numbered 329, Eighty-eighth Congress, at an estimated cost of $6,180,000."

The Water Resources Act of 1976 (Public Law 94-587) provides that:

"An Act

"Authorizing the construction, repair, and preservation of certain public works on rivers and harbors for navigation, flood control, and other purposes.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,"

"Sec. 137. The project for flood control in East St. Louis and Vicinity, Illinois, authorized by Section 204 of the Flood Control Act, approved October 27, 1965, is hereby modified to authorize the Secretary of the Army, acting through the Chief of Engineers, to construct the Blue Waters Ditch segment of the overall project independently of the other project segments. Prior to initiation of construction of the Blue Waters Ditch segment, appropriate non-Federal interests shall agree, in accordance with the provisions of section 221 of the Flood Control Act of 1970, to furnish non-Federal cooperation for such segment."

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Blue Waters Ditch in 1976. The results showed that the Blue Waters Ditch portion of the authorized project was still economically justified with a benefit to cost ratio of 1.35 to 1. Blue Waters Ditch was completed in 1989 and includes 4.4 miles of new/improved drainage channels and a 600 c.f.s. pump station that eliminates flooding from an estimated 700 acres of approximately 136,000 acres of the original project area.

A reevaluation of the recommendations contained in the 1965 Report under current conditions was completed for the Cahokia Canal and Harding Ditch Areas in 1984. This evaluation found the recommendations contained in the authorized project to not be economically justified under the existing interest rate at that time of 8 1/8 percent.

Major interior flooding in the project area resulted in four disaster declarations during the period 1993 to 1996. As a result, the 104th Congress, 2d Session provided funding via House Report 104-782, Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1997, to initiate a reevaluation of the authorized project.

The Water Resources Development Act of 1996 (WRDA) 1996 provided funding to initiate the General Re-evaluation Report for the East St. Louis and Vicinity, Illinois project.

1.1.2 Current Project Authority. The current project was authorized as part of the Water Resource Development Act of December 2000 (Public Law 106-541).

Water Resources Act of 2000 (Public Law 106-541) Title III Project - Related Provisions

"Sec. 310. EAST SAINT LOUIS AND VICINITY, ILLINOIS.

The project for flood protection, East Saint Louis and vicinity, Illinois (East Side levee and sanitary district), authorized by section 204 of the Flood Control Act of 1965 (79 Stat. 1082), is modified to include ecosystem restoration as a project purpose."

This expanded project purpose provides the opportunity for a fresh look at solutions across a broader spectrum for the Project area and permits new authorities and administration priorities to be incorporated into the planning process for this reevaluation effort.

1.2 PROJECT PURPOSE, SCOPE, AND REPORT ORGANIZATION

1.2.1 Project Purpose. The purpose of this reevaluation study is to re-examine the Cahokia Canal and Harding Ditch areas of the authorized East St. Louis and Vicinity, Illinois Project under current conditions, existing authorities, and Administration priorities with a view towards looking for new solutions to old problems. The principal goal is to identify potential improvements to the natural system for ecosystem restoration, which would restore the historic flood pulse to the floodplain in a manner, which could also provide, needed flood damage reduction. Using this approach, it is believed that bio-diversity in the bottomlands can be restored and serious watershed degradation problems can be addressed. This document presents the results of this extensive reevaluation effort and recommends a plan which will best serve the needs of the area when compared to the future without project condition.

1.2.2 Project Scope. This project follows the Corps' methodology for the reevaluation of a feasibility report. In general, the previous study information was examined and updated to current and future without project conditions for such things as land use, existing damages, hydraulic changes, and climate changes impacting hydrology. Additionally, an analysis of the pre-levee condition (ca. 1800) was made in order to understand the functions of the natural system and to permit a full array of ecosystem alternatives to be understood and explored that might best achieve project goals. Previous studies looked for strictly engineering solutions to the interior flooding problems experienced by the local population for nearly 100 years; it is believed that an analysis of the naturally functioning system prior to construction of the existing drainage canals could provide new solutions to old problems.

Through a series of public and agency involvement activities, goals for the project were identified and existing baseline data gathered for use in alternative formulation and analysis. As an outgrowth of utilizing existing Corps' policy guidance and extensive coordination among project partners, environmental restoration benefits were utilized to measure, evaluate and compare alternative plans through the application of an incremental cost analysis methodology. The Waterways Experiment Stations (WES) Integrated Biological Evaluation Procedure (IBEP) model was used in conjunction with the Institute for Water Resources' (IWR) plan for the determination of total National Environmental Restoration benefits and selection of the recommended plan. In addition to Corps' expertise, the Project Team included biologists from partnering agencies. They included representatives from: the U.S. Environmental Protection Agency, Region 5; the U.S. Fish and Wildlife Service, Region 10; the Natural Resource Conservation Service, Illinois; and, the Illinois Department of Natural Resources. The Project Team was augmented throughout the reevaluation process by technical experts from respective resource agencies as needs arose. Since a feasibility report does not include a design level of detail and thus, includes an inherent level of uncertainty, this reevaluation report documents the resultant uncertainties involved with plan selection and with the future tasks, which will be needed to minimize these uncertainties.

Engineering and real estate cost estimates have been based upon the analyses and assumptions made during the process of formulating and developing components of the recommended plan. Uncertainties in design details could impact future alternative analyses and subsequent design and cost estimates. Following release of the draft report, consultation with the Environmental Protection Agency and the U.S. Fish and Wildlife Service determined that the document as prepared fulfilled the requirements for an Environmental Impact Statement and that follow-on project documentation should follow the traditional tiered review approach. Use of a tiered approach was determined to be most appropriate for this project because of its size, the potential length of time required to implement it and the complexity of ecosystem features. Based upon recent Corps' emphasis, an integrated General Reevaluation Report and Environmental Impact Statement and Appendices report has been prepared.

The reevaluation of the project began with the execution of the Preconstruction Engineering and Design Agreement in May 1998 between the Corps and the local sponsor, the Metro East Sanitary District. As with all feasibility level reports, the recommended plan will be designed in greater detail after this report has been reviewed and approved. A follow-on Project Cooperation Agreement with the project sponsor will be required for the construction of the project.

1.2.3 Report Organization. This report consists of a General Reevaluation Report with an integrated Environmental Impact Statement and Appendices. The main portion of the General Reevaluation Report provides an overview of the project effort and summarizes information found in its Appendices. The Appendices provide supporting information for the investigations and the tasks conducted for the study.

The following is a synopsis of the information contained in this document that should help the reader focus attention to the sections of most interest or concern:

SECTION 1 - INTRODUCTION. Provides the overall project authority, a description of the project area and information on previous project efforts and portions of the originally authorized project that have been constructed.

SECTION 2 - PRE-DEVELOPMENT CONDITIONS. Describes the physical character of the floodplain from its development through actions of the glacial period and historic movement of the Mississippi River. The pre-development ecological conditions are described to include the wide variety of natural communities that thrived in the area and the disturbance dynamics that ensured their health and diversity. A discussion of the wetland functions is included that explores the importance of the disturbance dynamic on the sustainability of ecosystem diversity. This section provides the roadmap that was used in the formulation of the project. It was during the assessment of the predevelopment hydrologic disturbance dynamics on the floodplain from both Mississippi River and interior stream action that it became clear that an environmental project formulated to reestablish hydraulic interconnectivity and healthy disturbance dynamics to recreate quality habitat areas would provide flood damage reduction as a natural consequence. It was also clear that based on the character of the floodplain a naturally functioning ecosystem that did not require extensive mechanical augmentation should be able to be achieved.

SECTION 3 - EXISTING CONDITIONS. Provides an overview of the project area as it exists today both from a socio-economic and environmental quality point of view. This section describes a project area that still contains significant acreage dedicated to agricultural endeavors that is surrounded by urban development. It provides information regarding development patterns that show the bluff communities exploding in growth and increasing economic prosperity and floodplain communities growing but not at the same pace or with the same economic benefit. It describes a cycle of urban sprawl that is not unlike many other areas in the nation with the often-resultant loss of environmental quality, green space and open space. While numerous trail related recreation initiatives completed or underway are described, none of the current local plans address the loss of wildlife habitat, ecosystem diversity and environmental sustainability that is facing the area.

SECTION 4 - FUTURE WITHOUT PROJECT CONDITIONS. Describes what the project area is likely to look like fifty years into the future without the benefit of a project. This information is based on growth predictions as well as predictions of environmental decline developed by the restudy team. As with any projection of future conditions, these are based on past and present trends in the area. Continued rapid development of the bluffs is expected, as is the expansion of development on the flood plain. During the study period alone, 1998-2002, significant development has occurred on the floodplain. Based on the past and present trends of wetland losses, habitat segmentation and loss of diversity and quality the future conditions are not predicted to improve. The floodplain that sits at the confluence of the nations two great rivers that was the home of the ancient Cahokia civilization some 12,000 years ago and contained great expanses of wetlands, prairies and forests when European man arrived in the area, stands to loose its natural character if action is not taken today.

SECTION 5 - PROBLEMS AND OPPORTUNITIES. Provides a description of the problems facing the project area that have been gathered from extensive public involvement and the numerous prior studies conducted over the last half-century. Problems facing the ecological resources remaining in the project area are detailed providing a categorization of negative influences such as loss of bio-diversity, loss of disturbance dynamics, loss of habitat quality, fragmentation of existing resources and deteriorating water quality due to high sediment loads. These are coupled with problems centering on erosion and sedimentation, tributary stream channel instability, flooding and flood damages, loss of cultural resources and future outdoor recreation opportunities. Planning objectives and their related planning targets developed by the Project team from benchmarking the predevelopment condition are explained. This section establishes the criteria upon which formulation will proceed.

SECTION 6 - FORMULATION. Presents the measures developed for the planning objectives established in Section 5 and details the process used to identify the floodplain and tributary stream sites that were assessed using HEP and HGM methods to establish baseline conditions of the project area. A description of the iterative process used to ultimately identify the action areas that are taken through alternative plan development and evaluation is given. A description of each action areas predevelopment history is included along with its problems and opportunities.

The iterative process of alternative plan development that began with the identification of 256 potential alternatives that were eventually narrowed to 71 is explained along with their evaluation using an incremental cost analysis process. Results of the incremental cost analysis and plan selection procedures is also described with rationale for selection of the selected alternatives.

SECTION 7 - ENVIRONMENTAL CONSEQUENCES. Provides a discussion of the environmental consequences of the recommended plan.

SECTION 8 - RECOMMENDED PLAN. Describes the environmental features of the recommended plan as well as the construction features required to achieve the plan. The real estate plan is provided in summary along with a description of required PED activities designed to validate assumptions made during the planning process. A summary of the project cost estimate is also included.

SECTION 9 - IMPLEMENTATION. Describes the process that will be utilized to design and construct the project. This process will center on the development of an Engineering Design Report (EDR) for each recommended action area that will serve as the future decision document for the initiation of construction activities. The development of an Environmental Impact Statement as a part of this re-evaluation report makes the future use of the EDR a logical way to ensure future project outputs match those anticipated and that environmental impacts are revisited prior to the completion of design. Based on the size and complexity of this project a tentative fifteen-year construction schedule is used to develop the project-funding stream and construction features are divided into eight categories. Financial analysis of the sponsors indicates their ability to cost share the project.

SECTION 10 - PUBLIC INVOLVEMENT. Provides an overview of the multi phased public involvement process used for this project that demonstrates the collaboration that was used to accomplish the restudy effort.

APPENDIX A - HABITAT EVALUATION. Details the environmental analysis that supports the project process. This appendix provides the details of the gathering of baseline conditions, selection of predictor species, projection of future without and future with conditions and alternative development and analysis procedures through use of the incremental cost analysis process. This appendix also describes the results of the HEP and HGM procedures used in project analysis.

APPENDIX B - ENVIRONMENTAL. Provides supplemental information, charts, tables and illustrations required to further document environmental information presented throughout the report. This appendix also includes the Environmental Justice analysis prepared for the recommended plan by Region 5 of the USEPA.

APPENDIX C - HYDROLOGY AND FLOOD DAMAGE. Provides information related to the predevelopment and existing condition hydrology of the project area. An explanation of the formulation process used for the evaluation of hydrologic inputs to the action areas is provided and the modeling used for development and analysis of alternative plans is detailed.

APPENDIX D - GEOTECH. Provides supplemental information, charts, tables and illustration required to further document geotechnical information presented throughout the report.

APPENDIX E - SEDIMENT TRANSPORT. Details the studies conducted and formulation process used to determine the measures and alternatives viable for addressing the erosion and sedimentation problems of the project area. This appendix establishes the planning target applied to the project objectives and presents a demonstration project currently being undertaken by the State and USGS to validate project assumptions that will be used during the PED phase.

APPENDIX F - WATER AND AIR QUALITY. Provides information on water quality in the project area and future conditions predicted with and without the project. Information on air quality prepared by Region 5 of the USEPA in support of the project provides information on the existing condition and future with project analysis.

APPENDIX G - PUBLIC INVOLVEMENT. Documents the process of obtaining public input to the restudy effort and provides supporting information for Section 10 of the report

APPENDIX H - REAL ESTATE PLAN. Documents the real estate requirements of the selected plan and provides the cost estimate and estates required to execute the project.

APPENDIX I - LOCAL COOPERATION. Documents the intent of the sponsors to cost share the project.

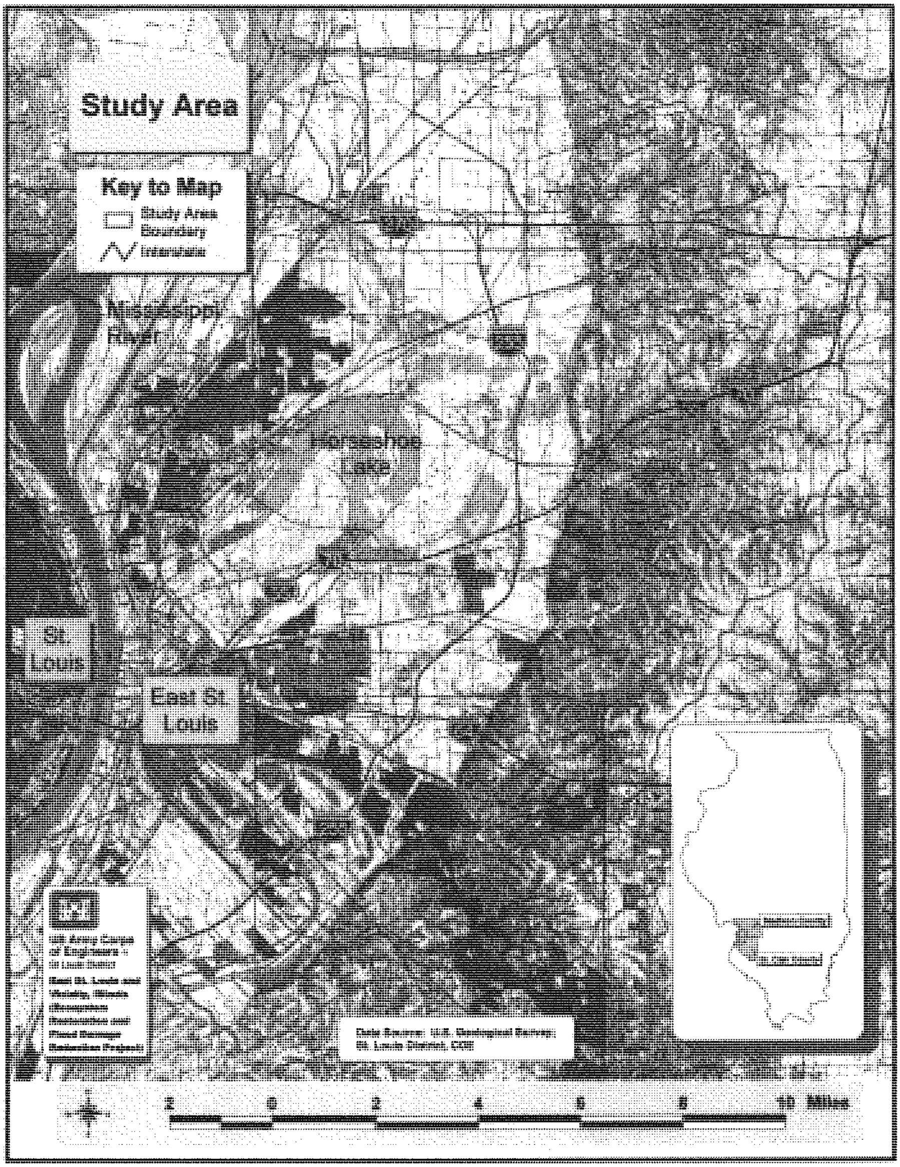
APPENDIX J - MCACES ESTIMATE. Provides the project estimate for project execution.

1.3 PROJECT AREA

1.3.1 Location. The East St. Louis and Vicinity, Illinois Project is located in Madison and St. Clair Counties, Illinois, along the left bank of the Mississippi River between river miles 175 and 195 above the Ohio River. It includes a portion of the bottomlands between the bluffs on the east and the Mississippi River and Chain of Rocks Canal on the west. It extends from the Prairie Du Pont canal on the south to the Cahokia Creek diversion channel on the north.

The project area includes approximately 55,000 acres of the 86,000 acres of floodplain that is protected by a levee system along the Mississippi River, the Chain of Rocks Canal, the Prairie Du Pont canal, and the Cahokia Creek diversion channel. An additional 51,000 acres is tributary to and drains into these bottomlands are also apart of the project area. Figure 1-1 depicts the project area.

Figure 1-1 Project/Study Area



1.3.2 Site Significance. The Study area is located within an extremely valuable and strategic ecosystem resource area. The implementation of ecosystem restoration plans within this area would contribute greatly to national, regional and local systems. The Study area's ecosystem significance relates directly to contributions towards the: North American Waterfowl Management Plan; Upper Mississippi River System Environmental Management Program; Clean Water Action Plan; Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force; and, federal government's list of "Species of Concern".

This area lies at the center of the world's fourth longest river system and is of national and international importance. It includes the largest urbanized floodplain north of New Orleans and sits at the confluence of the great rivers of North America, the Mississippi and the Missouri, which are among the nation's foremost natural and cultural resources.

This confluence has drawn people to it since man inhabited this country, becoming a crossroads in the middle of the continent. As far back as 12,000 years ago it was home to the ancient Cahokia civilization and contained great expanses or wetland, prairies and forests when European man arrived in the area in the 1700's. In 1982 a 2,000-acre portion of the Project area was designated by the United Nations as a World Heritage Site because of the areas significance. This designation places it in the company of such areas as the Grand Canon and the Mesa Verde.

The area provides essential habitat for waterfowl and migratory songbirds alike sitting at the heart of the major migratory flyways for both.

1.3.3 Organized Drainage and Levee Districts.

1.3.3.1 Introduction. Numerous drainage and levee districts have organized to provide local flood protection within the Project area since the late 1800's. These organizations are independently operated. However, discharges from each District drain into the canal system operated by the Metro East Sanitary District that extricates the water through a series of pumping stations and gravity drains through the main line levee into the Mississippi. The majority of these Districts operate on limited funding and in many instances are dependent upon the actions of only one or two participants. The following is a summary of each and their area of interest and current status. It should be noted that the area maintained by the various levee districts is larger than the area covered by this project.

1.3.3.2 The Metro East Sanitary District. The Metro East Sanitary District was originally organized as the East Side Levee and Sanitary District in 1907 and includes approximately 62,900 acres of bottomland or approximately 73 percent of the total bottomland within the Project area. The District extends approximately from the Cahokia Diversion Canal to the Prairie Dupont flank levee. The District also contains the principal urban and industrial developments in the area and operates and maintains all of the flood control facilities as well.

1.3.3.3 Chouteau, Nameoki, and Venice Drainage and Levee District. This District was organized in 1888 and includes a total of 4,066 acres located in the northeastern part of the Project area. The District extends generally from the Chain of Rocks Canal on the west to the Metro-East

Sanitary District on the east, and from the Cahokia Creek diversion channel on the north, to the Melvin Price Support Center on the south. The District maintains a system of ditches for interior drainage and also operates one pumping station along the Chain of Rocks Canal. The pumping station is used to remove runoff when gravity drainage is blocked.

1.3.3.4 County Ditch Drainage District. This District consists of about 4,740 acres within the northern portion of the of the Project area. It was organized as a drainage district in 1912. The District has an improved drainage channel that is designated as County Ditch. The ditch drains the District into the Cahokia Canal in the vicinity of the New York Central Railroad. In recent years, the local landowners adjoining the channel have handled channel maintenance.

1.3.3.5 Canteen Creek Drainage and Levee District. The District was organized in 1910 and includes an area of 1,349 acres along Canteen Creek. In recent years, the District has participated under a joint partnership with MESD and the Corps to rehabilitate this portion of the overall flood control system. Approximately half of the project is complete and work is ongoing.

1.3.3.6 Other Areas. Approximately 5,500 acres of the bottomland area are located between the eastern boundary of the Metro East Sanitary District, the bluffs to the west, the northern boundary of the district and to Interstate 55/70 on the south. There currently are no organized programs for maintenance of drainage facilities in these areas. Seven creeks, which originate in the uplands traverse this bottomland area and carry the runoff into the conveyance channels within the Metro East Sanitary District's area of responsibility.

1.3.4 Political Units of Interest. The project area is located in portions of Madison and St Clair Counties, Illinois and contains approximately 22 incorporated municipalities. The uplands portion of the Project area contains the municipalities of Edwardsville, Maryville, Glen Carbon, Collinsville, Fairview Heights, Belleville, and Swansea while Pontoon Beach, Granite City, Venice, Madison, Brooklyn, East St. Louis, Fairmont City, Washington Park, Sauget, Centreville, East Carondelet, Caseyville, Alorton, Cahokia and Dupo are located in the bottoms. Figure 1-2 and 1-3 depicts these areas. Figure 1-4 depicts the congressional boundaries of the project area.

Figure 1-2 Project/Study Area -Township Boundaries

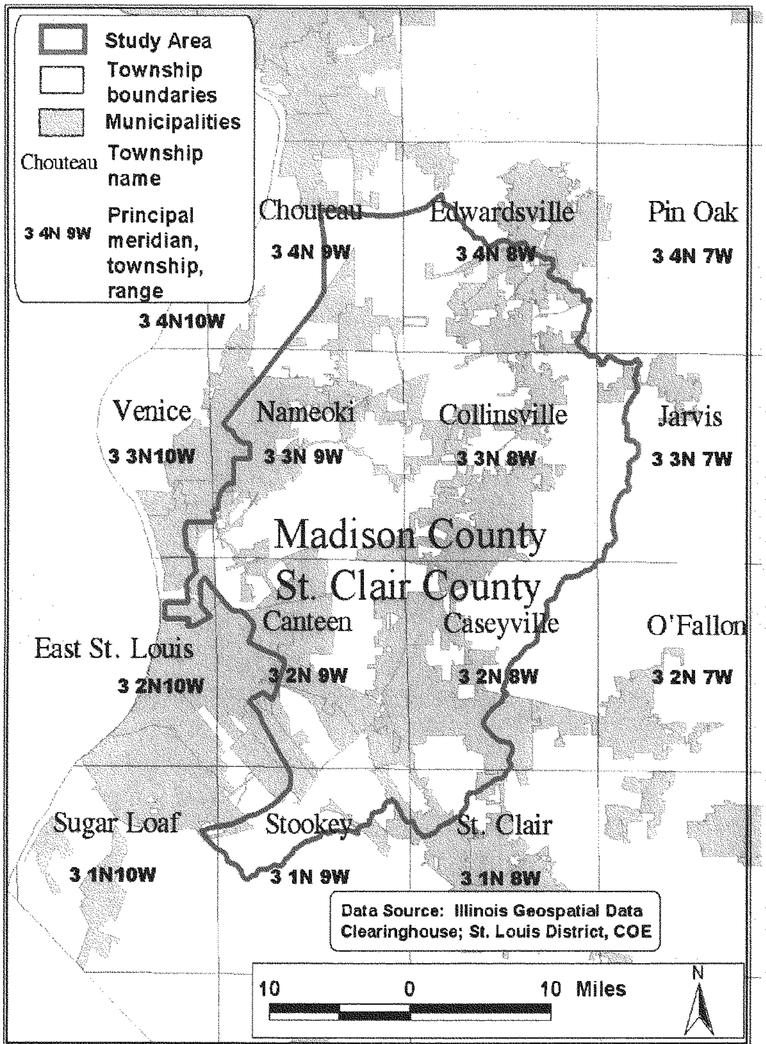


Figure 1-3 Project/Study Area - Municipal Boundaries

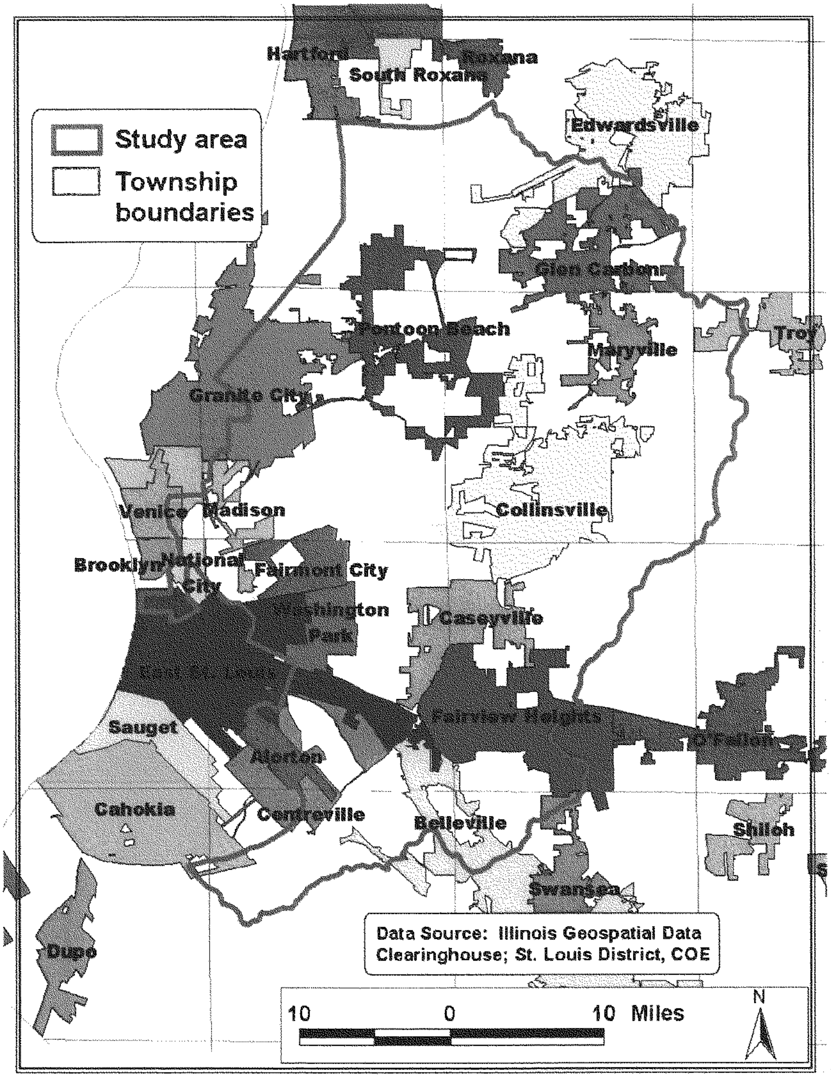
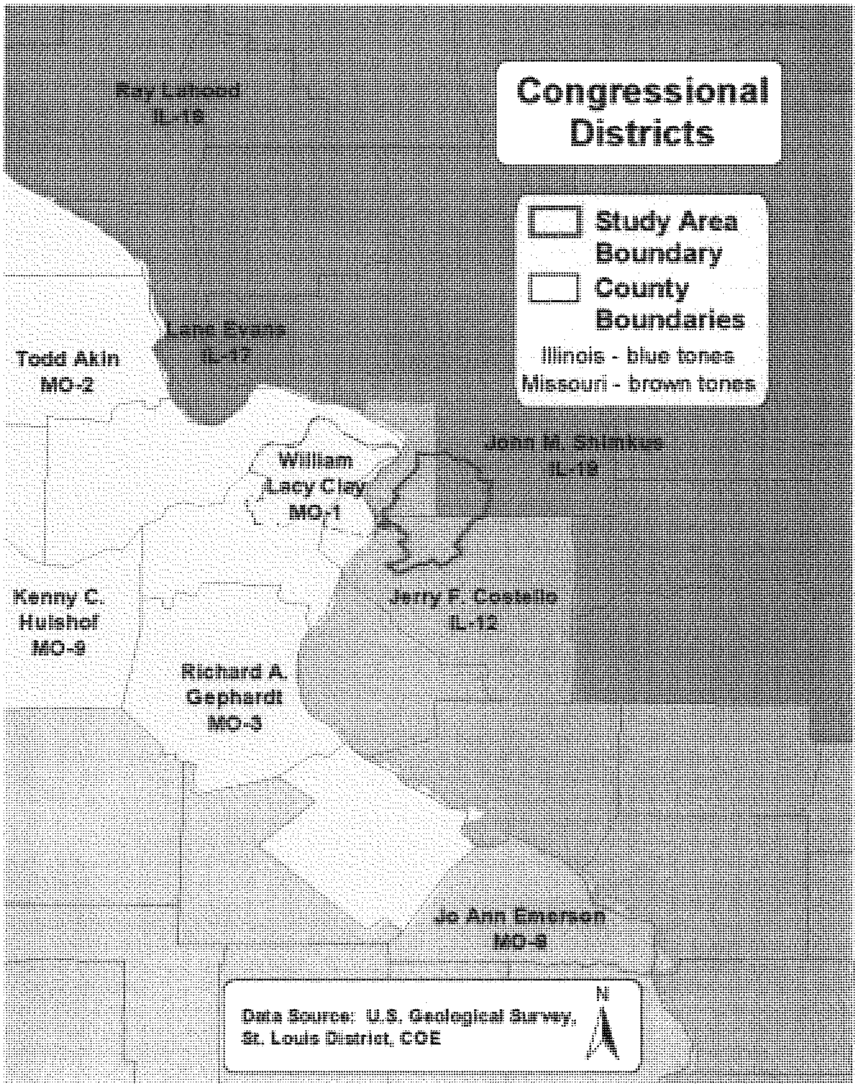


Figure 1-4 Project/Study Area - Congressional Boundaries



1.3.5 Major Sub-Basins and Watercourses. There are three principal basins within the Project area: the Cahokia Canal basin which drains approximately 74,300 acres; the Harding Ditch basin which drains approximately 27,439 acres; and, the Powdermill Creek/ Canal No. 1 basin which drains approximately 4,907 acres.

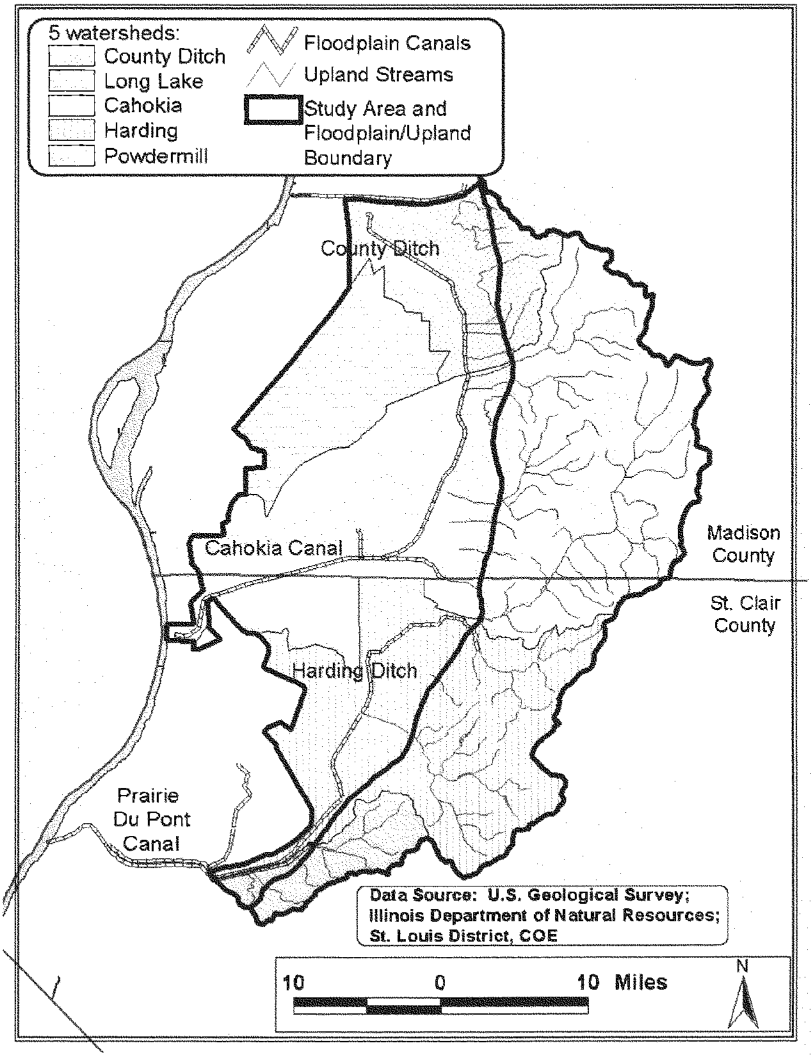
The Cahokia basin is comprised of four tributaries: Judy's Branch; Burdick Branch; Schoolhouse Branch; and, Canteen Creek. Cahokia Canal, County Ditch, the Horseshoe Lake Diversion Channel and Lansdowne Ditch form the floodplain tributaries of this basin. For study purposes this watershed was subdivided into three sub-basins, the County Ditch, which drains approximately 11,721 acres, Long Lake, which drains approximately 10,228 acres and Cahokia accounting for the remainder of the basin.

The Harding Basin is formed in the uplands and consists of Little Canteen Creek and Schoenberger Creek. Once formed, it then flows across the bottomland floodplain as "Harding Ditch".

Powdermill Creek is the only stream that drains into Canal No. 1. and thus, is responsible for forming this floodplain tributary.

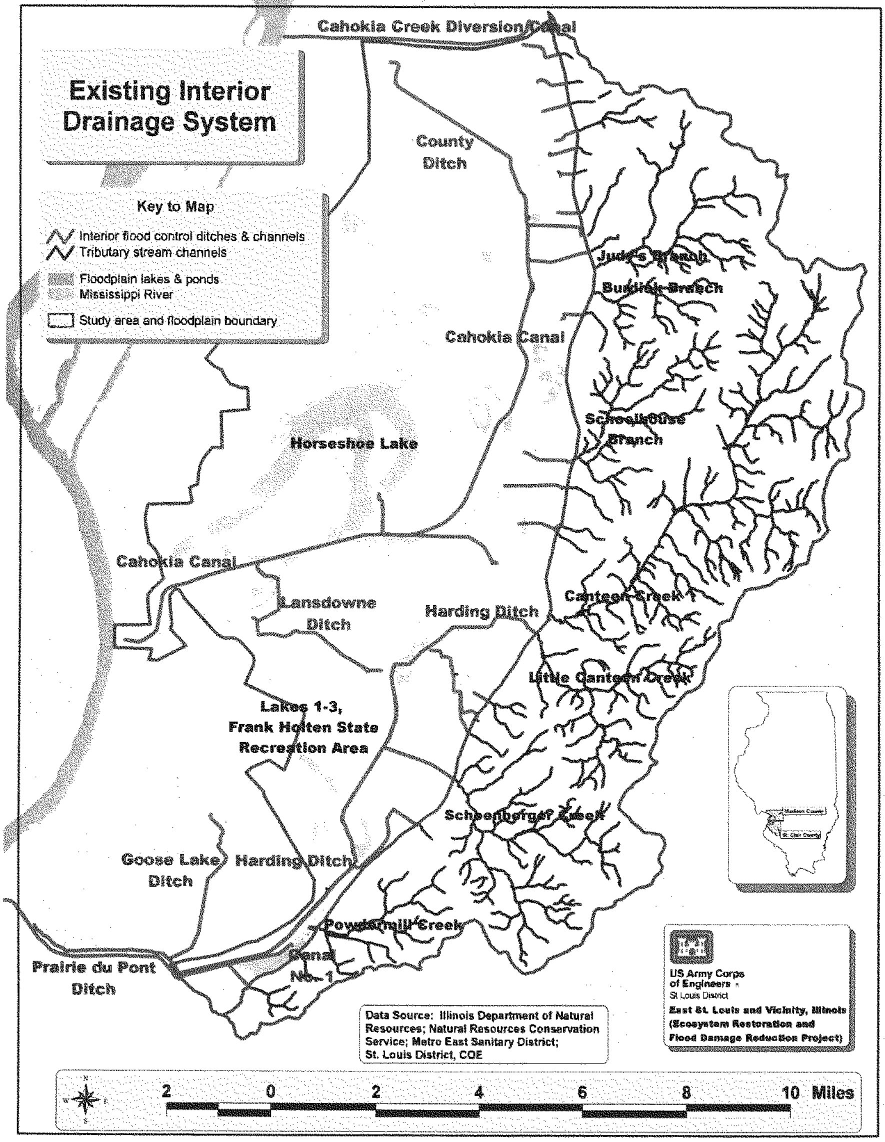
The tributaries streams are in a more natural, but somewhat degraded state, while on the floodplain watercourses have been channelized over time. The floodplain drains to the Mississippi River through levee gravity drains when river levels permit or through pumping plants when river levels do not. Figure 1-5 depicts the major sub-basins and watercourse, which make up the 5 watersheds of the project area.

Figure 1-5 Project Area Watershed Divisions



1.3.6 Existing Interior Flood Control Features. The interior floodplain is drained by a series of altered tributaries, which are now canals. These canals consist of some 40 plus miles of spoil bank ditches that capture water and carry it to the Mississippi River directly, or to the Mississippi River via the Prairie Du Pont Diversion Channel. These canals form the interior "flood control" system. Figure 1-6 depicts this interior drainage system.

Figure 1-6 Project Area Interior Drainage System



The main floodplain tributaries were formed when man altered existing streams to develop a system that was originated to serve agricultural needs. This system has not been significantly improved over time to accommodate either the urbanization or climactic changes experienced across the basins. These changes have dramatically increased interior flood control requirements since the mid 1900s.

The floodplain ditches are fed directly from tributary streams and smaller bottomland drainage systems. The ditches carry water from the bluffs, farm ditches, and localized pumping stations that extract water from the floodplain and place it into this interior flood control system. It is then carried to the Mississippi River. An urban levee and a full complement of interior pumping plants protect the floodplain from the Mississippi River.

1.4 NATIONAL ENVIRONMENTAL POLICY ACT REQUIREMENTS

1.4.1 Background. The National Environmental Policy Act (NEPA) of 1969, as amended, is the Nation's charter for environmental protection. The NEPA establishes policy, sets goals, and provides the means for carrying out the policy. Section 102(2) of the NEPA contains action-forcing provisions to ensure that federal agencies act in accordance with its letter and spirit, including a provision to prepare a detailed environmental report on the effects of a proposed federal action called an Environmental Impact Statement (EIS). The federal regulations for implementing the procedural provision of NEPA were published by the Council on Environmental Quality (CEQ) in the Code of Federal Regulations (CF) as 40 CFR Parts 1500-1508 (43 Federal Register 55978-56007, November 29, 1978).

1.4.2 Current Project Approach. This report documents the Corps of Engineers' investigations of potential modifications to the East St. Louis Interior Flood Control project for the purposes of ecosystem restoration and reduction of flood damages due to interior flooding all in compliance with the requirements of the NEPA. This report employs the integration concept established in the CEQ's NEPA regulations. Integration is based on the CEQ provision to combine documents such that "any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork" (40 CFR 1506.4). The Corps of Engineers' regulations implementing NEPA (ER 200-2-2) permit an EIS to be either a self-standing document combined with, and bound within an agency decision document, or an integrated document which contains NEPA-required discussions in the text of the decision document.

The St. Louis District has elected to integrate the General Reevaluation Report and Environmental Impact Statement into one report, for several reasons. First, the ecosystem restoration features and the flood damage reduction features of the proposed project are completely inter-related and must be presented in an integrated document. Secondly, this approach will reduce paperwork, redundancies, and allow the documentation of project formulation, plan selection, and plan impacts in one consistent report. Sections of the integrated report that include discussions required by the NEPA are marked with an asterisk in the Table of Contents to assist readers in identifying and locating this material.

1.5 PROJECT PROCESS

1.5.1 Plan Formulation. The project process followed the six step planning process as described in Engineering Regulation 1105-2-100, Planning Guidance Notebook, dated 22 April 2000. Even though this is a Re-evaluation Report, the full spectrum of plan formulation alternatives were developed in order to address the addition of ecosystem restoration as a project purpose. The guidance provided by Engineering Circular 1105-2-219, Cost Allocation For Multipurpose Projects Including Ecosystem Restoration dated 01 October 2000 was applied in order to accomplish the incremental analysis of the recommended plan.

1.5.2 Non-Federal Sponsor And Other Cooperating Agencies Involvement. While the Design Agreement identifies the non-Federal sponsor for the PED phase of the project as the Metro East Sanitary District (MESD), they are joined for this reevaluation effort in a separate four party agreement with the State of Illinois Department of Natural Resources (IDNR), Madison County, Illinois, and St. Clair County, Illinois. These entities serve jointly on a Metro East Regional Stormwater Committee that solicits input and participation from the public and private sector in identifying problems and opportunities for meeting the challenge of stormwater management across their areas of responsibility. This Committee provides a monthly forum for sharing project progress, identifying additional project issues and receiving input across the spectrum of project concerns.

The Environmental Protection Agency (EPA) and the Natural Resource Conservation Service (NRCS) agreed to participate with the Corps as cooperating agencies on the EIS for this project. This effort is a natural extension of their on-going efforts in the Metro East area to improve the quality of life and protect valuable natural resources. Each agency provided a biologist to participate throughout the Habitat Evaluation Procedures analysis and the Integrated Biological Evaluation Procedure (IBEP) for this project and also provided supporting technical expertise from their respective agencies. The EPA's Region 5 assisted in assessing water quality, air quality, hazardous and toxic waste plus environmental justice issues. The NRCS prepared extensive evaluations and analyses of sedimentation and stream erosion concerns in order to better define problems and opportunities.

The IDNR provided a biologist to the project team and provided technical support from their Office of Water Resources for hydraulic/hydrologic issues. The U.S. Fish and Wildlife Service provided a biologist to the project team and ensured that their resource issues and concerns were addressed throughout the process. Because unique archeological resources occur in the project area, close coordination was maintained with the Illinois State Historic Preservation Office during the formulation of alternative plans and subsequent plan evaluations.

1.6 PRIOR STUDIES, REPORTS AND EXISTING FLOOD CONTROL PROJECTS

1.6.1 Existing Project Accomplishments. The East St. Louis main line flood protection system, authorized by the Flood Control Act of 1936, has been complete for many years. Its features are approximately 19.8 miles of levee: floodwall improvements including: 6.1 miles of reconstructed riverfront levee, 4.8 miles of upper flank levee; 4.9 miles of lower flank levee; 0.9 miles of new riverfront levee; and 3.1 miles of riverfront floodwall. Complementary appurtenant works consist of gravity drainage structures at highway crossings, alterations and reconstruction of existing pumping plants, construction of new pumping plants, servicing of access roads on the levee crown, seepage corrective measures, and alterations to railroad tracks and bridges at levee crossings. The project levee grade (52 feet on the Market Street gage) affords protection against a flood with a 500-year return period.

1.6.2 Results of Prior Corps' Studies. In 1957, the Corps was authorized to study the engineering and economic feasibility of improvements to the interior flooding problem in the project area. Completion of the study and a recommended plan were documented in a Survey Report published in 1962. The Survey Report plan recommended 14 separate features: improvement of four channel systems; the construction of five bottomland detention areas; the construction of one upland reservoir on Little Canteen Creek; the use of two existing lakes for storage; the construction of one new channel; and, the construction of a new pump station for the Blue Waters Ditch area.

Based on the 1962 Survey Report, modification of the interior flood control system was authorized by the Flood Control Act of 1965 and had four major components: Blue Waters Ditch, Cahokia Low Water Dam, Harding Ditch drainage area, and the Cahokia Canal drainage area. The Water Resources Development Act (WRDA) of 1976 modified the 1965 Act by authorizing construction of the Blue Waters Ditch segment of the overall project independently of the other project segments. The Blue Waters segment was constructed in the 1980s.

Major repair work was done on the Cahokia Low Water Dam after the 1993 flood. The success of the repair will likely preclude the need to replace the low water dam as was originally authorized. The Harding Ditch and Cahokia Canal segments, the subject of this reevaluation study, were studied in the 1980s and resulted in a revised unpublished draft report in 1985. The conclusion stated in the document was that there is no economic justification for these two segments. The recommendation in the report was for those segments to be reclassified as inactive. However, due to severe flooding in 1995 through 1997 on the Harding Ditch and Cahokia Canal segments, a new Congressional appropriation in 1997 initiated a re-start of a general reevaluation of the interior area.

1.6.3 Other Related Projects (e.g., rehabilitation project, FEMA ditch clean-out). Due to the continuation of flooding problems, the State of Illinois became involved in the Dobrey Slough area. Flooding in this area was a problem from both surface water and from a rising groundwater table. In 1974, the State provided a solution for the more frequent surface water flooding by installation of a small pump station, which discharged into the Nameoki Ditch system.

During a Mississippi River flood event, which occurred in October 1986, a roller gate failed at the East St. Louis Pumping Station, resulting in river water backing into East St. Louis. This caused 1200 persons to be evacuated from their homes, and flood damages estimated at $35 million. This disaster focused attention on the need for rehabilitation of the deteriorated flood protection system, and led to the authorization of the Corps' "East St. Louis Flood Protection Rehabilitation Project." The majority of the rehabilitation took place along the mainline Mississippi River protection, but channel rehabilitation in the bottoms was also an authorized purpose. Much of the work has been completed, however, cleanout of the upper portion of Canteen Creek has not yet been completed. A supplemental report with additional rehabilitation items has been prepared.

After a large rainfall event in May 1995, significant interior flooding occurred throughout the bottoms area. This disaster reiterated the need to rehabilitate the deteriorated condition of the interior flood protection channels that were choked with vegetative growth and sediment. FEMA funded a $5 million cleanout of many of the major ditches in the bottoms. An additional $5 million dollars has spent on rehabilitation of many of the major ditches under the Corps Rehabilitation Project.

1.6.4 Relevant Studies, Reports, and Projects by Others. In 1905 a paper presented to the Association of Engineering Societies, provided a definitive look at the "Levee and Drainage Problem of the American Bottoms." This report discusses in detail the drainage problems facing the area in 1905 and proposes a number of potential solutions and costs. In many ways the organizational problems facing the area that was divided between two counties then, are still reflected today with respect to interior drainage problems.

In 1950, the Illinois Department of Public Works and Buildings' Division of Waterways issued a report entitled, "Proposed Hillside Diversion Project, Madison and St. Clair Counties, Illinois." The report included a recommendation for a project that included a bluff-line diversion channel, floodway enlargements, pumping station improvements, and run-off impoundments within the bottoms area of their project area.

In 1970, the Illinois Department of Transportation's Division of Water Resource Management completed a draft report entitled, "Flood Control Project For East St. Louis and Vicinity, Illinois," which incorporated the most desirable features of the 1950 report and added to this earlier plan, a reservoir on Prairie Du Pont Creek at the bluff line and the proposed deepening and widening of the Prairie Du Pont Diversion Channel.

In November 1972, the Illinois Department of Transportation issued a report entitled "Request for Public Law 99 Assistance, Dobrey Slough Flood Water Conduit." This report proposed a floodwater conduit to reduce flooding in the Dobrey Slough area.

In August 1975, the Southwestern Illinois Metropolitan and Regional Planning Commission issued a report entitled "Plan for Major Drainage: The American Bottoms and Hillside Drainage Area Planning Basin". The report proposed alternatives for reducing stormwater flooding in both the Cahokia Canal and Harding Ditch watersheds.

In December 1978, the Illinois State Water Survey issued a report on the analysis of the inflow hydrology of Horseshoe Lake. The report describes the drainage history of the lake, its hydrologic modeling, inflow frequency analysis, and hydrologic budget.

In August 1986, Hurst-Rosche Engineers, Inc. completed a report commissioned by the Metro-East Sanitary District (MESD) to identify the scope of rehabilitation and improvements needed to restore the flood control facilities under MESD operational control. The MESD's commissioning of the report was prompted by the failure of the roller gate at the East St. Louis Pumping Station in October 1986. The Hurst-Rosche report was used as a starting point to get the Corps' involved in the rehabilitation of the project.

Between 1990 and 1995 the Natural Resource Conservation Service (NRCS) in Madison and St. Clair Counties completed 6 planning studies that were designed to address flooding and sedimentation caused by erosion in the project area. However, no projects resulted from these studies:

Little Canteen Creek/Harding Watershed, Pre-Authorization Plan, May 24, 1995
Big Canteen Creek Hydrologic Unit Resource Plan February 9, 1995
Schoolhouse Branch Watershed Resource Inventory and Alternative Evaluation, September 15, 1995
Long Lake Watershed Resource Inventory and Alternative Evaluation, July 25, 1995
Judy's/Burdick Branches Watershed Resource Inventory and Alternative Evaluation, September 1, 1995

SECTION 2 - PRE-DEVELOPMENT CONDITIONS

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SECTION 2 - PRE-DEVELOPMENT CONDITIONS

2.1 INTRODUCTION

This section of the report provides an overall characterization of the conditions that existed in the Project area prior to construction of the Mississippi River levee system and prior to drainage and development activities in the East St. Louis floodplain. The Project Team determined that it was important to understand how the ecosystem of the Project area functioned prior to human development in order to realize how the functioning of the natural ecosystem has been impacted by human activity. This information provides a key to guide potential ecosystem restoration designed to beneficially utilize storm water as a replacement for the hydrology engineered out of the floodplain. In this manner ecosystem structures and functions can be better understood.

Three major topics are discussed in this section - structure, disturbance dynamics, and function of the predevelopment ecosystem. Structure is represented by the physical and biological conditions that existed in the ecosystem. Physical conditions include the predevelopment geology, stratigraphy, and hydrology. Biological or living resources include the communities, populations, and species that flourished, and these resources are described from three vantage points: as various types of land cover, as natural communities, and as species of flora and fauna.

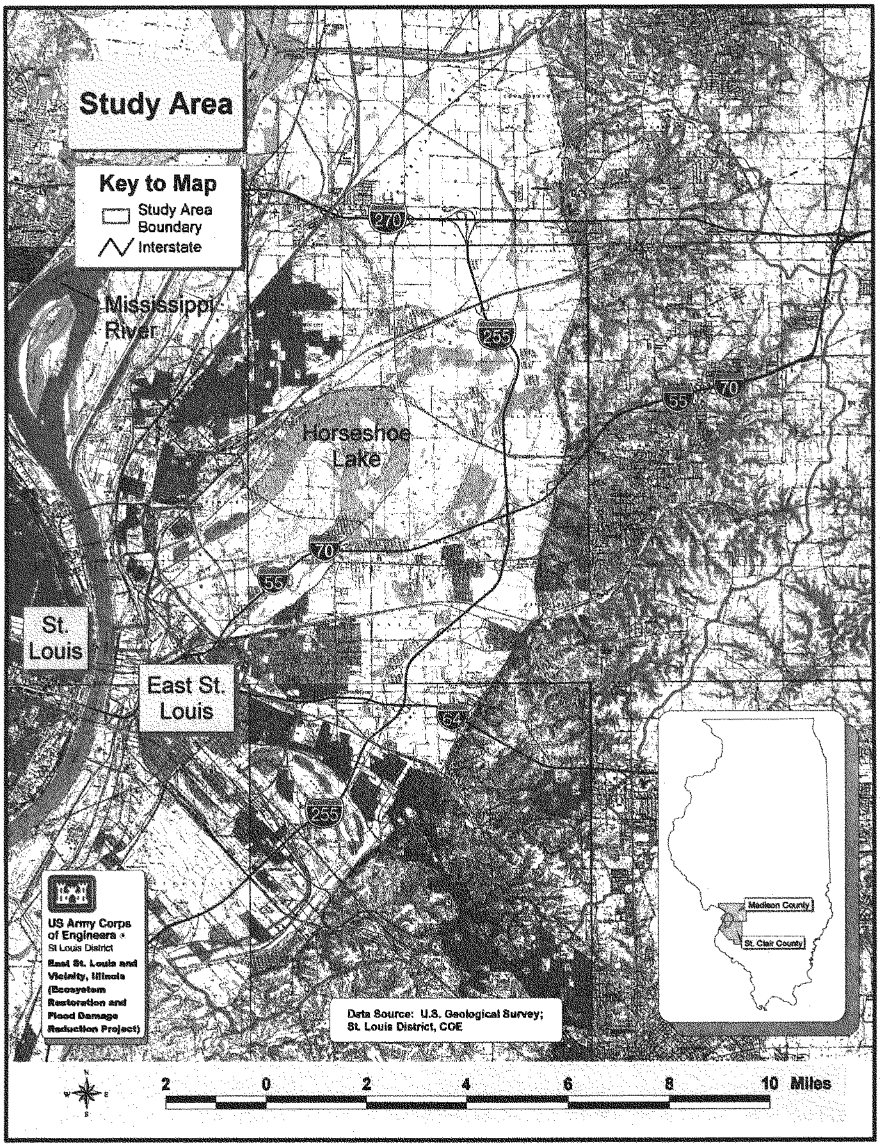
The discussion of disturbance dynamics describes the periodic episodes of flooding and wildfire that occurred in the ecosystem, and their importance in maintaining overall biological integrity. The final discussion describes ecosystem function, and focuses on wetlands and the functions they performed. These concepts are essential to the understanding of the inter-relationship between disturbance and the ecosystem of the floodplain and adjacent uplands.

2.2 PREDEVELOPMENT PHYSICAL CONDITIONS

2.2.1 Predevelopment Topography. Erosional and depositional forces have shaped the natural topography of the Project area over the last 7,000 years. The area has three main topographic areas: the relatively level alluvial flood plain of the Mississippi River, the upland bluff area of steep erodible slopes and narrow valleys, and the rolling hills of the uplands. The Project area is primarily located within a portion of the Mississippi River floodplain area known locally as the "American Bottom", and includes western portions of Madison and St. Clair Counties. The American Bottom extends beyond the Project area boundaries going farther north up to Alton and south into Monroe County near Dupo. The Project area is depicted in Figure 2-1. The American Bottom covers approximately 175 square miles (112,000 acres). The area is approximately 30 miles long and 11 miles wide at its widest point. The topography in the floodplain is nearly level bottomland. The floodplain generally slopes to the south and drops in elevation approximately 0.5-foot per mile mirroring the Mississippi River surface profile. The floodplain typically exhibits river meander scars, abandoned channel oxbow lakes, low-relief ridges, and swales.

Ancient Indian mounds rise above the American Bottom with the largest being Monks Mound that rises 85 feet above the adjacent floodplain and is located east of Fairmont City. The average elevation to the north near Alton is 415 feet above the National Geodetic Vertical Datum (NGVD) and to the south near Dupo is 405 feet NGVD. In the northern portion, there are terraces located along the foot of the bluff between East Alton and Roxana. The terraces are approximately 25 to 35 feet above the floodplain with elevations between 440 and 450 feet NGVD. The Project area north of Horseshoe Lake is typically higher than the adjacent floodplain with elevations between 420 and 435 feet NGVD. The topography near the Illinois bluff on the eastern edge of the floodplain is generally higher than the adjacent floodplain with elevations between 435 and 465 feet NGVD. The bluff rises steeply between 150 to 200 feet above the floodplain. The bluff has a rather rugged topography with the drainage channels forming valleys with steep slopes. Beyond the bluff line the topography consists of rolling hills and valleys with elevations ranging between 500 and 600 feet NGVD. Natural drainage patterns have carved steep narrow channels through the troughs and valleys. The Project area extends east beyond the American Bottom and into the adjacent uplands. The natural flat topography in the American Bottom is a major factor for widely meandering creeks and overland flows across the Project area. Abandoned channels and swales held water that formed large lakes and wetlands. The natural channels had very little slope and were not efficient in moving surface water from either the bluff or the American Bottom to reach the outlets to the Mississippi River. Surface water meandered slowly to the Mississippi River or remains in numerous natural depressions. These large flows from the bluffs and uplands created flood pulses that carried eroded sediments from the uplands and bluffs. The flows out of the bluffs enter the American Bottom with high velocities and are able to suspend more sediments than slower moving waters. Once sediment-loaded waters reached the nearly flat slopes, the slower moving waters allowed the sediments to aggrade (deposit sediments) in the creeks, swales, lakes, depressions, and adjacent lands with overland (out-of banks) flows.

Figure 2-1 Project Area



2.2.2 Predevelopment Geomorphology. Locally, the Mississippi River is quite old, and probably was established during the Mesozoic Era, and at the very latest during the Tertiary Period of the Cenozoic Era. The Mississippi River maintained its course at the eastern edge of the Ozark Plateaus (uplift) and eroded a broad bedrock valley bottom ranging in elevations between 290 and 310 feet NGVD with an average elevation of 300 feet NGVD, some 300 feet below the surrounding uplands. The eastern bluff has exposed bedrock outcroppings consisted of hard limestone deposits and softer deposits of shale, coal, and some sandstone. The limestones were formed during the Mississippian Period and are located north of Alton, Illinois, and south of Dupo, Illinois. Between Alton and Dupo, soft Pennsylvanian Period shales, coals, and some sandstones extend westward into St. Louis, Missouri, much like a tongue. It is this tongue of weaker shales and coals that enabled the young Mississippi River to cut a wider floodplain (11 miles wide at its widest point), which it was unable to do either upstream and downstream through harder limestone deposits.

2.2.2.1 Glacial Periods. Since the beginning of the Pleistocene Series (Ice Age) of the Quaternary Period, the character of the Mississippi River changed substantially. Investigations of Pleistocene Series deposits show a more complex history of multiple glaciation and interglacial period than previously surmised. For this Project the age and correlation of Nebraskan Stage and Kansan Stage glaciation are identified as pre-Illinoian Stage. Several deposits of old till that have been found are thought to be pre-Illinoian Stage glacial deposits, and probably the leading edge of the ice sheet lay somewhere within the Project area. The Liman Substage (first substage) of the Illinoian Stage glaciation (third glacial stage) moved across the Mississippi River, and a portion of the moraine is located in St. Louis County, Missouri (Bergstrom and Walker 1956). The Mississippi River probably flowed under the ice, but ponding probably took place upstream, and some of the results are preserved today in outstanding terraces along the lower Illinois River. Large boulders are occasionally struck by exploration drilling and sampling and well drilling in the American Bottom several feet below the deposits of till resting on the old riverbed. The Wisconsinan Stage glaciation (fourth stage) approached the Project area from the northeast, but stopped some seventy-five miles to the north of the Project area. However, these ice sheets had a major impact on the American Bottom, because the Mississippi, Missouri, and Illinois Rivers were major drainage ways for the heavily sediment-laden melt waters. The river channel began to aggrade to an estimated level of 445 feet NGVD, which is 35 feet above the current typical floodplain ground surface elevation of 410 feet. Heavy deflation took place during Wisconsinan Stage winters when westerly winds blew across the exposed glacial outwash consisting of materials of various sizes. The small, fine-grained materials, such as silts, fine sands, and rock flour, were carried by the winds and deposited on adjacent lands as loess (aeolian) deposits. The lighter particles were deposited on the upland as loess, attaining a thickness of 50 feet in places adjacent to the floodplain with a progressive decline in thickness as one moves eastward. As the Wisconsinan Stage glaciation retreated from the Mississippi River basin, the river began to degrade and remove some of the Pleistocene deposits within the Mississippi River valley fill.

2.2.2.2 Fluvial Geomorphology of the American Bottom. The Pre-development fluvial geomorphology of the American Bottom surficial geology was shaped by the succession of meandering former channels of the Mississippi River and its related flooding. Continuous cycles of degradation (erosion) and aggradation (deposition) of the Mississippi River and its tributaries meandering across the American Bottom floodplain during the past 7,000 years (Recent Epoch), have had great effects upon the configuration of the topography and environment. Most of the migration of the meandering Mississippi River occurred between the end of the Wisconsinan glaciation period and the 1800's. The continuous meandering of the Mississippi River across the American Bottom created abandoned channel deposits, backswamp deposits, sand and gravel point bar deposits, chutes and bar deposits, as shown in Figure 2-2 and described in more detail below.

Abandoned Channel Deposits. Abandoned channel deposits are the result of the gradual aggradation of fine-grained sediments within oxbow lakes formed by the lateral migration of the river. These deposits are thickest near the outside edge of the old channel meander loops. There are numerous abandoned channel deposits as shown in Figure 2-2. Present wetlands are located in these deposits since they drain so slowly.

Point Bar Deposits. Point bar deposits formed on the inside of the meander loops during the horizontal migration of the river channel. The river migrates laterally by depositing bars of sand and sometimes gravel on its inside edge of the old channel meander loops and shifting to the outside cutting the bank through periodic failures of the outside bank. The building of these series of bars results in a corrugated surface of sand ridges and clay-filled depressions or swales. These deposits create the ridge and swale topography common throughout areas near the river, such as portions of Cahokia, Madison, and Granite City.

Chute and Bar Deposits. Chute and bar deposits were formed in a manner similar to the point bar deposits except that the surface was frequently changed by the cut and fill action of fast flowing floodwaters. Many of the resulting chutes have characteristics similar to the abandoned channel deposits.

Backswamp Deposits. Backswamp deposits consist of fine-grained sediments laid in broad shallow basins during periods of flooding. The sediment rich floodwaters were ponded between natural levee ridges on separate meander belts or between natural levees and the bluffs.

Surface meander scars, shorelines, creeks, sloughs, and oxbow lakes are shown in Figure 2-2, such as Cahokia Creek, Pittsburg Lake, Cahokia Lake, and Horseshoe Lake. The topographic and soil patterns show a definite orientation related to the cutting and filing of the adjacent river. In the past it is possible that during periods of greater precipitation cycles that Pittsburg and Cahokia Lakes were connected, while during periods of drought the lakes almost completely dried up. Also, it may be interpreted that because of elevational differences, topographic breaks and abrupt termination of surface patterns, the former lakes differ in age. A geological cross section cut down to bedrock and across the American Bottom along with the different formations and the above described deposits are illustrated in Figure 2-3. The Mississippi River valley fill ranges in thickness from more than 120 feet in places, and feathers down to nothing near the bluff within the Project area. The surface deposits within the American Bottom are typically part of the Cahokia alluvium, which consists of up to 60 feet thick silty clay deposits on abandoned meanders, oxbow lakes, and point bar deposits (Grimley 2000).

Figure 2-2 Geological Map of the American Bottoms

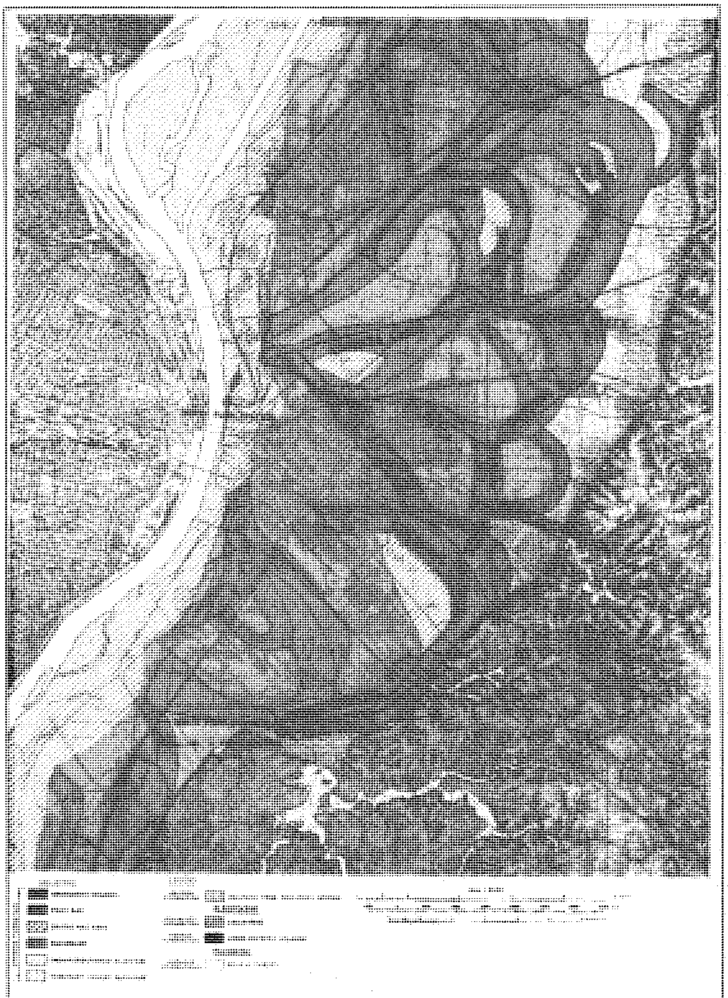
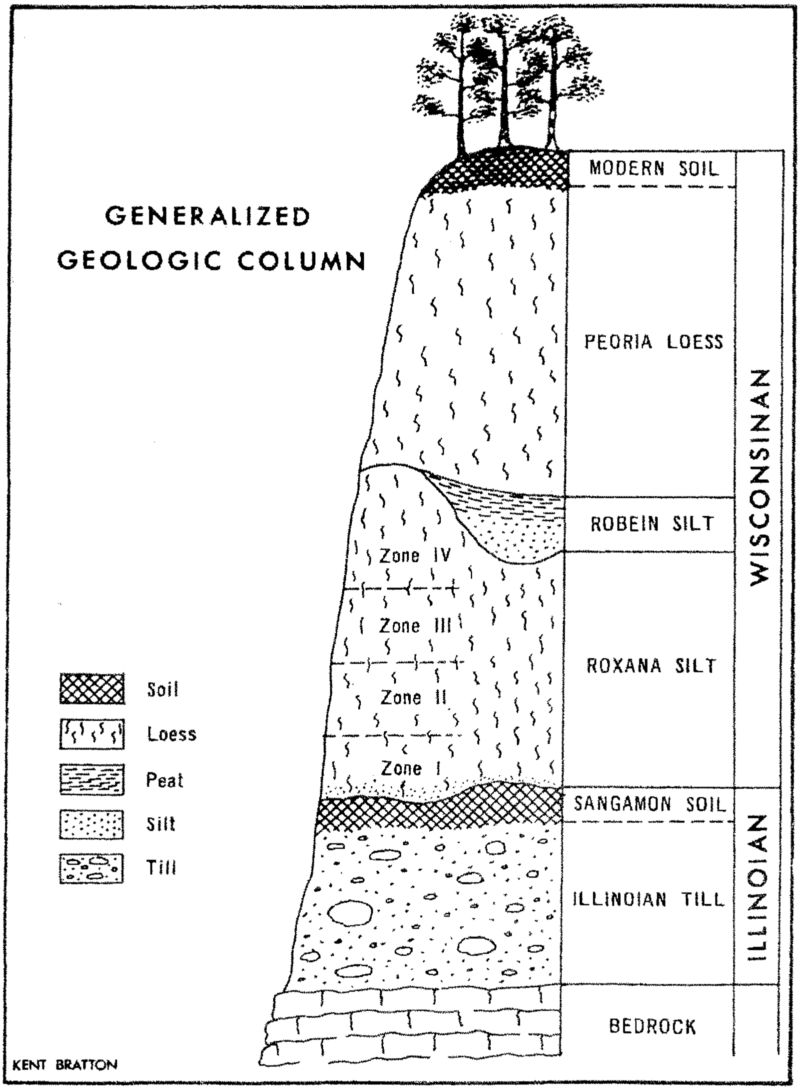


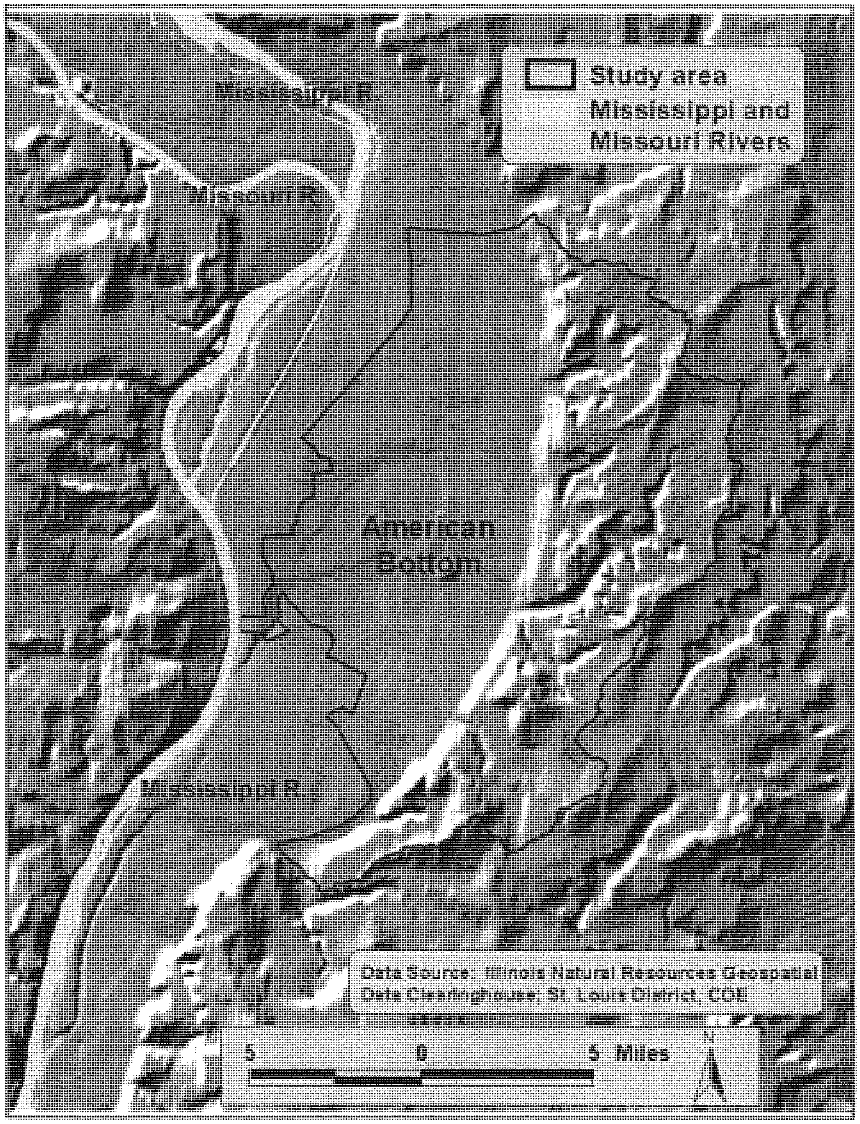
Figure 2-3 Geologic Cross Section



2.2.2.3 Pre-Development Upland Geomorphology. Loess is the dominant surficial soil in the upland and bluff areas. Loess consists of wind-deposited silt-sized particles carried by the wind from the glacial outwash as valley terrain along the Mississippi River. The glacial outwash came from the melting ice sheets to the north and consists of gravels, sands, silts and clays, which were deposited in the aggrading river valley. The prevailing westerly winds picked up the smaller particles of silts and clays and deposited them on the upland as loess. As a result of this major source area, the American Bottom, the thicker deposits are located in juxtaposition to the alluvial valley and thin to the east. Also, the loess is coarser in texture along the floodplain and becomes finer as one proceeds eastward. The level uplands are the remnants of a glacial plain formed by the deposition of a nearly flat, surficial body of lodgment till, over which a mantle of loess was deposited by the wind. The stream valleys and the slopes are a reflection of the pre-Pleistocene Series topography. The valleys were probably only partly filled with drift or were eroded by post-Illinoisan Stage streams. Most of the streams have eroded to bedrock somewhere along the valleys and have narrow floodplains, with the exception of the Schoenberger Creek, the longest stream on the upland section of the Project area. Roxana Silt was deposited during the Altonian Substage of the Wisconsinan Stage, and has been dated as extending from 70,000 Before Present (B.P.) to about 28,000 years B.P. The Roxana usually composes about one half of the total loess deposits. However, in some portions of the upland the overlying Peoria has been removed by erosion and the modern soil profile is developed in the Roxana Silt. Robein Silt is a localized formation, which was deposited during the Farmdalian Substage from 28,000 to 20,000 B.P. Farmdalian time was a period of warming during the Wisconsinan Stage. Peoria Loess was deposited during the period from 20,000 to 7,000 years B.P. It is the more dominant surficial material in the Project area, as can be seen in the prominent loess pits along the Mississippi River Valley and bluffs.

2.2.3 Physiography. The Project area is located in part in two geological provinces, Ozark Plateau on the west and Central Lowlands on the east. The uplands are in the Springfield Till Plain of the Central Lowlands. The Springfield Till Plain was formed by Illinoian glacial drift that formed a nearly level surface, except where stream dissection has taken place (Ekblaw and Horberg 1948). Narrow flat-topped divides, V-shaped valleys, and slopes of up to 35 percent characterize the bluff. The area has a mean slope of eight degrees and an average local relief of 132 feet (Sandy 1971; Schoen 1972). Figure 2-4 shows the general physical relief of the Project area.

Figure 2-4 Physical Relief of Project Area



2.2.4 Predevelopment Stratigraphy.

2.2.4.1 General. The geologic history of the Project area was divided into three main periods. The periods are: (1) bedrock formations were formed during the Paleozoic Era; (2) deposition of the unconsolidated glacial materials occurred during the Pleistocene Series; and (3) erosion and deposition of the unconsolidated materials occurred and modern soils formed during the Recent Epoch.

2.2.4.2 Paleozoic Stratigraphy. During the Paleozoic Era the Project area, as well as most of the Midwest, was intermittently submerged beneath the sea. Responding to continental tectonic activity with continental plate movements in the nearby Ozark Plateaus and the more distant Appalachian Mountains to the east, the seas alternately advanced, depositing sedimentary rocks, and retreated from the area. This migration of seas brought periods of marine deposition, followed by times of erosion. These events are recorded in some 1,500 to 3,000 feet of sedimentary rocks, mostly limestone, shale and sandstone, which underlie the glacial and Recent Epoch aged sediments. The bedrock formations underlying the Project area were primarily formed during the Pennsylvanian and Mississippian Periods of the Paleozoic Era. Rocks of the Mississippian Period underlie the western floodplain and strata of the Pennsylvanian Period underlie the eastern bluff and uplands of the Project area. The Mississippian Period materials are chiefly limestone and shale of the Chesterian and Meramecian Series. The Pennsylvanian Period materials include shale, coals, sandstone, and shale interbedded limestone. The Pennsylvanian Period materials occasionally outcrop along some of the more deeply incised valleys on the upland. The seas withdrew from the Project area after the Pennsylvanian Period, after which a long period of erosion occurred until the ice sheets appeared in the Midwestern United States about one million years ago; thereafter began the depositional history of the Pleistocene Series on the uplands and the Mississippi River valley.

2.2.4.3 Pre-Wisconsinan Stage, Pleistocene Series Stratigraphy. The upland areas of the Project area are covered with glacial materials that vary in thickness from zero to over one hundred feet. The Banner Formation of the Kansan Stage probably overlies much of the bedrock of the Project area. The extent and thickness of this formation is not known. This geological unit consists of glacial till and outwash of sands, gravels, and silts. (Willman and Frye 1970). Overlying the Banner Formation is the Glasford Formation of the Illinoisan Stage. It includes glacial tills and outwash deposits (Willman and Frye 1970). The material is overlain by the Sangamon Soil that developed in the formation during the Sangamonian Stage interglacial stage (Sangamonian Stage ended about 75,000 years B.P.) The till represents deposits laid down directly by the ice and consists of particle sizes ranging from clays to large boulders. Overlying the earlier glacial tills are different ages of loess deposited during the Wisconsinan Stage.

2.2.4.4 Wisconsinan Stage Stratigraphy.

2.2.4.4.1 General. The Wisconsinan Stage deposits may be divided into three geologic formations: Roxana Silt, Robein Silt, and Peoria Loess. The Roxana and Peoria are composed mostly of silts of varying mineral composition while the Robein Silt consists of peat, and organic-rich and deoxidized silts deposited in water. The Robein occurs only locally and in rather small deposits, which have not been adequately mapped (Bratton 1971).

2.2.4.4.2 Roxana Silt. The most distinctive characteristic of the Roxana Silt is the red color, caused by the rare iron mineral lepidocrocite (Layne-Western 1965) and the weathered surface at the Roxana-Peoria contact. This contact surface is high in clay content and as a result gravitational waters tend to slide laterally along the surface. Lutzen (1970) reported that about fifty percent of the gravitation water flowed along this contact. This condition may cause construction problems related to the water seeps and the possibility of slab failures in the loess deposits on steep slopes.

2.2.4.4.3 Robein Silt. This formation consists of peat, tree limbs, roots and high organic silts that are probably reworked sheet wash from the Roxana Silt. The Robein Silt appears to be localized in old stream valleys or lakes on the Roxana Silt surface. This is apparent because the deposition occurred in water-saturated conditions.

2.2.4.4.4 Peoria Loess. The Peoria Loess is prominent as the upland surficial deposit in western Illinois. The particle size distribution of the Peoria Loess is about 80 percent silt-sized material (0.05-0.002 mm). The most important aspect of the mineralogy of the Peoria is the 20 per cent or so of clay. Seventy per cent of the clay minerals are montmorillonite or expanding clays (Frye and Glass 1962).

2.2.4.5 Recent Epoch Stratigraphy.

2.2.4.5.1 General. The Recent Epoch generally is accepted to begin at the end of the last ice age, Wisconsinan Stage. It defines all deposits younger than the top of the Wisconsinan Stage and extends 7,000 years B.P. to the present. The upper portions of the surficial soils within the Project area were formed during the Holocene Stage. However, the lower portion of some of the surficial soil deposits were aggrading during the Wisconsinan Stage since as soon as the glaciers melted away, an assortment of soils were being deposited. In many areas the soils were intermixed, overlapped, and intertongued. The boundaries between Wisconsinan Stage and Recent Epoch deposits are blurred.

2.2.4.5.2 Cahokia Alluvium. The Cahokia Alluvium (Willman and Frye 1970) is named after the village of Cahokia that is within the Project area. The Cahokia Alluvium consists of soil materials deposited in the floodplains and channels. The formation consisted of poorly sorted silt, clay, and silty sand with lenses of sands and gravels. The formation thickness varies considerably but rarely exceeds 50 feet. The Cahokia Alluvium rests on the Henry Formation of the Wisconsinan Stage.

2.2.4.5.3 Peyton Colluvium. The Peyton Colluvium (Willman and Frye 1970) is named after Peyton Creek in Peoria County located at the base of the Illinois River bluff. The formation is sometimes described as slope wash and alluvial fans (Wanless 1957). The formation consists of narrow bands located at the base of the bluff, and consists of poorly sorted materials from bluff slope failures and eroded materials from the uplands and bluff areas. The materials have accumulated on the lower slopes and at the base of the slopes by erosion, soil creep, slope instability failures, slope wash, and mudflows. Numerous alluvial fans and cones developed at the mouths of streams and gullies, and are deposited on floodplain areas and terrace surfaces. The Peyton Formation is a surficial deposit and possibly intertongued with the Cahokia Alluvium.

2.2.5 System Hydrology/Watershed Characteristics. The naturally flat topography in the American Bottom (Bottom) is a major factor for the existence of wide meandering creeks and overland flows across the Project area. Abandoned river channels and swales hold water that form large lakes and wetlands. The natural channels have very little slope and are not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River. Surface water meanders slowly to the Mississippi River or remains in numerous natural depressions. These large flows from the bluffs and uplands create flood pulses that carry eroded sediments from the uplands and bluffs. The flows out of the bluffs enter the Bottom with high velocities and are able to suspend more sediments than slower moving waters. The slower moving surface waters allow the sediments to drop out and be deposited (aggrade) in the creeks and deposited on adjacent lands during overland (out-of banks) flows

Drainage prior to settlement in the early 1900's generally flowed toward the Mississippi River and was intercepted by swales, creeks, and major channels. Flooding from the Mississippi River and its major tributaries frequently inundated large areas of the floodplain.

The natural over bank drainage and meandering creeks flowing into the Mississippi River became blocked beginning in the early 1900's by the flood protection systems that were constructed. Prior to 1910, the original Cahokia Creek channel in the Bottoms received 260 square miles of upland drainage area. The channel extended approximately 51 miles north of the Project area and about 40 miles across the American Bottom. The mouth of Cahokia Creek was located south of East St. Louis near Mississippi River Mile 179.0. Under pre-development conditions, all the hillside streams in the Project area except for Powdermill Creek, drained to Cahokia Creek as it meandered through the Bottom. Cahokia Creek flowed naturally through McDonough Lake, Brushy Lake, Horseshoe Lake and Indian Lake as it skirted the western edge of East St. Louis before entering the Mississippi River. The original Cahokia Creek channel flowed closer to the bluff line than the man-made Cahokia Canal that was built in the 1900's. Little Canteen Creek also flowed through Brushy Lake as it entered Cahokia Creek. Schoenberger Creek flowed northwesterly out of the bluff, through the Crooked Lake and Spring Lake areas, and then westerly to Cahokia Creek downstream of Indian Lake. Powdermill Creek flowed into Pittsburg Lake, which became the Grand Marais Lakes in Frank Holten State Park. From Pittsburg Lake flow eventually entered Prairie Du Pont Creek. Figures 2-5a and 2-5b depict these presettlement floodplain watershed characteristics. Numbered watersheds in Figure 2-5a are identified in a hydraulic history of the Project area that appears in Section C.1 of Appendix C.

Figure 2-5a Historic Bluff Watersheds of American Bottom

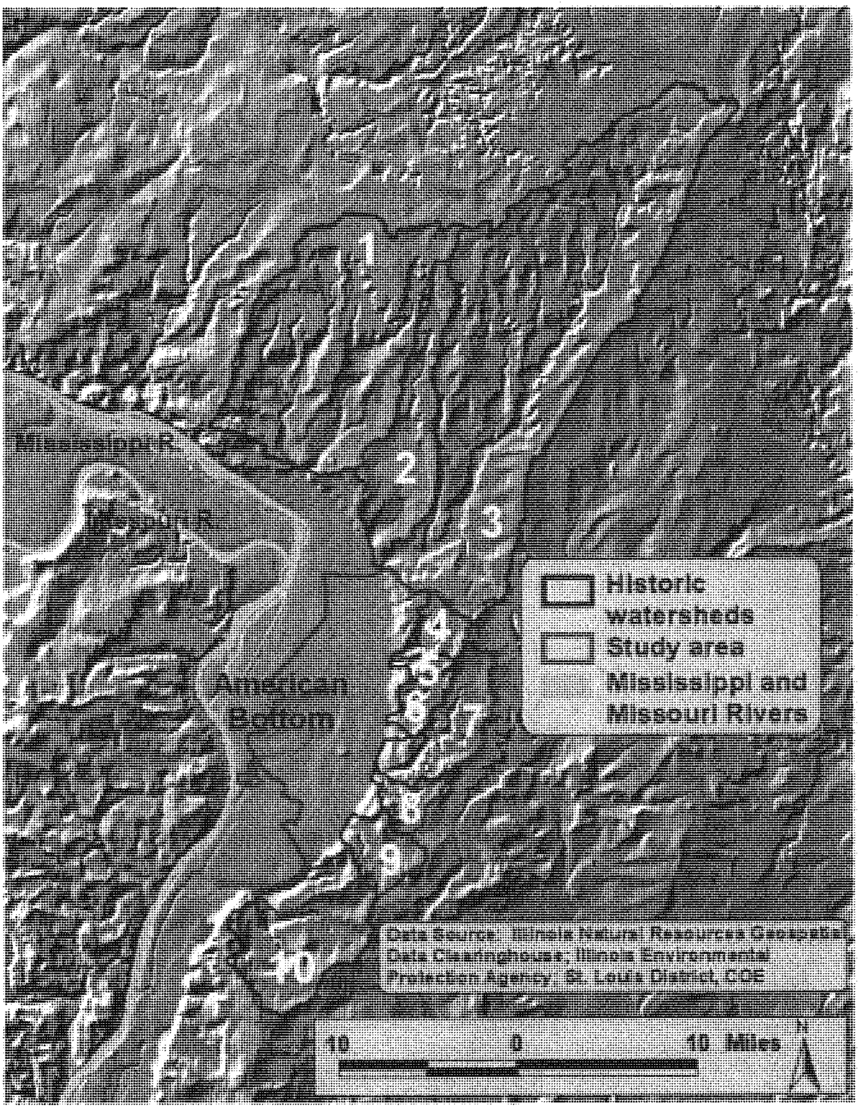
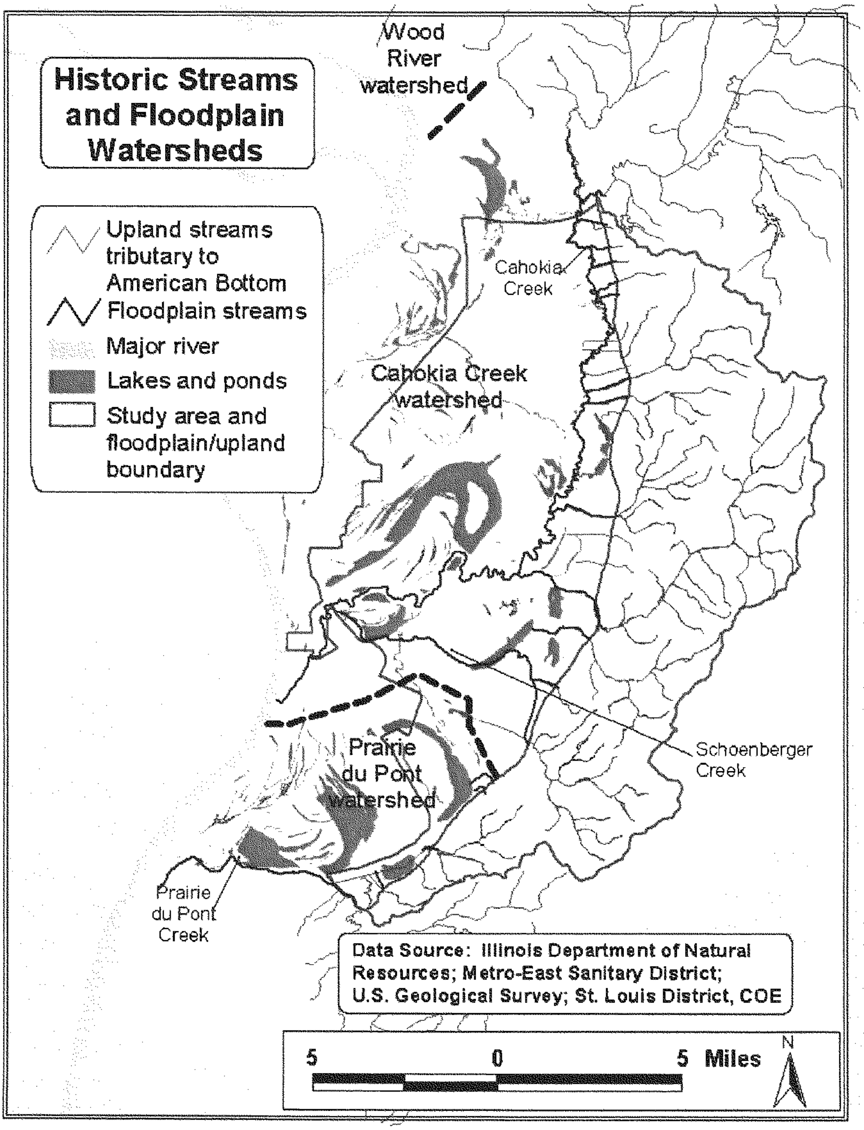


Figure 2-5b Historic Streams and Floodplain Watersheds



2.3 PREDEVELOPMENT ECOLOGICAL CONDITIONS

Two hundred years ago, the Project area and vicinity supported a great diversity of living resources. Vast expanses of forest and prairie occurred there. On the Mississippi River floodplain, complexes of backwater lakes, sloughs, and marshes punctuated the forests and prairies. Streams beginning in the uplands meandered across the floodplain to discharge into the Mississippi.

Prior to describing these resources, it is helpful to know that the two major landforms in the Project area – the Mississippi River floodplain and the adjacent uplands – each correspond to a distinct ecological or natural division in Illinois.

2.3.1 Illinois Natural Divisions. Illinois has been classified into fourteen natural divisions or distinct regions that share similar geologic history, soils, topography, plant and animal distributions, and presettlement vegetation (Schwegman 1973). This classification of natural divisions formed the framework for the classification of natural communities used by the Illinois Natural Areas Inventory in the mid-1970s to survey Illinois for high quality remnants of its natural heritage (White 1978). Two natural divisions occur in the Project area.

The Lower Mississippi River Bottomlands Division is represented by the relatively flat Mississippi River floodplain in southern Illinois, reaching from Alton (Madison County) at the north to Thebes (Alexander County) at the south. Tree species diversity in this Division is higher than that of the Mississippi River floodplain to the north because of the presence of some southern species (White and Madaney 1976). The Northern Section, one of two subdivisions in this division, extends from Alton to about the midpoint of the division at Chester (Randolph County). Presettlement vegetation in this Section consisted of forests, prairies, and marshes (White and Madaney 1976).

The upland portion of the Project area is found in the Middle Mississippi Border Division. This region is represented by a relatively narrow band of bluffs and dissected uplands overlooking the Mississippi River in the middle third of the state. Forest was the predominant kind of presettlement vegetation, and some prairie occurred also. The Glaciated Section of this Division, one of two subdivisions, extends into the Project area from the north, and terminates at about the Prairie Du Pont Creek watershed, just outside the southern limit of the Project area.

In the vicinity of the American Bottom, a third division, the Southern Till Plain Division, lies east of the Middle Mississippi Border Division, and just east of the Project area's uplands. This Division consists of dissected Illinoisian glacial till plain covered in presettlement times with forest and prairie (White and Madany 1978).

2.3.2 Predevelopment Living Resources. The predevelopment living resources that occurred in the Project area consisted of the communities, populations, and species of plants and animals that flourished there. In this section, these resources are described from three perspectives. First, the land cover is characterized to provide a broad description of environmental conditions. Second, natural communities that were present are portrayed, offering a more detailed view. Lastly, the flora and fauna as distinct species are summarized.

2.3.3 Land Cover. Figure 2-6 displays a reconstruction of land cover conditions from about 1800. The map is a visual interpretation of unpublished field notes made in 1811 by surveyors from the General Land Office (GLO) of the Federal government, and was created recently by biologists with the Illinois Natural History Survey (INHS 1998). The GLO surveyors established our rectilinear survey system consisting of townships, ranges, and sections. They marked the location of section and quarter section corners on the ground. While surveying, they made notes about their work, and often included comments about changes in topography and vegetation as they progressed. From the surveyors' notes, various kinds of land cover were consistently mentioned. Six of these occur in the Project area, and they include timber, scattered timber, lake-slough-pond, prairie, wet prairie, and brushy prairie.

Figure 2-6 displays these six types of land cover. Nearly 60 percent of the Project area was forested, and about 33 percent consisted of different kinds of prairie (Table 2-1). Aquatic areas, including lakes, sloughs and ponds, covered about five percent of the land's surface. Only three percent of the Project area is not reflected in Figure 2-6.

Figure 2-6 Predevelopment Land Cover of the Project Area

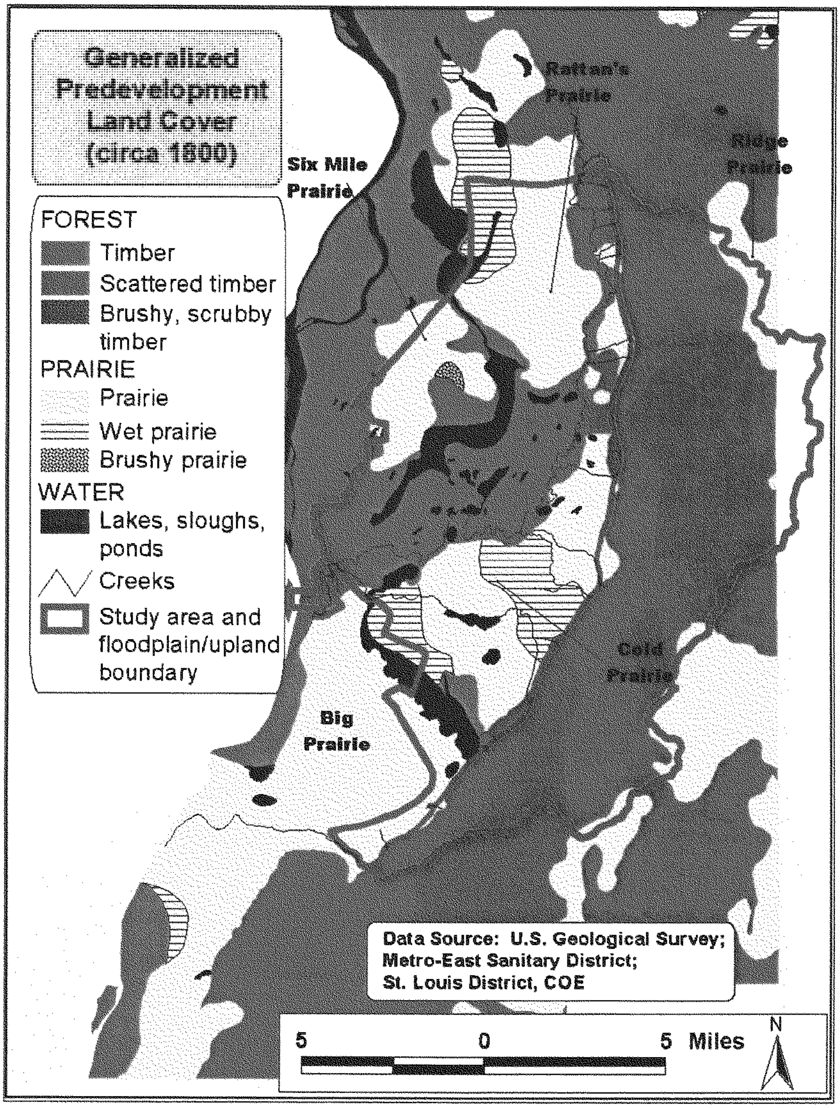


Table 2-1 Predevelopment Land Cover Within the Project area

Land Cover Classes	Area (acres)	Percent of Project Area
Timber	45,300	42.5
Scattered timber	17,600	16.5
Subtotal "forested"	*62,900*	*59.0*
Lake -slough – pond	4,950	4.6
Prairie	28,700	26.9
Wet prairie	6,650	6.2
Brushy prairie	200	0.2
Subtotal "prairie"	*35,550*	*33.3*
Unmapped	3,200	3.0
Total	**106,600**	**100.0**

With respect to the distribution of these cover classes in the Project area by landform, about 69 percent of all forest in the Project area occurred in the uplands (Table 2-2). Over 90 percent of all kinds of prairie were in the floodplain. All of the lakes, sloughs, and ponds were in the bottoms. Additionally, nearly all the scattered timber was in the uplands, and all the wet and brushy prairies were in the bottoms.

Table 2-2 Predevelopment Land Cover Within the Project area by Landform

Land cover classes	Area (acres)		Percent of Project Area		Percent of Land Cover Class	
	Floodplain	**Upland**	**Floodplain**	**Upland**	**Floodplain**	**Upland**
Timber	18,800	26,500	17.6	24.9	41.5	58.5
Scattered timber	750	16,850	0.7	15.8	4.3	95.7
Subtotal "forested"	*19,550*	*43,350*	*18.3*	*40.7*	*31.1*	*68.9*
Lake -slough - pond	4,950	0	4.6	0.0	100.0	0.0
Prairie	25,400	3,300	23.8	3.1	88.5	11.5
Wet prairie	6,650	0	6.2	0.0	100.0	0.0
Brushy prairie	200	0	0.2	0.0	100.0	0.0
Subtotal "prairie"	*32,250*	*3,300*	*30.2*	*3.1*	*90.7*	*9.3*
Unmapped	50	3,150	<0.1	3.0	1.6	98.4
Total	**56,800**	**49,800**	**53.3**	**46.7**		

The land cover map in Figure 2-6 actually extends further south, to the mouth of the Kaskaskia River. A similar pattern of forests and prairies in the uplands and on the floodplain can be seen along this 60-mile reach of the Mississippi River.

Figure 2-6 is currently the best approximation of predevelopment land cover conditions in the American Bottom, but it is only a generalized view. Detail is lacking because the surveyors went about establishing a grid system consisting of 1-mile squares and traversed the landscape along section boundaries. Since their method did not require them to cross the interior of each section, their notes mainly reflect the vegetation conditions they saw along the lines they surveyed, and not within each 1-mile square section. The map also includes discrepancies.

One example is the shape of Horseshoe Lake. Its portrayal in Figure 2-6 does not resemble its actual shape. The reason for this is not known, but may reflect difficulties the surveyors had in maintaining straight survey lines while traversing (or skirting around) this large water body.

2.3.4 Predevelopment Natural Communities. The description of predevelopment natural communities in this section is based on the classification system of the Illinois Natural Areas Inventory (INAI). In the mid-1970s, biologists systematically inventoried all of Illinois to locate, identify, and assess the condition of the state's remaining natural heritage (White and Madaney1978). The inventory or classification system they employed divides the earth's surface of land and water into nine community classes. They are forest, prairie, savanna, wetland, lake and pond, stream, primary, cave, and cultural. Rocky areas, such as cliffs, glades, and lakeshores, make up the primary class, and areas of human disturbance, such as cropland, pastureland, and developed land, represent the cultural class.

Two hundred years ago, six classes were found in the Project area - forest, prairie, wetland, lake and pond, creek and river, and cultural; a seventh, savanna, may have occurred also. Although cliffs and glades and caves were never present, they occurred not far away to the south and to the north.

The INAI hierarchy subdivides most of these classes into subclasses, and each of these subdivisions consists of a number of similar yet discrete natural communities. A natural community is "a group of organisms that are interrelated with each other and their environment" (White and Madaney 1978:316). Communities are distinguishable from each other by a set of unique characteristics, such as topographic position, soil moisture, vegetation structure, and species composition. Soil moisture is often a key characteristic, and is reflected in the names of many communities. For example, soil moisture categories include xeric (excessively drained), dry (somewhat excessively drained), dry-mesic (well drained), mesic (moderately well drained), wet-mesic (somewhat poorly drained), wet (poorly drained), and hydric (very poorly drained).

It is noteworthy that although most names of natural communities are based on the dominant type of vegetation present, each community represents not just the plants it supports, but also all the animals and other organisms living there. In addition, the transition between two adjacent communities may be abrupt or very gradual, reflecting how quickly or slowly factors such as topography, soil type, and soil moisture change across the landscape.

Twenty-six different natural communities occurred or may have occurred in the Project area. They are described below for each of the seven classes. Identification of these communities was facilitated using White and Madaney (1978) and IDNR (1998e). Overlaying the land cover map of Figure 2-6 upon the digital soil surveys for Madison and St. Clair Counties (NRCS 2000a,b) also assisted in the identification process. The description of each community includes plant and animal species that are typical or characteristic.

2.3.4.1 Forest. Trees dominate forests, and their canopy coverage averages 80 percent or more. Below the overstory or canopy layer, most forests have understory trees and shrubs and a ground layer of herbaceous plants. Seven different forest natural communities probably occurred within the Project area, and they fell into two forest subclasses – upland forest and floodplain forest. It is important to note that these communities did not occur in isolation one from the other, but they "fit together" in a mosaic to create large continuous expanses of "forest."

As many as seven types of forest natural communities occurred in the Project area. In the uplands, four upland communities probably were present. "Dry upland forest" was limited to the dry south and southwest facing slopes of ridge crests and upper portions of bluffs overlooking the Mississippi River. "Dry-mesic upland forest" appears to have been common, and occurred in the dissected terrain behind the bluffs, specifically on the upper slopes of ravines and ridges adjacent to upland streams. It also extended onto the flatter ground east of this dissected terrain. (Rather than "dry-mesic upland forest", savanna may have actually occurred here – see the savanna discussion below). "Mesic upland forest" was also common, and occurred in the dissected terrain on the lower slopes along upland streams, in ravines, and on high terraces adjacent to these stream channels. "Wet-mesic upland forest" occurred on the flat drainage divide where there were small, irregularly shaped areas that ponded rainfall.

Two types of floodplain forest occurred in the uplands. Ribbons of "mesic floodplain forest" occupied the narrow floodplains of upland streams. A few localized concentrations of "wet-mesic floodplain forest" were found where the underlying soils had impaired drainage and were relatively impermeable to ponded surface water. Examples of this community probably occurred in the Schoenberg Creek watershed.

On the Mississippi River floodplain, three kinds of communities were present. "Mesic floodplain forest" was typically confined to terraces or higher ground consisting of permeable soils. This community experienced infrequent or rare flooding from the Mississippi River, and depending on location, occasional flooding from upland tributaries. "Wet-mesic floodplain forest" was common, and occupied lower elevations that were somewhat poorly drained and had slowly permeable soils. This community experienced seasonal surface inundation or ponding from rainfall and local runoff, as well as periodic flooding from the Mississippi River and upland tributaries. "Wet floodplain forest" occupied the lowest topography of the forested communities. It was supported by poorly drained soils, overland flooding was more pronounced, and depth and duration of surface inundation were greater than that of the "wet-mesic" community.

Typical tree canopy and animal species are listed in Table 2-3 for each of the seven forest communities. The plants in this table are a small fraction of the total number of canopy, subcanopy, shrub, woody vine, and groundcover species. Appendix B contains a more complete plant list for many of these communities. Likewise, the animals included in this table, as well as the other tables in this section for each community, are not meant to represent all animals that are typical or characteristic for that community type, but only as examples of some of them.

Table 2-3 Typical Plants and Animals from Seven INAI Forest Natural Communities that Occurred or May Have Occurred in the Predevelopment Project area.

INAI Community	Plants (canopy trees)*	Animals*
Dry upland forest	pignut hickory, false shagbark hickory, shagbark hickory, mocker nut hickory, white ash, white oak, northern red oak, post oak, chinquapin oak, black oak	Reptile: eastern fence lizard, five-lined skink, ground skink Bird: summer tanager
Dry-mesic upland forest	false shagbark hickory, shagbark hickory, white ash, white oak, chinquapin oak, northern red oak, post oak, black oak	Reptile: broad head skink Mammal: white-footed mouse, fox squirrel
Mesic upland forest	sugar maple, false shagbark hickory, shagbark hickory, white ash, white oak, northern red oak, basswood, American elm	Amphibian: tiger salamander Bird: wood thrush Mammal: fox squirrel
Wet-mesic upland forest	silver maple, hackberry, sweet gum, bur oak, pin oak, American elm, big shellbark hickory, green ash	Mammal: meadow jumping mouse
Mesic floodplain forest	silver maple, river birch, green ash, Kentucky coffee tree, hackberry, sweet gum, cottonwood, sycamore, pecan, black walnut, white oak, bur oak, black oak, chinquapin oak, pin oak, northern red oak, basswood, American elm	Mammal: eastern mole
Wet-mesic floodplain forest	silver maple, pecan, big shellbark hickory, bitternut hickory, hackberry, honey locust, green ash, black walnut, pin oak, swamp white oak, American elm	Bird: pileated woodpecker, wood duck
Wet floodplain forest	silver maple, pecan, big shellbark hickory, green ash, honey locust, sycamore, cottonwood	Bird: great blue heron Mammal: mink

*Plants from IDNR (1998e), animals primarily from White and Madany (1978)

2.3.4.2 Prairie. Tall grasses and a variety of other herbaceous plants dominate natural prairies in the Midwest. Woody plants, including trees and shrubs, are minor elements, and tree canopy coverage averages 10 percent or less. Similar to forests, the prairie class is subdivided into smaller groupings of prairie natural communities, and the subclasses that apparently were represented within the Project area include the tallgrass prairie, sand prairie, and hill prairie groups. Most of the five communities comprising the tallgrass prairie group – dry, dry-mesic, mesic, wet-mesic, and wet – probably occurred in the Project area. These kinds of prairie were supported by fine-textured soils.

As many as six kinds of prairie communities occurred in the Project area. In the uplands, "dry-mesic prairie" and "mesic prairie" probably made up the bulk of Ridge Prairie, which extended east of the "dry-mesic forest" located behind the bluff. On the flat drainage divide, there were numerous, small, irregularly shaped areas that ponded rainfall. "Wet-mesic prairie" probably occurred here as an additional component of Ridge Prairie.

On the Mississippi River floodplain, "wet-mesic prairie" was very extensive. Most of Rattan's Prairie consisted of this community. Because this area was broad and flat, it had somewhat poor drainage conditions, and its soil was slowly permeable to ponded rainfall. Similarly, "wet-mesic prairie" also made up a substantial part of Cold Prairie. "Mesic prairie" most likely formed Six-Mile Prairie, which occupied relatively high ground. This community also must have formed parts of Cold Prairie and Big Prairie, at a minimum those portions on the alluvial fans along the bluff. "Wet prairie" may have been found where prairies and floodplain lakes and sloughs came into contact, or where localized ponding occurred for very prolonged periods within "wet-mesic prairie".

Sand prairies are distinct from tallgrass prairies because of the coarse, sandy soils on which they are found. Like tallgrass prairies, soil moisture in sand prairies ranges from dry to wet. "Mesic sand prairie" probably occurred on either side of the "mesic floodplain forest" that bordered Cahokia Creek as it entered the Mississippi River floodplain, as reflected in Figure 2-6.

Hill prairies in Illinois are classified according to the type of substrate that supports them, such as loess, glacial drift, dolomite, or sand. They were found on west or south-facing slopes of river bluffs. Because loess comprises the mantle covering the uplands within the Project area, any hill prairies that were present probably would have been "loess hill prairie". Figure 2-6 displays a relatively small area of upland prairie along the bluff top just north of where Canteen Creek enters the floodplain. This prairie most likely was "loess hill prairie".

The "brushy prairie" reflected in Figure 2-6 as part of Six-Mile Prairie may have been an area of "mesic prairie" that was being invaded by young trees and shrubs. "Shrub prairies" are another distinct but minor group of prairies in Illinois, and they are known to have occurred only in the northern part of the state (White and Madany 1978). Table 2-4 provides the names of plants and animals that are typical of all six prairie natural communities.

Table 2-4 Typical Plants and Animals from Six INAI Prairie Natural Communities that Probably Occurred or May Have Occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
Dry-mesic prairie	Dominant: little bluestem, Indian grass, needle grass Characteristic: lead plant, pale purple coneflower, rough blazing star	Bird: upland sandpiper
Mesic prairie	Dominant: big bluestem, Indian grass, northern drop seed Characteristic: cream wild indigo, shooting star, rattlesnake master, prairie blazing star, hoary puccoon, white prairie clover, sand prairie phlox, compass plant, prairie dock	Reptile: plains garter snake, prairie king snake Bird: dickcissel, eastern meadowlark, grasshopper sparrow Mammal: prairie vole, short-tailed shrew

Table 2-4 Continued

INAI Community	Plants*	Animals*
Wet-mesic prairie	Dominant: big bluestem, blue joint grass, prairie switch grass, Indian grass, prairie cord grass Characteristic: prairie sundrops, Culver's root, golden alexanders	Reptile: massasauga Bird: bobolink
Wet prairie	Dominant: blue joint grass, prairie cord grass, various sedges Characteristic: prairie Indian plantain, southern blue flag, winged loosestrife, water parsnip	Bird: American bittern
Dry-mesic sand prairie	Dominant: little bluestem, Indian grass, needle grass Characteristic: flax-leaved aster, rough blazing star, showy goldenrod, bird's foot violet	Amphibian: Illinois chorus frog Reptile: bull snake Bird: lark sparrow, savannah sparrow, vesper sparrow Mammal: plains pocket gopher
Loess hill prairie	Dominant: little bluestem, side-oats grama, Indian grass Characteristic: green milkweed, false boneset, grooved yellow flax, fringed puccoon, pale beard tongue, scurfy-pea, prairie blue-eyed grass, great plaines ladies' tresses	Reptile: six-lined racerunner

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.3 Savanna. Savannas are a class of natural communities intermediate in structure between forest and prairie. Trees are common, but grow spaced far enough apart not to create a closed canopy. A few species of oaks typically dominate the canopy, and the ground is covered by herbaceous plant species often found in prairies. The savanna class is subdivided into three subclasses – savanna, sand savanna, and barrens – and each subclass is divided into two or more communities based upon degree of soil moisture. Unlike the forest and prairie classes, there are no remnants of savanna communities within the Project area or surrounding region today, and whether savanna actually occurred remains to be verified. White and Madany (1978:337), in describing where savannas were found in Illinois, state, "Savannas occurred as an ecotonal belt along streamside forests, as 'islands' in prairie or forest, and on extensive areas of hilly land."

Two types of savanna may have been found within the Project area. Indirect evidence for their occurrence may be the "scattered timber" land cover class shown in Figure 2-6. The GLO surveyors noted large expanses of this cover type in the rugged uplands, and smaller areas on the floodplain. These areas may represent the "dry-mesic savanna" and "mesic savanna" natural communities. Plants and animals typical of these two communities are shown in Table 2-5.

Table 2-5 Typical Plants and Animals from Two INAI Savanna Natural Communities that may have Occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
Dry-mesic savanna	Dominant: white oak, burr oak, post oak, black oak, little bluestem, Indian grass, needle grass Characteristic: American filbert, wild quinine, common carrion flower, starry campion	Bird: eastern bluebird, red-headed woodpecker, northern flicker, field sparrow, white-eyed vireo, indigo bunting Mammal: deer mouse, fox squirrel
Mesic savanna	Dominant: white oak, burr oak, big bluestem, little bluestem, Indian grass Characteristic: golden alexanders	Mammal: fox squirrel

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.4 Wetland. The wetland class as used by the Inventory includes "natural communities that are flooded or have hydric soils and that have a vegetative cover" (White and Madanay 1978:340). The class is subdivided into six subclasses (marsh, swamp, bog, fen, sedge meadow, panne, seep and spring) according to differences in vegetation. The subclasses marsh and swamp probably were represented. The term "wetland" as used today also includes forests and prairies with seasonally wet soils. In terms of the natural community classification system, "wet-mesic floodplain forest", "wet floodplain forest", "wet-mesic prairie", and "wet prairie" would also be considered wetlands. An additional form of wetland would be the "pond" natural community, described below as part of the "lake and pond" class.

Following the INAI classification, two kinds of wetland natural communities probably were present in the Project area. The "marsh" natural community represented the marsh subclass. Tall, grass-like plant species dominate "marsh", and the ground is either saturated or inundated by shallow water during most of the year. This natural community would have been restricted to the Mississippi River floodplain, where it occurred in low depressions. Although the GLO surveyors apparently did not distinguish marsh from wet prairie, there was a large marsh north of Six-Mile Prairie at the location in Figure 2-6 shown as wet prairie. This is historic "Grassy Lake". The shallow fringe of floodplain lakes, ponds, and sloughs (described below under the lake and pond class) most likely consisted of the "marsh" natural community.

The swamp subclass consists of the "swamp" and "shrub swamp" natural communities. True forested swamps are found in extreme southern Illinois, and did not occur within the Project area around the year 1800. "Shrub swamp" was restricted to the Mississippi River floodplain, where it was associated with ponds (described below under the lake and pond class) located in wet floodplain forest. Coverage by trees is less than 20 percent, and by shrubs more than 50 percent. An example of this community was found in proximity to a small pond located in a meander scar just north of Cold Prairie.

Table 2-6 Typical Plants and Animals from Three INAI Wetland Natural Communities that Occurred or may have Occurred in the Predevelopment Project area.

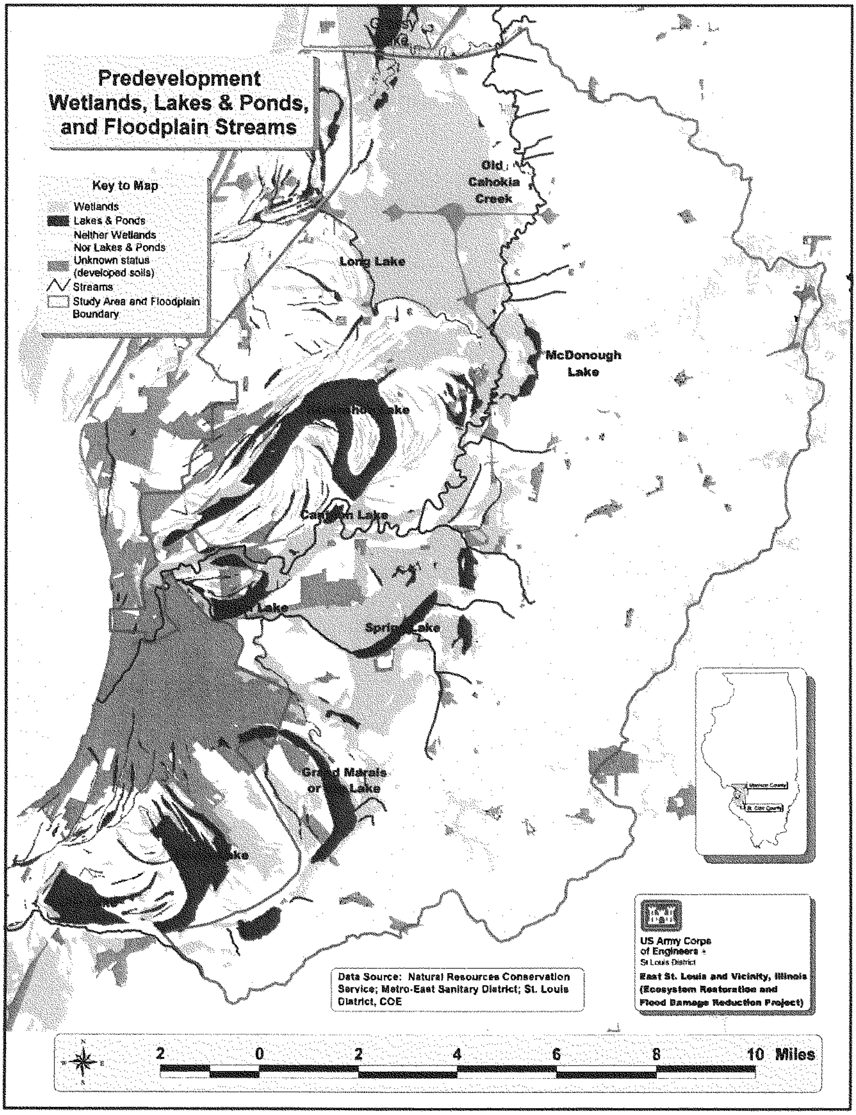
INAI Community	Plants*	Animals*
Marsh	Dominant: common lake sedge, common reed, water knotweed, river bulrush, great bulrush, broad-leaved cattail Characteristic: common water plantain, false aster, mermaid weed, common arrowhead	Bird: red-winged blackbird, yellow-headed blackbird, marsh wren, rails, bitterns, many waterfowl Mammal: muskrat
Shrub swamp	Dominant: buttonbush, sandbar willow	Reptile: red-eared slider turtle

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.4.1 Wetland Distribution and Extent. Figure 7-2 displays the location and extent of predevelopment wetlands, along with lakes and ponds and floodplain streams. According to this mapping, historic wetlands were largely confined to the Mississippi River floodplain, and most of these floodplain wetlands occurred away from the river in a broad band adjacent to the bluff.

The digital soil surveys for Madison and St. Clair Counties (NRCS 2000a,b) were used to develop the spatial extent of wetlands in Figure 2-7. These surveys are useful because soil properties observed today reflect historic conditions, and soil scientists have classified each kind of mapped soil as either possessing wetland (hydric) properties or not. Wetland soils can be contrasted with nonwetland soils, and this difference serves to distinguish between historic wetlands and historic nonwetland areas.

Figure 2-7 Predevelopment Wetlands, Lakes & Ponds, Floodplain Streams



A limitation of this method is that it reveals no information about the historic wetland status of areas already developed at the time of the soil survey. Activities such as excavation, filling, and dumping have extensively disturbed surface soils in many areas to the point that these sites no longer reflect historic conditions. To display the spatial extent of man-made disturbances, "developed" soils have been distinguished from soils that have not been developed. Among the "developed" soils, some experienced lesser disturbances than other more developed soils. These lesser-disturbed soils, called urban land complexes, still exhibit hydric or nonhydric properties, whereas the more disturbed soils do not. Therefore, wetlands shown in Figure 2-7 consist of undeveloped wetland soils, as well as urban land complex soils exhibiting hydric conditions.

Wetland soils comprise nearly 23 percent of the Project area (Table 2-7). About 95 percent of these wetland soils occur in the floodplain. Two-thirds of the Project area is comprised of nonwetland soils, and nearly 66 percent of those occur in the uplands. Less than five percent of the Project area is mapped as water, and about 90 percent of water is mapped on the floodplain. "Urban complex soils" account for about 11 percent of the Project area. Although development has occurred in these soils, they have not been so disturbed as to lose their hydric or nonhydric soil status. Almost six percent of the Project area is made up of developed soils that have been greatly disturbed, and about 83 percent of them occur on the floodplain.

Table 2-7 Distribution of Soil Types within the Predevelopment Project area.

Type of Soil	Area (acres)			Percent of Project Area		
	Floodplain	Uplands	Total	Floodplain	Uplands	Total
Wetland	20,953.9	1,131.9	22,085.8	19.7	1.1	20.7
Wetland/Urban land complex	2,210.0	0.0	2,210.0	2.1	0.0	2.1
Nonwetland	18,717.2	42,989.1	61,706.3	17.6	40.3	57.9
Nonwetland/Urban land complex	5,697.2	3,984.6	9,681.8	5.3	3.7	9.1
Water	4,054.8	456.1	4,510.8	3.8	0.4	4.2
Developed	5,276.2	1,068.4	6,344.6	5.0	1.0	6.0
Not mapped	4.9	97.2	102.1	<0.0	0.1	0.1
TOTALS	**56,914.1**	**49,727.3**	**106,641.4**	**53.4**	**46.7**	**100.1**

From the perspective of each major landform, about 40 percent of the bottoms consists of wetland soils, and another seven percent of water (Table 2-8). Nearly 43 percent of the floodplain has nonwetland soils, and another 10 percent has highly developed soils. In the uplands, nearly 95 percent consists of nonwetland soils, roughly two percent of wetland soils, and about one percent of water.

Table 2-8 Distribution of Soil Types by Major Landforms within the Predevelopment Project area.

Type of Soil	Percent within Floodplain	Percent within Uplands
Wetland	36.8	2.3
Wetland/Urban land complex	3.9	0.0
Nonwetland	32.9	86.4
Nonwetland/Urban land complex	10.0	8.0
Water	7.1	0.9
Developed	9.3	2.1
Not mapped	0.0	0.2
TOTALS	**100.0**	**99.9**

This analysis based on modern soil mapping demonstrates that 47 percent or nearly one-half of the Mississippi River floodplain within the Project area consisted of wetland and aquatic habitats. Of that area, about 85 percent was wetlands.

2.3.4.4.2 Wetland Hydrology. Water has always been the "life-blood" of wetlands. Wetlands within the Project area were supplied by a variety of sources, including 1) rainfall and local runoff; 2) overbank flooding from rivers and creeks, 3) adjacent lakes and ponds, and 4) groundwater. By virtue of their topographic position, water gravitated towards wetlands. Their flat or depressional topography naturally impeded surface drainage. Once water got there, it was inhibited from soaking down into the ground because of naturally impermeable surface soils. Figure 2-7 shows the historic floodplain.

When it rained, direct rainfall collected in wetlands, and if storm intensity and duration were sufficient enough to saturate the landscape, rainwater would sheet flow as surface runoff into wetlands from adjacent higher ground. When the Mississippi River began to rise, its waters backed up into the floodplain segments of the upland tributary channels and entered floodplain lakes. This occurred in two principal tributaries, Cahokia Creek and Prairie Du Pont Creek. As the river continued rising, water levels in these aquatic features spread out to inundate adjacent wetland areas. During bigger floods, the Mississippi River spilled out of its banks to inundate the floodplain. During very large events, most of the American Bottom was under water, and relatively little ground remained exposed. Such great events were typically of long duration.

Of all the upland tributaries, Cahokia Creek was the chief source of upland drainage. Because it traversed the entire Project area, floodwaters from Cahokia Creek spilled across a large area, beginning at the bluff. Duration of these events would have been less than that of large Mississippi River floods, at least when the river was low enough not to impede Cahokia Creek drainage into it. Conditions were similar for the other upland tributaries, except that they contributed lesser amounts of floodwaters that affected more localized areas. With respect to the other sources of wetland hydrology, water in lakes and ponds was the source for wetlands located at their fringe. Groundwater was also a source for those wetlands located in the lowest depressions on the floodplain, during times when the groundwater table raised up high enough to reach the wetland's bottom.

For many wetlands in the American Bottom, water or hydrology typically came from more than one source, and for some, all sources contributed at one time or another. Which sources were contributing at a particular time depended on local rainfall and flood conditions as well as groundwater elevations. However, from day to day and year-to-year, specific sources were the driving force of wetland hydrology for certain wetlands (i.e., Brinson 1993). Some were located close to creek or river channels and received frequent overflows. Others were found at the fringes of lakes or ponds. Still others occurred in either depressions or on relatively broad flat areas that primarily received rainfall and local runoff.

2.3.4.5 Lake and Pond. Bodies of open, standing water are classified as lakes and ponds. The lack of emergent woody or "grass-like" vegetation distinguishes them from wetlands. Ponds are typically small and shallow enough to support the growth of rooted aquatic plants. Lakes are larger and deeper, and according to White and Madaney (1978:348), "A lake has an area of deep water sufficiently large enough to produce somewhere on its periphery a barren, wave-swept shore." The land and pond natural communities were found within the Project area in predevelopment times.

Historic lakes and ponds in the Project area are shown in Figure 2-7. The large body of water today called Horseshoe Lake was an example of the "lake" natural community. Several other large bodies of open, standing water were also present in pre-development times. The lakes at present-day Holten State Park were once a single extensive body of water called Pittsburg or Big Lake. To its southwest, just outside the Project area, was another large water body eventually named Goose Lake. Although the extent of Horseshoe Lake has changed little over time, the latter two water bodies have either disappeared or been much reduced in extent due to drainage and development. Despite their size, they most likely were examples of the "pond" natural community. The middle of these ponds may have been deep enough to inhibit the establishment of rooted aquatic vegetation. Smaller examples of ponds include McDonough Lake. Examples of typical plants and animals found in these two communities are provided in Table 2-9.

Table 2-9 Typical Plants and Animals from Two INAI Lake and Pond Natural Communities that Occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
Pond	Characteristic: spatterdock, various pondweeds (*Potamogeton* spp.), great duckweed, small duckweed, various knotweeds (*Polygonum* spp.)	Amphibian: bullfrog Fish: golden shiner, pugnose minnow, black bullhead, bantum sunfish, banded pygmy sunfish, white crappie
Lake	(typically not present)	Fish: white crappie

*Plants from White and Madany (1978), animals primarily from same source

2.3.4.6 Stream The stream class represents permanent, flowing waters. Streams are divided into two subclasses, creek and river. Creeks have watersheds less than 200 square miles, and watersheds of rivers are 200 square miles or more. The communities within each subclass are distinguished mainly by steepness of the streambed. Low gradient streams fall less than one foot per mile, medium gradient streams fall from one to 10 feet per mile, and high gradient streams fall greater than 10 feet per mile.

Six kinds of stream natural communities apparently occurred within the Project area. The "high-gradient creek" natural community has a substrate consisting of sand and gravel, and the water's surface consists of alternating pools and riffles. This community was common in the Project area, and coincided with the steeper portions of creeks in the uplands. The "medium-gradient creek" community was also located in the uplands, either "upstream" or "downstream" of creeks with high gradients. Again, pools and riffles are typical, and the substrate includes sand and gravel as well as silt and organic matter.

Channels of upland tributaries located on the Mississippi River floodplain represented the "low-gradient creek" community. Here the channel bottom is made of silt and organic matter, currents are sluggish, and there are no riffles. Historic maps show that there were about 26 miles of floodplain channels in the American Bottom from upland tributaries that drained into Cahokia Creek. Another 9 miles of floodplain channels originated from Prairie Du Pont Creek and its tributaries.

Historic streams in the Project area are shown in Figure 2-5b and Figure 2-7. Under the INAI classification system, Cahokia Creek was a river, and all other upland tributaries were creeks. The upland portion of Cahokia Creek would be classified as a "medium-gradient river". "Gravel riffles and raceways and sand bars are characteristic of this community" (White and Madaney 1978:350). On the Mississippi River floodplain, the Cahokia Creek channel represented the "low-gradient river" community. Sand bars would have been present in the meandering channel for some distance from the bluff, and would have been largely replaced by silt deposits closer to the Mississippi River. To cross a straight-line distance of about 21 miles, Cahokia Creek meandered across the American Bottom for about 38 miles. After passing Horseshoe Lake, it approached the Mississippi River and turned south, paralleling it for some distance before entering the Mississippi where Prairie Du Pont Ditch now joins the river at the downstream end of today's Arsenal Island, about even with the southern limit of the Project area.

A long linear water body called Long Lake extended across the American Bottom from the vicinity of Alton south to McDonough Lake. The origin of its formation is uncertain, but at one time it apparently carried stream flow from the Wood River upland tributary. Under this condition, the large channel of Long Lake would have been a floodplain stream. Just outside the Project area, the Mississippi River was an example of the "large river" natural community. Species typical of these six communities are listed in Table 2-10.

Table 2-10 Typical Plants (where applicable) and Animals from Six INAI Stream Natural Communities that occurred or may have occurred in the Predevelopment Project area.

INAI Community	Plants*	Animals*
High-gradient creek	Characteristic: water willow	Amphibian: pickerel frog Fish: banded sculpin, blackstripe topminnow, central stoneroller
Medium-gradient creek	(typically not present)	Fish: longear sunfish, red shiner, suckermouth minnow, black crappie
Low-gradient creek	(typically not present)	Fish: yellow bullhead, creek chub, redfin shiner
Medium-gradient river	(typically not present)	Reptile: smooth softshell Fish: channel catfish, stonecat, smallmouth bass
Low-gradient river	(typically not present)	Reptile: spiny softshell turtle Fish: flathead catfish
Major river	(typically not present)	Fish: paddlefish, shovelnose sturgeon, river shiner, blue catfish, bigmouth buffalo Bird: black tern

*Plant from White and Madany (1978), animals primarily from same source

2.3.4.7 Cultural. The only kinds of cultural features occurring on the predevelopment landscape would have been homesteads, areas of cropland, successional fields where "virgin" forest had been cleared, and dirt roads. By 1800, the French farmers living at their village of Cahokia had been farming portions of the bottomland prairies very close to the Project area for almost a century. With limited exceptions, all farming activities occurred on individually owned agricultural plots within a large, communally fenced area known as the Commons.

In addition to these residents, groups of American immigrants began arriving in the area during the mid-1780s. Many of these extended families were headed by Revolutionary War veterans, eager to build a new life for themselves as yeoman farmers on our fledgling country's western-most frontier - the fertile floodplain of the Mississippi River. By 1800, relatively few American pioneers had migrated into the area. The total number of American farmsteads on the American Bottom numbered less that 25 prior to the Louisiana Purchase in 1804.

The settlement pattern of the independent Americans was totally unlike that of their established French-Canadian neighbors. Almost as soon as they arrived, the Americans began to establish isolated farmsteads on fertile prairie tracts throughout the Project area. The boundaries of these late eighteenth and early nineteenth century tracts can still be seen on modern U. S. Geological Survey topographic maps. Only several hundred people were living within the Project area at that time and of those, only a portion was farming.

The average size of the American farmstead was approximately 160 acres. Assuming each family had a farm, the total area in agriculture would have been no more than 4,000 (160 x 25) acres. Under such a worst-case scenario of development, the area of indigenous native prairie impacted by the Americans would have been no more than about 12 percent of the total floodplain prairie in the Project area (using figures from the GLO land cover analysis). Combined, the agricultural pursuits of the French and American farmers probably disturbed no more than 10 percent of the terrestrial portion of the American Bottom (floodplain) ecosystem. There is presently no evidence to suggest that either of these groups engaged in any type of drainage or levee construction activities. Therefore, it can be assumed that the aquatic portion of the project area was largely unaffected by their respective presence.

2.3.4.8 Flora And Fauna. Because environmental disturbances caused by the early Americans were minimal two hundred years ago, it is fair to assume that all plant and animal species that lived in the vicinity of the Project area just prior to European settlement were still present around 1800. Populations of plants and animals for the most part had not yet been reduced in numbers, although hunting probably affected some animal species. The natural communities these species and populations comprised had yet to experience significant man-made changes. The various forces of nature were still the primary influences on the predevelopment ecosystem, including its constituent species.

A high level of species diversity was characteristic of the Project area and its vicinity. The juxtaposition of two major landforms, floodplain and uplands, and the localized physical variations in each, created the setting for an abundance of life forms to exist. Lists of plants and animals that existed, or may have existed, in the Project area are not included in this report. Such lists would include present-day species (less introduced species) and those that have since disappeared. However, current species of mammals, birds, fishes, reptiles and amphibians, and vascular plants are presented in Appendix B. These tables indicate which natural communities or habitats each species uses (at various levels of detail), and introduced species are highlighted.

2.3.4.8.1 Mammals. More than 45 species of mammals lived in the area, including an opossum, rabbit, and various shrews and moles, bats, rodents, carnivores, and ungulates (those with hoofs). They utilized all habitats, from forests, prairies, and herbaceous wetlands, to creeks and lakes (Appendix B). Other than a few bat species, they lived there year-round. A number of these species no longer occur in the Project area. They include five carnivores and two ungulates - gray wolf (*Canis lupus*), river otter (*Lontra canadensis*), bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), black bear (*Ursus americanus*), wapiti or elk (*Cervus elaphus*), and bison (*Bison bison*). All but the river otter and bobcat are extinct today in Illinois (Hoffmeister 1989; IDNR 1998d). The early settlers hunted a variety of larger species to eat, such as rabbit, squirrels, beaver, raccoon, bear, deer, and elk.

2.3.4.8.2 Birds. About 285 species of birds used to inhabit the Project area and environs (Appendix B). They belonged to many taxonomic groups, included the loons, grebes, pelicans and cormorants, egrets and herons, geese and ducks, hawks and falcons, gallinules, rails, shorebirds, gulls and terns, doves, parakeets, cuckoos, owls, nighthawks, swifts and hummingbirds, woodpeckers, and the diverse songbirds. Like mammals, they made use of all terrestrial, wetland, and aquatic habitats. Many bird species reproduced and stayed throughout the year. Others also raised young but then left before winter to migrate to warmer climates, returning the following year. Still other species passed through the area seasonally, on their way to distant breeding or wintering areas. Three species, the passenger pigeon (*Ectopistes migratorius*), ivory-billed woodpecker (*Campephilus principalis*), and Carolina parakeet (*Conuropsis carolinensis*), are now globally extinct (IDNR 1998b). Ten others have since disappeared from the project area: swallow-tailed kite (*Elanoides forficatus*), greater prairie chicken (*Tympanuchus cupido*), ruffed grouse (*Bonasa umbellus*), barn owl (*Tyto alba*), Chuck-wills-widow (*Caprimulgus vociferous*), Bewick's wren (*Thryomanes bewickii*), Swainson's warbler (*Limnothlypis swainsonii*), Bachman's sparrow (*Aimophila aestivalis*), and white-winged crossbill (*Loxia leucoptera*) (IDNR 1998b; McMullen, pers. comm). Many kinds of birds were part of the diet of early Americans, especially ducks, geese, turkey, ruffed grouse, prairie chicken, woodcock, dove, and bobwhite.

2.3.4.8.3 Fishes. Over 90 species of fish lived in the various creeks, rivers, ponds, and lakes in the Project area (Appendix B), including the Mississippi River. They were very diverse taxonomically, representing 24 families. Some species lived in the Mississippi River only, while others also used the adjacent standing waters on the floodplain. A few species were restricted to the small upland creeks. Many had broad ecological tolerances and inhabited upland creeks, floodplain habitats, and the Mississippi River. Like mammals and birds, these animals also were an important part of the diet of early settlers, especially those in the catfish and sunfish groups.

2.3.4.8.4 Reptiles and Amphibians. At least 65 species of reptiles and amphibians occurred in the Project area. Reptiles consisted of various salamanders, toads, and frogs, and amphibians included a variety of turtles, lizards, and snakes (Table 3-38 in Section 3). For these species as a whole, every habitat in the floodplain and uplands was exploited. Amphibians as a group needed some kind of aquatic habitat, such as a wetland, pond, lake, creek, or river, for breeding, yet the adults of many species also used nonaquatic areas, such as forests and prairies, for their other activities (IDNR 1998f). Most turtles also required some type of aquatic habitat for survival. A number of lizards and snakes did not, and instead existed in terrestrial habitats such as forests and prairies. The alligator snapping turtle (*Macroclemys temminckii*) no longer exists in the Project area (IDNR 1998f). Among reptiles and amphibians, early settlers ate turtles and occasionally frogs and snakes.

2.3.4.8.5 Plants. A variety of species of vascular plants were found in the Project area. These plants included all the trees, shrubs, vines, forbs, grasses, and sedges (Appendix B). (The nonvascular plants, or ferns, mosses, liverworts and others, are not treated in this report.) They formed the preponderance of vegetation that constituted the various natural communities described previously in this section. Plants grew in all habitats, except for those places where either flowing or standing water prevented the establishment of either emergent or rooted floating water-tolerant species. Early settlers ate the fruits of some species, such as nuts from hickory and pecan trees, or fleshy fruits of wild plums and the persimmon.

2.4 PREDEVELOPMENT ECOSYSTEM DISTURBANCE DYNAMICS

A variety of natural disturbances, such as flooding, wildfire, drought and windstorms, occurred periodically during predevelopment times. A disturbance can be defined as "any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability or the physical environment" (White and Pickett 1985:10).

Disturbance dynamics are the processes of change that occur in living resources and their environment in response to disturbance. Disturbances are important to some ecosystems, including those prone to flooding and fire, because they are necessary in order to maintain biological growth and productivity (Cox 1993; Middleton 1999). Middleton (1999:5-6) highlighted the importance of "flood pulsing" in wetlands, or "the idea that the physical and biotic functions of the floodplain wetland are dependent on the dynamics of water discharged from the river channel."

The flooding and wildfire disturbances that were common influences on the ecosystem around 1800 have been largely eliminated from today's environment. They are discussed in this section. Other natural disturbances like drought and windstorms still occur today, and they are not treated because they are unimportant to this report.

2.4.1 Flooding Disturbances. Recurring "flood pulses" caused by riverine overflow was typical of the predevelopment American Bottom. Whenever the Mississippi River or any of the upland tributaries that drained into the bottoms got out of bank, a "pulse" of floodwaters spread out on the floodplain. As water moved laterally, it sought the lowest position on the landscape through gravity, and in so doing often entered wetlands and aquatic areas. As a result, water levels in the affected wetlands and aquatic areas typically rose. Floodwaters remained temporarily stored in these areas until they could drain (if a natural outlet existed), which often coincided with receding levels on the river (or creek) that was the source of flooding. If no natural drainage outlet existed in the wetlands and aquatic areas, water levels would gradually diminish by losses due to evapotranspiration and infiltration into the ground.

Flood pulses are important to wetlands and other floodplain habitats for a variety of reasons. In riverine wetlands they drive processes such as sediment deposition and nutrient transport (see discussion below on wetland functions). Flood pulses also serve as a temporary connection or link between the floodplain and river channel. For example, in the spring some fish species living in the Mississippi River respond to the river's rise and enter the floodplain to gain access to spawning sites (Gutreuter and Theiling 1999), including wetlands. Pulses of floodwater also disperse plant seeds. The decurrent false aster (*Boltonia decurrens*), a Federally listed threatened plant of nonforested wetlands along the lower Illinois River, responded to the great flood of 1993 by expanding its limited distribution to include inundated areas of the leveed floodplain (Middleton 1999).

Flood pulses varied on a continuum from small to very large, in terms of depth and duration. Because the watershed of the Mississippi River at St. Louis was so immense relative to the combined area of all the upland watersheds that drained into the American Bottom, it was the primary source of flood pulses that inundated large portions of the floodplain. Flooding from the Mississippi River varied by season and from year to year. Floods could happen during any month, but they usually occurred in the spring (April-June) and fall (September-October). Springtime events were often higher and greater in duration. Low flow periods typically coincided with summer and winter.

In many years, the Mississippi River rose and gently overflowed its banks, spreading out over the adjacent floodplain to a minor degree. But on an infrequent basis it inundated much of the American Bottom. The following account describes five instances of "big" flood pulses during a 130-year time period.

"At long intervals, the floods of the Mississippi inundate these bottoms. In 1725, a great inundation of the American bottom occurred. In the year 1770 another of less depth visited the bottom, and two years thereafter, in the year 1772, a great rise in the river overflowed the whole bottom. ...The next extraordinary flood occurred in the year 1785, and was next to the highest ever known in the Mississippi. ...The next inundation was the year 1844, and was some higher than that of 1785. The height of the flood of 1844 is marked on a stone monument, erected on Water Street, in the city of St. Louis, and exhibits a terrific flood, rushing over the whole bottom, from bluff to bluff. Since my observation, there have been many small rises in the river, that seemed to portend danger; but no great injury was produced by them. Those deep and sweeping inundations did much injury to the agricultural interest of the country." (Reynolds 1857).

The 1844 event was the greatest recorded flood, prior to the construction of the flood protection system, to cover the American Bottom, in terms of spatial extent and stage or elevation. Under predevelopment conditions of no floodplain development, it appears to have been about a 60-year flood event. No railroad embankments had yet been built to impede its flow (Helm 1905). Peak floodwaters varied in depth across the floodplain, ranging from a maximum of about 20 feet in the vicinity of Indian Lake (near today's Fairmont City, southwest of the intersection of I-55/70 and Route 111), to little or no inundation in the vicinity of Cahokia Creek where it first enters the Mississippi River floodplain. During the flood, "...steamboats were able to sail over it [the American Bottom] from St. Louis to the bluffs six miles from the river channel" (Norton 1912). Because daily records of river levels at St. Louis are not available for years prior to 1861, a description of the 1844 flood's 20-foot plus rise and fall must come from historic accounts.

"The year 1844 was the year of our great flood, and in it the "June rise" was not to be mistaken. The river reached a height of 20 feet not before April 26, and continued above that stage till August 10, 3 ½ months; on May 14 it reached 25 feet, and continued at or above that until August 5, over 2 ½ months; over a month, from June 13 to July 17, it was higher than 30 feet; for 16 days, from June 20 to July 6, it ranged above 35 feet, and for 8 full days, June 24 to July 1, it maintained itself above 40 feet." (Engelmann 1868; readings refer to the St. Louis gage, zero equivalent to 379.94 feet NGVD).

The last major Mississippi River flood event to inundate the American Bottom occurred in 1903. It peaked at an elevation 3.32 feet lower than the 1844 event, which corresponds with a 20-year event under predevelopment conditions. A number of railroad embankments had already been built that impeded the movement of floodwaters across the bottoms. Some of these acted like dams, keeping water out of certain areas.

Bluff tributaries also inundated portions of the American Bottom from time to time, independent of the Mississippi River. Cahokia Creek was chief among these tributaries. Its upland watershed was not only much greater than any other upland tributary, but the floodwaters it carried were augmented by flows from a number of smaller upland tributaries that joined it on the floodplain. Before traversing the American Bottom and discharging into the Mississippi River, Cahokia Creek and its waters linked together a chain of wetland and aquatic complexes that lie adjacent to its 40-mile long meandering channel. If rainfall was intense over its headwaters, Cahokia Creek spilled out of its banks and ran over much of the bottoms. For example, in 1902 and again in 1904, heavy rainstorms in June caused the creek to overtop. This occurred along the reach of channel extending from where it entered the bottoms to the vicinity of East St. Louis, where ground elevations were relatively higher (Helm 1905). At the time, about 40 square miles of the American Bottom were flooded, including a relatively large area of higher ground not inundated since the 1844 flood from the Mississippi.

2.4.2 Wildfire Disturbances. Like flooding, wildfire also was a cyclical phenomenon during predevelopment times. Fires started naturally, as from lightning strikes, but they also were set by people, whether Native Americans or early settlers. When intentional, fire could be used to facilitate the hunting of wild animals, or to clear open areas under invasion from woody encroachment. Fires occurred any time of the year, depending on how dry conditions were, but were most prevalent in the fall and early winter (IDNR 2000).

Wildfire was characteristic of terrestrial areas. In the uplands, prairies and forests burned periodically. Many of the tree species occurring in upland forests have adaptations for surviving fire, such as thick bark. On the floodplain, prairies also were susceptible to fire. The drier floodplain forests also burned, but forested wetlands usually did not, where moisture levels in leaf litter and the ground's surface typically were high. As tree species of forested wetlands generally do not have thick bark, fire often injures mature individuals; seedlings and saplings often die when exposed to fire. Herbaceous wetlands on the floodplain, such as marshes and wet prairies, must have also burned if aboveground plant parts were dry enough.

Fire is important ecologically for maintaining the overall biological integrity of natural habitats adapted to it. In prairies and other herbaceous plant communities, fall or winter burning removed the build-up of dead aboveground plant parts such as leaves and stems, while underground root systems were protected and dormant until the next spring. Without periodic elimination of dead growth, the amount of each year's new growth would be reduced. Other effects of fire on prairie grasses include increased flowering, improved seed germination, and earlier emergence of new growth in the spring (Snyder 1994). Fire also suppressed the encroachment of trees into prairies. In forests, fire maintained plant species composition and diversity, and variably aged populations of trees (IDNR 1998e). In all areas, nutrients bound in plant materials were released by fire to the soil as ash.

To the early settlers, wildfire was a serious threat to human life and personal property. "Two men burned to death in a prairie fire" at Big Prairie in the American Bottom (McClain 1997:37).

2.5 PREDEVELOPMENT ECOSYSTEM FUNCTION

The functions an ecosystem performs are the physical, chemical, and biological processes that are necessary for self-maintenance (Brinson 1993), such as primary production, nutrient cycling, and decomposition. The ecosystem functions of the Project area in predevelopment times reflected the dynamics within the uplands, floodplain, and Mississippi River, and the interactions occurring between these three physical entities. Seven functions are described in this section – store surface water temporarily, maintain characteristic plant community, provide habitat for wildlife, nutrient cycling, remove and sequester elements and compounds, retain particulates, and export organic carbon. These functions are not intended to be comprehensive for the entire ecosystem. Rather, they are meant to serve as a foundation for understanding how wetlands were a vital component of the historic ecosystem. This knowledge can then be applied in developing solutions to today's environmental and flooding problems and opportunities in the Project area.

2.5.1 Temporary Storage of Surface Water. In light of the flooding problems facing the Project area today, perhaps the most important wetland function intrinsic to the historic ecosystem was the ability to temporarily store floodwater. Due to properties such as width, slope, and roughness (Brinson et al. 1995), riverine wetlands in the American Bottom routinely detained riverine overflow from the Mississippi River and adjacent upland watersheds, and released it slowly back to the creeks and river. Aquatic areas (sloughs, lakes, ponds) associated with these riverine wetlands also received overbank floodwaters, and they performed this function. Likewise, nonwetland areas in the American Bottom that became inundated during the larger flood events, such as in 1903 and 1844, also temporarily stored floodwater.

Wetlands detaining overbank flows dissipate energy, and reduce the velocity of moving water. From a flood damage perspective, the capacity for erosion is reduced. Similarly, storage of riverine overflow in wetlands prolongs the passage of a flood event, and thereby reduces the peak discharge downstream (Brinson et al. 1995; Ainslie et al. 1999).

2.5.2 Maintenance of Plant Community Characteristics. Another important wetland function was the maintenance of its own characteristic plant community, like that of forest, prairie, or marsh, which are distinct in terms of species composition and physical characteristics (Brinson et al. 1995). Large areas of these various wetland plant communities existed in the American Bottom. They created much primary production in the form of plant biomass. The type of plant community affected other functions, such as wildlife habitat.

2.5.3 Provision of Wildlife Habitat. The various wetland plant communities served as habitat for many kinds of animals, ranging from macroinvertebrates ("bugs") to vertebrates (animals with backbones) (Brinson et al. 1995). The composition and spatial complexity of the vegetation above ground affected the kinds of animals living there and their abundance. Forested wetlands exhibited vertical stratification (understory, subcanopy, overstory), and this structural complexity offered various opportunities for animals to find sites for shelter, nesting, breeding and foraging. Prairies and marshes had simpler structure, which offered opportunities for other species.

At the landscape scale, the heterogeneity of wetland types in the American Bottom helped maintain higher levels of species diversity. The extensive spatial distribution of wetlands, and the linkages or connections that existed between different wetland types, facilitated the movement and dispersal of animals. Movements between wetlands, between wetlands and uplands, and between uplands (via the relatively small, irregularly shaped wetlands) occurred, in addition to those between wetlands and aquatic areas. Nonwetland areas in the American Bottom also provided wildlife habitat.

2.5.4 Nutrient Cycling. Cycling of nutrients, a fundamental ecosystem function, consists of the "abiotic and biotic processes that convert elements from one form to another; primarily recycling processes" (Brinson et al. 1995). In one process, nutrients are taken up from the soil in inorganic form by plants and transformed into organic forms during photosynthesis and growth. In another process, after the plant dies, these organic nutrients are converted back into inorganic form through microbial decomposition, for renewed uptake by plants. In ecological terms, the function is represented by net primary productivity and detritus turnover. Wetlands in the American Bottom performed this function. Nutrient cycling was also a fundamental process in nonwetland areas.

2.5.5 Removal of Elements and Compounds. Surface water can import natural nutrients (like nitrogen, phosphorus, or potassium), contaminants (such as herbicides and pesticides), and other elements and compounds into wetlands. Once there, wetlands can permanently remove these materials from the water column, or immobilize them (Brinson et al. 1995, Ainslie et al. 1998). The avenues by which they are removed or immobilized include "sorption, sedimentation, denitrification, burial, decomposition to inactive forms, uptake and incorporation into long-standing woody and long-lived perennial herbaceous biomass, and similar process" (Brinson et al. 1995:47). Practical applications of this function are the current use of artificial or natural wetlands to "clean" partially treated wastewater or sewage effluent. As purifiers, wetlands improve the quality of water as it moves downstream. Wetlands in the American Bottom had performed this function, as did aquatic areas.

2.5.6 Particulate Retention. Floodplain wetlands naturally retain organic and inorganic particulates carried in by overbank floodwater. When moving floodwater enters a wetland, its velocity is reduced by the wetland's roughness and increased cross-sectional area. As velocity is reduced, the capacity of the water to carry suspended particulates is reduced, and particulates (>0.45 micrometers or 0.00045 millimeters in diameter) drop out of the water column and settle (Brinson et al. 1995; Ainslie et al. 1998). Sedimentation is a common example of this physical process. Deposition of silt is often observed in wetlands after floodwaters recede. Sedimentation raises ground or substrate surface elevations, creates topographic variability, and augments nutrient levels; the accumulation of organic particulates supports decomposition, nutrient cycling, and detrital food webs (Brinson et al. 1995). Wetlands and aquatic areas in the American Bottom naturally retained organic and inorganic particulates.

2.5.7 Organic Carbon Exportation. Organic carbon in the form of dead and live plant material is exported from wetlands by moving water. Carbon material is either dissolved or particulate. Dissolved forms include organic materials leached out of litter and surface soil during periods of surface inundation. Particulates include living biomass, leaf litter, and fine and coarse woody debris. Organic carbon is typically flushed out of riverine wetlands by overbank floodwater. Downstream aquatic areas usually receive this material. The microbial food web, which forms the base of the detrital food web in aquatic ecosystems, is fueled in large part by the energy in this organic carbon (Bronson et al. 1995). Given their proximity to the Mississippi River and floodplain lakes and ponds, wetlands in the American Bottom would have been significant sources of organic carbon. Adjacent nonwetland areas on the floodplain would also have been sources of organic carbon, but their rates of carbon export are lower than those of wetlands (Brinson et al. 1995).

2.6 SUMMARY AND CONCLUSIONS

Prior to the construction of the levee and drainage system, the Project area ecosystem was vibrant and diverse. Water resources played a significant role in ecosystem maintenance. Rainfall, Mississippi River action, Cahokia Creek overflows, and runoff contributed from bluff tributaries all provided flood pulse disturbance dynamics at varying intervals throughout a given year. These actions, coupled with the occurrence of fire, provided the natural system with the maintenance necessary to ensure its biological integrity.

The historic dynamics that contributed to the healthy functioning of the predevelopment ecosystem provide an insight into ways in which improvements can be made to reintroduce these missing disturbance components and make improvements in habitat quality and ecological function while creating a sustainable ecosystem. This historic information provides a framework for the understanding of existing conditions of the Project area and how today's natural resources are different from an ecosystem and flooding dynamics perspective, and what may be beneficial for their restoration.

SECTION 3 – EXISTING CONDITIONS
(AFFECTED ENVIRONMENT)

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SECTION 3 – EXISTING CONDITIONS (AFFECTED ENVIRONMENT)

3.1 INTRODUCTION

This section of the report provides an overall characterization of existing conditions in the Project area. A significant portion of the information contained in this section is taken from technical documents available from NRCS, USACE, and USGS reports and maps, as well as ordinances, regulations, Master Plans and additional documents from local municipalities, counties, regional and state agencies.

It is important to understand how the historic natural ecosystem of the uplands and bottomlands in the Project area functions today after widespread agricultural development and extensive urbanization. This information also forms the basis for the identification of natural resource problems and opportunities that help guide potential ecosystem restoration objectives, such as restoration of flooding patterns and hydraulic functions that could benefit, rather than detract from, ecosystem structure and function, and at the same time, reduce flood damages in the Project area.

The topics addressed in this section include: Land Cover, Land Use and Socio-Economic Profile, Topography-Drainage-Fluvial Geomorphology, Geology and Soils, Climate and Weather, Air Quality, Noise, Surface Water-Floodplain Management, Stormwater Quality, Aquatic Biological Resources, Terrestrial Biological Resources, Wetlands, Threatened-Endangered and State Listed Species, Cultural Resources, Socio-Economics, Recreation Resources, Aesthetics, Infrastructure, and Hazardous-Toxic-Radiological Wastes. Where appropriate, the explanations of existing conditions will be classified by the affected watershed. In order to facilitate the organization of information, the five sub-basins utilized in the February 1984 study of the Project area, Re-evaluation Report and Environmental Assessment, Cahokia Canal - Harding Ditch Areas, East St. Louis and Vicinity, Illinois Interior Flood Control Project were again used.

3.2 LAND COVER

Land cover of the Project area consists of the various natural and man-made features and structures that are present on the earth's surface. This section describes land cover of the overall Project area, its landforms, and its major watersheds. The land cover characterization reflects the fact that, except for New Orleans, the Project area lies within the largest concentration of industrial, commercial, and residential land use on the Mississippi River floodplain.

3.2.1 Introduction. The Illinois Land Cover Database (ILCD) (IDNR 1996a) has been used to represent existing land cover conditions. Illinois' Critical Trends Assessment Project was initiated in the early 1990s to establish a baseline for the state's ecological and environmental conditions, identify trends in these conditions, and then periodically monitor future changes. As part of this effort, a land cover database was developed for the entire state. It is based primarily on Landsat Thematic Mapper (TM) satellite imagery.

Imagery for the Project area and its vicinity was acquired in 1991 (IDNR 1996a). The spatial resolution of the imagery and database is about 28.5 meters by 28.5 meters (93.5 feet by 93.5 feet), which means the smallest area capable of being discriminated by the satellite is about 0.2 acres. Land cover of the project area is displayed in Figure 3-1.

Figure 3-1 Project Area – Land Cover

The ILCD data for the Project area are broken down into six major land cover categories, and 17 minor categories (Table 3-1). Definitions for these land cover categories can be found in IDNR (1996a, 1996b).

3.2.2 Land Cover for Project Area. As shown in Table 3-1, about 68 percent of the Project area consists of urban/built-up, cropland, and grassland areas. Because these are "man-made" cover types, they are grouped together. The largely "natural" cover types - forested, wetland, and open water areas - make up the remaining 32 percent. Of the minor land cover categories, row crops are the most common, and account for about 25 percent of the Project area. Next in decreasing abundance are deciduous closed-canopy forest, urban grassland, and medium density urban/built-up land.

Table 3-1 Land Cover of the Project Area (from Illinois Land Cover Database).

Major Category	Area (acres)	% Area	Minor Category	Area (acres)	% Area
Urban/Built-Up Land	20,749.2	19.5	High Density Medium Density Low Density	3,734.0 15,984.9 1,030.3	3.5 15.0 1.0
Cropland	29,896.2	28.0	Row Crops Small Grains Orchards/Nurseries	26,155.9 3,706.3 34.0	24.5 3.5 < 0.1
Grassland	22,295.4	20.9	Urban Grassland Rural Grassland	19,016.3 3,279.1	17.8 3.1
Forested/ Wooded Land	21,995.7	20.6	Deciduous Closed Canopy Deciduous Open Canopy	20,018.0 1,977.7	18.8 1.9
Wetland	8,275.2	7.8	Shallow Marsh/Wet Meadow Deep Marsh Forested Wetlands Shallow Water Wetlands	2,188.9 649.7 3,978.0 1,458.6	2.1 0.6 3.7 1.4
Open Water	3,429.6	3.2	Open Water	3,429.6	3.2
TOTAL	**106,641.4**	**100.0**		**106,641.4**	**100.0**

3.2.3 Land Cover by Landform. Within the Project area, the bottoms, or Mississippi River floodplain, and uplands comprise roughly equal proportions in area (54 percent versus 46 percent). The floodplain supports proportionally more urban/built-up, cropland, wetland, and open water areas (Table 3-2). In the uplands, a greater proportion of grassland and forest areas occur. These patterns reflect to a large degree the overall differences between the two landforms in terms of topography (flat floodplain versus rolling to steep uplands), geomorphology (alluvial or river-formed versus glacial till plain), and current land uses.

Table 3-2 Percent Land Cover of Project Area by Landform

Major Category	Floodplain (54 % of area)	Upland (46 % of area)
Urban/Built-Up	11.6	7.8
Cropland	19.9	8.1
Grassland	9.7	11.2
Forest	2.5	18.2
Wetland	7.0	0.7
Open Water	3.2	< 0.1
Total	**53.9**	**46.1**

Within each landform (Table 3-3), cropland is dominant in the floodplain or bottoms, whereas forest is most abundant in the uplands. Cropland, urban/built-up, and grassland account for about 77 percent of the bottoms, whereas in the uplands, these three major categories cover about 59 percent of the area. Wetlands and open water are much more common in the bottoms.

Table 3-3 Percent Land Cover of Project Area within Landforms

Major Category	Floodplain (54 % of area)	Uplands (46 % of area)
Urban/Built-Up	21.5	17.0
Cropland	36.9	17.6
Grassland	18.0	24.3
Forest	4.6	39.4
Wetland	13.0	1.6
Open Water	5.9	0.1
Total	**99.9**	**100.0**

3.2.4 Land Cover by Project Watersheds. Land cover assessments for each of the Project area's five major watersheds are presented in the order of their geographic position from north to south. Figure 3-2 displays these areas. This information is presented because assumptions were made about future changes in land cover by watershed without any project, specifically, losses of deciduous forest in the uplands due to future development in each watershed. A detailed table of land cover by landform and watershed is included in Appendix B.

County Ditch. The County Ditch watershed comprises about 11 percent of the Project area (or 11,721 acres), and its floodplain component accounts for 75 percent of the watershed's area (Table 3-4). Of the five major watersheds, it exhibits the smallest proportion of urban/built-up land. In the bottoms, the chief category is cropland, whereas in the uplands it is grassland. Urban/built-up, cropland, and grassland constitute about 87 percent of the bottoms, and 69 percent of the uplands. Forest, wetland, and open water areas account for about 13 percent and 31 percent of these landforms, respectively. Portions of Madison City, Pontoon Beach, Edwardsville, and Glen Carbon lie within this watershed.

Figure 3-2 Project Area Watershed Divisions

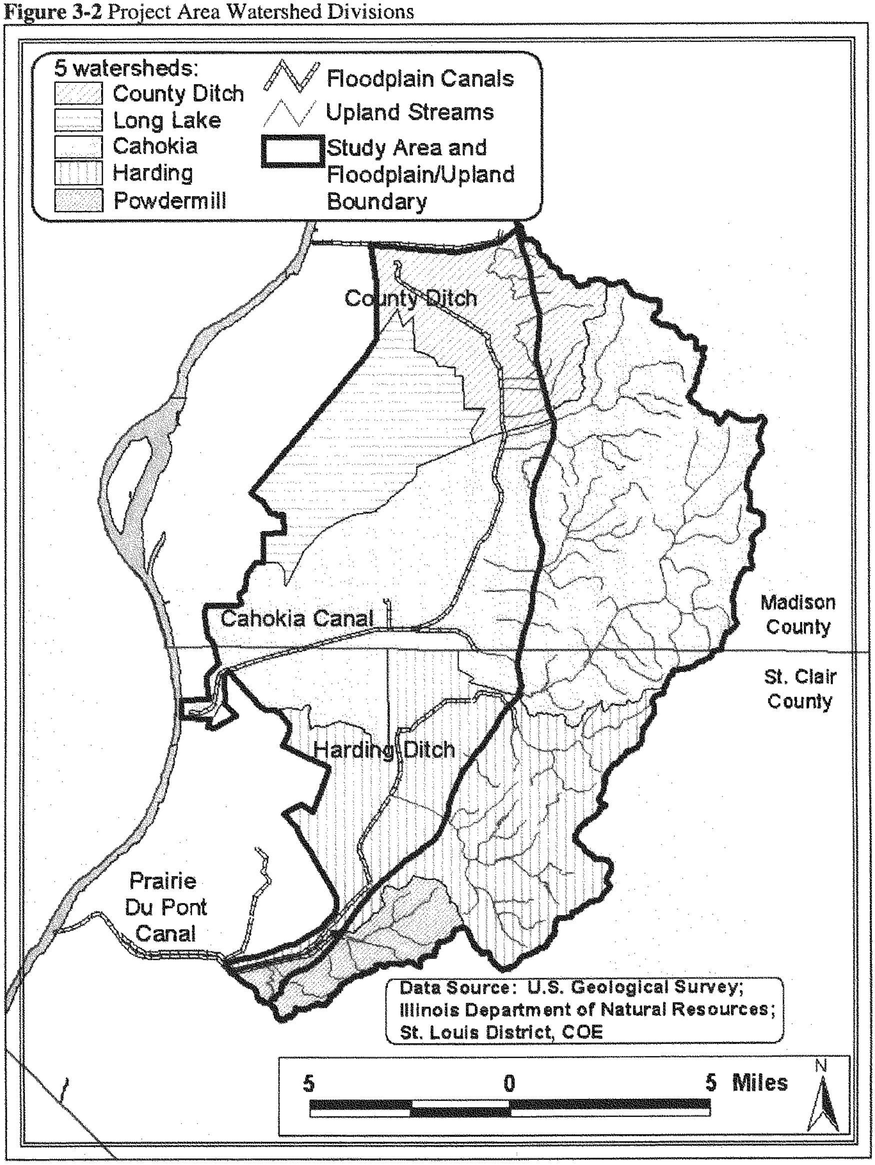


Table 3-4 Percent Land Cover of County Ditch watershed within Landforms

Major Category	Floodplain (75 % of area)	Uplands (25 % of area)
Urban/Built-Up	1.8	11.6
Cropland	70.7	13.5
Grassland	14.5	43.4
Forest	5.2	29.3
Wetland	7.1	2.1
Open Water	0.7	0.2
Total	**100.0**	**100.1**

Long Lake. The Long Lake watershed constitutes about 10 percent of the Project area (or 10,228 acres), and consists of only floodplain because no tributary streams drain into this area. This floodplain area has the greatest relative amount of urban/built-up land of all the watersheds (Table 3-5). This reflects the presence of Granite City and Pontoon Beach within this watershed. Urban/built-up, cropland, and grassland comprise about 91 percent of the area, whereas forest, wetland, and open water account for only 9 percent.

Table 3-5 Percent Land Cover of Long Lake watershed

Major Category	Floodplain only
Urban/Built-Up	39.8
Cropland	33.1
Grassland	18.1
Forest	2.1
Wetland	4.3
Open Water	2.5
Total	**99.9**

Cahokia. The Cahokia watershed is the largest of the five watersheds, and makes up about 49 percent of the Project area (or 52,297 acres). The two landforms, floodplain and uplands, have about equal proportions (Table 3-6). In the floodplain, cropland is the primary land cover category; in the uplands, forest is dominant. Urban built-up, cropland, and grassland account for about 68 percent of the bottoms, and about 64 percent of the uplands. Of the remaining categories, wetland and open water dominate the bottoms, and forest the uplands. Pontoon Beach, National City, Washington Park, Collinsville, Glen Carbon, and Maryville are among the communities within this watershed.

Table 3-6 Percent Land Cover of Cahokia watershed within Landforms

Major Category	Floodplain (46 % of area)	Uplands (54 % of area)
Urban/Built-Up	16.9	17.3
Cropland	35.3	20.8
Grassland	16.2	26.3
Forest	3.6	33.8
Wetland	16.8	1.8
Open Water	11.2	0.1
Total	**100.0**	**100.1**

Harding. The Harding watershed comprises about 26 percent of the Project area (or 27,439 acres). Floodplain and uplands have similar areas (Table 3-7). The urban/built-up category is dominant in the bottoms, and forest is most common in the uplands. About 75 percent of the bottoms consists of urban/built-up, cropland, and grassland, whereas about 48 percent of the uplands is covered by these categories. Forest, wetlands, and open water make up about 25 percent of the bottoms and 52 percent of the uplands. Washington Park, East St. Louis, Centreville, Alorton, Caseyville, Fairview Heights, and Belleville are among the communities within this watershed.

Table 3-7 Percent Land Cover of Harding watershed within Landforms

Major Category	Floodplain (46 % of area)	Uplands (54 % of area)
Urban/Built-Up	31.2	18.7
Cropland	19.3	12.4
Grassland	23.9	16.8
Forest	7.5	50.7
Wetland	15.7	1.4
Open Water	2.5	0.0
Total	**100.1**	**100.0**

Powdermill. The Powdermill watershed represents about 5 percent of the project area (or 4,907 acres). Cropland and forest are the most dominant land cover categories in the bottoms and uplands, respectively (Table 3-8). About 62 percent of the bottoms and 55 percent of the uplands consist of urban/built-up, cropland, and grassland. A substantial portion of the floodplain consists of wetland land cover. Although much of the watershed is unincorporated, a portion of Belleville lies within it.

Table 3-8 Percent Land Cover in Powdermill watershed within Landforms

Major Category	Floodplain (20 % of area)	Uplands (80 % of area)
Urban/Built-Up	1.6	13.0
Cropland	41.9	17.5
Grassland	17.9	24.2
Forest	11.7	44.6
Wetland	26.7	0.6
Open Water	0.1	<0.0
Total	**100.1**	**100.0**

3.2.5 Land Cover Data Deficiencies. The land cover data sets reflect conditions from about 1991, and are out of date by close to 10 years when compared to the point in time - spring of 1999 - that defines this Project's baseline condition. Since 1991, additional development has taken place within the Project area, and the proportions of some categories, such as agriculture, grassland, or forest, are expected to have declined to some degree due to increasing urbanization.

3.3 LAND USE AND SOCIO-ECONOMIC PROFILE

3.3.1 Land Use and Related Activity. Both Madison and St. Clair Counties have prepared master planning documents that include information on existing land use within the Reevaluation area. These documents include a discussion concerning future land use that will be discussed in the next section of this report. The master plans are living documents that are subject to periodic reviews to consider public input, major changes in demographics, government policies, infrastructure, public policy, economic, and employment activities. Below are some of the pertinent information from these master-planning documents, which describes the existing land use and related issues within the Reevaluation area.

3.3.1.1 Existing Land Use Planning Strategy. The existing land use planning strategy in Madison and St. Clair Counties can be summarized as follows: conserve agricultural lands; diversify employment opportunities; give the environment consideration in land use decisions; ensure housing availability; manage growth in a sensible manner; utilize best management conservation practices; provide open space and recreational opportunities; and, provide a safe, efficient, compatible transportation system.

3.3.1.2 Planning Subareas. The master plan reports divide the counties into subareas. Madison County has subdivided itself into the American Bottom, Bluffs, and Rural/Agricultural Corridors, while St. Clair County has subdivided itself into the North American Bottom, South American Bottom, Development, and Southern Tier Corridors. For the purposes of the description here, the Madison County classification system will be applied to that portion of the two counties that fall within the Project area (i.e. the American Bottom Corridor and the Bluffs Corridor).

3.3.1.2.1 American Bottom Corridor. This corridor consists of developed and undeveloped lands in the western third of the counties. On the western edge of this corridor is the Mississippi River. Historically, this area was important for industrial and business uses. The largest municipalities within the Project area portion of the corridor are East St. Louis and Granite City. Corridor land uses include residential, industrial/commercial (including Granite City Steel, Gateway Commerce Center Industrial Commercial Park) and recreational (Lewis and Clark State Park, Horseshoe Lake, Gateway International Raceway, Cahokia Mounds State Park, Frank Holten State Park). Approximately one-fourth of the county's population lives in the American Bottom Corridor.

3.3.1.2.2 Bluffs Corridor. This corridor includes the central region of the two counties. On the west is the American Bottom Corridor, and on the east a broad expanse of farm land. The Bluffs Corridor is a blend of residential development, open space and farmland. The majority of the population of the two counties lives here. The scenery and general amenities of the area make it desirable for residential development. Within the Project area, this corridor includes the growing communities of Edwardsville, Glen Carbon, Maryville, Collinsville, Fairview Heights, and Belleville. The Bluffs Corridor is in the midst of its largest population increase in 20 years. This change includes a shift of population from the older urbanized communities in the American Bottom Corridor to the Bluffs Corridor communities.

3.3.1.3 Land Use Classification By Corridor. Table 3-9 presents the overall land use data for the Project area using the available classifications. As indicated below, both the American Bottom and the Bluff Corridor have considerable amounts of undeveloped lands. The land use data show no physical constraints to future development.

Table 3-9 Current Project Area Land use by Corridor

Parameter	Grand Total	Urban				Open Space	
		Total Urban	High Density Urban	Medium Density Urban	Low Density Urban	Water/ Wetland	Other
Am. Bottoms							
Acres	58,989	12,709	3,040	9,167	502	11,161	35,119
%	100.0	21.5				18.9	59.6
Bluffs							
Acres	50,373	8,569	789	7,226	554	843	40,961
%	100.0	17.0				1.7	81.3
Total							
Acres	109,362	21,278	3,829	16,393	1,056	12,004	76,080
%	100.0	19.5				11.0	69.5

3.3.1.4 Urban Land Use. The following provides a description of the urban land uses and related activity found within the Reevaluation area. Within the urban setting, commercial, industrial, and residential uses dominate.

3.3.1.4.1 Commercial Uses. Commercial uses include retail, professional, and business services, offices and related showrooms, warehouses, eating and drinking establishments, automobile related commercial activities, and agricultural businesses. The commercial development category includes Regional (or highway) and community (or general) developments. Regional development activities are those that serve the market provided by the transportation corridor. Interstate interchange areas are a typical example of this type of development. Community development includes a variety of activities related to urban arteries, individual businesses, professional office parks, and malls. The number of businesses and their value has grown steadily, with retail sales increasing 18 percent between 1992 and 1995. The retail sector generated $2.0 billion in sales from 2,400 establishments during 1992. By comparison, the services sector generated receipts of $877 million from 6,797 establishments (see Table 3-10).

3.3.1.4.2 Industrial Uses. Manufacturing, wholesale, warehouse, and distribution uses are included in this category. Madison County has a strong industrial development history and has a strong transportation system needed for such development. However, the county has been following the nationwide trend of declining manufacturing due to global competition. Data on manufacturing was reported for four metro-east areas in 1992:

Belleville, East St. Louis, Granite City and the City of Madison. Within these communities there were a total of 118 manufacturing establishments with a total value of shipments of $1.7 billion. Large manufacturers characterize the American Bottom Corridor of Madison County with steel mills and refineries that account for most of the traditional manufacturing jobs. Key features enhancing the utility of this area include Mel Price L&D, Lock 27, Foreign Trade Zone 31, Tri-City Port District, Chain of Rocks Canal and the former U.S. Army Mel Price Support Center. In the Bluffs Corridor, Madison County benefits from the convergence of several interstate highways. Industries in this zone exist interspersed with residential areas. St. Clair County is likewise well suited for industrial development. The completion of I-255 has integrated the regions highway network thereby adding to the system's convenience. The highway represents one of the best opportunities in the Midwest for light industrial, warehouse, and distribution facilities. The renovation of the Martin Luther King Bridge over the Mississippi River also contributes to the areas economic health. The main industries in St. Clair County are the Monsanto Company, Cerro Copper, and Peabody Coal.

Table 3-10 Retail Trade and Services Industries by County (1992)

Location	All Establishments			
	Retail Trade		Service Industries	
	No. of Estab.	Total Sales ($1,000)	No. of Estab.	Total Receipts ($1,000)
MADISON COUNTY				
Collinsville	295	292,000.0	942	99,100.0
Edwardsville	239	148,500.0	1,059	87,800.0
Glen Carbon	35	26,300.0	188	6,300.0
Granite City	319	242,900.0	900	105,500.0
Madison	60	18,600.0	80	7,700.0
Maryville	12	1,400.0	27	5,700.0
Pontoon Beach	9	6,100.0	12	
Venice	5		20	1,300.0
ST. CLAIR COUNTY				
Alorton	3		13	200.0
Belleville	590	493,800.0	2,076	344,600.0
Cahokia	153	114,600.0	304	32,800.0
Caseyville	33	21,300.0	139	10,200.0
Centreville	14	3,100.0	22	5,000.0
Dupo	20	2,600.0	97	3,500.0
East St. Louis	204	94,300.0	354	41,300.0
Fairview Heights	349	492,200.0	397	106,600.0
Swansea	65	69,800.0	187	20,900.0
Washington Park	33	15,100.0	29	2,200.0
COMBINED TOTALS	**2,400**	**2,027,500.0**	**6,797**	**877,200.0**

3.3.1.4.3 Residential Housing and Households. Table 3-11 provides information about housing characteristics of the two counties as compared to the state as a whole. In general, in the area west of the bluffs, both counties provide important advantages to housing developers in the form of low land costs and easily developable land.

Table 3-11 Housing Information by County and State

Category	Madison County			St. Clair County			State of Illinois		
	1980	1990	% Change	1970	1990	% Change	1970	1990	% Change
Total units	93,682	101,098	+7.9	91,354	103,432	+13.2	3,703,367	4,506,275	+21.7
Vacancies	4,586	NA	NA	5,025	8,068	+60.6	199,982	301,920	+51%
Median value ($)	36,200	51,400	+42.0	43,000	61,000	+41.9	70,000	90,000	+28.6

An on-going trend in Madison County is the building of larger houses for fewer people. Single family detached housing is the dominant housing type. Madison County's goal is to provide a diversity of housing types while providing a sense of community rather than promoting conventional urban sprawl. Open space is seen as a primary vehicle for creating areas with a strong sense of community.

In St. Clair County, residential construction is booming particularly with new housing construction occurring in Belleville and Fairview Heights. The number of new housing units increased by 13.2 percent between 1970 and 1990 (Table 3-11). About 95 percent of all units were occupied. In addition, the median property value increased 41.9 percent during the same time period. The number of households increased by 4.8 percent, which is close to the statewide rate (Table 3-12).

Table 3-12 Households – State and Counties' Level (1,000's)

Category	Madison County			St. Clair County			State of Illinois		
	1980	1996	% Change	1980	1996[2]	% Change	1980	1996	% Change
Total Households	89.0	94.9	+6.6	91.0	95.3	+4.8	4,045.4	4,202.2	+3.9

3.3.1.5 Agricultural Use. The agricultural land use category applies to areas of productive farm ground, farmsteads, very low-density residential uses and agricultural-related business and industry. A major concern within the area is preventing premature conversion of farmland to other land uses. The total acreage of land farmed has been on the decline between 1978 and 1992. The acreage drop was 10 percent in Madison County, and 13 percent in St. Clair County (Table 3-13). A decline in the number of farms was evident during the same time period with a 26 percent reduction in Madison County and a 30 percent reduction in St. Clair County. At the same time, farm size has been increasing with a 21.6 percent increase in Madison County and a 24.8 percent increase in St. Clair County. The total cropland acres farmed has declined by roughly 5 percent in both counties over the same time period.

Table 3-13 Agricultural Use.

Category	Madison County			St. Clair County		
	1978[1]	1992[2]	% Change	1978[1]	1992[2]	% Change
No. of farms	1,754	1,299	-25.9	1,371	953	-30.5
Farm Acres	333,000	300,000	-9.9	305,000	264,000	-13.4
% of all land	71.0	NA		70.8	NA	
Ave. size of farm (acres)	190	231	21.6	222	277	24.8
Cropland (acres)	284,000	271,000	-4.6	260,000	245,000	-5.8

In 1992, approximately 516,000 acres within Madison and St. Clair Counties were classified as cropland (Table 3-13). The areas' farm operators produce cash grain and vegetable crops with relatively few involved in livestock production or dairying. Overall, agriculture plays a far less significant role in the economy of the area than does manufacturing. However, it is important to note that within the area, several unique agricultural activities exist. The alluvial fan region at the foot of the bluffs is one of the few areas in the nation suited for the production of horseradishes. In addition, the area known as Poag Terrace is famous for the production of melons

During the period 1978 to 1992, the average market value of land and buildings per farm increased by 36.5 percent in Madison County and by 19.8 percent in St. Clair County. On a per acre basis, the increase was less dramatic, however. The increase was 8.8 percent for Madison County and 3.9 percent for St. Clair County. The market value of agricultural products sold per farm increased very substantially, with an increase of 96.9 percent for Madison County and 68.9 percent for St. Clair County.

In the Project area, agricultural lands currently support row crops, small grains, orchards/nurseries, and rural grassland. Typically, row crops include corn and soybeans, and small grains consist of wheat and sorghum. A specialty crop is horseradish (discussed below). According to the Illinois Land Cover database (1996a), these four kinds of agricultural lands comprised about 28 percent (Table 3-1) of the Project area as of the early 1990s (see Section 3.2). A more recent inventory of agricultural lands in the Project area does not exist.

However, in 1999 the Natural Resources Conservation Service (NRCS) conducted a comprehensive inventory of cropland in the upland portion of the Project area. This inventory was done for this Project to identify potential locations where a variety of best land management practices might be implemented to reduce soil erosion from cropland, and thereby minimize the transfer of upland sediment to the floodplain. Because best professional judgment indicated that most sediment entering the floodplain drainage system had its origin in the uplands, there was no similar inventory of the floodplain portion of the Project area.

The NRCS inventory identified almost 10,500 acres of cropland in the tributary watersheds (Table 3-14). Information concerning this inventory, including maps of identified cropland, is found in Appendix E. Most of this cropland is located in the headwater or eastern portion of the tributary watersheds. (Watersheds in the Project area are depicted in Figure 3-2.) According to this survey, cropland comprises about 21 percent or one-fifth of the uplands within the Project area. In the Cahokia and Powdermill tributary watersheds, about one-quarter of the land is cropland, whereas less than 15 percent occurs in the County Ditch and Harding watersheds (Table 3-14). The proportion of cropland in the minor tributary watersheds varies more widely.

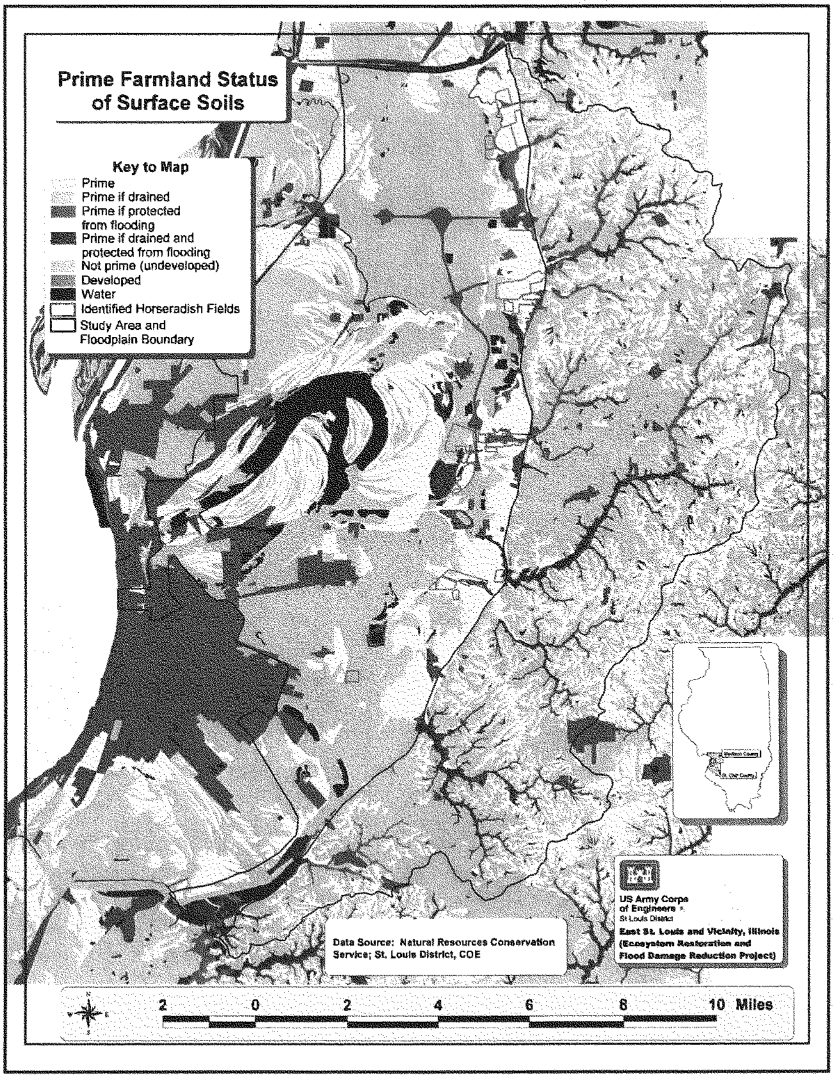
Table 3-14 Cropland identified by NRCS in the Project area's tributary watersheds.

Major Watershed	Minor Watershed	Cropland (acres)	% of Minor Watershed	% of Major Watershed
County Ditch	Bluff 1	372.9	13.0	13.0
Long Lake	(no uplands)	0.0	0.0	0.0
Cahokia	Judy's Branch	1,007.6	18.6	25.1
	Burdick Branch	366.9	20.5	
	Bluff 2	191.1	28.0	
	Schoolhouse Branch	843.0	18.6	
	Bluff 3	0.0	0.0	
	Canteen Creek	4,603.8	31.9	
Harding	Little Canteen Creek	1,133.5	22.5	14.4
	Bluff 4	65.2	6.9	
	Schoenberger Creek	875.1	11.3	
	Bluff 5	39.0	4.0	
Powdermill	Powdermill Creek	463.1	16.0	24.4
	Bluff 6	527.2	45.5	
TOTAL		**10,488.4**		**21.2**

The Project area exhibits variation in the suitability of soils for the production of crops. Based on the digital soil surveys of Madison and St. Clair Counties (NRCS 2000a, 2000b), each of the over 150 different types of soils mapped within the Project area has been classified by the NRCS according to its status as prime farmland. This classification groups soils into five categories: 1) area not prime, 2) all areas are prime, 3) only drained areas are prime, 4) only areas protected from flooding or not frequently flooded during the growing season are prime, and 5) only drained areas that are either protected from flooding or not frequently flooded during the growing season are prime. Appendix B displays all the different mapped soils and their status as prime farmland.

Figure 3-3 displays the relative suitability of the Project area's soils for the production of crops. The category of soils that is not prime has been subdivided into developed soils (which includes all developed and urban land class soils from Appendix B), areas mapped as water, and undeveloped soils that are not prime. The distribution of these various categories across the Project area is generally irregular.

Figure 3-3 Prime Farmland Status of Surface Soils in the Project Area



In Table 3-15, the area and relative proportion of these prime farmland categories is displayed for the Project area as well as its floodplain and upland components. Undeveloped soils that are not prime comprise the greatest proportion of the Project area (about 43 percent), including both floodplain and uplands. A similar pattern occurs for the second most abundant category, prime soils, which makes up about 25 percent of the Project area. Developed soils and water combined constitute over 21 percent of the Project area, with the majority in the floodplain. The remainder of the project area (about 9 percent) consists of the three categories of conditionally prime soils.

Table 3-15 Prime farmland status of surface soils in the Project area, by landform.

Prime Farmland Status of Soils	Floodplain		Upland		Project Area	
	Area (acres)	**% Area**	**Area (acres)**	**% Area**	**Area (acres)**	**% Area**
All areas are prime	14,621.0	13.7	12,372.2	11.6	26,993.1	25.3
Only drained areas are prime	1,963.1	1.8	2,264.7	2.1	4,227.8	4.0
Only areas protected from flooding or not frequently flooded during the growing season are prime	612.6	0.6	647.3	0.6	1,259.9	1.2
Only drained areas that are either protected from flooding or not frequently flooded during the growing season are prime	1,993.7	1.9	2,155.4	2.0	4,149.1	3.9
Not Prime - Undeveloped	20,121.9	18.9	26,262.8	24.6	46,384.7	43.5
Not Prime - Developed	13,214.0	12.4	5,064.8	4.7	18,278.8	17.1
Not Prime – Water	4,064.2	3.8	457.1	0.4	4,521.3	4.2
Not mapped	299.1	0.3	527.6	0.5	826.8	0.8
TOTAL	**56,889.5**	**53.5**	**49,751.9**	**46.6**	**106,641.4**	**100.1**

It is important to note that the areas of soils belonging to the prime, conditionally prime, and undeveloped-not prime categories in Figure 3-3 and Table 3-15 do not consist exclusively of farmland currently in use. These areas also include all existing natural habitats, such as wooded areas, marshes, old or abandoned fields, and other similar undeveloped areas.

Horseradish – Specialty Crop: Horseradish has been produced in the American Bottom since the late 1800s, and today about 60 percent of the world's supply comes from this area (Horseradish Information Council 2002). Local producers estimate that about 1,800 acres of farmland are used each year to grow horseradish. In a particular field, horseradish is grown about once every three years, and other crops are planted in the off years. Annual production of horseradish therefore rotates within a total land base estimated by producers to be 2.5 to 3 times what is planted annually (4,500 to 5,400 acres), or roughly 5,000 acres. The St. Louis District consulted with local producers to identify horseradish fields within the Project area. Although this survey was not comprehensive, it yielded 1,537 acres of horseradish fields (Figure 3-3). These identified fields were considered to be a unique agricultural resource within the Project area.

Most horseradish fields are concentrated on alluvial deposits located along the base of the bluff, but some are scattered across the American Bottom. Consequently, the soils occurring within this unique farmland are variable with respect to their prime farmland status as designated by the NRCS. Within the area of horseradish fields shown in Figure 3-3, 68 percent is considered prime, 12 percent is prime if drained, 8 percent is prime if protected from flooding or not frequently flooded during the growing season, 7 percent is prime if drained and protected from flooding or not frequently flooded during the growing season, and 5 percent is not prime. A list, of the 32 different soils found in these identified horseradish fields, is provided in Table B.4 of Appendix B.

3.3.1.6 Open Space. Examples include Horseshoe Lake State Recreation Area, Lewis and Clark Historic Site, Southern Illinois University Campus at Edwardsville. Remaining wetlands in the County are considered an important element of the open space system and are recommended for protection. It is recommended that open space lands be preserved by public agencies and private organizations (e.g. homeowner associations). Areas indicated as open space often have development limitations (e.g. flooding) and can still be preserved if development occurs.

3.3.2 Socio-Economics.

3.3.2.1 Population Size and Location. The seven counties that comprise the Southwestern Illinois region have about five percent of the state's total population. Madison and St. Clair Counties have approximately 40 percent coequal shares of the Southwestern Illinois region's population (Table 3-16). In 1990 about three-fourths of Madison County's population lived in incorporated places. Today, the greatest concentrations of population within the Project area portions of Madison County are found in Collinsville, Edwardsville, Glen Carbon and Granite City. Within St. Clair County the major centers of population are Belleville, Cahokia, East St. Louis, Fairview Heights and Swansea.

Table 3-16 Madison & St. Clair Counties Share of Southwestern Illinois Population.

County	Population 1980	% of S.W. Illinois	Population 1990	% of S.W. Illinois
Madison	247,671	39.1	249,238	39.4
St. Clair	265,469	41.9	262,852	41.5
Monroe	20,117	3.2	22,422	3.5
Bond	16,224	2.6	14,991	2.4
Clinton	32,617	5.2	33,944	5.4
Washington	15,472	2.4	14,965	2.4
Randolph	35,566	5.6	34,583	5.5
S.W. Illinois	633,136		632,995	

3.3.2.2 Population Trends. Historic population figures for Madison and St. Clair Counties are presented in Table 3-17. Between 1970 and 1980 both counties showed a decline in population numbers. Since 1980 that decline has continued for St. Clair County, while for Madison County the data is showing a gradual recovery in population. Table 3-18 shows the change in population at the city and village level between the years 1960 and 2000, and between the years 1990 and 2000.

During the 1960-2000 time frame, towns' showing major drops in population included Brooklyn (-64.8 percent), East St. Louis (-61.4 percent), Venice (-53.0 percent), and Madison (-33.8 percent). Caseyville was the only entity reflecting a major gain during that period.

Table 3-17 Historic Population Data – State and County Level

Region	Population						% Change 1950-2000	% Change 1990-2000
	1950	1960	1970	1980	1990	2000		
Illinois	No Data	No Data	No Data	11,426,518	No Data	12,419,293	N/A	N/A
Madison	182,307	224,689	250,911	247,691	249,238	258,941	+42.0	+3.9 %
St. Clair	205,995	262,509	285,591	267,531	262,852	256,082	+24.3	-2.6 %

Table 3-18 Population – Cities & Villages Level

City/Village	Population				
	1960	1990	2000	% Change 1960-2000	% Change 1990-2000
MADISON COUNTY					
Collinsville		22,446	24,707		+10.1
Edwardsville		14,579	21,491		+47.4
Glen Carbon		7,731	10,425		+34.8
Granite City	40,073	32,862	31,301	-21.9	-4.8
Madison	6,861	4,629	4,545	-33.8	-1.8
Maryville		2,576	4,651		+80.6
Pontoon Beach		4,013	5,620		+40.0
Venice	5,380	3,571	2,528	-53.0	-29.2
ST. CLAIR COUNTY					
Alorton	3,282	2,960	2,749	-16.2	-7.1
Belleville		42,785	41,410		-3.2
Brooklyn	1,922	1,144	676	-64.8	-40.9
Cahokia	15,829	17,550	16,391	+3.6	-6.6
Caseyville	2,455	4,419	4,310	+75.6	-2.5
Centreville		7,489	5,951		-20.5
Dupo		3,164	3,933		+24.3
East St. Louis	81,712	40,944	31,542	-61.4	-23.0
Fairmont City	2,688	2,140	2,436	-9.4	+13.8
Fairview Heights		14,351	15,034		+4.8
Swansea		8,201	10,579		+29.0
Washington Park	6,601	7,431	5,345	-19.0	-28.1

One can also see that between 1990 and 2000, a number of Madison County localities showed substantial increases in population: Maryville increased by 80.6 percent, Edwardsville by 47.4 percent, Pontoon Beach by 40.0 percent, and Glen Carbon by 34.8 percent. Venice showed a notable population decrease -29.2 percent.

St. Clair County showed a slight decrease in overall population during the 1990-2000 period. The cities that saw the largest decreases were those located west of the bluff and included East St. Louis (-23 percent), Washington Park (-28.1 percent), and Centreville (-21 percent). St. Clair County communities showing population gains included Fairview Heights (+4.8 percent), Swansea (+29.0 percent), Fairmont City (+13.8 percent), and Dupo (+24.3 percent).

3.3.2.3 Age Distribution. The age distribution trends between 1980 and 1996 were similar between the two counties, and were similar to the statewide trends. The under age 5 years group and the over age 65 years group increased slightly, the 17-65 years group held constant, and the 5-17 years old group decreased somewhat. The median age of the population between 1980 and 1996 increased in Madison County (31.0 to 36.9 years) and St. Clair County (28.5 to 34.9 years) consistent with the statewide increase (29.9 to 35.5 years). In 1990, the median age for blacks in Project area communities, for which data are available, was 26.0 years for blacks and 38.8 years for whites. The community showing the greatest difference in median age was East St. Louis, with 58.5 years for whites and 27.3 years for blacks.

3.3.2.4 Education. Another indicator of social well-being is the level of local educational attainment. There is a direct positive relationship between education and other measures of personal welfare such as income. The overall total population numbers have not changed greatly for Madison and St. Clair Counties over the past 16 years. However, during that period, enrollment in schools (grade school and college) have decreased somewhat, while the numbers of those having completed high school or college has increased noticeably. This change may be a result of median age of the population increasing during that same period. The current high school completion rate for both counties is comparable to that of the statewide average, but is about one-third lower in both counties for advanced schooling. The educational attainment rate is somewhat higher for communities east of the bluff line than those west of the bluff line.

3.3.2.5 Labor. Based on 1980 data, the labor force gender split was similar in the two counties and statewide. The breakdown was about 60 percent male and 40 percent female. Comparative data was not available for 1996. With regard to unemployment, the unemployment rate declined over the period 1980 to 1996 for both counties. In Madison it dropped 3.1 percent (from 8.7 to 5.6 percent), and in St. Clair County it dropped from 4.3 percent (from 10.3 to 6.0 percent) during this time period.

Census data parameters have changed enough over the years that a detailed comparison for each employment sector is infeasible. However, a more generalized comparison by reflecting the workforce numbers for those in manufacturing (goods) versus those in other areas (primarily services) is possible (Table 3-19). From this comparison, employment in the manufacturing sector has been on a decline for both Madison (-28.5 percent) and St. Clair (-42.8 percent) since 1960 and that the decline far exceeds the statewide trend (-14 percent). On the other hand, employment in the services sector appears to have picked up the slack employment.

In net overall employment, increases were seen in both Madison (+40 percent) and St. Clair (+22.9 percent) counties. The increase was similar to the statewide increase (+38.9 percent) for Madison County, but was somewhat lower for St. Clair County.

Table 3-19 Civilian Labor Force Information

Item	Civilian Labor Force								
	Madison County			St. Clair County			Illinois		
	1960	1990	% Change	1960	1990	% Change	1960	1990	% Change
Total Employment	80,757	113,082	+40.0	85,859	105,544	+22.9	3,899,472	5,417,967	+38.9
Manufacturing Employment	33,676	24,086	-28.5	25,844	14,776	-42.8	1,240,032	1,056,504	-14.8
Other Employment (Services)	47,081	88,996	+89.0	60,015	90,768	+51.2	2,659,440	4,361,463	+64.0

3.3.2.6 Income. In general, income within the two counties rose approximately 200 percent between 1980 and 1996. During that time period the median household income increased over 80 percent. The percentage of persons living below the poverty level increased by nearly one-third in Madison County, but rose less than 5 percent in St. Clair County. Reference T indicates the region's economy, as in Illinois and the U.S. has changed steadily from a manufacturing base to a more service related economy. In 1992, workers in the manufacturing sector average an annual pay of $35,036, those in the retail trade averaged $10,833 per year, and those in the services sector averaged $21,278 per year. Geographically, manufacturing jobs pay less in the Belleville area than in other regions. Geography does not appear to be much of a factor relative to the retail trade industry. The same can be said for the services industry; however, Belleville and some of the smaller towns (with a small number of workers) west of the bluff line (Centreville, Madison, and Venice) were noticeably higher than the average in this department. As of 1996, East St. Louis had approximately 400 people employed by the riverboat, and many with some form of health insurance.

3.3.2.7 Financing. Table 3-20 presents local government revenue, expenditure and debt information for Madison and St. Clair Counties. Data for Illinois is presented for comparison. Examination of such data can yield valuable information concerning the local governments ability to meet the demand for more government services. For both counties, revenues have increased at a rate about equal to that of expenditures. Consequently, government debt has not changed markedly for the period 1980 to 1994. In 1992, for Madison County, the revenues were slightly less than the expenditure rate, and for St. Clair County the revenues were slightly more than the expenditures. At the state level for 1992, revenues exceeded expenditures, but the percent increase in debt for the 1980 to 1994 period was much higher than it was for the counties.

Table 3-20 Local and State Government Finances ($1,000's)

Year	Madison County		St. Clair County		Illinois	
	Amount ($)	% Change	Amount ($)	% Change	Amount ($)	% Change
Government General Revenue						
1976	166,945.0		191,049.0		8,818,641.0	
1992	392,600.0	+135.2	477,600.0	+150.0	29,778,000.0	+237.7
Government Expenditures						
1976	173,185.0		174,690.0		8,622,886.0	
1992	399,900.0	+130.9	461,500.0	+164.2	21,543,000.0	+149.8
Government Debt						
1976	117,675.0		153,663.0		6,745,321.0	
1992	193,700.0	+64.6	254,300.0	+65.5	22,676,000.0	+236.2

Of the cities/villages for which data was available in 1992, Belleville, East St. Louis and Granite City showed the highest amounts of incoming revenue. Belleville showed the greatest amounted debt, with its debt being two and a half times greater than its 1992 revenue (Table 3-21).

Table 3-21 Local Government Finances ($1,000's)

City/ Village	Local Government Finances, 1992			
	General Revenue	General Expenditures	Debt Outstanding	Debt as % of General Revenue
MADISON COUNTY				
Belleville	20,700.0	22,900.0	51,400.0	248
Cahokia	7,300.0	6,600.0	6,300.0	86
Collinsville	9,400.0	9,900.0	12,100.0	129
Edwardsville	7,000.0	7,000.0	7,900.0	113
Granite City	18,700.0	24,100.0	6,200.0	33
ST. CLAIR COUNTY				
East St. Louis	16,000.0	22,600.0	14,400.0	90
Fairview Heights	6,400.0	4,000.0	300.0	5

3.3.2.8 Transportation. Among the most significant features that have been developed in the Project area are those associated with transportation. The southwestern Illinois railroad network, constructed largely in the last century, focuses upon East St. Louis. Fifteen railroad entities operate approximately fifteen main line routes in the area. In addition, the 35 rail yards located within the Project area represent 50 percent of total rail yards in the St. Louis metropolitan area. Inbound rail traffic is approximately 6400 cars per day while outbound traffic is about 5600 cars per day. Much of the daily traffic (77 percent) does not originate or terminate in the Project area but rather is through traffic destined fore other parts of the nation. Plans for railroad consolidation in the St. Louis metropolitan area call for the construction of several regional rail switching yards within the area. Existing and proposed highways in southwestern Illinois consist of an interstate highway network that includes I-70, I-55, I-255, I-270 and I-64 that links the eastern United States with other mid-western markets.

3.4 EXISTING TOPOGRAPHY DRAINAGE FLUVIAL GEOMORPHOLOGY

3.4.1 Topography. The Project area is primarily located within the Mississippi River floodplain area known locally as the "American Bottom" which includes western portions of Madison and St. Clair Counties. The American Bottom extends beyond the Project area boundaries north to Alton and south into Monroe County near Dupo (see Figure 2-4). The American Bottom covers approximately 175 square miles (112,000 acres). It is approximately 30 miles long and 11 miles wide at its widest point. The existing topography has not changed demonstrably since the Pre-development period with the exception of man made structures, which have been added to the floodplain, altering drainage patterns. In the floodplain it is nearly level bottomland. The floodplain generally slopes to the south and drops in elevation approximately 0.5-foot per mile mirroring the Mississippi River surface profile. The floodplain exhibits river meander scars, abandoned channel oxbow lakes, low-relief ridges, and swales. Ancient Indian mounds rise above the bottoms with the largest being Monks Mound, which rises 85 feet above the adjacent floodplain and is located east of Fairmont City. The average elevation to the north near Alton is 415 feet and to the south near Dupo, 405 feet. In the northern portion, there are terraces located along the foot of the bluff between East Alton and Roxana. The terraces are approximately 25 to 35 feet above the floodplain with elevations between 440 and 450 feet.

The Project area north of Horseshoe Lake is typically higher than the adjacent floodplain with elevations between 420 and 435 feet. The topography near the Illinois bluff on the eastern edge of the floodplain is generally higher than the adjacent floodplain with elevations between 435 and 465 feet. The bluff rises steeply between 150 to 200 feet above the floodplain. The bluff has a rather rugged topography with the creek channels forming valleys with steep slopes. Beyond the bluff line the topography consists of rolling hills and valleys with elevations ranging between 500 and 600 feet. Some shallow surface depressions less than 5 feet deep have been created in the last 100 years by mine subsidence located east of the bluff line.

Man made changes to the area include railroad beds that crisscrossed the area and form mini levee systems across the surface of the floodplain. In the 1800's, East St. Louis was protected from high waters by the railroad embankments of the: Ohio and Mississippi; St. Louis and Southeastern; St. Louis, Alton, and Terre Haute; and, the Cairo Shortline. The exception was an open culvert in the Ohio and Mississippi Railroad embankment between Third and Fourth Streets.

When the water began rising following heavy rains in 1863, East St. Louis had this open culvert closed. The Ohio and Mississippi Railroad, who feared damage to the embankments from the water pressure, promptly reopened it. The city closed it again and placed a guard to protect it. United States troops were sent in to open the embankment and a riot ensued. The citizens were driven away with bayonets and the culvert remained open. The city sustained damage from the flood (Reavis 1876:69). Later, the development of the interstate highway system through the area would further change the topography. Raised roadways, similar to the railroad embankments, changed the natural characteristics of the area forever.

3.4.2 Drainage. By the 1800's, changes to topography through the development of the railroad lines traversing the area had altered the natural drainage patterns of the area. Likewise, manmade levee systems designed to protect cropland from flooding changed the natural drainage. Then, in the 1900's, as a result of increased development in the area, drainage districts were formed for the sole purpose of managing the drainage of the floodplain. By 1904, engineering plans were underway for the construction of a system of canals and drainage ditches designed to carry water as quickly and directly as possible to the River. The construction of this system eliminated the creek system that originally flowed across the Project area. By this time, a levee system had been constructed along the Mississippi River to protect the area from River flooding and in 1910, the tributary drainage area of Cahokia Creek was eliminated from the floodplain and diverted into a large diversion canal on the northern end of the Project area for the purpose of having the creek flow directly into the River. All flow was diverted into the Cahokia Creek Diversion Canal and levees were constructed along the northern boundary of the newly formed East Side Levee and Sanitary District. The Diversion Canal that is approximately 4.5 miles long flows directly west into the Mississippi River at Mile 195. A grade control structure with a low water dam was constructed near the Diversion Canal's mouth to prevent channel head cutting and to stabilize its channel bottom grade. The grade control structure was severely damaged during flash flood events coincident with low Mississippi River levels in 1912, 1913, 1915, 1943, and 1946. The grade control structure was quickly rebuilt near, or at the same location, after each event. The Corps of Engineers rebuilt the structure in 1946 and recently rehabilitated it in 1994. The levee system continued to be improved and today an urban design (500-year) flood control system protects the Project area within the floodplain with large earthen levees and floodwalls. On the northern Project boundary, a levee is located on the left descending bank of the Cahokia Creek Diversion Canal and ties into the bluff west of Edwardsville. On the southern Project boundary, a levee is located on the right descending bank of the Prairie Du Pont Creek and ties into the bluff. While this mainline protection system has continually been improved over time, the original interior drainage canals and ditches remain as originally constructed in the early 1900's.

The natural topography is still a major factor contributing to storm drainage and flooding problems within the Project area. The natural and manmade drainage channels have very little slope and are not efficient in moving surface water from either the bluff or the bottoms to reach the outlets to the Mississippi River. Surface water meanders slowly to the Mississippi River or remains in numerous natural depressions.

These problems have increased because of the increased flows from the bluffs and uplands without any corresponding improvements to the drainage system. The flows out of the bluffs enter the American Bottom with high velocities and are able to suspend more sediments than slower moving waters. The slower moving surface waters allow the sediments to aggrade (deposit sediments) in the channels and adjacent lands with overland (out-of banks) flows.

The natural over bank drainage and meandering creeks flowing into the Mississippi River became blocked by the flood protection systems constructed in the early 1900's. The open water areas and wetlands have shrunk more than 40 percent in size with the excavation of 40 miles of drainage ditches and canals constructed between 1907 and 1950 (Bruin and Smith, 1953).

Additionally, the carving up of the natural drainage areas by railroad and road embankments makes drainage of the floodplain areas even more difficult. These manmade features continue to isolate wetlands and open water areas, thus eliminating them from their pre-settlement function of storm water storage. To make the problem worse, groundwater was typically very shallow in most areas within the floodplain as shown on Figure 3-4. The combination of shallow groundwater and poor draining alluvial soils of alternating layers of clays, silts, and sands further promoted the need for the development of the extensive drainage system of levees and varying sizes of drainage ditches, channels, and canals. During the height of the industrial period to until the mid 20th century, the groundwater surface was generally lowered between 2 and 12 feet with localized reductions as a result of extensive ground water pumping in ten areas for industrial and municipal purposes as shown on Figure 3-5. When this pumping stopped, groundwater returned to its historical level and areas like Dobrey Slough that were constructed with dry basements in the 1950's, suffer groundwater flooding today as a result of the cessation of groundwater pumping for industrial purposes. Figure 3-6 shows these post pumping groundwater elevations as of 1990.

Figure 3-4 Groundwater Elevations in Project Area Prior to Pumping

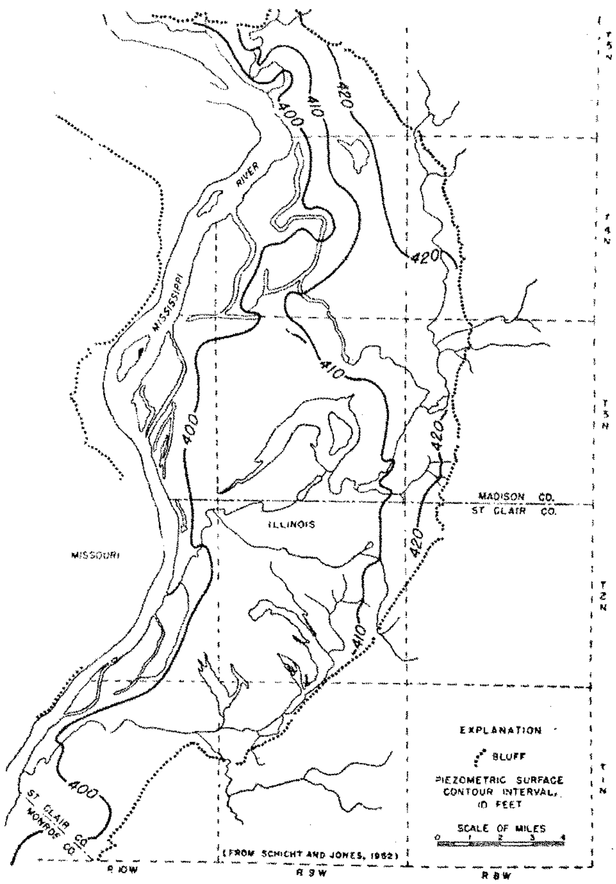


Figure 3-5 Groundwater Elevations in Project Area during Pumping-1956

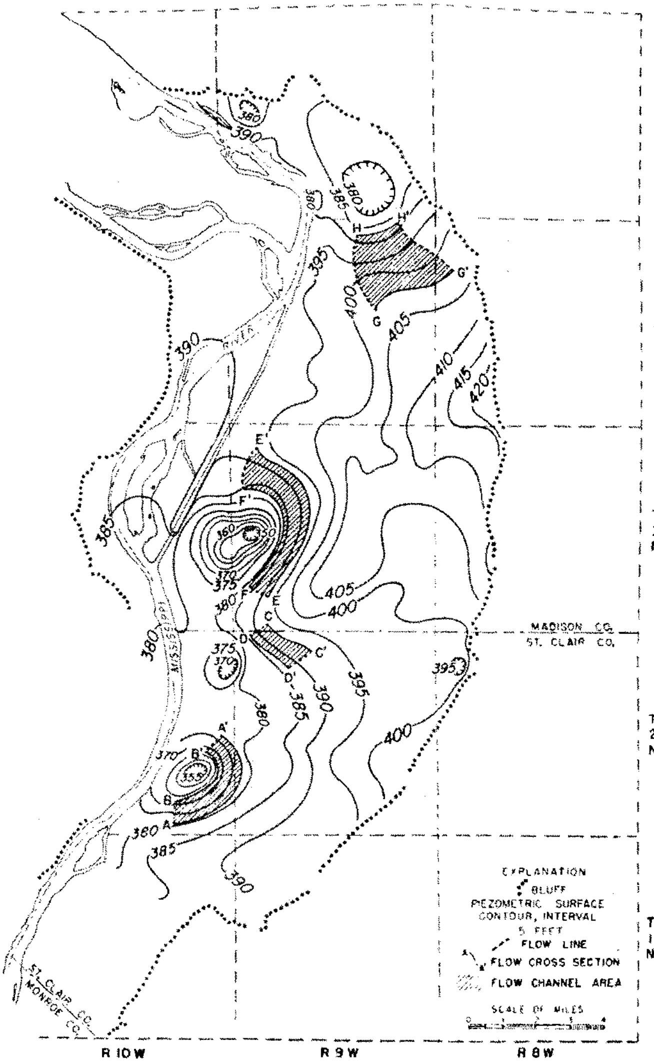


Figure 3-6 Groundwater Elevations in Project Area Post Pumping-1990

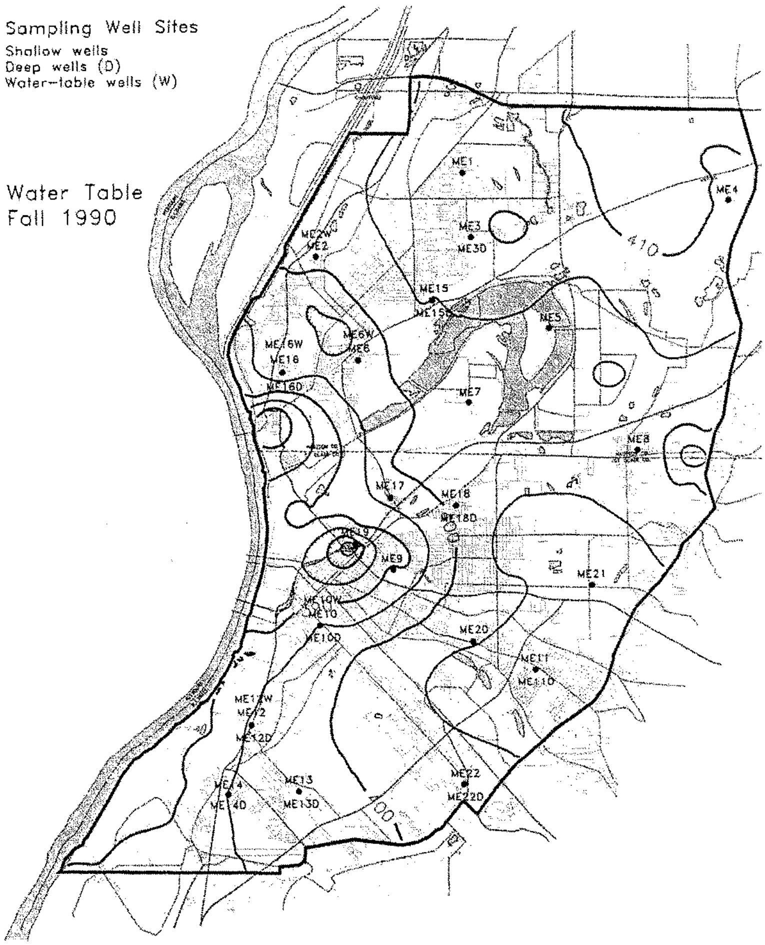
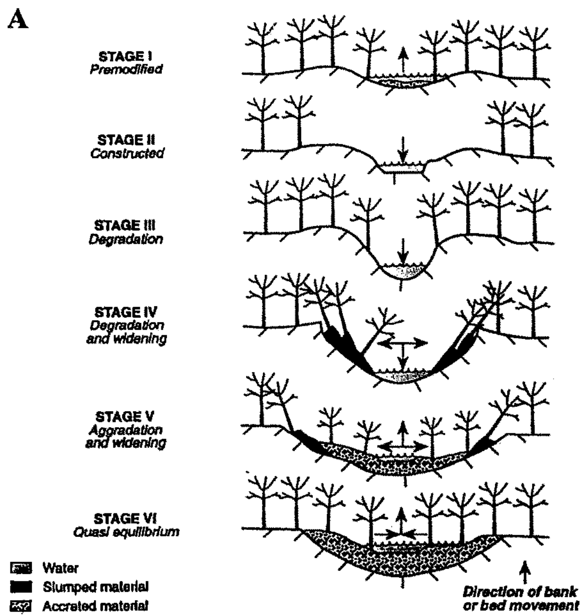


Figure 3. Potentiometric surface map, Fall 1990

3.5 GEOMORPHOLOGY

Since the 1800's, the ongoing geomorphic processes are the stream erosional degradation and sediment aggradation in both the uplands and American Bottom. The tributary streams will proceed through successional changes over time based on the forces placed upon them. This natural progression is depicted by the six stages of channel formation shown in Figure 3-7. The geology, which was formed over millions of years, will maintain its characteristics in spite of the activities of man. In the bluffs, this character includes deep loess cliffs that are highly erodible. This characteristic makes the bluff streams vulnerable to the effects of the changing bluff hydrology, which now produces larger, quicker runoff actions on the streams from the increasing amount of impervious surfaces. These effects are accelerating the successional changes and as a result, are creating instabilities that are adversely impacting infrastructure, stream quality, and floodplain drainage.

Figure 3-7 Six Stages of Channel Formation



A detailed discussion of sediment and erosion within the Project area are contained in Appendix E.

3.6 SURFICIAL SOILS

3.6.1 Alluvial Soils. The surficial alluvial soils that cover the American Bottom are related to their mode of river deposition. The alluvial soils are underlying glacial deposits from the Pleistocene Epoch. The alluvial soils vary in thickness from a few feet to 50+ feet. The soil classifications used for the alluvial soil types are based on the engineering Unified Classification System. The classification system identifies soils based on their grain size and cohesion characteristics. Sands are typically subdivided into well graded, poorly graded, and silty. Silts are subdivided as to whether they have high plasticity or low plasticity. The clays are generally subdivided as to whether they have high plasticity or low plasticity. Five alluvial soil types are identified by their depositional fluvial geomorphic process: abandoned channel, backswamp, point bar, chutes and bar deposits comprise the majority of the unconsolidated deposits and are described below:

Abandoned Channel Deposits. Abandoned channel deposits are predominately fine-grained sediments transported into the abandoned channel during periods of flooding. These deposits normally accumulate slowly and in thin layers. Soil types vary from silty sand (SM) to silt (ML) mixtures in the channel neck area to highly plastic fat clays (CH) common in the bendways. The predominate soil type found in the abandoned channel is fat clay (CH).

Backswamp Deposits. Backswamp sediments occur in thin layers deposited by the floodwaters that periodically deposited on the floodplain. The soil types found in the backswamp deposits vary from silty sand (SM) to fat clay (CH). The predominate soil type found in the backswamp deposits is lean clay (CL).

Point Bar Deposits. Point bar sediments extend as deep as the bottom of the old channel (thalweg). There are two main soil types within the point bar sand and silt in the elongated bar deposits or ridges deposited during rising river stages. Silty clay and fat clay were deposited in the depressions or swales during receding flood stages. Soil types found in point bar deposits vary from silty sand (SM) to fat clay (CH). The predominate soil type in the ridge areas is silty sand (SM). In the swale areas silty clay (CL) and fat clay (CH) are predominate soil types.

Chutes and Bar Deposits. Chutes and bar sediments form more irregular surface topography than point bar deposits. The chutes and bar deposits are graded at the base with sand and gravel and become finer with silty sand (SM) and sand (SP) toward the surface in the ridges and silty clay (CL) and fat clay (CH) in the chutes.

3.6.2 Upland Soils. The bluffs and uplands within the Project area are predominately glacial drift deposits and aeolian (wind deposited) loess deposits.

3.6.3 Soil Mapping Units.

3.6.3.1 General. The Natural Resources Conservation Service (NRCS) has completed their soil surveys for Madison County and St. Clair County that characterize the upper 60 inches of soil. The soil surveys are very detailed and useful in defining soil types to assist in agricultural planning and operations and also in delineating wetlands and creating wetlands. Tables 3-22 and 3-23 summarize the NRCS soil classifications in the floodplain and uplands.

Table 3-22 Floodplain Soil Mapping Units in the Study Area

Floodplain Soil Mapping Units	Area (acres)	% Of Area	% of Accumulative Area
Darwin silty clay, 0 to 2 percent slopes	16,521.7	29.00	29.00
Shaffton clay loam, 0 to 2 percent slopes	6,462.0	11.34	40.34
Landes very fine sandy loam, 2 to 5 percent slopes	4,563.2	8.01	48.35
Water	4,058.5	7.12	55.47
Urban land	2,633.3	4.62	60.10
Dupo silt loam, 0 to 2 percent slopes	2,281.0	4.00	64.10
Orthents, loamy, undulating	2,273.3	3.99	68.09
Nameoki silty clay, 0 to 3 percent slopes	2,100.0	3.69	71.78
Worthen silt loam, 0 to 5 percent slopes	1,887.7	3.31	75.09
Beaucoup silty clay loam, 0 to 2 percent slopes	1,682.8	2.95	78.04
Tice silty clay loam, 0 to 2 percent slopes	1,511.2	2.65	80.69
Fluvaquents, loamy, 0 to 2 percent slopes	1,463.4	2.57	83.26
Fults silty clay, 0 to 2 percent slopes	1,407.4	2.47	85.73
Dozaville, 0 to 2 percent slopes	1,003.2	1.76	87.49
Birds silt loam, 0 to 2 percent slopes	878.2	1.54	89.03
McFain silty clay loam, 0 to 2 percent slopes	819.6	1.44	90.47
Wakeland silt loam, 0 to 2 percent slopes	816.2	1.43	91.90
Littleton silt loam, 0 to 2 percent slopes	565.6	0.99	92.89
Bloomfield loamy fine sand, 1 to 3 percent slopes	551.1	0.97	93.86
Onarga sandy loam, 0 to 3 percent slopes	327.9	0.58	94.44
Ambraw loam, 0 to 2 percent slopes	312.4	0.55	94.98
Dumps	304.7	0.53	95.51
Wilbur silt loam, 0 to 2 percent slopes	344.0	0.60	96.11
Oakville fine sand, 2 to 10 percent slopes	251.9	0.44	96.55
Orion silt loam, 0 to 2 percent slopes	246.6	0.43	96.98
Haymond silt loam, 0 to 2 percent slopes	234.4	0.41	97.40
Rocher loam, 0 to 5 percent slopes	235.3	0.41	97.81
Arenzville silt loam, 0 to 2 percent slopes	213.1	0.37	98.18
Gorham silty clay loam, 0 to 2 percent slopes	207.3	0.36	98.54

Table 3-22 Continued

Floodplain Soil Mapping Units	Area (acres)	% Of Area	% of Accumulative Area
Ridgeville fine sandy loam, 0 to 2 percent slopes	160.7	0.28	98.83
Drury silt loam, 2 to 5 percent slopes	150.1	0.26	99.09
Pits, gravel	69.7	0.12	99.21
Raddle silt loam, 0 to 3 percent slopes	59.4	0.10	99.32
La Hogue loam, 0 to 3 percent slopes	58.7	0.10	99.42
Otter silt loam, 0 to 2 percent slopes	54.4	0.10	99.51
Bartelso silt loam, 0 to 2 percent slopes	46.7	0.08	99.60
Aquents, clayey, 0 to 2 percent slopes	42.5	0.07	99.67
Riley clay loam, 0 to 3 percent slopes	30.1	0.05	99.72
Hurst silt loam, 0 to 10 percent slopes	36.6	0.06	99.78
Colp silty clay loam, 5 to 10 percent slopes	24.8	0.05	99.83
Sylvan-Bold silt loams, 18 to 60 percent slopes	40.9	0.07	99.90
Okaw silt loam, 0 to 2 percent slopes	13.6	0.02	99.93
Ridgway silt loam, 2 to 5 percent slopes	7.9	0.01	99.94
Haynie silt loam, 0 to 2 percent slopes	6.8	0.01	99.95
Bold silt loam, 15 to 30 percent slopes	1.0	0.00	99.96
Menfro silt loam, 5 to 35 percent slopes	1.1	0.00	99.96
Floodplain Total	56,962.0	100.00	

Table 3-23 Upland Soil Mapping Units in the Study Area

Upland Soil Mapping Units	Area (acres)	% of Area	% of Accumulative Area
Menfro silt loam, 2 to 60 percent slopes	18,826.5	37.90	37.90
Sylvan-Bold silt loams, 18 to 60 percent slopes	10,869.9	21.88	59.78
Winfield silty clay loam, 2 to 20 percent slopes	8,409.0	16.93	76.71
Edwardsville silt loam, 0 to 5 percent slopes	1,926.9	3.88	80.59
Wakeland silt loam, 0 to 2 percent slopes	1,906.0	3.84	84.43
Downsouth silt loam, 2 to 5 percent slopes	879.5	1.77	86.20
Bethalto silt loam, 0 to 5 percent slopes	864.2	1.74	87.94
Mascoutah silty clay loam, 0 to 2 percent slopes	840.6	1.69	89.63
Orthents, silty, steep	802.9	1.62	91.25

Table 3-23 Continued

Upland Major Soils Mapping Units Soil Name	Area (acres)	% of Area (%)	% of Accumulative Area (%)
Wilbur silt loam, 0 to 2 percent slopes	736.8	1.48	92.73
Caseyville silt loam, 0 to 5 percent slopes	547.6	1.10	93.83
Water	456.5	0.92	94.75
Sylvan silty clay loam, 10 to 15 percent slopes	433.8	0.87	95.62
Worthen silt loam, 0 to 5 percent slopes	412.0	0.83	96.45
Drury silt loam, 2 to 5 percent slopes	391.2	0.79	97.24
Orion silt loam, 0 to 2 percent slopes	345.3	0.69	97.94
Wakenda silt loam, 2 to 10 percent slopes	249.6	0.50	98.44
Birds silt loam, 0 to 2 percent slopes	238.4	0.48	98.92
Urban land	221.0	0.44	99.36
Littleton silt loam, 0 to 2 percent slopes	72.5	0.15	99.51
Dumps	49.4	0.10	99.61
Bloomfield loamy fine sand, 1 to 3 percent slopes	37.6	0.08	99.68
Bold silt loam, 15 to 30 percent slopes	33.7	0.07	99.75
Arenzville silt loam, 0 to 2 percent slopes	24.2	0.05	99.80
Virden silt loam, 0 to 2 percent slopes	21.7	0.04	99.84
Shaffton-Urban land complex, 0 to 2 percent slopes	18.4	0.04	99.88
Haymond silt loam, 0 to 2 percent slopes	15.2	0.03	99.91
Otter silt loam, 0 to 2 percent slopes	14.2	0.03	99.94
Pierron silt loam, 0 to 2 percent slopes	9.6	0.02	99.96
Dupo silt loam, 0 to 2 percent slopes	6.3	0.01	99.97
Marine silt loam, 0 to 2 percent slopes	5.8	0.01	99.98
Beaucoup silty clay loam, 0 to 2 percent slopes	4.5	0.01	99.99
McFain silty clay loam, 0 to 2 percent slopes	3.9	0.01	100.00
Upland Total	49,674.4	100.00	

3.7 CLIMATE AND WEATHER

The Project area is located directly across the Mississippi River from the city of St. Louis. This is near the confluence of the Missouri and Mississippi Rivers and is also near the geographical center of the United States. Because of its central U.S. location, St. Louis feels the effects of warm moist air moving north from the Gulf of Mexico and the cold air masses moving south from Canada. The conflict along the frontal zones of these invading air masses provides a variety of weather conditions.

Winters are brisk with temperatures dropping to zero or below generally only two or three days per year. The record low temperature at the current weather station site is -18 degrees F, occurring in January 1985, although temperatures as low as -22 degrees F have been measured at other area sites. Snowfall averages about 20 inches per season. Daily temperatures of 32 degrees or less occur less than 25 days per year, while temperatures of 90 degrees F or higher occur about 35-40 days a year. The record high temperature for the area is 115 degrees F, occurring in July 1954. Temperatures exceeding 100 degrees F occur every other year generally, although some years may see 15 or more days with temperatures exceeding 100 degrees F. The prevailing wind direction is from the south for May through November and from the northwest for December through April.

Precipitation averages about 36 inches per year. The winter months are the driest while the months of May through July are the wettest. Rainfall can be severe at times with as much as eight inches of rain recorded in a 24-hour period in 1957. Thunderstorms occur between 40 and 50 days per year, with a few being severe, causing hail and damaging winds. Tornadoes have produced damage and loss of life in the St. Louis area. Climatological data for the area are summarized in Table 3-24. Data were collected at the National Weather Service meteorological station at Lambert-St. Louis International Airport.

An important condition affecting precipitation in the Project area of Madison and St. Clair counties in Illinois is the St. Louis urban effect. Studies by the Illinois State Water Survey have shown substantial increases in rainfall downwind of the City of St. Louis. The increases tend to be the largest in relatively heavy rainstorms and most pronounced in spring and summer when most of the large rainstorms occur. Frequency rainfall values for Madison and St. Clair Counties used in this Project have been adjusted to account for the St. Louis urban effect.

Table 3-24 Climatological Data for St. Louis, Missouri.

Month	Temperature (°F)			Precipitation Average (Inches)	Wind Velocity (mph)	Wind Direction
	Average Daily		Average Monthly			
	Min	Max	Mean			
January	19.9	37.6	28.8	1.90	10.6	NW
February	24.5	43.1	33.8	2.14	10.8	NW
March	33.0	53.4	43.2	3.36	11.8	WNW
April	45.1	67.1	56.1	3.63	11.4	WNW
May	54.7	76.4	65.6	3.93	9.5	S
June	64.3	85.2	74.8	3.78	8.8	S
July	68.8	89.0	78.9	3.99	8.0	S
August	66.6	87.4	77.0	2.78	7.6	S
September	58.6	80.7	69.7	2.85	8.1	S
October	46.7	69.1	57.9	2.77	8.9	S
November	35.1	54.0	44.6	3.13	10.1	S
December	25.7	42.6	34.2	2.54	10.4	WNW
Annual	45.3	65.5	55.4	36.66	9.7	S

Source: NOAA 1992, Local Climatological Data of St. Louis, Missouri and NWS 1995, St. Louis WSCMO AP, St. Louis County, Missouri.

3.8 AIR QUALITY

Air Quality information was prepared under a cooperation agreement, by the USEPA Region 5. Appendix F provides the criteria and definitions utilized to assess air quality for a given area. The Project area is located to the east of St. Louis, within the Metropolitan St. Louis Interstate Air Quality Control Region (AQCR). This AQCR covers part of Missouri and Illinois. Areas within the AQCR are further defined according to the attainment status of criteria pollutants. The Metropolitan St. Louis AQCR includes the Illinois counties of Madison, Monroe, and St. Clair, which are referred to as the Metro-East Nonattainment Area (IEPA, 1995). The Metro-East Nonattainment Area is a moderate nonattainment area for ozone. The Project area is in attainment for most of the criteria pollutants, sulfur dioxide, particulate matter, carbon monoxide, nitrogen dioxide, and lead. The area is "nonattainment" for the pollutant ozone and is classified as moderate. A portion of the area is also a "maintenance" area for particulate matter. The townships of Granite City and Nameoki are "maintenance" for PM10. Appendix F provides further information on this classification.

3.9 NOISE

Noise is not considered to be an issue in the preparation of this General Re-evaluation Report. The Project area spans some 266 square miles, which includes industrial, transportation, recreational, residential, retail and agricultural zones. Each of these areas, which are dispersed in pockets of varying sizes and density, make their own contribution to the noise characteristics of the region. The agricultural and open space areas would be expected to have typical noise levels in the range of 34-70 decibels (dB) depending on their proximity to transportation arteries. The use of farm equipment, transport trucks, heavy equipment, tractors, plows, irrigation equipment, and railroad lines, would be expected to provide dominant background noise in the rural areas. Noise associated with transportation arteries such as highways, railroads, airports etc., inherent in areas of higher population would be significant and probably override those sounds associated with natural emissions. Other sources of noise would be expected to include noise from everyday activities, operation of construction and landscaping equipment, and operations of commercial and industrial facilities. In general, urban emissions are not being expected to exceed about 60 dB, but may attain 90 dB or greater in busier urban areas or near frequently used, high volume transportation arties.

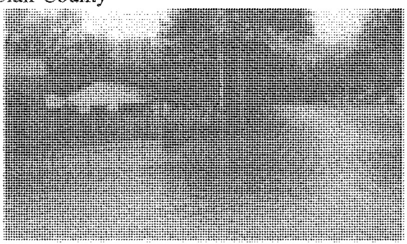
3.10 SURFACE WATER – FLOODPLAIN MANAGEMENT

Surface water-floodplain management has been a challenge for the inhabitants of the bottoms since the early 1900s when the push began in earnest to farm the rich land and develop for industry and commerce the area that sits on the river at the crossroads of the nation. With the diversion of Cahokia Creek and the construction of the Mississippi River levee system, the challenge of taking the remaining surface water from the bluffs to the river, while protecting the intermediate area from flooding, has yet to be met. As early as 1905 the problem of managing interior flooding was sited as being key to the future development of the area. By 1908, construction had begun on a canal system that was designed to manage this surface water as it traveled from the bluff to the river. The system instituted during this period is the same system that is in service today with only minor changes. Past urbanization of the area and climactic changes have increased significantly the peak volume this original system is now expected to contain.

However, no alteration of the system has occurred to increase its capacity. In the bluff area the tributary streams are still in existence, however on the floodplain essentially no natural streams remain. The construction of the interior flood control system eliminated the floodplain streams and in the process severed the once important hydrological connection between the tributary streams and floodplain wetlands.

When storm events exceed the capacity of the interior flood protection system it is overtopped on the floodplain. The result is severe flooding when rainfall events of moderate intensity occur. Figure 3-8 shows the results of these events.

Figure 3-8 Flooding in St. Clair County



3.10.1 Surface Water.

3.10.1.1 Drainage System. As detailed in the earlier discussion on drainage, natural surface water courses have been altered since pre-settlement times to attempt to carry water as quickly and directly as possible from the base of the bluffs to the river. To this end, eighteen principal ditches, canals and streams traverse the area under study. This combination of streams in the bluffs, and ditches and canals in the bottoms, forms today's storm water drainage/management system to carry water from the bluffs to the Mississippi River. Figure 3-9 shows a typical drainage canal seen across the Project area.

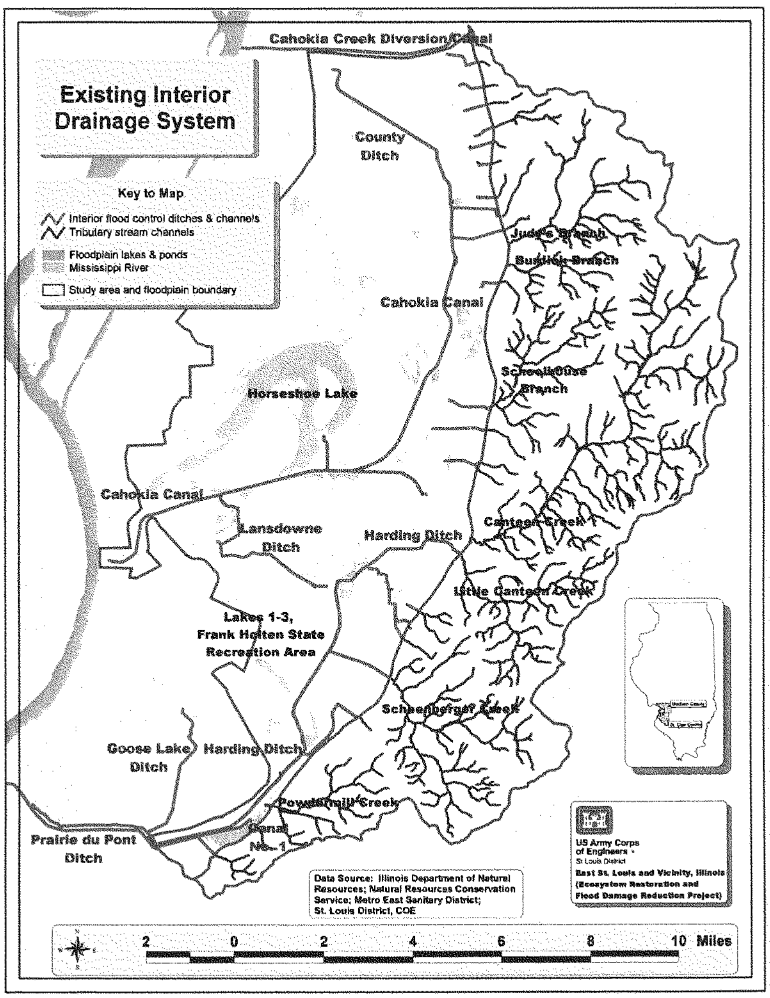
Figure 3-9 Canal System

In addition to those listed below, there are many lateral ditches and farm ditches. The locations of the principal watercourses are indicated on Figure 3-10. The principal watercourses are described as follows:

3.10.1.1.1 County Ditch. County Ditch originates in the bottomland area in the vicinity of the intersection of the Gulf, Mobile & Ohio Railroad and the Cahokia Creek Diversion Channel in the extreme northern end of the Project area and flows generally in a southeasterly direction to converge with Cahokia Canal at Illinois State Highway 162. The ditch is approximately 5.6 miles long with an average channel slope of 1.8 feet/mile. County Ditch is completely man-made and as such, was not a modified natural stream.

3.10.1.1.2 Cahokia Canal. Cahokia Canal originates in the bottomland area at the point of confluence of County Ditch and Judy's Branch. It flows generally in a southwesterly direction for an approximate distance of 12.4 miles, and terminates at the North Pumping Station. The channel has an average channel slope of 1.8 feet per mile. The cross-sectional area of the canal varies from 1,000 square feet minimum at the origin to 2,120 square feet maximum at its terminus. Of the total of 75,333 acres that drain into Cahokia Canal, 43,841 acres are bottomland and 31,492 acres are upland. Currently, within the Metro East Sanitary District, the channel is in fair condition. The original Cahokia Creek, located downstream of the diversion cutoff, was straightened and realigned to flow past the southern end of Horseshoe Lake and under the stockyards through three very long, large, box culverts to its relocated confluence with the Mississippi River at Mile 180.6. After Cahokia Creek was modified to a constructed channel, it became known as Cahokia Canal.

Figure 3-10 Project Area - Drainage System



3.10.1.1.3 Judy's Branch. Judy's Branch originates in the uplands and enters the bottomland area at Highway 157 in the northeastern part of the Project area. It flows in a southwesterly direction, parallel to the Norfolk and Western and Illinois Central Railroads, and discharges into the upper end of Cahokia Canal. Judy's Branch has a drainage area of 8.6 square miles and an average slope of 30 feet per mile. The natural stream changes to a channelized ditch approximately 3500 feet downstream of Highway 157.

3.10.1.1.4 Burdick Branch. Burdick Branch originates in the uplands area and discharges into Cahokia Canal just south of Judy's Branch. The stream enters the bottomland at Highway 157 and changes from a natural channel to a channelized ditch approximately 3000 feet downstream of Highway 157. Burdick Branch has a drainage area of 2.8 square miles and an average slope of 43 feet per mile.

3.10.1.1.5 Schoolhouse Branch. Schoolhouse Branch originates in the uplands and enters the bottomland area at Highway 157 in the eastern part of the Project area. The bottomland reach is a channelized ditch which flows westerly and parallels the Illinois Terminal Railroad until it discharges into Cahokia Canal south of McDonough Lake. Schoolhouse Branch has a drainage area of 7.2 square miles and an average slope of 30 feet per mile.

3.10.1.1.6 Canteen Creek. Canteen Creek originates in the uplands and enters the bottomland area at Highway 157 through the northern section of Caseyville, Illinois. The bottomland reach is a channelized ditch flows in a northwesterly direction and discharges into Cahokia Canal just east of the Horseshoe Lake control works. Canteen Creek has a drainage area of 22.6 square miles with an average slope of 17.4 feet per mile.

3.10.1.1.7 Horseshoe Lake Canal. Horseshoe Lake Canal is a zero grade floodway interconnecting Cahokia Canal and Horseshoe Lake. The channel provides access to divert water to or from Horseshoe Lake which functions as a storage area for flows into Cahokia Canal. Historically, Cahokia Creek flowed into and out of the southern end of Horseshoe Lake. After Cahokia Creek was straightened and re-aligned (then Cahokia Canal), the man-made Horseshoe Lake Diversion Canal was constructed to reconnect the lake and the canal. In addition to the connecting canal, a gated control structure on Cahokia Canal immediately downstream of the connecting canal was also built to enhance the flood retention ability of Horseshoe Lake.

3.10.1.1.8 Lansdowne Ditch. Originally, Lansdowne Ditch was a portion of Schoenberger Creek in the bottoms. It begins just east of the Alton and Southern Railroad in the vicinity of Spring Lake and flows northwesterly and discharges into Cahokia Canal downstream from the Horseshoe Lake control works. When the upper Harding Ditch levees are overtopped, flow from Harding enters Lansdowne Ditch through the culvert openings under the Alton and Southern Railroad track.

3.10.1.1.9 Nameoki Ditch. Nameoki Ditch originates in the bottomland areas in the vicinity of Granite City, Illinois, and flows in a southerly direction through the eastern section of Granite City and discharges into Horseshoe Lake. Nameoki Ditch is a man-made channel built to provide storm drainage for the eastern portion of the city of Granite City.

3.10.1.1.10 Long Lake Ditch. Long Lake Ditch originates in the bottomland area downstream of the Norfolk and Western Railroad crossing of Long Lake. Generally, this ditch flows southerly and discharges into Horseshoe Lake via Elm Slough. The Long Lake ditch is a man-made channel built by the Metro-East Sanitary District to shorten the flow path to Horseshoe Lake.

3.10.1.1.11 Mitchell Ditch. Mitchell Ditch originates in the bottomland area in the northern section of the Project area adjacent to the Norfolk and Western Railroad and flows in a southeasterly direction into lower Long Lake. Mitchell Ditch is a man-made channel that drains the community of Mitchell and a large area of agricultural land.

3.10.1.1.12 Harding Ditch. The Harding Ditch drainage area lies in the eastern part of the American Bottom. It originates in the vicinity of Caseyville, Illinois where Little Canteen Creek enters the bottoms. Harding Ditch flows in a generally southerly direction through a section of East St. Louis and then passes through Frank Holten State Park for a distance of 6.8 miles. The outflow from the State Park then enters lower Harding Ditch and flows 4.1 Miles to the South Pumping Station. The average channel slope on Harding Ditch is approximately 2 feet/mile. Schoenberger Creek enters the American Bottom at the community of French Village, flows westerly and enters Harding Ditch 0.9 Miles upstream of Frank Holten State Park. The drainage area includes 10,900 acres of bottomland and 16,050 acres of upland. Thirteen roads and four railroads cross Harding Ditch. The road crossings include Black Lane, Forest Blvd., Bunkum Road, 1-64, Rock Road, St. Clair Avenue (U.S. Highway 50), Marybell Avenue, State Street, Lake Drive, Illinois Highway 15, Illinois Highway 13, Corners Avenue, and Illinois Highway 163. The four railroad crossings are the CSX Railroad, the Metro-Link Light Rail, Southern Railroad and the Illinois Central Railroad. All of the crossings are bridges. The Harding Ditch is an entirely man-made channel built to intercept all hillside drainage from Little Canteen Creek south to Prairie Du Pont Creek.

3.10.1.1.13 Canal No. 1. Canal No. 1 is a large drainage channel in the southern part of the Project area. It is fed by the hillside runoff from Powdermill Creek that enters the American Bottom downstream of Frank Holten State Park. Canal No. 1 flows parallel, and adjacent to, Harding Ditch for 2.8 miles and exits the Project area at the Canal No. 1 Pumping Station located at the Prairie Du Pont Diversion Channel. Canal No. 1 drains 3,200 acres of uplands and 850 acres of bottomland. The canal has an average channel slope of 2.6 feet/mile. One road crosses Canal No. 1 at Illinois Highway 163. Siltation is a problem at Canal No. 1. Lack of sufficient maintenance has allowed excessive growth to occur in the Canal thereby reducing its effective flow area. Canal No. 1 is an entirely man-made channel which was originally intended to intercept Schoenberger Creek near the bluff line with the intention of relieving Harding Ditch of becoming overloaded from the Shoenberger Creek flows.

3.10.1.1.14 Little Canteen Creek. Little Canteen Creek originates in the uplands in the upper portion of the Project area and enters the bottomland through the city of Caseyville, Illinois. The stream converges into Harding Ditch at the Baltimore and Ohio Railroad crossing. The reach of Little Canteen Creek between Long Street and its convergence with Harding Ditch has been channelized. Little Canteen Creek drains 5,095 acres and has an average channel slope of 32 feet per mile.

3.10.1.1.15 Schoenberger Creek. Schoenberger Creek originates in the uplands just below the Little Canteen Creek watershed and enters the bottomland at the community of French Village. The bottomland reach at Highway 157 is a channelized ditch that flows northwest parallel to U.S. Highway 50 and discharges into Harding Ditch 0.9 miles upstream of Frank Holten State Park. Schoenberger Creek drains 7,700 acres and has an average channel slope of 31 feet per mile.

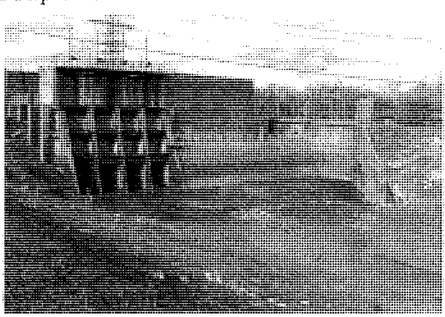
3.10.1.1.16 Powdermill Creek. Powdermill Creek originates in the uplands in the southern part of the Project area where it enters the bottomland area and flows directly into Canal No. 1 in the vicinity of the Illinois Central Railroad. Powdermill Creek has a hillside drainage area of 2,765 acres and has an average channel slope of 54 feet/mile.

3.10.1.1.17 Prairie Du Pont Creek. Prairie Du Pont Creek flows out of the hillside in the southern-most part of the Project area. It has a drainage area of 38.5 square miles and an average channel slope of 17.6 feet per mile. When the flow reaches the bottoms, it is channeled to the Mississippi River between 5.1 miles of flank levees. This channelized portion is known as the Prairie Du Pont Diversion Channel. Discharge from Harding Ditch, Canal No. 1, and Blue Waters Ditch enter the Diversion Channel through either gravity drains or by pumping.

3.10.1.1.18 Additional Ditches. In addition to the principal channels described above, there are numerous small farm ditches and urban ditches which are in place to remove local runoff as well as to channelize bluff runoff through the bottomland.

3.10.1.2 Pumping Facilities. The 19 existing pump stations that form the floodplain storm water management system in the Project area are of two types. There are 14 perimeter levee pump stations and five internal pump stations within the limits of the Metro East Sanitary District (MESD). The figure shows the perimeter North Pump Station that receives its flow from the Cahokia Canal. In addition, there is one pump station along the Chain of Rocks Canal levee in the Chouteau, Nameoki and Venice Drainage and Levee District. It has three pumps with a combined capacity of 78 c.f.s. at a static head of 18 feet. Figure 3-11 shows one of the perimeter levee pump station situated on Cahokia Canal.

Figure 3-11 North Pump Station



The types, locations, capacities, number of pumps and operating jurisdiction are as follows:

3.10.1.2.1 Cahokia Pumping Station. This perimeter levee pump station is located at levee station 1315+16. There are two storm pumps in the station. One has a capacity of 31.4 c.f.s. at 20.0 t.d.h. (total dynamic head), and the other has a capacity of 60.1 c.f.s. at 15.4 t.d.h. The station is operated by the MESD.

3.10.1.2.2 Illinois Department of Transportation Station. This internal pump station is located at Harding Ditch just south of Forest Blvd. The station has two pumps with an estimated capacity of 44 c.f.s. at 16 t.d.h.

3.10.1.2.3 East St. Louis Pumping Station. This perimeter levee pump station is located at levee station 1110+50. There are three storm pumps in the station with a combined capacity of 1285.0 c.f.s. at 23.1 t.d.h. A municipality operates the station.

3.10.1.2.4 Fairmount Jockey Club Station. This internal pump station is located near the Fairmount Race Track and removes excess rainfall from the immediate area by discharging it into Canteen Creek. The station has two storm pumps with an estimated capacity of 12.5 c.f.s. at 5.0 t.d.h. Private interests operate the station.

3.10.1.2.5 Granite City Engineer Deport Lift Pumping Station. This perimeter levee pump station is located at levee station 798+16. There is a total of four storm water pumps with a combined capacity of 66.7 c.f.s. at 43.0 t.d.h. The Federal Government operates the station.

3.10.1.2.6 Granite City Seepage Pumping Station No. 1. This perimeter levee pump station is located at levee station 782+39. There are two storm water pumps in the station with a combined capacity of 11.1 c.f.s. at 33.0 t.d.h. The station is operated by the MESD.

3.10.1.2.7 Granite City Seepage Pumping Station No. 2. This perimeter levee pump station is located at levee station 814+65. There are two storm water pumps in the station with a combined capacity of 16.0 c.f.s. at 35.0 t.d.h. The station is operated by the MESD.

3.10.1.2.8 Granite City Seepage Pumping Station No. 3. This perimeter levee pump station is located at levee station 846+18. There are two storm water pumps in the station with a combined capacity of 11.1 c.f.s. at 33.0 t.d.h. The station is operated by the MESD.

3.10.1.2.9 Granite City Pumping Station. This perimeter levee pump station is located at Chain of Rocks Canal Station 46+70. There are four storm water pumps with a combined capacity of 406.0 c.f.s. at 43.0 t.d.h. The Federal Government operates the station.

3.10.1.2.10 Madison Pumping Station. This perimeter levee pump station is located at levee station 862+66. There are three storm water pumps in the station with a combined capacity estimated as 360.0 c.f.s. at 16.4 t.d.h. The station is operated by the MESD.

3.10.1.2.11 Monsanto Pumping Station. This perimeter levee pump station is located at levee station 115+90. There are six combined sewer pumps with a combined capacity of 154 c.f.s. at 38.5 t.d.h. The station is operated by the MESD.

3.10.1.2.12 North Pumping Station. This perimeter levee pump station is located at levee station 1009+00. There are five storm water pumps in the station with a combined capacity of 1396 c.f.s. at 14.8 t.d.h. The station is operated by the MESD.

3.10.1.2.13 Park Side Pumping Station. This internal pump station is located south of State Street and east of Harding Ditch and serves the adjacent area with discharge into Harding Ditch. There are two storm water pumps in the station with a combined capacity of 17.8 c.f.s. at 30.0 t.d.h. The station is operated by the City of East St. Louis.

3.10.1.2.14 Phillips Oil Co. Seepage Pumping Station. This perimeter pump station is located at levee station 1225+64. There are two storm water pumps in the station with a combined capacity of 22.0 c.f.s. at 33.7 t.d.h. The station is operated by the MESD.

3.10.1.2.15 South Pumping Station. This perimeter pump station is located at levee station 1505+50. There are four storm water pumps with a combined capacity of 528.0 c.f.s. at 15.2 foot static head. The station is operated by the MESD.

3.10.1.2.16 Canal No. 1 Pumping Station. This perimeter pump station is located at levee station 1511+30. There are three storm water pumps with a combined capacity of 130.0 c.f.s. at 12.0 foot static head. The station is operated by the MESD.

3.10.1.2.17 Venice Pumping Station. This perimeter pump station is located at levee station 891+22. There are three storm water pumps with a combined capacity of 90.0 c.f.s. at 40.0 t.d.h. The station is operated by the MESD.

3.10.1.2.18 Caseyville Station. This internal pump station is located near the Harding Ditch levee and serves an area in Caseyville by discharging into Harding Ditch. There is one storm water pump with a capacity of 1.7 c-f-s. A municipality operates the station.

3.10.1.2.19 Chouteau, Nameoki, and Venice. This perimeter pump station is located on the Chain of Rocks Canal. There are three storm water pumps with a total capacity of 78 c.f.s. at 18.0 t.d.h. The Chouteau, Nameoki, and Venice District's operate the station.

3.10.1.2.20 Existing Natural Detention Areas. Many lakes and sloughs in the Project area function as detention areas. Those areas that are part of the existing design systems are Horseshoe Lake and Frank Holten Lakes. The remaining detention areas are not currently dedicated for that purpose in the existing system but do provide detention storage. They are: Spring Lake; Crooked Lake; Upper and Lower McDonough Lakes; Elm Slough; Edelhardt Lake; Long Lake; and, Dobrey Slough.

3.10.2 Floodplain Management. Floodplain management is divided among the four drainage districts on the floodplain that have responsibility for the operation and maintenance of the canal and ditch system as well as the pumping facilities associated with them. Additionally, the county for unincorporated areas and each municipality have responsibility for floodplain management within their area of responsibility. This management responsibility takes the form of ordinance enforcement and the issuance of permits for any disruptive activity (i.e.: construction) that occurs within the drainage system, all within the context of the regulation of the federal flood insurance program.

The Federal and State Emergency Management Agencies also form a review and approval tier in the floodplain management process, as does the Corps of Engineers with its oversight responsibility for the Section 404 permit program. As in any urban setting where watersheds cross county and municipal boundaries, the effective management of the floodplain is a constant challenge.

The formation of the Metro East Regional Stormwater Committee has been an attempt on the part of the floodplain communities to address these challenges. The Metro East Regional Storm Water Committee charter envisions a region in which properly managed storm water leads to a higher quality of life for the residents and better protection for the overall environment.

In order to make this vision possible, the Committee has undertaken an effort to provide a general framework for the development and implementation of comprehensive storm water management in the area. It is this Committee that has participated throughout the Project process to provide a public and political forum for the Project formulation, assessment, and evaluation process. During this Project process, the Committee has worked for the adoption of comprehensive standardized Stormwater Management Ordnance. On February 3, 2000 Madison County adopted a comprehensive storm water management ordinance designed to achieve these goals. In St. Clair County, a similar ordinance has been formulated and its adoption is pending. The roll of this Regional Committee has been one of education, influence and maintaining focus. While its successes have been many, it is still working on behalf of the goal of regionalized comprehensive stormwater management.

3.11 WATER QUALITY

The Project area is within the watershed system referred to as the American Bottom Basin and/or the Mississippi South Central River Watershed by the Illinois Environmental Protection Agency. The Mississippi South Central Watershed encompasses parts of Jersey, Macoupin, Madison, St. Clair, Monroe and Randolph Counties in Illinois. The Corps' project area encompasses a subset area of the Mississippi south Central Watershed consisting of parts of Madison and St. Clair Counties. Streams within the project area which were assessed from historical water quality data were 1) Cahokia Chute, 2) Canal #1, 3) Prairie Du Pont, 4) Harding Ditch, 5) Cahokia Canal, 6) Canteen Creek, 7) Judy's Branch, 8) Cahokia Creek, 9) Indian Creek, and 10) Little Mooney Creek. Surface lakes assessed within the project area were the Horseshoe Lake, the three Frank Holten State Park Lakes, Dunlap Lake, Mt. Olive (Old) Lake, Weslake, Holiday Shores, and Edward and Thompson Farm Pond. A segment of the Mississippi River, which accepts the discharges from the project area, was also assessed by review of historical water quality data. A more in depth coverage of this information is contained in Appendix F.

The streams, lakes and river in the Project area have been assessed on a wide variety of water quality parameters over time. None of the streams, lakes or river segments is pristine and, therefore, a common practice is to identify the causes of water quality impairment and the possible sources of impairment. The water quality conditions of each water body within Illinois are compared to the governing Illinois Water Quality Standards as set up by the Illinois Environmental Projection Agency. The water quality standards vary by designated use of the water body.

The issue of classification of an area's water quality is complex in light of the fact that water systems will have varying use designations, impairments and impairment sources. The focus of this water quality assessment in light of the complexity of water quality classification has been to address the identified impairments and impairment sources based on historical water quality data within the project area. The lakes, ponds, streams and canal system within the project area are currently receiving waters, which have been impaired by multiple sources.

These areas are individually addressed in Appendix F. Overall general causes of impairment in the Project area include the following:

1. Priority Organic Contaminants
2. Metals Contaminants
3. Nutrient Enrichment (i.e., phosphorus, nitrogen, nitrates)
4. Siltation
5. Organic Enrichment/Low Dissolved Oxygen
6. Habitat Alteration
7. Suspended Solids
8. Excessive Algae
9. Noxious Aquatic Plants

The sources of impairment to water quality within the Project area vary widely from urban to industrial to agricultural. The following list of impairment sources is commonly found to be associated with most of the watersheds in the Project area.

1. Agricultural Operations
2. Construction/Land Development/Commercialization/Urbanization
3. Urban/Stormwater Runoff
4. Hydrologic/Habitat Modification via Channelization
5. Land disposal/Septic Tanks
6. Streambank Erosion

3.11.1 Groundwater Conditions in the American Bottom. As described earlier in this section, the bottoms portion of the Project area is part of the larger area known as the American Bottom. The valley fill, situated over bedrock, is composed of glacial (sands and gravels) and alluvium (sands, gravels, silts, and clay) materials. The average depth of the valley fill is 120 feet. This alluvial and glacial valley fill contains the large American Bottom aquifer. The groundwater in the aquifer is a dynamic system constantly changing in response to variations in the level of the Mississippi River, rainfall-infiltration, and man-induced ditching and pumping.

In contrast to surface water flow, groundwater flow in the aquifer is a relatively slow process since the groundwater flow must move through the valley fill. Thus, groundwater levels vary primarily with seasonal and long-term variations in river levels, rainfall, and pumpage. Most of the rainfall-infiltration naturally flowing into the aquifer comes from rainfall directly on the bottoms. About one-fifth of the water comes from groundwater and surface runoff from the bluffs. The groundwater in the bottoms then flows slowly westward and exits into the Mississippi River under normal circumstances. Under high Mississippi River levels, groundwater movement can be away from the River toward the interior. Combining above-average rainfall and long-duration high river levels produces the highest groundwater levels.

3.11.1.1 Groundwater Trends Since the Turn of the Century. Prior to major development in the East St. Louis area, groundwater as high as a few feet below the surface was common. Development first led to levees and drainage ditches, which lowered groundwater levels from 2 to 12 feet. During the period 1900 to the early 1950's, groundwater pumpage, mostly industrial, increased drastically.

As a result of this pumping, water levels in the industrial and urban areas were lowered 40 to 60 feet. A prolonged drought between 1952 and 1956 contributed to even lower groundwater levels with the lowest level on record occurring in 1956. Because groundwater levels were so low, many industries abandoned their wells, especially in the Granite City area. Instead, they opted to withdraw water from the Mississippi River. This reduction in pumping plus the end of the severe drought conditions caused groundwater levels in Granite City to raise approximately 50 feet. In general though, average levels rose from 0 to 10 feet throughout the bottoms during this same period. For most of the 1960's, pumpage increased slightly with a maximum pumpage of 110 MGD in 1964. Average groundwater levels declined from 0 to 5 feet. Starting in the late 1960's, pumpage steadily declined, especially in the major pumping centers in the East St. Louis area until withdrawals were only about 45 MGD in 1981. Existing groundwater levels are generally a few feet to 12 feet below the surface.

3.11.1.2 Groundwater Flooding Problems. As mentioned above, high groundwater was common in the early 1900's. No significant problems related to groundwater were noted since the area was primarily agricultural and undeveloped. Development and pumping increased through the first half of the century, including a post-World War II surge in residential development, which happened to coincide with the 1950's drought conditions. As early as 1961, rising groundwater levels began causing some failure to sewers that were built "in the dry". Since 1969, reductions in pumpage and periods of high Mississippi River levels and/or higher than normal rainfall, has caused constant problems. Flooding of basements, structural damage to homes, sewer failures, and high rates of sewer infiltration has occurred. Major groundwater flooding problems occurred in 1969, 1973, 1974, 1979, 1982, 1986, and 1993 through 1995.

3.11.1.3 Groundwater Quality. Iron, manganese, and dissolved solids concentrations exceed Illinois public water supply, effluent, and general water-quality standards. Also some samples have indicated high concentrations of nitrate + nitrate nitrogen, fluoride, mercury, zinc, lead, and sulfate. In general, any groundwater in the American Bottom would need to be treated before being discharged into the interior surface water system. Industrial contamination of the groundwater aquifer has also occurred at specific locations in the area. The contamination consists of organics and heavy metals.

3.12 ECOLOGICAL AND NATURAL RESOURCES

This section describes existing ecological resources and conditions in the Project area. Because development has extensively modified the natural environment over the past 200 years, losses occurring in the Project area to historic natural communities are described first. Then the remaining natural communities – forests, prairies, wetlands, lakes and ponds, and streams – are described, class-by-class. For each class, ecological problems are presented, along with brief assessments of the resource's natural quality and quality as wildlife habitat. Following this, plant and animal species occurring in the Project area are described. Finally, areas with special ecological status as well as endangered and threatened species are identified.

3.12.1 Significance of Resources. Aquatic resources of national and regional significance are found in the Project area. They include aquatic features, such as 2,000-acre Horseshoe Lake, and over 6,000 acres of various wetlands on the Mississippi River's floodplain, as well as over 200 miles of streams in small tributary watersheds. The national and regional level of significance attributed to these resources comes from institutional and technical sources. Sources of significance for the Project area's aquatic resources are described below. Details concerning significant resources in the Project area and their sources of significance are included in Annex B.25 in Appendix B.

North American Waterfowl Management Plan. Aquatic resources on the Mississippi River's floodplain in the Project area, such as Horseshoe Lake and surrounding wetlands, serve as resting and feeding habitat for about 30 species of waterfowl during fall and spring migration along the Mississippi Flyway. A few of these waterfowl species also use these aquatic resources as breeding habitat. These resources occur in a waterfowl habitat area of major concern designated under the North American Waterfowl Management Plan. Approved in 1993 under the NAWMP, the Upper Mississippi River/Great Lakes Region Joint Venture encompasses this area of concern and addresses its waterfowl status and habitat needs.

Additionally, the Project area's aquatic resources exist within a priority or focus area bordering the Mississippi River in Illinois that was designated in the Joint Venture's Implementation Plan. Additional wetlands are to be restored in this focus area to protect migratory waterfowl. The NAWMP and the UMR/GLR Joint Venture institutionally recognize the significance of these resources from an international and national perspective. The Joint Venture's Implementation Plan institutionally recognizes their significance from a regional perspective.

Upper Mississippi River System Environmental Management Program. The Project area's aquatic resources that are located on the Mississippi River's floodplain are part of the Upper Mississippi River System. This river system is the only inland waterway in the U.S. formally recognized by Congress as a nationally significant ecosystem and commercial navigation system. The Upper Mississippi River System Environmental Management Program was established in 1986 to monitor, research, and restore UMRS habitats. A Habitat Needs Assessment prepared for the UMRS-EMP in 2000 concluded that floodplain prairies, hardwood forests, marshes, and deep backwaters are the most threatened habitats of the UMRS due to past habitat loss and continuing degradation.

The Assessment called for the restoration of these habitats along the Mississippi River, especially in the reach where the Project area lies (St. Louis to Cairo). Based on the HNA, most floodplain habitats in the Project area (prairies, bottomland forests, marshes, and deep backwaters) can be recognized as technically significant from a regional perspective because of their status and trends. These resources can be recognized as institutionally significant from a regional perspective because they are in an area of the UMRS targeted for habitat restoration under the UMR-EMP.

Clean Water Action Plan. Five small watersheds within the Project area have been designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan. The Plan was initiated in 1998 to revitalize the nation's commitment to water resources. In support of the Plan, the Illinois Environmental Protection Agency and Natural Resources Conservation Service assigned restoration priorities for small Illinois watersheds. Watershed restoration measures can improve water quality and also restore aquatic systems. Under the Clean Water Action Plan, streams of the Project area's watersheds, including those of tributary watersheds that drain into the Mississippi River's floodlpain, are recognized as institutionally significant from a national perspective.

Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is a partnership of Federal and state agencies and tribes committed to the development of a national strategy to reduce the frequency, duration, size and degree of oxygen depletion of the hypoxic zone of the northern Gulf of Mexico. Since the Project area is located on the floodplain of the Mississippi River north of the Ohio River, it occurs in an area highlighted by the Task Force's Action Plan as potentially important to contributing to the Action Plan's goal of reducing nitrogen loads to the Gulf of Mexico and improving waters within the Mississippi River's basin. To help reduce nitrogen levels, the Plan recommends that Federal agencies identify opportunities to restore floodplain wetlands along and adjacent to the Mississippi River. Under the Action Plan, the Project area and its aquatic resources can be recognized as institutionally significant from a regional perspective.

Species of Concern. Aquatic resources within the Project area serve as migratory, wintering, or breeding habitat for 34 migratory bird species of concern, and support two Federally threatened species, the Bald eagle and false decurrent aster. The cause of concern for these species is declining or low population levels. These bird species of concern comprise four major groups - waterfowl, waterbirds, shorebirds, and land birds. They have been the focus of a number of ongoing bird conservation initiatives and partnerships in North America that aim to protect declining species before they become endangered or threatened. Initiatives for these four bird groups include the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, and Neotropical Migratory Bird Conservation Program. Habitat restoration efforts at the national and regional levels are being developed under these plans to protect these species. The listing of these birds as species of concern by the U.S. Fish and Wildlife Service illustrates that the Federal government recognizes them as highly significant. Their institutional significance is further supported by various international agreements the Federal government has entered into with Canada, Mexico, and other countries to foster continental and regional bird conservation strategies.

Aquatic habitats in the Project area are technically significant because they provide connectivity for the seasonal movements of these 34 migratory bird species of concern. They are also technically significant because of their potential for recovery of two federally threatened species.

3.12.2 Loss of Historic Natural Communities. Natural resources in the Project area have undergone dramatic changes since 1800. These changes include significant reductions in the spatial extent of historic forests, prairies, wetlands, lakes and ponds, and streams. In this section, estimates of Project area losses of these classes of natural resources are presented, and compared to statewide and county-level losses when possible. Changes also include losses of some kinds of natural communities, such that the diversity of today's natural communities is less than what it was historically. Further details concerning losses of natural communities are included in Appendix B.

3.12.2.1 Forest. Estimates of forest losses in the Project area range from about 60 to 70 percent (Table 3-26). This level of loss has occurred in both floodplain and upland areas. Similar losses of forest have occurred in Illinois at the state and county level. Loss of historic forest for the state is estimated to be about 63 percent, and about 58 percent and 67 percent for Madison and St. Clair Counties (IDNR 1994, 1996). One of the nine types of natural forest communities that were present in the Project area in predevelopment times has disappeared (Table 3-25). All wet-mesic upland forest that occurred on the flat drainage divide in the headwater reaches of the Project area's tributary watersheds appears to be gone. No map has been prepared to illustrate forest losses because the map representing historic forests is too generalized to allow for an accurate spatial comparison with current forest conditions.

Table 3-25 Estimates of spatial loss for historic natural community classes in the Project area and its landforms. (1)

Community Class	% Loss			Data Sources (2) (current, historic)
	Project Area	Floodplain	Uplands	
Forest	59	68	54	(ILCD, INHS)
	70	63	72	(NLCD, INHS)
Prairie	~100	99.9	100	(IDNR, INHS)
Savanna	(100 if present historically)		(all in uplands)	(IDNR)
"Wetland" (3)	66	68	30	(ILCD, NRCS)
	69	71	33	(IWI, NRCS)
	85	86	72	(NLCD, NRCS)
Lake and Pond	36	all in floodplain		(NLCD, 1909)
	45			(ILCD, 1909)
	50			(NRCS, 1909)
	52			(IWI, 1909)
Stream	(not assessed)	66	(not assessed)	(1998, 1909)

(1) Estimates based on area for all classes except streams (based on length)

(2) Data sources representing current conditions for each class include: ILCD - Illinois Land Cover Database (IDNR 1996a); NLCD - National Land Cover Database (USEPA 2000a); IDNR - Sinkhole Plain Area Assessment (IDNR 1998); IWI - Illinois Wetland Inventory (Suloway and Hubbell 1994); NRCS - digital soil surveys of Madison and St. Clair Counties (NRCS 2000a,b); digital orthophoto quarter quads (INRGDC undated).For historic conditions, INHS - digital presettlement land cover, INHS (1998) and this study; NRCS - digital soils surveys of Madison and St. Clair Counties (NRCS 200a,b);

1909 - digital topographic maps of American Bottom from 1909, this study.

(3) Includes marsh, shrub swamp, wet-mesic upland forest, wet-mesic floodplain forest, wet floodplain forest, wet-mesic prairie, wet prairie, and pond.

3.12.2.2 Prairie. The most striking loss in the Project area is the virtual disappearance of prairie. Roughly 35,000 acres of historic prairie have been reduced to about 33 acres, which are confined to the floodplain. This equates to an overall loss of about 99.9 percent. Losses across Illinois, the "Prairie State", are 99.99 percent (IDNR 1994). At least half of Madison and St. Clair Counties was once prairie (IDNR 1998c), and countywide losses are also at the same level. Of the eight types of prairie natural communities that were present historically, six have disappeared – two from the floodplain and four from the uplands (Table 3-26). Because prairie losses have been so extensive, no separate map has been prepared to illustrate them.

Table 3-26 Status of INAI community classes and natural communities in the existing Project area, according to landform. (1)

Community Class	Natural Community (2)	Mississippi River floodplain (3)	Adjacent uplands (4)
Forest	Dry upland forest		?
	Dry-mesic upland forest		√
	Mesic upland forest		√
	*Wet-mesic upland forest		lost
	Mesic floodplain forest	√	√
	*Wet-mesic floodplain forest	√	√
	*Wet floodplain forest	√	?
	Mesic sand forest	√	
Prairie	Dry prairie		lost if occurred
	Dry-mesic prairie		lost
	Mesic prairie	lost	lost
	*Wet-mesic prairie	√	lost
	*Wet prairie	lost	lost if occurred
	Mesic sand prairie	√	
	Loess hill prairie		lost
Savanna	Dry-mesic savanna		lost if occurred
	Mesic savanna		lost if occurred
Wetland	*Marsh	√	
	*Shrub swamp	√	
Lake and Pond	*Pond	√	
	Lake	√	
Stream	High-gradient creek		√
	Medium-gradient creek		√
	Low-gradient creek	√	√
	Low-gradient river	lost	
	Major river	√	
Cultural	Pastureland	√	√
	Successional field	√	√
	Developed land	√	√
	Tree plantation	√	√
	Artificial pond	√	√
	Prairie restoration	√	?
	Cropland	√	√

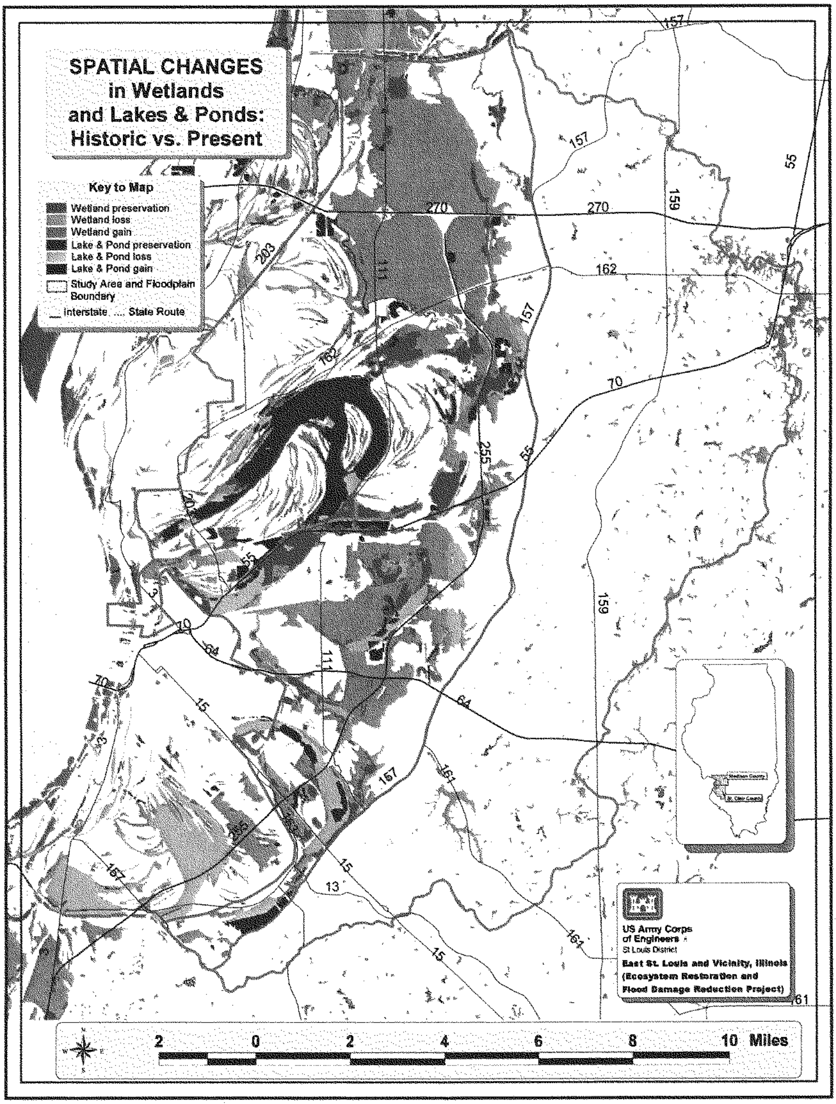
(1) Illinois Natural Areas Inventory (White and Madany 1978); floodplain and upland examples of the same natural community are distinct because they occur in different natural divisions; occurrence indicated by "√", unknown status indicated by "?"
(2) Natural communities that are wetlands are preceded by ""*
(3) Lower Mississippi River Bottomlands Natural Division, Northern Section
(4) Southern Till Plain Natural Division, Effingham Section

3.12.2.3 Savanna. Savanna is not currently known from the Project area (IDNR 1998e). It is included in this section only because it may have been present in predevelopment times in the uplands. If any remnants survived, they would have since changed into forest. Because periodic wildfires enabled this type of vegetation to persist in historical times, the suppression of wildfire that came with settlement caused vegetational changes in savanna. Tree density became greater and open savanna converted to closed forest. Other factors have led to the loss of savanna in addition to fire absence and destruction. These include fragmentation, degradation of the ground cover from intense grazing, and invasion by exotic plant species (IDNR 1998e).

3.12.2.4 Wetland. Estimates of wetland losses in the Project area range from about 65 to 85 percent. Losses of wetlands in the uplands may be less extensive than those in the floodplain. At least 90 percent of Illinois' historic wetlands are gone (IDNR 1994a). For Madison and St. Clair Counties, estimates of wetland losses are 61 and 63 percent, respectively (IDNR 1998c). Wetland diversity has declined because of the loss of three of ten historic wetland natural communities: wet-mesic upland forest and wet-mesic prairie in the uplands, and wet prairie in the floodplain.

Figure 3-12 displays the extent and location of wetland change in the Project area by contrasting the distribution of historic and current wetlands. Areas of preservation, historic loss, and recent gain are distinguishable from each other. In this figure, all soil mapping units in each county's soil survey that exhibit wetland or hydric characteristics represent historic wetlands. (Appendix B includes a table of all Project area soils and their wetlands status.) Wetlands included in the Illinois Wetland Inventory serve as the current condition. The amount of wetland loss is about 70 percent. Natural communities represented as wetlands in this figure include all those marked with an asterisk in Table 3-26, except for one. The exception is historic ponds. They are combined with historic lakes because they could not be easily distinguished using existing digital databases.

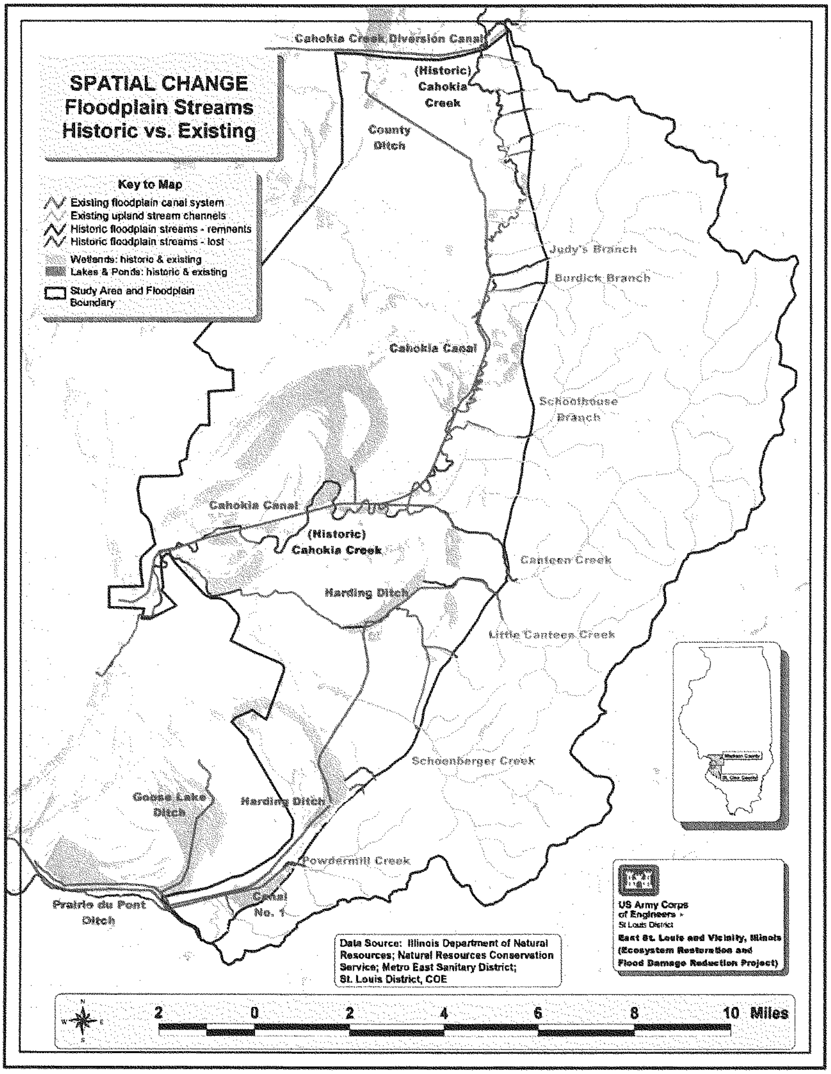
Figure 3-12 Project Area - Spatial Changes in Wetlands and Lakes & Ponds



3.12.2.5 Lake and Pond. Estimates of lake and pond loss range from about 35 to 50 percent in the Project area. No comparable data are available for Illinois or its counties. Because lakes and ponds still occur in the Project area today, diversity of natural communities within this class has not been reduced. Figure 3-12 displays the extent and location of changes in lakes and ponds in the Project area. Areas of preservation, historic loss, and recent gain are distinguishable from each other. Lakes and ponds depicted on the 1909, 2-foot contour maps developed by the East Side Levee and Sanitary District represent historic conditions. Existing conditions are represented by areas mapped as water in the digital soil surveys of Madison and St. Clair Counties. The amount of lake and pond loss shown in Figure 3-12 is about 50 percent.

3.12.2.6 Stream. The overall loss of all floodplain streams by length in the Project area is estimated to be about 66 percent. About 62 percent of the historic channel of Cahokia Creek in the Project area has been filled in for development or modified into ditches. The isolated remnants no longer convey flowing waters. Of the floodplain channels tributary to Cahokia Creek, about 72 percent have also been lost. Channels in the Project area within the Prairie Du Pont drainage area experienced a loss of about 57 percent. Like lakes and ponds, there are no statewide or county-level estimates of historic loss of streams. Figure 3-13 shows the location of historic floodplain channels and existing remnants. In this figure, stream channels depicted on the 1909 maps developed by the East Side Levee and Sanitary District represent historic conditions. Current conditions were obtained from 1998 digital aerial photographs.

Figure 3-13 Project Area - Spatial Change in Floodplain Streams



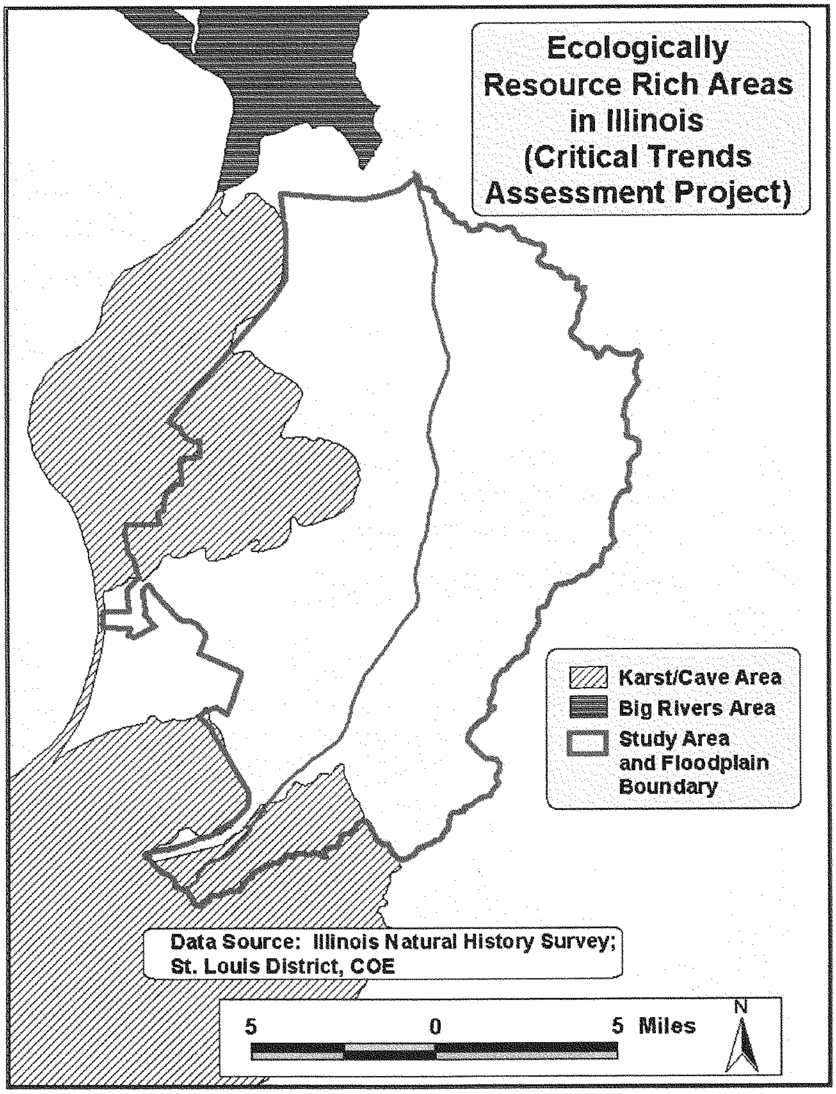
No estimate has been developed of the losses of historic tributary stream channels due to development. Portions of some tributary streams were straightened many years ago to facilitate the construction of railroad and road embankments that followed the stream bottoms. Examples of this are found in the Judy's Branch, Big Canteen Creek, and Powdermill Creek watersheds. By and large, historic tributary stream losses are much less than those in the bottoms. The tributary watersheds within the Study area are designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan.

3.12.3 Existing Living Resources. This section describes living resources that currently occur in the Project area. Like the preceding section on historic losses of natural resources, the framework for this section is based on the classes of natural communities used by the Illinois Natural Areas Inventory: forest; prairie; wetland; lake and pond; stream; and, cultural.

3.12.3.1 Resource Rich Areas. Despite extensive local losses of various historic natural resources, and degradation of remaining resources, the Project area lies in a belt of existing "resource rich areas" strung along the Mississippi River in southwestern Illinois. "Resource rich areas" are relatively large areas in Illinois where current biologically significant resources are concentrated. Thirty such areas have been identified statewide (Suloway et al. 1996). They were delineated and evaluated by the Illinois Natural History Survey as part of the Critical Trends Assessment Project and Ecosystems Program of the Illinois Department of Natural Resources (Suloway et al. 1996). They often occur along the state's major streams and rivers, and in addition to natural resources, include "developed" areas such as cropland and urban/built-up land.

Two resource rich areas are found in the vicinity of the Project area (Figure 3-14). "Big Rivers" lies just north, and "Karst/Cave Area" overlaps partially with the Project area. Many of Karst/Cave Area's significant natural features, such as caves, hill prairies, springs, marshes, and herpetological sites, are outside the Project area to the south in St. Clair, Monroe, and Randolph Counties. A number of these are found within the Project area and are discussed in detail in Section 3.12.3.

Figure 3-14 Project Area - Ecologically Resource Rich Areas



3.12.3.2 Forest. According to Illinois Land Cover data obtained in the early 1990s, about 26,000 acres of forest are found in the Project area (Appendix B). About 75 percent of this forest occurs in the uplands.

3.12.3.2.1 Forest in Tributary Watersheds. About 20,000 acres of forest exist in the tributary watersheds. Forest that once occupied the flatter upland topography has largely been eliminated for farming and development. The remaining forest is largely confined to steeper slopes. As a consequence, most of the remaining forest occurs in irregularly shaped areas that border tributary stream channels.

Mainly suburban areas and cropland surround these areas of forest. Forest located on slopes probably represents the dry-mesic upland forest and mesic upland forest communities. Most forest in the bottoms of tributary streams represents the mesic floodplain forest community. No estimates are available concerning the relative amount of each of these natural communities. Wetland forest occurs in the tributary watersheds in small quantities. About 300 acres of wetland forest are included in the Illinois Land Cover database and about 85 acres are included in the Illinois Wetlands Inventory (IWI) data collected in the mid-1980s. Wet-mesic floodplain forest represents nearly all the IWI wetland forest in the uplands. Over 750 acres of evergreen forest occurs in the uplands, according to the National Land Cover database but the coniferous woods category is not represented in the Project area in the Illinois Land Cover database in Appendix B. Assuming a relatively small amount of evergreen forest exists, it likely consists of species like pine that have been planted in groves as landscaping or tree farms. Although no figures are available, little upland forest is in public ownership.

3.12.3.2.2 Natural Quality of Upland Forests. Of the 20,000 or so acres of forest in the upland portion of the Project area, the Illinois Natural Areas Inventory of the mid-1970s recognized less than 15 acres as of high natural quality. The vast majority of the forest has been subjected to various disturbances since settlement, to the degree that it no longer resembles its historic condition.

3.12.3.2.3 Ecological Problems of Upland Forests. Upland forests in the Project area exhibit a loss of ecological integrity due to fragmentation, habitat degradation, introduction of exotic species, and, in the drier communities, absence of fire (IDNR 1998e). Forests have become fragmented due to surrounding development. Fragments have relatively high edge to interior ratios, meaning that most forest within a fragment is located relatively close to its border, and little of it consists of a "core" area in the interior at a distance from any edge. Fragments of upland forest occur in all minor and major tributary watersheds delineated for this Project. Most forest is concentrated in the Canteen Creek, Little Canteen Creek, and Schoenberger Creek watersheds, where fragments are generally larger than those in the other watersheds of the Project area. Use of forests as grazing areas for livestock is a typical cause of habitat degradation. Grazing at some time during the last 200 years probably has affected most remaining forest in the Project area. Sustained grazing leads to the disappearance of grazing-sensitive plant species, an increase in abundance of native thorn-bearing plants, and the introduction of exotic species (IDNR 1998e).

Logging can degrade forests when commercially desirable tree species are removed, especially when consideration for natural regeneration is not given. Absence of fire leads to changes in tree species composition and forest structure, which often results in denser stands of woody species, and higher levels of shade. In turn, the number of herbaceous plant species growing at ground level often declines, and the amount of ground surface they cover is reduced (IDNR 1998e). Because of the lack of fire, an increase in density of sugar maple (*Acer saccharum*) and a decline in oaks has been observed in old-growth oak-hickory upland forests in the Midwest (Shotola et al. 1992).

3.12.3.2.4 Vegetation of Upland Forests. Common canopy tree species of historic upland forest natural communities are provided in Table 2-3 of Section 2. Various oaks and hickories comprise many of the historic species in mesic upland and mesic floodplain forests. However, existing tree canopy cover consisting of hard mast species such as oaks and hickories was found to be relatively low, during this Project's assessment of quality of upland forests in ravines and along creek bottoms as wildlife habitat.

Based on assessment of 66 sites in the major tributary watersheds in the spring of 1999, means for tree canopy coverage consisting of hard mast species are 18 percent (County Ditch), 9 percent (Cahokia), 27 percent (Harding), and 11 percent (Powdermill). These data suggest that composition of tree canopy species has shifted in dominance from historic oaks and hickories to other species, such as sugar and silver maple, white and green ash, American elm, and sweet gum. A comprehensive description of canopy, subcanopy, shrub, woody vine, and ground-cover plant species of upland forest communities is provided by IDNR (1998e). A nearly complete list of such species is presented in Appendix B. Exotic species occurring in mesic upland and mesic floodplain forests include the tree, white mulberry; the shrubs, amur honeysuckle and multiflora rose; and the vine, Japanese honeysuckle (IDNR 1998e).

3.12.3.2.5 Wildlife Habitat of Upland Forests. Many species of birds use forests in the uplands, but remaining patches are "unlikely to have successful breeding populations of most species" because they are too small and narrow (IDNR 1998b:67). Most mammals using upland forests are likely to consist of species that can tolerate fairly close association with people, and common visible species would include the eastern chipmunk, eastern mole, woodchuck, and gray and fox squirrels (IDNR 1998d). Typical reptiles and amphibians using upland forests would include the black rat snake, five-lined skink, gray treefrog, and slimy salamander (IDNR 1998f). Lists of vertebrate species using forests are presented in Section 3.12.4.

For this Project, existing quality of forest as wildlife habitat was assessed in the spring of 1999 for three vertebrate species at 66 sites scattered across the upland portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the fox squirrel, mink, and wood duck were employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of forest in tributary watersheds is moderate for the fox squirrel and mink, and of very low suitability for the wood duck (Table 3-27). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-27 Existing habitat quality of forest in tributary watersheds of the Project area, expressed as habitat suitability indices (average and range) for three evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	**Range**
Fox squirrel	**0.54**	0 - 0.62
Mink	0.40	0 - 1
Wood duck	0.04	0 - 0.17

* TY0 denotes target year 0

3.12.3.2.6 Forest in the Bottoms. According to the Illinois Land Cover database, about 6,400 acres of forest occurred in the floodplain portion of the Project area in the early 1990s. From these data, about 3,500 acres consists of forested wetland. On the other hand, about 7,100 acres of forest are reflected in the National Land Cover Database from the same timeframe and about 2,700 acres consist of forested wetland. The Illinois Wetland Inventory (IWI) data collected in the mid-1980s provide the best estimate for the area of forested wetlands in the bottoms. According to this source, about 2,935 acres of bottomland forest (forested wetlands) occur in the five major floodplain watersheds. Wet-mesic floodplain forest and wet floodplain forest communities comprise this forested wetland. There are about 1,835 acres of the former, and 1,100 acres of the latter. About 60 percent of all this forested wetland is located in the Cahokia watershed. In this watershed, four relatively large tracts of forested wetland are found. All are within three miles of Horseshoe Lake. These tracts, with their area according to the IWI in parentheses, occur northeast of the lake at the west end (225 acres) and east end (135 acres) of Elm Slough, east of the lake in the vicinity of McDonough Lake (185 acres), and southeast of the lake at Brushy (Levy) Lake (205 acres).

Estimates of forest in the floodplain that is not wetland vary from about 2,700 to 4,375 acres, depending on the land use dataset. This type of forest is mesic floodplain forest. It occurs in all five major watersheds, and is extremely fragmented compared to forest in the uplands as well as forested wetland in the floodplain. Relatively large areas of publicly owned forest in the bottoms, both wetland and nonwetland, occur at Brushy (Levy) Lake, Cahokia Mounds State Historic Site, Frank Holten State Park, and Horseshoe Lake State Park.

3.12.3.2.7 Natural Quality of Forest in the Bottoms. Of the roughly 7,000 acres of forest in the bottoms portion of the Project area, the Illinois Natural Areas Inventory of the mid-1970s did not recognize any as possessing high natural quality. All forest was recognized as either moderately to heavily disturbed, or early to mid-successional.

3.12.3.2.8 Ecological Problems of Forest in the Bottoms. Like upland forest, forest in the Mississippi River floodplain also has declined in ecological integrity since settlement. Causes include fragmentation, changes in flooding frequency and duration, logging, habitat degradation due to grazing, and the introduction of exotic species (IDNR 1998e).

Excessive siltation from floodwaters is an additional cause of habitat degradation. The absence of fire does not represent an ecological problem because fire is not considered to have been an important factor in maintaining these communities (IDNR 1998e). Like upland forests, much floodplain forest was cleared for agriculture and development. Fragments of forested wetlands and forested nonwetlands occur in each of the major watersheds. Construction of the levee system along the Mississippi River and the interior flood control system within the Project area has dramatically reduced the depth and duration of flooding in remaining floodplain forests. Logging of commercially valuable tree species has led to the loss of many kinds of oaks and hickories; most forest remnants contain an abundance of soft-wooded species like silver maple, green ash, cottonwood, and elm. Many remaining forests would have been grazed at some time in the past, but the wettest ones most likely experienced the least grazing pressures.

3.12.3.2.9 Vegetation of Forest in the Bottoms. For this Project, vegetation at 33 sites in forested wetlands was assessed. Common tree species consisted of silver maple (*Acer sacharinum*), box elder (*Acer negundo*), black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulmus americana*). Sometimes pin oak (*Quercus palustris*) was observed. Typical shrubs and saplings included silver maple, American elm, green ash, hackberry (*Celtis occidentalis*), box elder, poison ivy (*Toxicodendron radicans*), and trumpet creeper (*Campsis radicans*). Dominant ground cover species at less wet sites (wet-mesic floodplain forest) included a sedge (*Carex hyalinolepis*), panicled aster (*Aster simplex*), lizard's tail (*Saururus cernus*), stoutwood reed (*Cinna arundinacea*), Lyme grass (*Elymus virginicus*), Canada wood nettle (*Laportea canadensis*), annual bedstraw (*Galium aparine*), swamp buttercup (*Ranunculus septentrionalis*), and jewelweed (*Impatiens capensis*). Many of the species of oaks and hickories present in historic forested wetlands are lacking.

A nearly complete list of plant species of forested wetlands is presented in APPENDIX B. A comprehensive description of vegetation of wet-mesic and wet floodplain forest communities is provided by IDNR (1998a,e). Some exotic species that have invaded floodplain forests include the vine, Japanese hops (*Humulus japonicus*); some grasses, including reed canary grass (*Phalaris arundinacea*) and common reed (*Phragmites australis*); and Japanese honeysuckle (*Lonicera japonica*) (IDNR 1998e).

3.12.3.2.10 Wildlife Habitat of Forest in the Bottoms. Numerous bird species use floodplain forests, but most species are unlikely to successfully breed in remaining patches of such forest because they are too small and narrow (IDNR 1998b). Most mammals using forest in the bottoms are likely to tolerate human disturbances, and common species would include the opossum, raccoon, white-tailed deer, mink, beaver, eastern cottontail rabbit, and white-footed mouse. Typical reptiles and amphibians using floodplain forests would include various salamanders, frogs, and snakes. Lists of vertebrate species using forests are presented in Section 3.12.4.

For this Project, existing quality of bottomland forest as wildlife habitat was assessed in the spring of 1999 for five vertebrate species at 35 sites scattered across the floodplain portion of the Project area. Nonwetland bottomland forest was treated separately from wetland bottomland forest. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the fox squirrel, mink, great blue heron, wood duck, and slider turtle were employed after modification for this Project.

HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of bottomland forest is moderate for the great blue heron, and relatively low for the fox squirrel, mink (wetland forests only), and slider turtle (Table 3-28). For the wood duck, these forests are unsuitable. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-28 Existing habitat quality of bottomland forest in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	**Existing HSI (TY0)***	
	Average	**Range**
Nonwetland bottomland forest		
Great blue heron	**0.52**	0 - 0.52
Fox squirrel	0.33	0 - 0.33
Mink	0.00	0 - 0
Wood duck	0.01	0 - 0.01
Wetland bottomland forest		
Great blue heron	0.45	0 - 0.62
Mink	0.29	0 - 1
Slider turtle	0.23	0 - 0.46
Wood duck	0.02	0 - 0.04

* TY0 denotes target year 0

3.12.3.3 Prairie. One remnant prairie occurs in the Project area on the Mississippi River floodplain, but apparently no historic upland prairie remains. The only other prairie vegetation in the Project area consists of man-made restorations. Restorations occur on a small scale in the bottoms. Over the last twenty years, roughly 100-200 acres have been planted at Cahokia Mounds State Historic Site. More recently, prairie vegetation has been established to a limited extent in the right of way along local interstate highways, such as I-255 and I-270, especially at interchanges. These restoration sites are publicly owned.

3.12.3.3.1 Natural Quality of Prairie. According to the Illinois Natural Areas Inventory of the 1970s, none of the remnant prairie in the Project area was of high quality. However, the Poag Railroad Prairie Natural Area, a 33-acre remnant, was identified as a significant example of two prairie communities because of the rarity of remnant prairie in Illinois.

3.12.3.3.2 Ecological Problems of Prairie. Ecological problems facing prairies include fragmentation, absence of fire, invasion by exotic species, habitat degradation, and for floodplain prairies, modification of flooding regimes (IDNR 1998e). Due to fragmentation, most remnants are small and isolated, and many plant species consist of relatively few individuals. Consequently, local extinctions of prairie plants are likely. The absence of fire allows woody vegetation to encroach, which leads to the elimination of shade-intolerant species. Exotic plant species can easily invade narrow, linear fragments. Grazing by livestock eliminates native species, and allows for the establishment of some weedy species.

Additional degradation occurs when prairie soils are disturbed, such as when soils along railroads are scraped, thereby allowing weeds to take hold. Improved drainage conditions for agriculture often create drier conditions in historical wet-mesic and wet prairie. Construction of the levee system along the Mississippi River and the interior flood control system within the Project area has significantly reduced the flooding regime in the Poag Road remnant prairie.

3.12.3.3.3 Vegetation of Prairie. Typical plants that occurred in various historic prairie communities are presented in Table 2-4 of Section 2. A nearly complete list of plants found in the wet-mesic prairie community is presented in Appendix B. No vegetational surveys of remnant or restored prairies were conducted for this Project. IDNR (1998a,e) provides a comprehensive description of plant species occurring in various prairie natural communities.

3.12.3.3.4 Wildlife Habitat of Prairie. For this Project, existing quality of prairie as habitat for the eastern meadowlark (bird) was assessed in the spring of 1999 at one prairie restoration site in the Project area. The habitat suitability index (HSI) model developed by the U.S. Fish and Wildlife Service for the eastern meadowlark was employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of the prairie restoration site is high for the meadowlark (Table 3-29). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-29 Existing habitat quality of a restored prairie in the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold.

Species	**Existing HSI (TY0)***	
	Average	**Range**
Eastern meadowlark	0.94	0 - 0.94

* TY0 denotes target year 0

3.12.3.4 Wetland. According to the Illinois Wetland Inventory data, there were 7,414 acres of wetlands in the Project area as of the mid-1980s (Table 3-30). Eight kinds of wetlands are represented. About 70 percent of all wetlands are classified as bottomland forest or shallow marsh/wet meadow. Open water wetlands make up another 15 percent, and the remaining 15 percent consists of various amounts of deep marsh, shallow lake, scrub-shrub, lake shore, and swamp.

The very small example of swamp does not represent true swamp, which is common to extreme southern Illinois, but bottomland forest that has semipermanent to permanent standing water (Suloway and Hubbell 1994).

A brief description of the IWI classification system and wetland types is provided in Appendix B. Although the wetlands identified in the Illinois Wetland Inventory serve satisfactorily in representing existing wetlands for purposes of this Project, they do not represent existing wetlands subject to Section 404 jurisdiction under the Clean Water Act, for two reasons.

First, the IWI database is about 15 years old, and is not representative of today's conditions. Second, delineation of Section 404 wetlands requires an on-site investigation, and information used to delineate IWI wetlands was obtained remotely by aerial photography.

With regard to the Project area's two major landforms, about 90 percent of all wetlands in the Project area are located on the Mississippi River floodplain (Table 3-30). All eight kinds occur in the bottoms, and five are found in the tributary watersheds. In the bottoms, bottomland forest and shallow marsh/wet meadow wetlands are most common, and collectively comprise about 65 percent of the total. In the uplands, most wetlands are nonwoody. The most common are open water and shallow marsh/wet meadow wetlands. About 82 percent of all wetlands in the Project area are natural. The remaining 18 percent are modified, and have been created or affected by either excavation or impoundment. Most of the eight kinds of wetlands consist of both natural and modified forms. Only shallow lakes and swamps are entirely natural. Unlike the bottoms, most wetland acreage in the uplands is man-made. Nearly all open water wetlands in the uplands were artificially created by either excavation or impoundment. The same is true for most open water wetlands in the bottoms.

Table 3-30 Wetlands and deepwater habitats in the Project area, as classified by the Illinois Wetland Inventory, using National Wetlands Inventory data.

	Project Area		Floodplain				Upland			
	Area (acres)	% of Total Area	Area (acres) natural	modified	all	% of Total Area	Area (acres) natural	modified	all	% of Total Area
WETLAND HABITAT										
Bottomland forest	3,022.8	40.8	2,907.8	28.8	2,936.6	39.6	84.0	2.2	86.2	1.2
Shallow marsh/ wet meadow	2,166.5	29.2	1,860.1	106.2	1,966.3	26.5	199.3	0.9	200.2	2.7
Open water	1,119.4	15.1	83.0	561.2	644.2	8.7	2.3	472.9	475.2	6.4
Deep marsh	630.1	8.5	529.6	98.0	627.6	8.5		2.5	2.5	0.0
Shallow lake	247.1	3.3	247.1		247.1	3.3				0.0
Scrub-shrub	201.1	2.7	179.6	15.3	194.9	2.6	4.6	1.7	6.3	0.1
Lake shore	26.6	0.4		26.6	26.6	0.4				0.0
Swamp	0.4	0.0	0.4		0.4	0.0				0.0
Total Wetland Habitat	*7,414.0*	*100.0*	*5,807.6*	*836.0*	*6,643.6*	*89.6*	*290.3*	*480.1*	*770.4*	*10.4*
DEEPWATER HABITAT										
Lake (Limnetic lake)	2,630.0	99.9	1,861.2	768.7	2,630.0					
River (Perennial river)	3.5	0.1	3.3	0.2	3.5					
Total Deepwater Habitat	*2,633.5*	*100.0*	*1,864.5*	*768.9*	*2,633.5*					
Total Wetland & Deepwater Habitat	**10,047.4**		**7,672.2**	**1,604.9**	**9,277.0**	**92.3**	**290.3**	**480.1**	**770.4**	**7.7**

Significant concentrations of wetlands are located at about a half-dozen floodplain sites in the Project area (Figure 3-15). They are briefly described according to the wetland categories and extent (acres) presented in the IWI. They are listed below in the order they occur from north to south in the Project area.

Elm Slough - (northeast of Horseshoe Lake, east of IL Route 111 and south of IL Route 162) supports four types of wetlands within a 280-acre tract. Wetland types include bottomland forest, deep marsh, shallow marsh/wet meadow, and scrub-shrub.

McDonough Lake - (east of Elm Slough on the west side of IL Route 159 between Il Route 162 and I-55/70) has a 310-acre area with five wetland types, as well as a deepwater lake. Wetlands include bottomland forest, deep marsh, shallow marsh/wet meadow, open water, and scrub shrub.

Brushy (Levy) Lake - (east of Cahokia Canal, south of Horseshoe Lake Road, west of I-255, and north of I-55/70) has five kinds of wetlands in a 275-acre area. They include bottomland forest, deep marsh, and shallow marsh/wet meadow, open water, and scrub-shrub.

Indian Lake - (south of I-55/70, east of IL Route 203, west of IL Route 111, north of Collinsville Road) supports 565 acres of bottomland forest, shallow marsh/wet meadow, deep marsh, and open water wetlands.

A portion of Cahokia Mounds State Historic Site - (south of Collinsville Road, west of I-255, north of Forest Boulevard) supports about 520 acres of various wetlands. They are somewhat scattered, and include five kinds: bottomland forest, shallow marsh/wet meadow, deep marsh, open water, and scrub shrub wetlands. A small area of deepwater lake is also present. Outside the Historic Site, to the south of Forest Boulevard, are about 110 acres of additional bottomland forest and shallow marsh/wet meadow wetlands, along with a deepwater lake.

A portion of Frank Holten State Recreation Area - (east of I-255, south of Lake Drive, west of IL Route 157) supports about 370 acres of wetland and deepwater lake habitats. Wetlands include bottomland forest, shallow marsh/wet meadow, and deep marsh.

Publicly owned lands at these sites are found only at Cahokia Mounds State Historic Site and Frank Holten State Recreation Area.

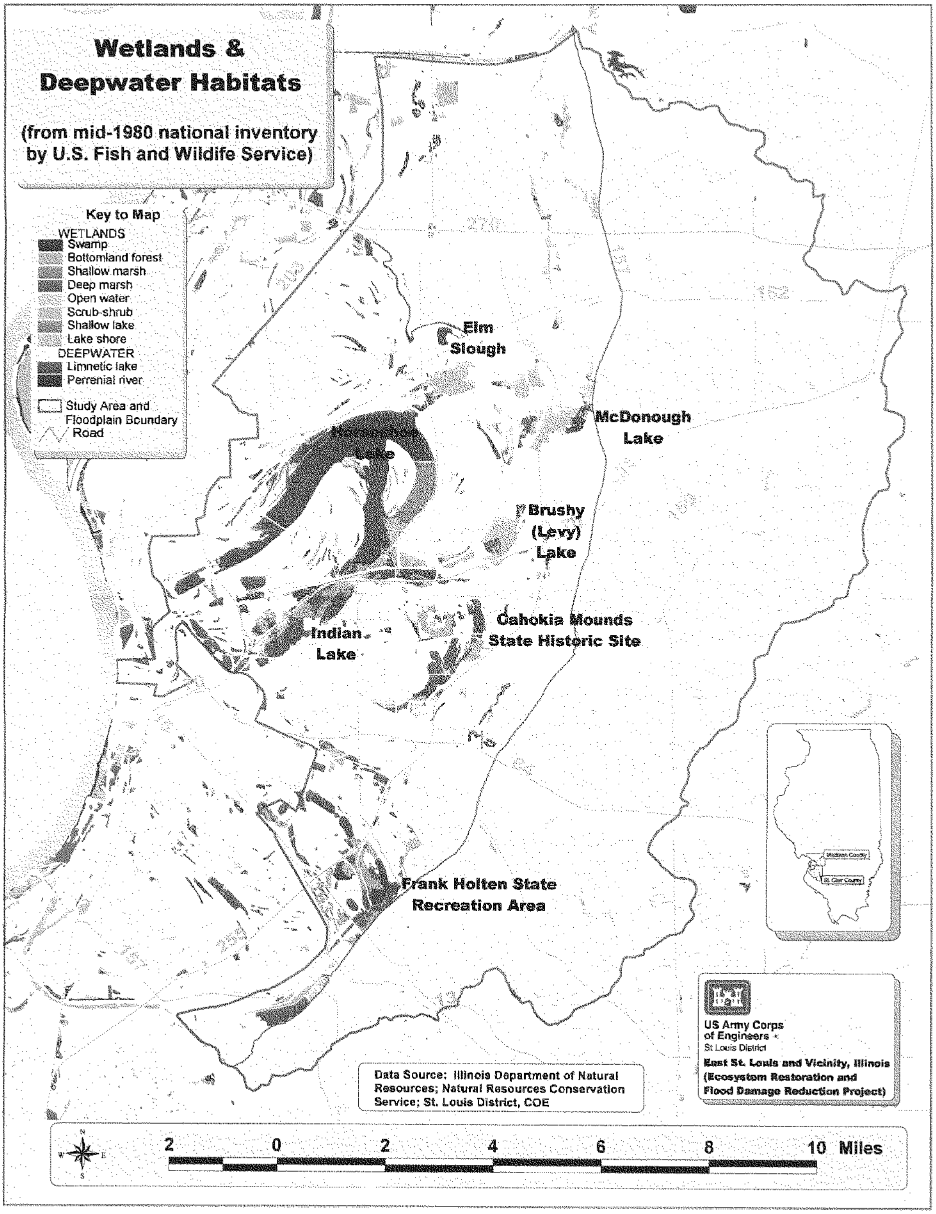


Figure 3-15 Wetlands and Deepwater Habitats of the Project Area (IWI data)

3.12.3.4.1 Natural Quality of Wetland. The Illinois Natural Areas Inventory of the mid 1970s recognized only one example of a relatively undisturbed wetland in the Project area. This site, Levee Lake Natural Area, had 103 acres of high quality shrub swamp and associated pond communities that were recognized as the best remaining examples in the American Bottom. Since the inventory, this natural area has been adversely affected by agricultural drainage.

3.12.3.4.2 Ecological Problems of Wetland. Ecological problems associated with forested wetlands and wetland versions of prairies are discussed above in the respective sections for these community classes. Problems related to marshes and shrub swamps are presented here. Those associated with ponds, another form of wetland, are given below. Problems in marshes and shrub swamps include alteration of the flooding regime (drier or wetter), introduction of sediments and agricultural chemicals or urban runoff, encroachment by exotic plant species, and "an overabundance of aggressive, disturbance-tolerant native species" (IDNR 1998e:53).

Construction of the levee system along the Mississippi River and the interior flood control system within the Project area has dramatically reduced the depth and duration of flooding in remaining marshes and shrub swamps.

3.12.3.4.3 Vegetation of Wetland. Common herbaceous plants noted in marshes during this Project include fox sedge (*Carex vulpinoidea*), broom sedge (*Carex scoparia*), a sedge (*Carex hyalinolepis*), water knotweed (*Polygynum amphibium*), curttop lady's thumb (*Polygonum lapathifolium*), common cattail (*Typha latifolia*), common reed (*Phragmites australis*), false nettle (*Boehmeria cylindrica*), swamp dock (*Rumex verticillatus*), and tall nettle (*Urtica gracilis*). Scattered shrubs and saplings were also encountered, and common species consist of poison ivy (*Toxicodendron radicans*), green ash (*Fraxinus penssylvanica*), and persimmon (*Diospyros virginiana*). Common cattail, river bulrush (*Scirpus fluviatilis*), and common reed are typical native plants that become overabundant when sediments, fertilizer-containing runoff, and a wetter hydrologic regime occur in marshes (IDNR 1998e). Shrub swamps consist of many grass, sedge, and forb species found in marshes, plus various shrubs, such as buttonbush (*Cephalanthus occidentalis*), false indigo bush (*Amorpha fruticosa*), swamp privet (*Forestiera acuminata*), and black willow (*Salix nigra*) (IDNR 1998e).

A comprehensive description of marsh and shrub swamp plant communities is provided by IDNR (1998a,e). A nearly complete list of plants for these two communities is presented in Appendix B.

3.12.3.4.4 Wildlife Habitat of Wetland. Vertebrates using forested wetlands as habitat are briefly discussed in the previous section on forest natural communities. There are numerous birds, mammals, and reptiles and amphibians that use other types of wetlands, especially marshes, as well. Lists of vertebrate species using marshes or herbaceous wetlands are presented in Section 3.12.4.

For this Project, existing quality of marshes and scrub-shrub wetlands as wildlife habitat was assessed in the spring of 1999 for five vertebrate species at 31 sites scattered across the floodplain portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the great blue heron, marsh wren, slider turtle, mink, and wood duck were employed after modification for this Project.

HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of marsh and scrub-shrub wetlands is above 0.5 for three of the five species (Table 3-31). These wetlands offer optimal habitat for the mink, and unsuitable habitat for the wood duck. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-31 Existing habitat quality of marsh and scrub-shrub wetlands in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	Range
Great blue heron	**0.66**	0 - 1
Marsh wren	**0.62**	0 - 0.7
Mink	**1.00**	0 - 1
Slider turtle	0.29	0 - 0.55
Wood duck	0.00	0 - 0.02

*TY0 denotes target year 0

3.12.3.4.5 Functional Capacity of Wetlands. Because of development, existing wetland hydrology is very different from historic conditions. Variable overflows from the Mississippi River, sometimes consisting of catastrophic events for human development, are absent from today's environment because of the main levee. Similar over bank flooding from tributaries, Cahokia Creek being the principle historic influence, has been greatly diminished across the Project area ever since construction of the interior flood control system about 100 years ago. The system's canals and levees have cut off many floodplain wetlands from their hillside sources of water. Principle sources of wetland hydrology for wetlands historically influenced by overflow from creeks and rivers now consist of local runoff and direct rainfall. Maximum depth of flooding is much reduced at all wetlands in the Project area. Whereas most wetlands in the American Bottom once experienced occasional flood depths greater than 10 to 20 feet, today's depths rarely exceed 1-2 feet. Duration of flooding during "big" events has also been reduced, from months to weeks or days.

Changes in wetland hydrology in terms of depth, duration, and water circulation patterns within the landscape are expected to have also altered the ability of existing wetlands to function as they once did. Functions performed by presettlement wetlands were discussed in Section 2.5. Of the five hydrogeomorphic (HGM) classes of wetlands historically present in the Project area, overbank flooding apparently played the dominant role in historic wetland hydrology for two – the riverine overflow and connected depression classes.

For the other three classes – flats, isolated depression, and fringe – sources other than overbank flooding served as the principle historic source of hydrology for those wetlands. Draft models for assessing functions of wetlands belonging to these three classes were intended to be developed and used in this Project to quantitatively track changes in functional capacity of all wetlands potentially impacted by all proposed plans. However, HGM models for these three wetland classes were not developed because of time and budget constraints.

For this Project, existing capacity of some wetlands to perform various functions was assessed in the spring of 1999 at 3 sites in the floodplain portion of the Project area. Functions assessed include floodwater detention, storage of surface water, nutrient cycling, export of organic carbon, removal and sequestration of elements as compounds, maintenance of characteristic plant community, and maintenance of wildlife habitat. Two of five hydrogeomorphic classes of wetlands occurring in the Project area were evaluated. Functional capacity was evaluated using the Expert HydroGeoMorphic Approach and draft functional capacity index (FCI) models developed by the Corps' Engineer Research and Development Center (Vicksburg, Mississippi) for this Project. FCI values potentially range from 0 to 1, the former representing no functional capacity, the latter optimal functional capacity.

According to the baseline assessment, average functional capacity is above 0.5 at each site for all applicable functions, or nearly so (Table 3-32). The only function to score below 0.5 was maintenance of habitat quality at Dobrey Slough. Evaluation procedures for wetland functional assessment are discussed in depth in Appendix A.

Table 3-32 Existing functional capacity of wetlands within three sites in the Project area, expressed as functional capacity indices for seven wetland functions. Indices potentially range from 0 (no capacity) to 1 (optimum capacity); indices ≥ 0.5 shown in bold. NA indicates not applicable.

Wetland Functions	Existing FCIs (TY0), by HGM subclass and Site*		
	Isolated depressional wetland	Connected depressional wetland	
	Dobrey Slough (entire site is isolated depressional: disturbed marsh, forested and scrub-shrub wetland)	Elm Slough (portion of site is connected depressional: deep marsh and scrub-shrub wetland)	Brushy Lake (portion of site is connected depressional: shallow marsh within Levee Lake INAI site)
Detain floodwater	NA	**0.58**	**0.53**
Store surface water	**0.86**	NA	NA
Cycle nutrients	**0.58**	**0.73**	**0.68**
Export organic carbon	NA	0.48	**0.58**
Remove & sequester elements as compounds	NA	**0.73**	**0.56**
Maintain characteristic plant community	**0.55**	**0.66**	**0.66**
Maintain wildlife habitat	0.27	**0.62**	**0.75**

* TY0 denotes target year 0.

3.12.3.5 Lake and Pond. A number of natural lakes and ponds occur in the Project area. Man-made water bodies are also present. The Illinois Wetlands Inventory (Suloway and Hubbell 1994) has been used to quantify these resources. According to this database, lakes are deepwater habitats, and ponds are shallow lake and open water wetlands. As of the mid-1980s, when the IWI data were collected, there were 2,630 acres of lakes in the Project area, all on the Mississippi River floodplain. About 1,365 acres of open water and shallow lake wetlands were also present, and 65 percent of these resources are also located on the floodplain. Figure 3-15 displays existing lakes and ponds in the Project area as deepwater habitats.

Among natural lakes, Horseshoe Lake is a very prominent landmark. It is found near the middle of the Project area. The lake is one of only a few large floodplain lakes in Illinois. Its surface area is 2,017 acres, and average water depth is about 2 feet (IEPA undated *a*). The bottom consists of soft mud and much of the lake supports little to no emergent or submergent vegetation. The shore is often margined by a thin band of herbaceous plants and trees, such as willow and cottonwood. An area dredged for sand and gravel in the lake has a maximum depth of 69 feet (IEPA undated *a*). About half of the lake (1,013 acres) lies in Horseshoe Lake State Park, and is publicly owned. It is used for fishing, hunting, and recreation. Except for a relatively small area owned by the Corps of Engineers, the rest of the lake is privately owned.

Long Lake, also a natural lake, lies north of Horseshoe Lake. It meanders across the northwest part of the Project area for about 3.5 miles. It has a 76-acre surface area, an average width of about 175 feet, and is apparently shallow (2-3 feet deep). Soft mud comprises the bottom, little aquatic vegetation is present, and logs and branches are often found on the bottom where the shore is tree-lined (Kulfinski and Thomerson 1981). Numerous residences abut the lake, and boat docks and riprap frequently cover the shoreline in addition to trees. The lake is privately owned, and it is used for fishing and recreation.

Toward the south end of the Project area, three lakes at Frank Holten State Recreation Area have a combined surface area of 173 acres. They are used for fishing, picnicking, and recreation. Average water depth ranges from 5 to 7 feet from one lake to another (IEPA undated *b,c,d*). Mowed grassy vegetation surrounds much of two lakes (Lakes 1 and 2, both known as Whispering Willow Lake), and trees and other natural vegetation envelop the third lake (Lake 3 or Grand Marais Lake). In the 1980s, improvements to these lakes were made by the State of Illinois. Diverting Harding Ditch around them reduced sediment loads into these lakes, dredging increased water depths, and rough fish were removed and replaced by game fish (Raman and Bogner 1994). These three lakes are the remnants of historic Pittsburg Lake.

Mullens Slough (or Mullins Creek Slough, 209 acres) is found at the extreme south end of the Project area along Canal No. 1. Water depths apparently reach about 6 feet, and average about 3 to 4 feet. Hard mud evidently makes up the bottom. Little to no emergent or submergent vegetation exists in the lake. Until the early 1990s, the lake was formerly cropland, until natural gravity drainage into Canal No. 1 became impaired. Its footprint occupies a portion of historic Pittsburg Lake. The Natural Resources Conservation Service obtained during the mid-1990s permanent conservation easements under the Emergency Wetlands Reserve Program from landowners of the slough, as well as some adjacent flood-prone cropland.

Smaller natural lakes occur at several locations, including McDonough Lake (about 50 acres), mentioned above for its surrounding wetlands. Man-made borrow pit lakes are scattered across the Project area. Two such water bodies (35 and 60 acres) are located along Cahokia Canal and I-55/70 near the southeast end of Horseshoe Lake.

3.12.3.5.1 Natural Quality of Lake and Pond. No high quality lakes occur in the Project area. The Illinois Natural Areas Inventory of the mid 1970s recognized only one example of a high quality pond, at Levee Lake Natural Area.

3.12.3.5.2 Ecological Problems of Lake and Pond. Other than drainage, ecological problems affecting lake and pond communities include siltation and habitat degradation (IDNR 1998e). Siltation is a natural process, but at a number of water bodies it is occurring at excessive rates because sediment-laden storm water regularly enters them. Horseshoe Lake is a prime example of this problem. Sediment carried into the lake via storm water from Cahokia Canal has reduced the average water depth, and has also formed a delta in the lake. Storm water can also carry various pollutants coming from agricultural and developed areas. Because of high levels of phosphorus (needed for plant growth) carried by inflows, Horseshoe Lake has experienced algal blooms in the summer that deplete dissolved oxygen levels, which can kill fish (IEPA undated *a-d*, Raman 1992, QST 1997). During the summer thermal stratification period, the lakes at Frank Holten State Recreation Area have experienced very low dissolved oxygen levels near their bottom, which limits the use of this zone as habitat by fish (Raman and Bogner 1994). The shallow depth of natural lakes and ponds can also lead to fish kills if a severe winter causes extensive freezing, or hot summers or drought cause these water bodies to dry up. Floodplain lakes and ponds can no longer be "recharged" with fishes carried by floodwaters from the Mississippi River, but instead need to be managed and stocked artificially. Nonnative fish species such as carp uproot aquatic plants growing in lakes and ponds, and in so doing reduce vegetative cover used by many aquatic invertebrates and fishes. Uprooting of plants by carp also raises turbidity levels in the water, which can interfere with sight-dependent feeding behavior of other fish species. Livestock can degrade lakes and ponds located in grazing lands by destroying shoreline vegetation and introducing animal wastes.

3.12.3.5.3 Vegetation of Lake and Pond. A comprehensive description of vegetation associated with lakes and ponds is provided in IDNR (1998a,e). These plants can be grouped into three categories: shore and mudflat species, emergent species (growing out of shallow water), and aquatics (often submerged) (IDNR 1998e). Examples of shore and mudflat species include giant ragweed (*Ambrosia trifida*), Spanish needles (*Bidens bipinnata*), and barnyard grass (*Echinochloa crus-galli*); of emergent species, yellow pond lily (*Nuphar luteum*), American lotus (*Nelumbo lutea*), and halberd-leaved rose mallow (*Hibiscus laevis*); of aquatic species, common duckweed (*Lemna minor*), coontail (*Ceratophyllum demersum*), and pondweed (*Potomogeton* spp.) (IDNR 1998e). A nearly complete list of plant species occurring in association with lakes and ponds is presented in Appendix B.

3.12.3.5.4 Wildlife Habitat of Lake and Pond. In the Project area, fish are an important group of animals in lakes and ponds. Twenty-one species of fish have been reported since 1984 from Horseshoe Lake and the three lakes at Frank Holten State Recreation Area. Yellow bass, common carp, bluegill, and orange spotted sunfish are commonly encountered at Horseshoe Lake during fish surveys using electrofishing techniques (QST 1997). About 10 additional fish species that have not been collected at these lakes are characteristic of natural standing water habitats (Appendix B).

Fishes support limited recreational and commercial opportunities in the Project area. Sport-fishing at Horseshoe and Holten lakes has been described as "poor" or "marginal" (Raman 1992, Raman and Bogner 1994). The more common species obtained by sport anglers at these lakes, in addition to the four mentioned above, include white crappie, black crappie, channel catfish, and freshwater drum (Raman and Bogner 1994, QST 1997). Commercial fishing at Horseshoe Lake is limited to fish salvage operations at an area of the lake drawn down annually in the late spring to promote the growth of herbaceous wetland plants for waterfowl management.

Other animal species use lakes and ponds as habitat. Among birds, waterfowl are common during migration in the spring and fall. Lists of vertebrate species using lakes and ponds are presented in Section 3.12.4.

For this Project, existing quality of lakes and ponds (lacustrine areas) as wildlife habitat was assessed in the spring of 1999 for four vertebrate species at 10 sites scattered across the floodplain portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the great blue heron, slider turtle, mink, and white crappie were employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of lakes and ponds is above 0.5 for the great blue heron and mink (Table 3-33). Sampled lakes and ponds were considered to be unsuitable to the white crappie because of the lack of deepwater habitat. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-33 Existing habitat quality of lakes and ponds in the Project area, expressed as habitat suitability indices (average and range) for four evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	**Existing HIS (TY0)***	
	Average	**Range**
Great blue heron	**0.61**	0 - 0.71
Mink	**0.74**	0 - 1
Slider turtle	0.44	0 - 0.78
White crappie	0.00	0 - 0

* TY0 denotes target year 0

3.12.3.6 Streams. Natural free-flowing streams in the Project area occur mainly in the uplands. In the American Bottom, they are restricted to relatively short portions of these tributary streams that extend onto sediment fans located on the Mississippi River's floodplain at the base of the bluff. From there to the Mississippi River, natural channels have been replaced by a series of ditches and canals.

The main tributary streams occur in the Judy's Branch, Burdick Branch, Schoolhouse Branch, Canteen Creek, Little Canteen Creek, Schoenberger, and Powdermill Creek watersheds. In their natural state, these streams possess substrates consisting of silts, sands, gravel, and some cobbles. Shale-like materials form the creek bed in some reaches. Because these streams have moderate gradients, pool and riffle complexes are also characteristic of relatively undisturbed streams.

In the bottoms, Cahokia Canal, Harding Ditch, County Ditch, Mitchell Ditch, Landsdowne Ditch, and Canal No. 1 have replaced most of the floodplain streams. These waterways are homogeneous in their structure. Channels are straight and lack meanders like natural streams. Channel bottoms consist mainly of silts and sands. Woody debris characteristic of natural streams is minimal. Riparian (woody) vegetation is largely absent along either side of the channel. Herbaceous vegetation growing in the channel and along its margin is often sparse. Because of the flatness of the channel gradient, riffles are uncommon. Occasionally beavers build dams across the channel bottom.

3.12.3.6.1 Natural Quality of Streams. No streams in the Project area were identified to possess high natural quality in the mid 1970's Illinois Natural Areas Inventory. Likewise, none were considered to be "biologically significant Illinois streams" by Page et al. (1992). Point locations on four floodplain streams in the Project area were assessed in the summer of 1998 using the Illinois Environmental Protection Agency's stream habitat assessment procedure ("SHAP"). This procedure assesses a total of 15 habitat parameters that fall under three general categories: substrate and instream cover; channel morphology and hydrology; and, riparian and bank features. SHAP ratings ranged across sites from "poor" at Cahokia Canal and Canal No. 1 to "fair" at Harding Ditch and "good" at Canteen Creek (IEPA 2000). The watersheds within the Study area are designated as priority watersheds for restoration in Illinois under the Clean Water Action Plan.

3.12.3.6.2 Ecological Problems of Streams. Ecological problems of streams in the Project area include fragmentation (often by channelization), loss of riparian vegetation, instability of channel banks and bottoms (mainly in the tributary watersheds), excessive transport of sediment, inflows of agricultural and urban runoff, desiccation, and encroachment by exotic species. Fragmentation includes replacement of natural channels with man-made ones, such that historic remnants are bypassed and no longer functional. This has happened to most floodplain streams in the Project area. In the tributary watersheds, some portions of streams were straightened many years ago to facilitate the construction of railroad and road embankments that followed the stream bottoms. Examples of this are found on Judy's Branch, Big Canteen Creek, and Powdermill Creek. In the headwaters, little riparian land cover exists along stream channels, which are often bordered by cropland. Recent development adjacent to tributary streams often extends to the edge of the ravine overlooking the stream. The lack of streamside riparian buffer strips often leads to unstable banks, and transport of sediment and agricultural nutrients from cropland into streams (IDENR 1994a). Desiccation of streams often occurs when adjacent lands are drained with underground tiles, such that during dry periods little "ground" water flows into streams to sustain base flow. On the other hand, base flow in some streams has been increased by treated effluent coming from individual homes in subdivisions not connected to a municipal sewer system. The increased base flow causes erosion or head cutting within the channel. In the bottoms, because floodplain ditches are maintained for the conveyance of storm water, woody vegetation is removed periodically during maintenance activities from both sides of the channel. Consequently, little to no shading is available to reduce summertime water temperatures.

3.12.3.6.3 Vegetation of Streams. Because flowing waters of streams can at times become erosive, vegetation associated with streams is often limited to stream banks, in-channel deposits of sediments, and areas of quiet or slowly moving water. A comprehensive description of vegetation associated with streams is provided in IDNR (1998a,e). Most species are herbaceous, and examples include common beggar ticks (*Bidens frondosa*), panicled aster (*Aster simplex*), and water willow (*Justicia americana*). Other species consist of trees typical of wet floodplain forest, such as silver maple (*Acer saccharinum*) (IDNR 1998e).

3.12.3.6.4 Wildlife Habitat of Streams. Thirty-three fish species have been captured from floodplain streams in the Project area since 1984 by the Illinois Environmental Protection Agency as part of its statewide surface water quality monitoring and assessment program. Sand shiner, red shiner, bigmouth shiner, gizzard shad, common carp, and green sunfish are common species encountered using electrofishing techniques (IEPA 2000). The same four floodplain sites that were assessed for quality of stream habitat ("SHAP") were also sampled under the program for their fish communities. Based on attributes of sampled fish communities, Alternate Index of Biotic Integrity (AIBI) values calculated for these sites ranged from 31.6 to 38.2 in the summer of1998. These AIBI values fall into the "moderate" category of five stream classes created for biological stream characterization (from best to poorest, the five categories are unique aquatic resource, 51-60; highly valued, 41-50; moderate, 31-40; limited, 21-30; restricted, less than 20).

Similar fish sampling within tributary watersheds in the Project area has not been conducted by IEPA. However, Thomerson (1981) reported that these tributary streams support five to seven species of fish, or fewer than larger hillside watersheds north and south of the Project area. Potential fish species expected to be found in the streams of Judy's Branch, Burdick Branch, Schoolhouse Branch, Canteen Creek, Little Canteen Creek, Schoenberger Creek, and Powdermill Creek watersheds include red shiner, sand shiner, bigmouth shiner, fathead minnow, creek chub, and green sunfish (Thomerson 1973, 1981). Creek chubs are a dominant element in these small creeks, and are able to survive in pools when streams dry up.

For this Project, existing quality of floodplain streams as wildlife habitat was assessed in the spring of 1999 for five vertebrate species at one site located in the floodplain portion of the Project area. Habitat suitability index (HSI) models developed by the U.S. Fish and Wildlife Service for the great blue heron, slider turtle, mink, black crappie, and wood duck were employed after modification for this Project. HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat.

According to the baseline habitat assessment, average habitat quality of floodplain streams is above 0.5 for the great blue heron, black crappie, and mink (Table 3-34). This habitat was unsuitable for the wood duck, and of low value for the slider turtle. Evaluation procedures for these species are discussed in depth in Appendix A.

Existing quality of tributary streams as habitat for aquatic invertebrates and fish was assessed in the summer of 2003 at 17 sites located in six tributary watersheds of the Project area. The Qualitative Habitat Evaluation Index method developed by the state of Ohio to assess the condition of its warm water streams was employed (see Appendix A). The average habitat quality of sampled tributary streams was 0.64.

Table 3-34 Existing habitat quality of floodplain streams in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	Range
Black crappie	**0.55**	0 – 0.79
Great blue heron	**0.54**	0 – 0.79
Mink	**0.72**	0 – 0.87
Slider turtle	0.27	0 – 0.45
Wood duck	0.01	0 – 0.16

*TY0 denotes target year 0.

3.12.3.7 Cultural. Following the classification system for natural communities used by the Illinois Natural Areas Inventory, a number of cultural communities occur in the Project area. These include cropland, pastureland, successional field (including abandoned fields and pastures, roadsides, and vacant lots), developed land, tree plantation (including orchards), artificial pond, and prairie restoration. These cultural communities are not discussed in detail here, but some are addressed briefly in other sections. Tree plantations are included in the section on existing forest, artificial ponds as modified open water wetlands, and prairie restorations are included in the section on prairie. About 70 percent of the Project area consists of cropland, grassland, and developed land, or as classified in Table 3-1, cropland, grassland, and urban/built-up land cover classes.

3.12.3.7.1 Vegetation of Cultural Areas. Plant species occurring in cultural areas are described in IDNR (1998a,e). A nearly complete list is provided in Appendix B. These species include those planted for agricultural practices, landscaping, and other purposes, as well as native species that colonize cropland, pastureland, successional fields, developed land, tree plantations, and other highly modified areas.

3.12.3.7.2 Wildlife Habitat of Cultural Areas. Some vertebrate animal species use various cultural areas as habitat. Lists of such species are presented in Section 3.12.4.

For this Project, existing quality of cultural habitats (specifically grassy or abandoned fields and abandoned subdivisions) as wildlife habitat was assessed in the spring of 1999 for one vertebrate species at six sites in the floodplain portion of the Project area. The habitat suitability index (HSI) model developed by the U.S. Fish and Wildlife Service for the eastern meadowlark was employed after modification for this Project.

HSI values potentially range from 0 to 1, the former representing unsuitable habitat, and latter optimal habitat. According to the baseline habitat assessment, average habitat quality of field-like habitats is below 0.5 for the meadowlark (Table 3-35). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 3-35 Existing habitat quality of cultural areas (fields) in the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing HSI (TY0)*	
	Average	Range
Eastern meadowlark	0.34	0 - 0.34

* TY0 denotes target year 0.

3.12.4 Natural Areas, Nature Preserves, and Endangered Species Sites. The Project area includes ten examples of natural areas, nature preserves, or endangered species sites (Table 3-36). There are three natural areas identified in the mid 1970s during the Illinois Natural Areas Inventory (INAI). These three sites supported significant and exceptional examples of natural communities. One of these received designation as a nature preserve. Among these three sites, forest, prairie, wetland, and pond communities are represented. In addition to these areas, habitats where endangered species have been found have been assigned special status, and are listed in a biological conservation database maintained by the Illinois Department of Natural Resources. Five such sites occur within the Project area.

Table 3-36 Natural areas, nature preserves, and endangered species sites in the Project area.

County	Name	Area of Overlap (acres) (1)	Recognizing Feature(s)
Natural Areas			
Madison	Bohm Woods	5	dry-mesic and mesic upland forest; 94 acres outside Project area
Madison	Poag Railroad Prairie	33	mesic sand and wet-mesic prairie;
/Madison	Levee Lake	230	pond, shrub swamp, marsh
Nature Preserves			
Madison	William & Emma Bohm Memorial	7	dry-mesic and mesic upland forest; 8 acres outside Project area
Endangered Species Sites			
Madison	Chouteau Catchfly Site	2	royal catchfly
Madison	Poag Railroad Prairie		Spring ladies' tresses
Madison	Precision habitat	475	Illinois chorus frog
Madison	Eagle Park Marsh	105	common moorhen, pied-billed grebe, yellow-headed blackbird
St. Clair	Fairmont City Site	38	decurrent false aster
St. Clair	East St. Louis (Alorton) Heron Colony	2	snowy egret, little blue heron, black crowned night-heron
Total Area in Project Area		893	

(1) Within Project area; acres for all sites taken from IDNR (1998c), except for precision habitat

3.12.4.1 Natural Areas and Nature Preserves. Bohm Woods Natural Area, a 99-acre privately owned tract supporting dry-mesic and mesic upland forest was identified by the INAI as relatively undisturbed and in high-quality condition (IDNR 1998c). This natural area straddles the Project area boundary in Madison County at the extreme north, near the point where Cahokia Creek turns into Cahokia Creek Diversion Channel. Most of it occupies bluff slopes. About 10 acres of this forest is formally dedicated as the William and Emma Bohm Memorial
Nature Preserve. "Bohm Woods is a fine example of dry-mesic and mesic upland forest and is known for its species-rich herbaceous understory" (IDNR 1998e:37). About five acres of this natural area and nature preserve fall within the Project area, within the watershed referred to in this Project as "Bluff 1".

Poag Railroad Prairie Natural Area, a 33-acre prairie remnant, was identified by the INAI as a significant example of two prairie communities (IDNR 1998c). The natural area is located in Madison County in the northern portion of the Project area. It is privately owned. It lies east of Illinois Route 111 along the embankment of a southwest-northeast extending railroad for a distance of about 1.8 miles. The entire natural area lies within the boundaries of historic Rattan's Prairie, a predominantly wet-mesic prairie of over 15,000 acres. At its eastern limit, the natural area extends for about one-quarter mile onto the sandy terrace along the bluff where historic Cahokia Creek entered the Mississippi River floodplain. Poag Railroad Prairie consists of both wet-mesic and sand prairie communities, but their current quality and extent have not been reported (IDNR 1998e). Biologists from the St. Louis District and Illinois Natural History Survey briefly visited the site in the spring of 1999 for this Project, and little if any of the purportedly wet-mesic portion appeared to possess wetland hydrology.

Levee Lake Natural Area is in Madison County in a meander scar of the Mississippi River, about 1.5 miles east of Horseshoe Lake. The INAI site envelops 230 acres (IDNR 1998c), and is under private and public ownership (Metro East Sanitary District). In terms of natural communities, about half of the area consisted in the mid-1970s of pond, shrub swamp, and marsh, and the remainder of wet floodplain forest and wet-mesic floodplain forest. The examples of pond, shrub swamp, and marsh were judged to be of high quality at that time. "Levee Lake is a high quality wetland. This ... area is the largest and least disturbed complex of marsh, pond, and swamp communities in the American Bottoms" (IDNR undated). However, the hydrological characteristics of this area were later altered, evidently in the 1980s. Normal wet-season surface water levels in the pond, shrub swamp, and marsh areas were lowered when a series of surface ditches was dug on adjacent private cropland to carry drainage to Cahokia Canal. The pond and shrub-swamp communities have since been replaced by marsh and encroaching woody growth consisting of willows.

Brushy Lake is the name used in this Project to refer to the Levee Lake Natural Area and adjacent lands to the north and south. A detailed biological analysis of a 389-acre tract enveloping the natural area was conducted for this Project (ZE 1998).

3.12.4.2 Endangered Species Sites. Chouteau Catchfly Site is a locality in Madison County at which the royal catchfly (*Silene regia*), a state endangered plant, has been found. The INAI site is along the western border of the northern portion of the Project area. It envelops less than two acres along a railroad embankment on private property.

The royal catchfly was historically found in prairies and savannas. This site lies in the western portion of historic Rattan's Prairie, and southwest of historic Grassy Lake.

The Poag Railroad Prairie Natural Area (described above) is an INAI site at which a state-endangered plant, spring ladies' tresses (*Spiranthes vernalis*), has been found recently. This plant is an orchid.

Precision habitat for the Illinois chorus frog (*Pseudacris streckeri illinoensis*), a state-threatened species, is located in Madison County on the Mississippi River floodplain in the vicinity of the historic channel of Cahokia Creek. Four separate areas have been established to help meet this species' life history requirements.

Eagle Park Marsh is an INAI site located in Madison County. It once supported a population of breeding yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), a state-endangered species. This marsh and open water area is found at the tip of the western arm of Horseshoe Lake, south of National City. The site encompasses about 105 acres on private property.

Fairmont City is an INAI site in St. Clair County that supports the decurrent false aster (*Boltonia decurrens*), a state and federally endangered plant. This site occurs in a meander scar of the Mississippi River near Fairmont City, and is located on private property within the area south of I-55/70, west of Route 111, north of Collinsville Road, and east of Route 203. It coincides with an open, marshy area. Indian Lake is the name used in this Project to refer to the larger area enveloping this site, which is delineated by the four roads described above.

East St. Louis (Alorton) Heron Colony is a site in St. Clair County that supports a rookery used by various state-listed species of herons and egrets. These species include the snowy egret (*Egretta thula),* little blue heron (*Egretta caerulea)*, and black-crowned night-heron (*Nycticorax nycticorax)*, all state-endangered species. The cattle egret (*Bubulcus ibis*) and great egret (*Ardea alba*) also use this rookery. It is located on private property in Alorton, to the southeast of East St. Louis.

3.12.5 Existing Species.

3.12.5.1 Plants. Roughly 1,000 plant species consisting of various trees, shrubs, vines, grasses, sedges, forbs, and ferns occur, or are likely to occur, in the Project area. Appendix B presents 949 plant species by common and scientific name, as well as the natural communities in which each one occurs. Plant species are ordered by physiognomic class (tree, shrub, etc.). Also, within each physiognomic class, all species are ranked from "driest" to "wettest" according to their likelihood of occurring in wetlands. This likelihood is represented by the coefficient of wetness as assigned by the National Wetland Inventory to each plant species in the upper Midwest (Reed 1988).

About 18 percent of the Project area's flora, consisting of 173 species, is not native to Illinois. Table B.9 in Appendix B displays the prevalence of exotic species in the Project area's natural communities. Exotic species occur in all kinds of natural communities, but, excluding cultural areas, are most prevalent in remnant prairies and savannas. Recommended methods of eradication for many of these species are provided by IDNR (1998e).

For Appendix B, it should be noted that plant species indicated for each kind of community are representative of the Project area as a whole, and not a particular site. All plant species living at an individual site would represent some fraction of the total. The occurrence of fewer species at individual sites reflects the loss of some species due to habitat destruction and degradation, as well as natural variation from site to site.

Recommendations for the long-term maintenance of local natural vegetation communities have been described by IDNR (1998e) in its "Sinkhole Plain Area Assessment," which addresses the Project area as well as a larger contiguous area to the south. First, an update of the Illinois Natural Areas Inventory, conducted in the mid 1970s, should be carried out to identify and map any natural community remnants, including moderately degraded ones, missed the first time around. Second, ecological problems occurring at specific remnants should be identified and prioritized, so that effective rehabilitation measures can be developed. Third, remnants of native vegetation with the greatest ecological integrity should receive priority for rehabilitation and management. Fourth, existing natural areas with higher levels of ecological integrity should have sizable buffer zones established around them, or additions made to narrow existing zones. Corridors or connections between isolated areas should be established. These actions would help to keep invasive plant species from entering such areas. Fifth, long-term programs for the application of periodic prescribed fire in remnants of natural vegetation should be developed, where fire was historically an important ecological component. And, lastly, the long-term survival of local populations of threatened and endangered plant species should be ensured.

3.12.5.2 Invertebrates. Macroinvertebrates. Roughly 350 relatively common macro invertebrate species consisting primarily of beetles, worms, water bugs, midges, caddis flies, mayflies, damselflies, dragonflies, damselflies, leeches, mosquitoes, clams, crayfish, mussels, and snails occur, or are likely to occur, in the Project area. Table B.10 in Appendix B presents invertebrate species by common and scientific name. In this table, macro invertebrate species are ordered alphabetically by common name (leech, clam, etc.). Also, within each group, all species are arranged alphabetically. Additionally, Table B.11 in Appendix B presents 51 species of mosquitoes that may occur in the Project area, as well as their human pest potential, primary activity period, status as a disease vector, flight range, preferred larval habitat (oviposition site), and preferred adult habitat. The mosquito species presented in this table are arranged alphabetically.

Aquatic Biota. The use of aquatic organisms to evaluate water quality is well established. The underlying principle is that good water quality supports a diverse biological community with pollution-intolerant forms (Wilhm 1975, IEPA 1989). An evaluation of aquatic macro invertebrate community composition in the American Bottom basin was performed in 1984 as part of IEPA's *Intensive Survey of the American Bottoms Basin* (IEPA 1989). Slight to moderate stream degradation was observed. In general, the macro invertebrate populations sampled appeared to be influenced by a variety of sources originating from agricultural, industrial, urban, and municipal activities. Channelization was also a negative factor at several sites. Stream impacts were generally greater in the highly developed East St. Louis area compared to outlying areas, as indicated by the Macro invertebrate Biotic Index (MBI).

The MBI is a pollution tolerance rating system which ranges from 0 to 11; a rating of zero is assigned to taxa found only in unaltered streams of high water quality, and a rating of 11 is assigned to taxa known to occur in severely polluted or disturbed streams. Mean MBI values of 6.2 (upper America Bottom), 6.8 (middle America Bottom, including the East St. Louis area), and 6.0 (lower America Bottom) illustrated this pattern (IEPA 1989).

Within the middle American Bottom, the sample site at Canal No. 1 was described as a channelized reach that received urban runoff and storm sewer discharges. A MBI value of 6.7 and representation by only 21 taxa revealed the effects of these negative influences (IEPA 1989). The sample site at the Cahokia Canal revealed 23 taxa and a MBI of 6.7. Factors influencing the community composition include channelization, nearby land development, and agricultural and urban runoff (IEPA 1989). Two sites were sampled within Canteen Creek. Each site contained 17 taxa, and MBI values were calculated at 7.9 for Site One and 6.5 for Site Two. Sites One and Two both received urban, agricultural, and mine debris runoff; in addition, Site Two was channelized and substantially degraded by Collinsville municipal wastewater treatment plant effluent (IEPA 1989).

Although the area supports a moderate diversity of aquatic macro invertebrates, aquatic species have disappeared from the area in recent decades (IDNR 1998g). However, with improvements in water quality, species that have been extirpated could return, and natural communities could become reestablished where they have been eliminated or altered (IDNR 1998g).

Mosquitoes. Mosquitoes are by far the most important arthropods subject to control for general health reasons in the United States, according to the Public Health Study Team of the Environmental Studies Board (National Research Council 1976). Mosquitoes are a perennial problem in the American Bottom because of spring flooding and the region's long, wet summers. Drainage and mosquito control efforts in the area serve to reduce the problem.

Approximately fifty-seven species of mosquitoes have been collected in Illinois (Ross and Horsfall 1965). Of these, 12 species are considered a major pest to humans in the state (Kulfinski and Myer 1981, ESHD 2001). These include *Aedes albopictus*, *Aedes sollicitans*, *Aedes sticticus*, *Aedes triseriatus*, *Aedes vexans*, *Anopheles punctipennis*, *Anopheles quadrimaculatus*, *Coquillettidia perturbans*, *Culex erraticus*, *Culex pipiens*, *Culex salinarius*, and *Psorophora ciliata.*

- *Aedes albopictus* was first identified in Illinois in 1986 (ESHD 2001). It breeds primarily in artificial containers and water-filled tree cavities. It is a possible vector for LaCrosse encephalitis and dog heartworm in Illinois, and Dengue fever and Yellow fever in other states.

- *Aedes sollicitans* is associated with frequently flooded marshes and sulfuretted water from coal mining or salt water from oil wells. It is a vector for Eastern equine encephalitis, Western equine encephalitis, dog heartworm, and Venezuelan equine encephalitis, although the species is not known to transmit the disease in Illinois (ESHD 2001).

- *Aedes sticticus* breeds in temporary pools. It is not a known disease vector.

- *Aedes triseriatus* breeds in water-filled tree cavities and artificial containers. It is the primary vector for LaCrosse encephalitis in Illinois, and a vector for Eastern equine encephalitis and Western equine encephalitis in other states.

- *Aedes vexans*, which breeds in temporary pools and floodplains, is the major nuisance mosquito in the project area. These mosquitoes are vicious biters and account for most of the East Side Health District's (ESHD, IL) mosquito related complaints (ESHD 2001). *A. vexans* is a possible vector for Eastern equine encephalitis, Western equine encephalitis, LaCrosse encephalitis, and Dengue fever, although the species is not known to transmit diseases in Illinois (ESHD 2001).

- *Anopheles punctipennis* breeds in artificial containers, bogs, ponds and lakes with emergent vegetation, and marginal vegetation of sluggish streams. It is a disease vector for LaCrosse encephalitis, malaria, and dog heartworm.

- *Anopheles quadrimaculatus* breeds in artificial containers, sluggish streams, ponds and lakes with emergent vegetation, marshes, and semi-permanent wetlands. It is a disease vector for Eastern equine encephalitis and Western equine encephalitis in other states and was a vector for malaria in Illinois in the past.

- *Coquillettidia perturbans* breeds in ponds and lakes with emergent vegetation. It is a disease vector for Eastern equine encephalitis, LaCrosse encephalitis, and Flanders virus in other states.

- *Culex erraticus* breeds in ponds and lakes with emergent vegetation and in swamps. It is not a known disease vector.

- *Culex pipiens* breeds in artificial containers, temporary pools, catch basins, ditches, marshes, and polluted waters. In Illinois it is a disease vector for St. Louis encephalitis, and dog heartworm. In other states it is a vector for Western equine encephalitis, LaCrosse encephalitis, Flanders virus, Filariasis, and West Nile virus.

- *Culex salinarius* breeds in artificial containers, water-filled tree holes, grassy unshaded temporary pools, and marshes. It is a disease vector for St. Louis encephalitis, Flanders virus, and dog heartworm.

- *Psorophora ciliata* is associated with frequently flooded marshes, and temporary pools. It is a vector for Eastern equine encephalitis, but is not known to transmit the disease in Illinois (ESHD 2001).

According to the East Side Health District (IL) and the Illinois Department of Public Health, the only mosquito-borne encephalitis documented in humans in Illinois in the past ten years include St. Louis encephalitis, and LaCrosse encephalitis. The last major outbreak of St. Louis encephalitis in Illinois occurred in 1975 (ESHD 2001).

There is evidence from Illinois and other Midwestern states that the St. Louis encephalitis virus continues to be transmitted in the avian reservoir at a low level, thus the potential for an outbreak of St. Louis encephalitis exists. LaCrosse encephalitis is the most consistently occurring mosquito borne illness in Illinois, existing as an endemic rather than an epidemic disease (ESHD 2001). No confirmed human cases of Eastern equine encephalitis have been reported from Illinois, and there has been little Western equine encephalitis activity in the U.S. in recent years (ESHD 2001). According to the Illinois Department of Public Health (IDPH 2002), the West Nile virus was first documented in Illinois in September 2001 when laboratory tests confirmed its presence in two dead crows found in the Chicago metropolitan area. By September 2002, birds, mosquitoes, and horses have tested positive for the virus in nearly all the state's counties. Also, about 270 confirmed human cases of West Nile viral encephalitis have been reported in Illinois from 23 counties, including 10 deaths. The City of Chicago and adjacent Cook County are the source of over 200 cases and seven deaths. In Madison and St. Clair Counties, there have been 5 and 6 confirmed human cases, respectively, and no deaths (IDPH 2002).

Some observations in the field indicate that mosquitoes are not a problem in constructed wetlands. Generally, functioning stormwater wetlands are less likely to produce mosquitoes than are nutrient laden secondary sewage and agricultural wastewater ponds, or ponds that do not have frequent turnover (Adams 1983, Bennett 1971). Furthermore, healthy ecosystems provide habitat for insectivorous birds, fish, copepods, and other animals that feed on larval and adult mosquitoes. The best fish for mosquito control are those species that reproduce quickly and have a wide tolerance of environmental conditions. Commonly stocked species include guppies (*Poecilia reticulata*), mosquitofish (*Gambusia affinis*), and pupfish (*Cyprinodon* spp.) (McClean 1995).

Other Pestiferous Invertebrates. Other pestiferous insects in the area include several biting flies e.g. some black flies (Simuliidae), sand flies (Phlebotominae), biting midges (Ceratopogonidae), horse flies and deer flies (Tabanidae), and the sable fly *Stomoxys calcitrans* (Muscidae). Many non-biting flies, particularly the housefly and numerous species of non-biting midges (Chironomidae) frequently constitute a major nuisance because of their numbers. In addition to flies (Diptera) several ants, bees, wasps, and hornets (Hymenoptera) are a major cause of discomfort or possibly death. Several species of chiggers (*Eutrombicula*) are also present in the area, and cause dermatitis after feeding on the skin (Kulfinski and Myer 1981).

Two spiders that occur in the project area are particularly dangerous. The black widow spider (*Latrodectus mactans*) and the brown recluse spider (*Loxosceles reclusa*) both occur with frequency in the area. Two tick-vectored diseases are a potential problem in the project area. These are Rocky Mountain spotted fever and tularemia. *Dermacentor variabilis* has the greatest potential for spreading these diseases because it is the only local species that bites humans with any notable frequency. It is associated with wooded and brushy areas and along the banks of streams. *Amblyomma americanum* also bite humans, but does so with considerably less frequency than does *Dermacentor variabilis*. *Haemaphysalis leporio* rarely bites humans, but is important in disseminating the parasites among wild animal reservoirs.

3.12.5.3 Fishes. The existing fish fauna is much reduced from what it was historically, and today has little relationship to the original fauna (Parker 1973). Native species are wide-ranging, and are characteristic of habitats that have been heavily modified and subjected to considerable environmental fluctuations, such as in water temperature, flow, turbidity, and dissolved oxygen. As shown in Table 3-37, thirty-six species of fish have been collected since 1984 during fish surveys of channels and lakes within the Project area. Thirty-three species inhabit floodplain channels, and twenty-one species occur in lakes. None of the 36 species are federally or state protected. Three species, the gold fish, common carp, and grass carp, are exotic or non-native.

Collection sites for these 36 species are restricted to the bottoms or floodplain of the Mississippi River. None are in the uplands, but some in channels are located along the base of the bluff where tributary streams enter the floodplain. No collection sites are in the Mississippi River. Lake species are represented by collections in Horseshoe Lake and the three lakes at Frank Holten State Recreation Area.

A longer list of 98 species that includes additional fishes that may occur in the Project area as well as the adjacent Mississippi River appears in Appendix B. Habitat preferences are indicated, as well as relative abundance. Habitat types include streams, small rivers, medium and large rivers, and standing water. Stream habitat could be considered to represent the upland tributaries in the Project area, small rivers the floodplain channels, medium and large rivers the Mississippi River, and standing water the floodplain's lakes and ponds. Three listed species are included in the long list, and they are discussed in Appendix B in Annex B.14.

A number of fish species apparently have disappeared since settlement (Parker 1973). Their loss is most likely due to habitat modifications caused by development. These species would include the alligator gar (*Lepisosteus spatula*), central mudminnow (*Umbra limi*), northern pike (*Esox lucius*), muskellunge (*Esox masquinongy*), blacktail shiner (*Cyprinella venusta*), ironcolor shiner (*Notropis chalybaeus*), taillight shiner (*Notropis maculatus*), pugnose minnow (*Opsopoeodus emiliae*), lake chubsucker (*Erimyzon sucetta*), spotted sucker (*Minytrema melanops*), freckled madtom (*Noturus nocturnus*), starhead topminnow (*Fundulus notti*), bantam sunfish (*Lepomis symmetricus*), crystal darter (*Ammocrypta asprella*), western sand darter (*Ammocrypta clara*), stargazing darter (*Percina uranidea*), and banded pygmy sunfish (*Elassoma zonatum*). The muskellunge and alligator gar have been extirpated from Illinois (IDENR 1994), and the others would be regionally or locally extinct.

Management recommendations for fish have been described by IDNR (1998b) in its "Sinkhole Plain Area Assessment," which addresses the Project area as well as a larger contiguous area to the south. The major recommendation is establishment of natural riparian vegetation along streams. Riparian zones of native plant species would reduce levels of pollutants entering streams, such as silt and chemicals, by acting as filters of runoff. Vegetation would also stabilize unstable banks, and would provide shade to lower higher than normal water temperatures. Other recommendations, besides the cessation of removal of riparian vegetation, include a halt to further stream channelization, drainage of floodplain lakes, and introduction of non-native fish species. Avoidance of mainstream impoundments and rectification of existing pollution problems was also suggested. A watershed approach to developing management strategies was stressed.

Table 3-37 Fish species collected in the Project area since 1984, according to habitat type (1).

Common name	Family/*Species* Name	Channels	Lakes
Bowfins	**Amiidae**		
Bowfin	*Amia calva*	X	X
Herrings, Shads, Sardines	**Clupeidae**		
Gizzard shad	*Dorosoma cepedianum*	X	X
Minnows & Carps	**Cyprinidae**		
Central stoneroller	*Campostoma anomalum*	X	
Goldfish (I)	*Carassius auratus*	X	X
Grass carp (I)	*Ctenopharyngodon idella*	X	
Red shiner	*Cyprinella lutrensis*	X	
Common carp (I)	*Cyprinus carpio*	X	X
Golden shiner	*Notemigonus crysoleucas*	X	X
Emerald shiner	*Notropis atherinoides*	X	
Bigmouth shiner	*Notropis dorsalis*	X	
Sand shiner	*Notropis ludibundus*	X	
Fathead minnow	*Pimephales promelas*	X	
Bullhead minnow	*Pimephales vigilax*	X	
Creek chub	*Semotilus atromaculatus*	X	
Suckers	**Catostomidae**		
River carpsucker	*Carpiodes carpio*	X	
White sucker	*Catostomus commersoni*	X	
Smallmouth buffalo	*Ictiobus bubalus*	X	X
Bigmouth buffalo	*Ictiobus cyprinellus*	X	X
Shorthead redhorse	*Moxostoma macrolepidotum*	X	
Freshwater Catfishes (N. America)	**Ictaluridae**		
Black bullhead	*Ameiurus melas*	X	X
Yellow bullhead	*Ameiurus natalis*	X	X
Channel catfish	*Ictalurus punctatus*	X	X
Pikes	**Esocidae**		
Grass pickerel	*Esox americanus*	X	
Salmonides	**Salmonidae**		
Rainbow trout	*Oncorhynchus mykiss*		X
Livebearers	**Poeciliidae**		
Mosquitofish	*Gambusia affinis*	X	
Temperate Basses	**Moronidae**		
White bass	*Morone chrysops*	X	X
Yellow bass	*Morone mississippiensis*		X

Table 3-37 Continued

Common name	Family/*Species* Name	Channels	Lakes
Sunfishes and Freshwater Basses	**Centrarchidae**		
Warmouth	*Chaenobryttus gulosus*	X	
Green sunfish	*Lepomis cyanellus*	X	X
Orangespotted sunfish	*Lepomis humilis*	X	X
Bluegill	*Lepomis macrochirus*	X	X
Redear sunfish	*Lepomis microlophus*		X
Largemouth bass	*Micropterus salmoides*	X	X
White crappie	*Pomoxis annularis*	X	X
Black crappie	*Pomoxis nigromaculatus*	X	X
Drums and Croakers	**Sciaenidae**		
Freshwater drum	*Aplodinotus grunniens*	X	X
Number of Species Per Habitat Type		33	21

(1) list does not reflect the Mississippi River; (I) = introduced species
Source: IEPA (1989, 2000), Raman (1992), and Raman and Bogner (1994).

3.12.5.4 Reptiles and Amphibians. As shown in Table 3-38, a total of 65 species of reptiles and amphibians occur or may occur in the Project area. Various kinds of salamanders and toads and frogs comprise the 22 amphibian species, of which 12 have documented occurrences. Forty-three species of reptiles include a number of turtles, lizards, and snakes; twenty-four of these species have been documented from the area. All species are native. None have been introduced. Reptiles and amphibians are found in all communities of the Project area. In cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, they are less diverse than in forest, prairie, wetland, creek and river, and lake and pond habitats.

The alligator snapping turtle (*Chelydra serpentina*) has become locally extinct. One species of frog and three species of snakes are either state or federally protected species. They are discussed in Appendix B in Annex B.14.

Overall habitat quality in the Project area for reptiles and amphibians has been described as "fair" due to the extensive loss of forests and wetlands and fragmentation of remaining habitats (IDNR 1998f). In its "Sinkhole Plain Area Assessment", which also addresses a larger contiguous area to the south, IDNR (1998f) has provided various management recommendations for reptiles and amphibians. The most important actions that would benefit these species are as follows. First, restoration of a continuous riparian zone consisting of floodplain forests, backwater sloughs, and wetlands along the Mississippi River would provide a corridor for dispersal, and connect populations isolated by various types of development. Second, reduction of road kills caused by vehicular traffic on roads along the base of the bluff would lessen an important source of mortality. Movements between the bottoms and upland areas correspond to seasonal migrations between breeding or hibernation areas.

Third, within the uplands, corridors of natural vegetation need to be created to connect existing (often small) wetlands, such as isolated sinkholes or man-made ponds. Forest or grassland connections need to be established to link ponds, lakes and impoundments. Fourth, small temporary fishless ponds need to be maintained in forests, especially forests in the tributary watersheds, as breeding areas; at least some of the shore along these ponds needs to remain unmowed. And, lastly, sand prairie remnants need to be restored and managed to benefit the Illinois chorus frog and massasauga rattlesnake. Wetland and ponds in or adjacent to sand prairies need to be restored to benefit the Illinois chorus frog.

Table 3-38 Amphibian and reptile species that occur or are likely to occur in the Project area (1).

Name (2,3)			Habitat (4)						Relative Abundance (5)
Common Name	**Order/*Species* Name**		**For**	**Pra, Sav**	**Wet**	**Cre**	**Lake**	**Cult**	
Amphibians	**Amphibia**								
Salamanders	**Caudata**								
Spotted salamander	*Ambystoma maculatum*		X		X				U
Smallmouth salamander	*Ambystoma texanum*	*	X	X	X				C
Tiger salamander	*Ambystoma tigrinum*		X	X	X		X		C
Longtail salamander	*Eurycea longicauda*		X			X			U
Cave salamander	*Eurycea lucifuga*		X						U
Mudpuppy	*Necturus maculosus*					X			R
Eastern newt	*Notophthalmus viridescens*		X		X		X		U
Western lesser siren	*Siren intermedia*				X	X	X		U
Toads and Frogs	**Anura**								
Cricket frog	*Acris crepitans*	*			X	X	X		C
American toad	*Bufo americanus*	*	X	X	X	X	X	X	C
Fowler's toad	*Bufo fowleri*	*	X	X	X	X	X		C
Cope's grey treefrog	*Hyla chrysoscelis*		X		X				C
Eastern grey treefrog	*Hyla versicolor*	*	X		X				C
Spring peeper	*Pseudacris crucifer*	*	X		X		X		C
Illinois chorus frog (ST)	***Pseudacris streckeri illinoensis (ST)***	*			**X**				R
Western chorus frog	*Pseudacris triseriata*	*	X		X		X	X	C
Plains leopard frog	*Rana blairi*		X	X	X	X			U
Bullfrog	*Rana catesbeiana*	*	X	X	X	X	X	X	C
Green frog	*Rana clamitans*	*	X		X	X			C
Pickerel frog	*Rana palustris*	*	X		X				U
Southern leopard frog	*Rana sphenocephala*	*	X		X		X		C
Northern leopard frog	*Rana pipiens*			X	X	X	X		U
Reptiles	**Reptilia**								
Turtles	**Testudines**								
Smooth softshell	*Apalone mutica*					X			U
Spiny shoftshell turtle	*Apalone spinifera*	*			X	X	X		C
Snapping turtle	*Chelydra serpentina*	*			X	X	X		C
Painted turtle	*Chrysemys picta*	*			X	X	X		C

Table 3-38 Continued

Name (2,3)			Habitat (4)						Relative Abundance (5)
Common Name	**Order/*Species* Name**		**For**	**Pra, Sav**	**Wet**	**Cre**	**Lake**	**Cult**	
Map turtle	*Graptemys geographica*					X			C
False map turtle	*Graptemys pseudogeographica*					X			C
Common musk turtle	*Sternotherus odoratus*				X	X	X		C
Eastern box turtle	*Terrapene carolina*	*	X	X		X			C
Ornate box turtle	*Terrapene ornata*			X					U
Red-eared slider	*Trachemys scripta*	*			X	X	X		C
Lizards	**Squamata (Sauria)**								
Six-lined racerunner	*Cnemidophorus sexlineatus*	*		X					U
Five-lined skink	*Eumeces fasciatus*	*	X	X					C
Broadhead skink	*Eumeces laticeps*	*	X	X					C
Slender glass lizard	*Ophisaurus attenuatus*			X					R
Eastern fence lizard	*Sceloporus undulatus*	*	X	X					C
Ground skink	*Scincella lateralis*	*	X						U
Snakes	**Squamata (Serpentes)**								
Copperhead	*Agkistrodon contortrix*		X	X					C
Worm snake	*Carphophis amoenus*	*	X	X					U
Racer	*Coluber constrictor*	*	X	X	X	X	X		C
Timber rattlesnake (ST)	***Crotalus horridus (ST)***		**X**	**X**					R
Ringneck snake	*Diadophis punctatus*	*	X	X					U
Great Plains rat snake (ST)	***Elaphe guttata emoryi (ST)***		**X**	**X**					R
Black rat snake	*Elaphe obsoleta*	*	X	X	X				C
Fox snake	*Elaphe vulpina*			X	X				R
Eastern hognose snake	*Heterodon platirhinos*	*	X	X	X				U
Prairie kingsnake	*Lampropeltis calligaster*	*		X				X	C
Speckled kingsnake	*Lampropeltis getula*	*	X	X					U
Milk snake	*Lampropeltis triangulum*	*	X	X					U
Plainbelly water snake	*Nerodia erythrogaster*	*			X	X	X		C
Diamondback water snake	*Nerodia rhombifer*	*			X	X	X		C
Northern water snake	*Nerodia sipedon*	*			X	X	X	X	C
Rough green snake	*Opheodrys aestivus*	*	X						U
Bullsnake	*Pituophis melanoleucus*			X					U
Graham's crayfish snake	*Regina grahamii*				X		X		U
Massasauga (SE, FC)	***Sistrurus catenatus (SE, FC)***	*		**X**	**X**				R
Brown snake	*Storeria dekayi*		X	X	X	X	X	X	C
Redbelly snake	*Storeria occipitomaculata*		X	X					U

Table 3-38 Continued

Name (2,3)			Habitat (4)						Relative Abundance (5)
Common Name	**Order/*Species* Name**		**For**	**Pra, Sav**	**Wet**	**Cre**	**Lake**	**Cult**	
Flathead snake (ST)	***Tantilla gracilis (ST)***		X	X					R
Western ribbon snake	*Thamnophis proximus*		X	X	X	X			U
Plains garter snake	*Thamnophis radix*			X				X	U
Common garter snake	*Thamnophis sirtalis*		X	X	X	X	X	X	C
Lined snake	*Tropidoclonion lineatum*	*	X	X					R
Earth snake	*Virginia valeriae*		X						U

(1) Known species are indicated by "" in middle column, and come from Parker (1973, 1974, 1981); likely to occur species come from IDNR (1998f) and Phillips et al. (1999).*
(2) Bold type indicates Illinois threatened (ST), Illinois endangered (SE), or Federal species of concern (FC).
(3) I = Introduced species
(4) The following habitat codes taken from Hofmann and Heske (1998) and Hoffmeister (1989) are used.
For = Forest (wetland and nonwetland)
Pra, Sav = Prairie and savanna
Wet = Wetland (not forested)
Cre = Creeks and rivers
Lake = Lakes, ponds, and impoundments
Cult = Cultural
(5) Relative abundance taken from IDNR (1998f). The following relative abundance codes are used:
C = Common
U = Uncommon
R = Rare

3.12.5.5 Birds. Numerous species of birds, as shown in Table 3-39, occur regularly or occasionally in the Project area. Table B-39 lists 126 species that occur regularly, and displays for each species the types of habitat used and breeding status within each habitat type. Birds are the most diverse group of vertebrates living in the Project area, and consist of species from over 40 families. Herons, waterfowl, sandpipers, woodpeckers, flycatchers, swallows, warblers, sparrows, and blackbirds are bird families that are represented by numerous species. When bird species that occasionally use the Project area are added to those that are regular inhabitants, the total number of species increases to 288. Appendix B includes a table of all of the bird species known to occur, or likely to occur, in the Project area. Of the 288 species, one dove, one starling, one finch, and two sparrows are exotic or non-native.

Habitat loss and degradation are associated with the loss of a number of bird species, or a change in status from breeding to migratory. According to IDNR (1998b), birds that historically occurred in the Project area but are now globally extinct include the passenger pigeon (*Ectopistes migratorius*), ivory-billed woodpecker (*Cempephilus principalis*), and Carolina parakeet (*Conuropsis carolinensis*). Locally extinct species include the swallow-tailed kite (*Elinoides forficatus*), greater prairie chicken (*Tympanuchus cupido*), ruffed grouse (*Bonasa umbellus*), Bewick's wren (*Thryromanes bewickii*), and Bachman's sparrow (*Aimophila aestivalis*) (IDNR 1998b).

Others include the barn owl (*Tyto alba*), chuck-will's-widow (*Caprimulgus carolinensis*), Swainson's warbler (*Limnothlypis swainsonii*), and white-winged crossbill (*Loxia leocoptera*) (McMullen 2001). Of the 288 species that may occur in the Project area, 147 of them probably breed in existing habitats, and the rest are migrants that pass through the area. At least six species formerly bred in the Project area and its environs, but do not do so today because of habitat alterations. These species include the trumpeter swan, osprey, least tern, black tern, yellow-bellied sapsucker, and yellow-headed blackbird (IDNR 1998b). Several species that were once gone are now back, and they include the double-crested cormorant, bald eagle, and wild turkey (IDNR 1998b).

Of the 288 species that may use the Project area, 27 of them are federally or state protected. These listed species are discussed in Appendix B in Annex B.14. The diversity and number of threatened and endangered birds is an indication that remaining natural habitats in the Project area that are or could be used by these species are important natural resources.

Birds use all natural communities in the Project area. While a number of species are able to use multiple kinds of habitats, many others are limited to one or only a few. Two major groups of migratory bird species pass through the Project area seasonally: water birds and landbirds. A major flyway for migratory waterfowl is centered on the Mississippi River and its adjacent floodplain. As these species typically use water bodies and herbaceous wetlands as resting areas, Horseshoe Lake and surrounding wetlands serve as stopover points in the fall and spring. Other migrant birds, such as shorebirds from the plover, stilt and avocet, and sandpiper families, and species from the gull and tern family, also use Horseshoe Lake and other local waterbodies. The Mississippi River corridor and its adjacent uplands also serve the needs of many migrant landbirds. Many of these species are from the hawk, flycatcher, warbler, and sparrow families, as well as many other less diverse groups.

For those that do not use a variety of habitats, habitat destruction and fragmentation have adversely affected the status of a number of species. Many grassland birds adapted to Midwestern native tallgrass prairies have experienced significant population declines after the disappearance of their native habitat (Herkert et al. 1993). Loss of forest has also adversely affected many forest species. Research in Illinois has shown that birds breeding in forest sites smaller than 500 acres generally suffer high rates of nest predation (70-90 percent) and a high incidence of brood parasitism by brown-headed cowbirds (70-80 percent) (IDNR1998b, Robinson et al. 2000). As a result, forest fragments smaller than 500 acres act as population "sinks" because they attract breeding birds, but most offspring die before reaching maturity. Except for some fragments in the uplands, most forest fragments in the Project would be expected to act as "sinks."

A number of management recommendations for birds were described by IDNR (1998b) in its "Sinkhole Plain Area Assessment," which addresses the Project area as well as a larger contiguous area to the south. First, the highest priority action for birds is preservation of existing wetlands and forests, including restoration of savanna. This action is needed because many wetlands and forests in the assessment area currently support significant populations of state-listed bird species. Savanna restoration is recommended because savannas seem to support a number of migrating species.

Second, prairie restorations are important because they will benefit grassland birds that as a group have exhibited a significant population decline in the Midwest (citation). Prairie restorations to benefit birds should not consist of dense stands of tall prairie grasses, but a mixture of grasses and forbs. To benefit breeding grassland birds that are area-sensitive, restoration areas should exceed 150 to 250 acres (Herkert citation). Third, forests should be restored in blocks of 500 acres or larger. Sites meeting this size requirement are considered to be favorable for sustaining regional bird populations. Research in Illinois has shown that birds breeding in sites smaller than 500 acres generally suffer high rates of nest predation (70-90 percent) and a high incidence of brood parasitism by brown-headed cowbirds (70-80 percent) (IDNR1998b, Robinson et al. 2000). As a result, forest fragments smaller than 500 acres act as population "sinks" since they attract breeding birds, but most offspring die before reaching maturity. Fourth, native plant communities should be restored in small forest fragments. Within developed areas, the planting of oaks and maintenance of shrubby areas is recommended to benefit some migrating species. Fifth, wetlands should have vegetated buffers established around their perimeter. Buffers can consist of prairie restorations or woody vegetation. Such areas would help shield wetlands from encroaching development, and would serve as nesting areas also. Sixth, in cropland areas, ground cover consisting of plant residue from crops should be maximized as much as possible; shrubs should be maintained along ditches, and roadsides should be mowed infrequently.

And, finally, the amount of emergent vegetation should be increased along edges of ponds, lakes, and impoundments, and woody riparian corridors along creeks and rivers should be enhanced. Nesting platforms at the edges of lakes could serve the osprey and double-crested cormorant.

Table 3-39 Bird species that regularly occur in the Project area (1).

Name (2,3)		**Habitat (4,5)**								
		UpFor	**ForWet**	**Shrub**	**Grass**	**Sav**	**HeWet**	**Water**	**Crop**	**Cult**
Grebes	**Podicipedidae**									
Pied-billed Grebe (ST)	***Podilymbus podiceps (ST)***						**B M**	**B M**		
Pelicans	**Pelecanidae**									
American White Pelican	*Pelecanus erythrorhynchos*							M		
Cormorants	**Phalacrocoracidae**									
Double-crested Cormorant	*Phalacrocorax auritus*						B	M		
Herons	**Ardeidae**									
Great Blue Heron	*Ardea herodias*	B	B				B W M	B W M		
Great Egret	*Ardea alba*						B M	M		
Snowy Egret (SE)	***Egretta thula (SE)***						**B M**			
Little Blue Heron (SE)	***Egretta caerulea (SE)***						**B M**	**M**		
Cattle Egret	*Bubulcus ibis*		B		M		B M		M	
Green Heron	*Butorides virescens*		B M				B M	B M		
Black-crowned Night-heron (SE)	***Nycticorax nycticorax (SE)***		**B M**				**B M**	**B**		

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Swans, Geese, & Ducks	**Anatidae**									
Canada Goose	*Branta canadensis*						B W M	B W M	B W M	M
Wood Duck	*Aix sponsa*		B M				B M	M		
Gadwall	*Anas strepera*						W M	W M		
American Wigeon	*Anas Americana*						M	M		
Mallard	*Anas platyrhynchos*		B W M		B		B W M	B W M	B W M	
Blue-winged Teal	*Anas discors*				B		B M	M		
Canvasback	*Aythya valisineria*						W M	W M		
Greater Scaup	*Aythya marila*						W M	W M		
Lesser Scaup	*Aythya affinis*						W M	W M		
Common Goldeneye	*Bucephala clangula*							W M		
Bufflehead	*Bucephala albeola*						M	W M		
Hooded Merganser	*Lophodytes cucullatus*		B M				M	M		
Rudy Duck	*Oxyura jamaicensis*						B M	M		
Eagles, Kites, & Hawks	**Accipitridae**									
Northern Harrier (SE)	***Circus cyaneus (SE)***				B W M		B W M		W M	
Cooper's Hawk	*Accipiter cooperii*	B W M		B W M		B W M				W M
Red-tailed Hawk	*Buteo jamaicensis*	B W M		B W M	B W M				B W M	B W M
Falcons	**Falconidae**									
American Kestrel	*Falco sparverius*				B W M	B W M			B W M	B W M
Grouse	**Phasianidae**									
Wild Turkey	*Meleagris gallopavo*	B W M	B W M	B W M		B W M			W M	
Quail	**Odontophoridae**									
Northern Bobwhite	*Colinus virginianus*			B W M	B W M	B W M			B W M	
Rails	**Rallidae**									
American Coot	*Fulica americana*						B M	W M		
Plovers	**Charadriidae**									
Killdeer	*Charadrius vociferous*				B M		B M		B M	B M
Sandpipers	**Scolopacidae**									
Lesser Yellowlegs	*Tringa flavipes*						M			
Solitary Sandpiper	*Tringa solitaria*						M			
Spotted Sandpiper	*Actitis macularia*						M	B		
Semipalmated Sandpiper	*Calidris pusilla*						M			
Least Sandpiper	*Calidris minutilla*						M			
Common Snipe	*Gallinago gallinago*				M		M			
American Woodcock	*Scolopax minor*	B M	B M	B M						
Jaegers, Gulls, & Terns	**Laridae**									
Ring-billed Gull	*Larus delawarensis*						W M	W M	W M	
Herring Gull	*Larus argentatus*						M	W M	M	

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Doves	**Columbidae**									
Rock Dove (I)	*Columba livia*								B W M	B W M
Mourning Dove	*Zenaida macroura*			B W M					B W M	B W M
Cuckoos, Roadrunner & Anis	**Cuculidae**									
Yellow-billed Cuckoo	*Coccyzus americanus*	B M	B M	B M		B M				
Owls	**Strigidae**									
Eastern Screech-owl	*Otus asio*			B W M		B W M				B W M
Great Horned Owl	*Bubo virginianus*	B W M	B W M			B W M			B W M	B W M
Barred Owl	*Strix varia*		B W M			B W M				
Goatsuckers	**Caprimulgidae**									
Common Nighthawk	*Chordeiles minor*				M	B			M	B M
Whip-poor-will	*Caprimulgus vociferus*	B M				B M				
Swifts	**Apodidae**									
Chimney Swift	*Chaetura pelagica*	B M	B M	B M	M	B M	M	M	M	B M
Hummingbirds	**Trochilidae**									
Ruby-throated Hummingbird	*Archilochus colubris*	B M	B M	B M		B M				B M
Kingfishers	**Alcedinidae**									
Belted Kingfisher	*Ceryle alcyon*						B W M	B W M		
Woodpeckers	**Picidae**									
Red-headed Woodpecker	*Melanerpes erythrocephalus*	W M	B W M			W M			B M	B M
Red-bellied Woodpecker	*Melanerpes carolinus*	B W M	B W M	B W M		B W M				B W M
Downy Woodpecker	*Picoides pubescens*	B W M	B W M	B W M		B W M				B W M
Hairy Woodpecker	*Picoides villosus*	B W M	B W M	W M		B W M				B W M
Northern Flicker	*Colaptes auratus*	B W M	B W M	B W M		B W M				B W M
Flycatchers	**Tyrannidae**									
Eastern Wood-pewee	*Contopus virens*	B M	B M			B M				B M
Acadian Flycatcher	*Empidonax virescens*	B M	B M							
Willow Flycatcher	*Empidonax traillii*			B M		M	B M			
Eastern Phoebe	*Sayornis phoebe*		B M							B M
Great Crested Flycatcher	*Myiarchus crinitus*	B M	B M	M		B M				M
Eastern Kingbird	*Tyrannus tyrannus*	M		B M	B M	B M			B M	
Larks	**Alaudidae**									
Horned Lark	*Eremophila alpestris*				B W M				B W M	
Swallows	**Hirundinidae**									
Purple Martin	*Progne subis*				B M		B M	B M		B
Tree Swallow	*Tachycineta bicolor*		B M		B M		B M	B M		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*		B		B M		B M	B M		
Bank Swallow	*Riparia riparia*				B M		B M	B M		
Cliff Swallow	*Petrochelidon pyrrhonota*				B M		B M	B M		
Barn Swallow	*Hirundo rustica*			B M	B M		B M	B M	B M	B M

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Jays & Crows	**Corvidae**									
Blue Jay	*Cyanocita cristata*	B W M	B W M	B W M		B W M			B W M	B W M
American Crow	*Corvus brachyrhynchos*	B W M	B W M	B W M	B W M	B W M	B W M	B W M	B W M	B W M
Fish Crow	*Corvus ossifragus*	B M	B M					B M		
Chickadees & Titmice	**Paridae**									
Carolina Chickadee	*Poecile carolinensis*	B W M	B W M	B W M		B W M				B W M
Black-capped Chickadee	*Poecile atricapillus*	B W M	B W M	B W M		B W M				B W M
Tufted Titmouse	*Baeolophus bicolor*	B W M	B W M			B W M				B W M
Nuthatches	**Sittidae**									
White-breasted Nuthatch	*Sitta carolinensis*	B W M	B W M			B W M				B W M
Wrens	**Troglodytidae**									
Carolina Wren	*Thryothorus ludovicianus*	B W M	B W M	B W M		B W M				B W M
House Wren	*Troglodytes aedon*	B W M		B W M		B W M				B W M
Sedge Wren	*Cistothorus platensis*				B M		B M			
Kinglets	**Regulidae**									
Golden-crowned Kinglet	*Regulus satrapa*	W M	W M			W M				W M
Gnatcatchers	**Sylviidae**									
Blue-gray Gnatcatcher	*Polioptila caerulea*	B M	B M	B M		B M				
Thrushes	**Turdidae**									
Eastern Bluebird	*Sialia sialis*	B W M		B W M	B M	B W M			B W M	B W M
Wood Thrush	*Hylocichla mustelina*	B M	B M			M				M
American Robin	*Turdus migratorius*	B W M	B W M	B W M	M	B W M			M	B W M
Mockingbirds & Thrashers	**Mimidae**									
Gray Catbird	*Dumetella carolinensis*		B M	B M		B M				B M
Northern Mockingbird	*Mimus polyglottos*			B W M						B W M
Brown Thrasher	*Toxostoma rufum*			B M	B	B M			B M	B M
Waxwings	**Bombycillidae**									
Cedar Waxwing	*Bombycilla cedrorum*	B W M	B W M	B W M		B W M				B W M
Starling	**Sturnidae**									
European Starling (I)	*Sturnus vulgaris*	B W M	B W M			B W M			B W M	B W M
Vireos	**Vireonidae**									
Bell's Vireo	*Vireo bellii*			B M	B M					
Yellow-throated Vireo	*Vireo flavifrons*	B M	B M							M
Warbling Vireo	*Vireo gilvus*	M	B M	B M		B M				B M
Red-eyed Vireo	*Vireo olvaaceus*	B M	B M	M		B M				M

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Warblers	**Parulidae**									
Northern Parula	*Parula americana*	B M	B M			M				M
Yellow Warbler	*Dendroica petechia*		M	B M		M	B M			M
Yellow-throated Warbler	*Dendroica dominica*	M	B M							
Cerulean Warbler	*Dendroica cerulea*	B M	B M			M				M
American Redstart	*Setophaga ruticilla*	M	B M	M		M				M
Prothonotary Warbler	*Protonotaria citrea*		B M							
Worm-eating Warbler	*Helmitheros vermivorus*	B M								
Ovenbird	*Seiurus aurocapillus*	B M		M		M				M
Louisiana Waterthrush	*Seiurus motacilla*	B M	M							
Kentucky Warbler	*Oporornis formosus*	B M	M			M				
Common Yellowthroat	*Geothlypis trichas*			B M	B M	B M	B M		B M	B M
Tanagers	**Thraupidae**									
Summer Tanager	*Piranga rubra*	B M				B M				M
Scarlet Tanager	*Piranga olivacea*	B M	B M			B M				M
Grosbeaks & Buntings	**Cardinalidae**									
Northern Cardinal	*Cardinalis cardinalis*	B W M	B W M	B W M		B W M			B W M	B W M
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	B M	B M	B M		B M				M
Indigo Bunting	*Passerina cyanea*	B M	B M	B M		B M			M	
Dickcissel	*Spiza Americana*				B M				B M	
Towhees & Sparrows	**Emberizidae**									
Chipping Sparrow	*Spizella passerina*	B M		M	M	B M				B M
Field Sparrow	*Spizella pusilla*			B W M	B W M	B W M	W M		B M	
Lark Sparrow	*Chondestes grammacus*			B M	B M				B M	
Grasshopper Sparrow	*Ammodramus savannarum*				B M					
Song Sparrow	*Melospiza melodia*			B W M	B W M		B W M		B W M	B W M
White-crowned Sparrow	*Zonotrichia leucophrys*			W M	W M					W M
Blackbirds & Orioles	**Icteridae**									
Bobolink	*Dolichonyx oryzivorus*				M		M			
Red-winged Blackbird	*Agelaius phoeniceus*	W	W	B M	B W M	B M	B M		B W M	B M
Eastern Meadowlark	*Sturnella magna*				B W M				B W M	
Common Grackle	*Quiscalus quiscula*	B W M	B W M			M	B		W M	B W M
Brown-headed Cowbird	*Molothrus ater*	B W M	B W M	B M	B M	B M	B M		B W M	B W M
Baltimore Oriole	*Icterus galbula*	B M	B M	B M		B M				B M

Table 3-39 Continued.

Name (2,3)		Habitat (4,5)								
		UpFor	ForWet	Shrub	Grass	Sav	HeWet	Water	Crop	Cult
Finches	**Fringillidae**									
House Finch (I)	*Carpodacus mexicanus*	M	M	B W M		M				B W M
American Goldfinch	*Carduelis tristis*	W M	W M	B W M	B W M	W M				B W M
Old World Sparrows	**Passeridae**									
House Sparrow (I)	*Passer domesticus*								B W M	B W M
Eurasian Tree Sparrow (I)	*Passer montanus*			B W M					B W M	B W M
NUMBER OF SPECIES PER HABITAT TYPE		57	60	51	38	60	51	35	38	62

(1) This TABLE is a shortened version of TABLE found in Appendix B. Species considered to regularly occur in the Project area are taken from IDNR (1998d) and Parker (1981).
(2) Bold type indicates Illinois threatened (ST), Illinois endangered (SE), and/or federally endangered (FE) species.
(3) (I) = Introduced species
(4) Habitats assignments taken from IDNR (1998b); the following habitat codes are used:
UpFor = Upland and mesic forest
ForWet = Forested wetland, including wet floodplain forest and forested swamps)
Shrub = Shrublands (open habitats dominated by shrubs, inclluding old hayfields)
Grass = Grasslands (including pasture and hayfield)
Sav = Savanna
HeWet = Wetlands (seasonally flooded, open habitats such as marshes and sedge meadows)
Water = Lakes, ponds, impoundments, rivers, larger streams
Crop = Crops
Cult = Residential areas (including urban centers and the "urban forest")
(5) Breeding status taken from IDNR (1998b); the following codes are used:
B = Breeding (species that currently or historically have bred in the area)
W = Winter (species present from December through February)
M = Migrant (species present during the March-May and late August-November periods)

3.12.5.6 Mammals. As shown in Table 3-40, there are 41 mammal species that occur or are likely to occur in the Project area. The most diverse groups include the shrews and moles, bats, rodents, and carnivores. The remaining groups of mammals are represented by single species of opossum, rabbit, and deer. Twenty-five of the species have documented occurrences in the Project area. Two species of bats are federally protected, and are discussed in Appendix B in Annex B.14. Two species are not native – the Norway rat and house mouse.

Mammals are found in all habitats of the Project area. Many species inhabit forest, including both upland forests as well as floodplain forests. Most species use a variety of habitats. About half use forests and prairies as well as nonwoody wetlands, such as marshes. Only two species are restricted to prairies and grasslands. Mammals found in cultural areas, such as cropland, pasture, successional field, developed land, and tree plantations, are rather diverse. Stray cats and dogs could be added to the 15 species of mammals that inhabit cultural areas.

Since settlement, a number of species have been extirpated from Illinois or on a regional basis within the state. Most of them are carnivores, and/or they require large home ranges. They include the black bear (*Ursus americanus*), badger (*Taxidea taxus*), river otter (*Lutra canadensis*), gray fox (*Urocyon cinereoargenteus*), timber wolf (*Canis lupus*), cougar (*Felis concolor*), bobcat (*Lynx rufus*), elk (*Cervus elaphus*), and bison (*Bison bison*). Franklin's ground squirrel (*Spermophilus franklinii*) may be another example of a locally extinct species. Four of these species deserve mention because they are assumed not to be present within the Project area. Extensive tracts of forest required by the gray fox (Hoffmeister 1989) are not present in the Project area. The badger is not included only because it is apparently uncommon, and there are relatively few records of its occurrence in southwestern Illinois (Hoffmeister 1989). Relatively high levels of human disturbance and impaired water quality in much of the Project area presumably deter the river otter, a state endangered species (IDNR 1998d). However, individuals released not far away by otter reintroduction programs in Illinois or Missouri (or their offspring) may disperse into the Project area, and Horseshoe Lake is considered to be habitat (IDNR 1998d). Human disturbance and forest fragmentation are assumed to deter the bobcat (a state-threatened species), although an individual was killed in Collinsville in 1982, and trappers reported earlier sightings in Madison County (IDNR 1998d).

A number of management recommendations for mammals were provided by IDNR (1998d) in its "Sinkhole Plain Area Assessment" that addresses the Project area as well as a larger contiguous area to the south. First, upland and floodplain forests should be preserved for species dependent on forest, such as the Indiana bat, bobcat, and gray fox. Secondly, riparian forests, or those forests occurring along streams and other waterways, should be preserved and restored to benefit mammals using them, such as the river otter. Thirdly, pollutants such as silt and chemicals that enter aquatic habitats and wetlands as runoff should be reduced to benefit species using these areas, such as the river otter and mink. And, lastly, existing remnant prairies should be preserved along with other grasslands, and prairie restorations should be created to benefit grassland species like the badger and red fox. Restoration of hill prairies by removing encroaching woody vegetation would also benefit grassland small mammals.

Table 3-40 Mammal species that occur or are likely to occur in the Project area (1).

Name (2, 3)			Habitat (4)							Relative Abundance (5)
Common name	***Order/Species name***		**For**	**Pra**	**Wet**	**Cre**	**Lake**	**Cave**	**Cult**	
Opossums	**Didelphimorphia**									
Virginia opossum	*Didelphis virginiana*	*	X	X	X	X (e)			X (b)	C
Shrews and Moles	**Insectivora**									
Southeastern shrew	*Sorex longirostris*		X	X	X					C
Northern short-tailed shrew	*Blarina brevicauda*	*	X	X	X					C
Southern short-tailed shrew	*Blarina carolinensis*	*	X	X	X					C
Least shrew	*Cryptotis parva*	*		X						C
Eastern mole	*Scalopus aquaticus*	*	X	X					X	C
Bats	**Chiroptera**									
Little brown bat	*Myotis lucifugus*	*	X			X	X	X	X (b)	C

Table 3-40 Mammal species that occur or are likely to occur in the Project area (1).

Name (2, 3)			Habitat (4)							Relative Abundance (5)
Common name	***Order/Species name***		**For**	**Pra**	**Wet**	**Cre**	**Lake**	**Cave**	**Cult**	
Indiana bat (SE, FE)	***Myotis sodalis (SE, FE)***		**X**			**X**	**X**	**X**		**R**
Gray bat (SE, FE)	***Myotis grisescens (SE, FE)***		**X**			**X**	**X**	**X**		**U**
Northern long-eared bat	*Myotis septentrionalis*	*	X			X	X	X	X (b)	U
Silver-haired bat	*Lasionycteris noctivagans*		X			X	X	X	X	C
Eastern pipistrelle	*Pipistrellus subflavus*		X			X	X	X	X	C
Big brown bat	*Eptesicus fuscus*		X			X	X	X	X (b)	C
Red bat	*Lasiurus borealis*	*	X			X	X			C
Hoary bat	*Lasiurus cinereus*	*	X			X	X			U
Evening bat	*Nycticeius humeralis*		X			X	X		X	U
Rabbits	**Lagomorpha**									
Eastern cottontail	*Sylvilagus floridanus*	*	X (e)	X					X	C
Rodents	**Rodentia**									
Eastern chipmunk	*Tamias striatus*	*	X							C
Woodchuck	*Marmota monax*	*	X (e)	X						C
Gray squirrel	*Sciurus carolinensis*	*	X						X	C
Fox squirrel	*Sciurus niger*	*	X						X	C
Southern flying squirrel	*Glaucomys volans*		X							C
Plains pocket gopher	*Geomys bursarius*	*		X						C?
Beaver	*Castor canadensis*	*			X	X	X			C
Deer mouse	*Peromyscus maniculatus*	*		X						C?
White-footed mouse	*Peromyscus leucopus*	*	X	X	X (mf)					C
Prairie vole	*Microtus ochrogaster*	*		X					X	C
Woodland vole	*Microtus pinetorum*	*	X							U
Muskrat	*Ondatra zibethicus*	*			X	X	X			C
Southern bog lemming	*Synaptomys cooperi*			X	X					U?
Norway rat (I)	*Rattus norvegicus*	*							X (b)	C
House mouse (I)	*Mus musculus*	*							X (b)	C
Meadow jumping mouse	*Zapus hudsonius*		X	X	X					U?
Carnivores	**Carnivora**									
Coyote	*Canis latrans*		X	X	X					C
Red fox	*Vulpes vulpes*		X	X	X					C
Raccoon	*Procyon lotor*	*	X	X	X				X (b)	C
Long-tailed weasel	*Mustela frenata*		X	X	X					C
Mink	*Mustela vison*		X		X	X	X			C
Striped skunk	*Mephitis mephitis*		X	X	X					C
Even-toed Ungulates	**Artiodactyla**									
White-tailed deer	*Odocoileus virginianus*	*	X	X	X					C
NUMBER OF SPECIES PER HABITAT TYPE			31	20	16	14	13	7	15	

Table 3-40 Continued

(1) Known species indicated by "" in middle column, and are based on Parker (1973, 1974, 1981) and Hoffmeister (1989); likely species are based on Hoffmeister (1989) and IDNR (1998d).*
(2) Bold emphasis denotes federally endangered (FE), state endagered (SE) species.
(3) (I) indicates introduced species.
(4) Taxonomy and nomenclature follow Wilson and Reeder (1993). The following habitat codes are used:

For = Forest (wetland and nonwetland)
Pra = Prairie, grassland
Wet = Wetland (not forested)
Cre = Creeks and rivers
Lake = Lakes, ponds, and impoundments
Cave = Caves
Cult = Cultural

Habitat use taken from IDNR (1998d) and Hoffmeister (1989). The following habitat use codes are used:

e = edge
b = buildings
mf = mostly forested

(5) Relative abundance taken from IDNR (1998d). The following relative abundance codes are used:

C = Common
U = Uncommon
R = Rare

3.13 ENDANGERED AND THREATENED SPECIES

This section lists the federally and state-listed endangered and threatened species that may occur within the Project area. Ten federally-listed species are included, as are 47 state-listed species, which include the federally-listed species (Table 3-41). Details concerning the probable occurrence of individual species in the Project area are provided in a biological assessment included in Appendix B in Annex B.14.

The potential presence of such species was determined through consultations with the U.S. Fish and Wildlife Service (USFWS), the Illinois Department of Natural Resources (IDNR) with its Natural Heritage Database, and Corps biologists. Information was also obtained from review of prior reports and publications, and from a field survey conducted for this Project.

In 1998, a survey for federally- and state-listed species was conducted in a portion of the Project area (ZE 1998). Two floodplain sites, Brushy (Levy) Lake and Frank Holten State Park, were assessed for use by listed species. Brushy (Levy) Lake lies about one mile east of Horseshoe Lake in the center of the Project area, between I-255, I-55/70, and Cahokia Canal. Holten State Park, about four miles south of Brushy (Levy) Lake, is in the southern part of the Project area. The survey identified any known historic use, actual use during site visits in the fall of 1998, and potential use by listed species in these areas.

3.13.1 Federally-Listed Species. Under the Endangered Species Act of 1973, federal agencies are required to conserve biological and wildlife species that have been federally listed as endangered or threatened. A species is endangered if it is in danger of extinction throughout all or a significant portion of its range, and threatened if it is likely to become endangered within the foreseeable future. All federal agencies must consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that any actions authorized, funded, or carried out by the agencies are not likely to jeopardize the continued existence of any endangered or threatened species, or to result in the destruction of or substantial damage to its critical habitat. While this consultation is in progress, an agency must not make an irretrievable commitment of resources to its project.

In connection with this East St. Louis and Vicinity, Illinois Project, consultation with the USFWS is required to ensure thorough consideration of potential effects on endangered and threatened species. There may be opportunities for the Corps to restore or protect habitat for threatened and endangered species, or to contribute to endangered species recovery plans, as part of ecosystem restoration projects and initiatives.

The U. S. Fish and Wildlife Service identified eight federally-listed species, and one species of concern (Table 3-41), that may be present in the Project area in a letter dated March 10, 1999 (see Appendix G). The piping plover (*Charadrius melodus*) has been added to this list by the Corps because it has been recently sighted within the Project area.

In its letter, the USFWS indicated that no designated critical habitat exists within the Project area for any of these species. Similarly, there is no designated critical habitat for the piping plover or massasauga. The potential or documented occurrences of federally-listed species in the Project area are discussed in a biological assessment included in Appendix B. In Illinois, all these federally-listed species are also state-listed species, including the massasauga.

3.13.2 State-Listed Species. The 1999 letter from USFWS requested that a list of state-listed species be obtained from IDNR for this Project. IDNR forwarded information about state-listed species in a letter dated May 3, 2000, accompanied by a map of the Project area. State-endangered and state-threatened species that may occur in the Project area are included in Table 3-41.

This list was developed from the information submitted by IDNR, and from lists of plants, amphibians and reptiles, fishes, birds, and mammals that are likely to occur in the Project area (see Appendix B). The potential or documented occurrences of state-endangered species in the Project area are discussed in a biological assessment included in Appendix B.

Table 3-41 Threatened and endangered species occurring or likely to occur in the Project area. E = endangered, T = threatened, C = federal species of concern.

Common Name	Scientific Name	Listing Status	
		State	Federal
Plants			
Pale false foxglove	*Agalinis skinneriana*	T	
Decurrent false aster	*Boltonia decurrens*	T	T
Small burhead	*Echinodorus tenellus*	E	
Mud plantain	*Heteranthera reniformis*	E	
Bead grass	*Paspalum dissectum*	E	
Eastern prairie fringed orchid	*Platanthera leucophaea*	E	T
Royal catchfly	*Silene regia*	E	
Spring ladies' tresses	*Spiranthes vernalis*	E	
Prairie spiderwort	*Tradescantia bracteata*	T	
Freshwater Crustacean			
Illinois cave amphipod	*Gammarus acherondytes*	E	E
Fish			
Pallid sturgeon	*Scaphirhynchus albus*	E	E
Sturgeon chub	*Macrhybopsis gelida*	E	
Flathead chub	*Platygobio gracilis*	E	
Amphibians			
Illinois chorus frog	*Pseudacris streckeri illinoensis*	T	
Reptiles			
Timber rattlesnake	*Crotalus horridus*	T	
Great Plains rat snake	*Elaphe guttata emoryi*	T	
Massasauga rattlesnake	*Sistrurus catenatus*	E	C
Flathead snake	*Tantilla gracilis*	T	
Birds			
Pied-billed Grebe	*Podilymbus podiceps*	T	
American Bittern	*Botaurus lentiginosus*	E	
Least Bittern	*Ixobrychus exilis*	T	
Snowy Egret	*Egretta thula*	E	
Little Blue Heron	*Egretta caerulea*	E	
Black-crowned Night-heron	*Nycticorax nycticorax*	E	

Table 3-41 Continued

Common Name	Scientific Name	Listing Status	
		State	Federal
Yellow-crowned Night-heron	*Nyctanassa violaceus*	E	
Osprey	*Pandion haliaetus*	E	
Mississippi Kite	*Ictina mississippiensis*	E	
Bald Eagle	*Haliaeetus leucocephalus*	T	T
Northern Harrier	*Circus cyaneus*	E	
Red-shouldered Hawk	*Buteo lineatus*	T	
Peregrine Falcon	*Falco peregrinus*	E	
King Rail	*Rallus elegans*	E	
Common Moorhen	*Gallinula chloropus*	T	
Piping Plover	*Charadrius melodus*	E	E
Upland Sandpiper	*Bartramia longicauda*	E	
Wilson's Phalarope	*Phalaropus tricolor*	E	
Common Tern	*Sterna hirundo*	E	
Forster's Tern	*Sterna forsteri*	E	
Least Tern	*Sterna antillarum*	E	E
Black Tern	*Chlidonias niger*	E	
Short-eared Owl	*Asio flammeus*	E	
Brown Creeper	*Certhia americana*	T	
Veery	*Catharus fuscescens*	T	
Loggerhead Shrike	*Lanius ludovicianus*	T	
Henslow's Sparrow	*Ammodramus henslowii*	E	
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	E	
Mammals			
Gray bat	*Myotis grisescens*	E	E
Indiana bat	*Myotis sodalis*	E	E

3.14 CULTURAL RESOURCES

The American Bottom portion of the Project area is arguably the richest, most complex, archaeological region in all of North America. Native American occupation of the Project area began at least 12,000 years ago and continued up until the early nineteenth century when the last groups of Native Americans were displaced from the area by ever-increasing numbers of Euro-American settlers.

The crown jewel of this archaeological legacy is the Cahokia Mounds World Heritage Site, located near the center of the Project area. Eight centuries ago this site covered 5 square miles of the Mississippi River floodplain and was, in turn, surrounded by hundreds of supporting communities. These settlements ranged in size from large towns and villages to individual farmsteads. Research suggests that these settlements were strategically located to garner maximum productivity from the regions bountiful, ecologically diverse, natural resources. Even today, more than six centuries after the last of these prehistoric residents of the Central Mississippi River valley mysteriously abandoned the area, fragments of their discarded tools are commonly observed throughout the Project area by the trained eye of archaeologists.

Unfortunately, the cultural value of these prehistoric remains were not well protected until well into the twentieth century. By then, the remains of many of these sites had been significantly damaged, or destroyed. As metropolitan areas continue to encroach onto the American Bottom portion of the project area, those archaeological remains not in public ownership / protection are increasingly vulnerable to commercial and residential development. Such development has already claimed all, or substantial portions of, three of the largest prehistoric Mississippian Temple Mound centers within the project area. These include the East St. Louis Mound Group, the Mitchell Mound Group, and the Lohman Mound and Village site.

The preponderance of professional archaeological investigations conducted within the project area during the late twentieth century were administered by the Illinois Department of Transportation. For the most part these investigations were associated with interstate highway construction - the largest of those being Interstate 255. The right-of-way for this highway traverses the entire length of the American Bottom portion of the East St. Louis Ecosystem Restoration Project area. Scores of archaeological remains, some deeply buried and dating back more than 4000 years, were identified and excavated in advance of construction related to that project.

Unfortunately, only a small portion of the American Bottom has been systematically surveyed for the presence of archaeological remains. Therefore, it is impossible to reliably estimate the number of archaeological sites that have been lost as a result of commercial and residential development. However, it is safe to assume that the number is large. The scientific value (and corresponding loss to the Nation) of the information once contained in these destroyed archaeological sites is incalculable. Present-day land use within the areas being considered for potential ecosystem restoration includes agricultural fields, former residential and commercial tracts, lakes / sloughs, and public land. The preservation and enhancement of significant archaeological remains within these contexts is a priority of this Project.

3.15 OUTDOOR RECREATIONAL RESOURCES

Special districts and municipal recreation departments provide the majority of close-to-home outdoor recreational opportunities in the state. Local districts provide outdoor recreation sites, facilities, and programs that are nearby and convenient. In addition to providing parkland, facilities, and programs, districts are now providing day care services, senior centers, and other services and programs to accommodate changing public needs.

The voters of Madison and St. Clair Counties approved a metropolitan park and recreation district in November of 2000. The objectives of this park district, which will be supported by tax revenues, are: to preserve natural lands adjacent to waterways to filter pollutants and protect wildlife habitat; to provide safe places for families and children to play by repairing worn equipment and improving maintenance in existing parks; to create trails and paths for walking, biking and other compatible uses; to create new parks in newer communities; and, to provide expanded disabled and public access to recreational areas.

Within the Project area, the State of Illinois owns and maintains Horseshoe Lake State Recreation Area, Cahokia Mounds State Historic and World Heritage Site, Frank Holten State Park. The two parks are managed for both recreational activities and as wildlife management areas. Horseshoe Lake provides seasonal duck hunting opportunities within sight of the Arch. While there are fishing opportunities, they are limited for consumption purposes because of existing contamination. Likewise, the interior drainage canal and borrow sites along the I-55/I-70 highway route provide informal fishing opportunities. Frank Holten provides a more urban recreational experience with the inclusion of an 18-hole golf course while Horseshoe Lake provides both primitive and supported overnight campsite facilities. Within the local communities there are small city parks as well as school and neighborhood recreational areas that support those living in the immediate vicinity with basic recreational facilities. The Southern Illinois University at Edwardsville campus provides a first class soccer facility and ball fields that are used locally and regionally.

3.15.1 Local Focus. The recent focus on urban sprawl has brought to the forefront concerns over a loss of green and open space in the developing areas. This has brought together a coalition of public and private groups working in concert with state and local agencies looking for opportunities to obtain and protect areas for their recreation and wildlife habitat value. The Confluence Greenway Partnership has brought credibility to the notion that multiple agencies can work cooperatively to make a regional concept a reality. Additionally, this partnership has paved the way to demonstrate how recreation benefits can be realized along with the preservation and enhancement of wildlife areas that provide their own inherent benefits to the regional recreational setting. These concepts are being replicated in both the floodplain and the bluff communities. The Project area's physical setting, location and colorful history provide a wide array of potential scenic and cultural attractions to benefit residents of the region as well as tourists from outside the region. The steep, forested bluffs rise upward from the Mississippi River and its flood plain and provide many miles of scenic vistas with the potential for connectivity within the Project area and to other regionally developed/developing recreational opportunities.

Surveys conducted by Trail Net in the region indicate that about half the population will visit a trail system for walking, hiking, jogging, in-line skating and biking. Annual regional visits could number as many as 10 million. Currently, existing features are limited but there are many opportunities in neighboring areas across the region. (Tables 3-42 and 3-43).

Table 3-42 Existing Trails in the Project Area

Existing Trails	County	Sponsor	Length/Surfaced	Links
Delyte-Morris	Madison	SIUE/Edwardsville	5 miles paved	MCT Trail, Glen Carbon Trail,
Glen Carbon Heritage Trail	Madison	City of Glen Carbon	3.2 ,miles paved	Delyte-Morris,
MCT (Vadalabene Nature Trail)	Madison	MCT	8 miles paved	Delyte-Morris Trail,
Vadalabene River Road Trail Confluence Bikeway	Madison, Jersey	IDOT	14.5 miles paved	Pere Marquette St. Park, Alton Bike Trail, Clark Bridge, Katy Trail, American Discovery Trail

Table 3-43 Existing trails in the Metro East area but outside the Project Area

Existing Trails	County	Sponsor	Length/Surfaced	Links
Lewis and Clark National Historic Trail (Millenium Trail)	Madison Co. (Wood River) to Les Shirley Park Oregon		3,700 miles	Confluence Greenway
Mississippi River Trail	St. Louis To New Orleans (Routing complete from Modoc, IL south)	Mississippi River Cycling and Hiking Corridor	1,200 miles	
American Discovery Trail (a segment of Confluence Greenway and a National Millennium Trail)	St. Louis MO to New Haven, IL via the River to River trail		6,350 miles, 6 national trails, 10 national historic trails, 23 national recreation trails, 14 national parks, 16 national forests	Confluence Greenway Cahokia, Monroe Co, Randolph Co., Fort de Chartes, Fort Kaskaskia Historic Site
Bicentennial Transamerica	Randolph Co.		4,500	ADT, Kaskaskia

3.15.2 Greenways/Trails. Greenways offer opportunities to creatively preserve open space in rapidly developing areas, protect important natural resources such as wetlands and wildlife corridors, and provide opportunities for outdoor activities such as bicycling and walking. Greenways and trails have been one of the top public concerns identified through the SCORP Public Participation program for years. Southwestern Illinois offers tremendous greenway opportunities.

Table 3-44 Existing Greenways

	Existing Greenways	County
1	American Discovery Trail	St. Clair and Monroe
2	Delyte Morris Bikeway/Greenway	Madison
3	Glen Carbon Heritage Greenway	Madison
4	Lewis and Clark National Historic Trail	Madison
5	Valdalabene Bikeway (River Road Bikeway) Trail Greenway	Madison
1	Bluff Greenway and Trail	St. Clair and Monroe
2	Mississippi Levee Greenway and Trail	St. Clair and Monroe
3	Schoolhouse Trail Greenway	Madison

3.16 AESTHETICS

The Project area's aesthetic (visual) characteristics run the gamut from less attractive, heavily urbanized/heavy industrial sites to natural areas with pristine-like qualities. The landscape is a smorgasboard of visual stimuli, including upland and bottomland forests, lakes, rivers, canals, marshes, ponds, small and large cities, farmland, and parks. The topographic features include remarkably flat expanses of bottomlands as well as bluff areas in the uplands. Man-made features abound in the form of flood control structures, interstates, highways, roads, utility structures, communication facilities, buildings, signs, billboards, and many other things normally associated with a heavily urbanized area. Unique to this area is the ancient man-made Cahokia Mounds World Heritage Site, and Monks Mound, its primary feature, can be seen from a distance. Also prominent is the highly visible St. Louis Gateway Arch located just across the Mississippi River.

3.17 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

Over 80 hazardous waste sites have been identified in the vicinity of the Project area through the Superfund program. Many of the sites are related to former industrial or landfill operations. These sites fall into four Superfund categories. First, there are 29 CERCLIS sites at which clean up is being considered, and they are listed in the U.S. EPA's Comprehensive Environmental Response, Compensation, and Liability Information System (USEPA 2002a). Second, two sites are on EPA's National Priorities List (USEPA 2002b), and involve long-term remedial response actions. Third, two sites have been proposed for inclusion on the NPL (USEPA 2002c). Lastly, 49 sites have been archived (USEPA 2002d). Archived sites include those for which an assessment has been completed and EPA has determined no steps will be taken to designate the site as a priority by listing it on the NPL, and no further remedial action is planned under the Superfund Program.

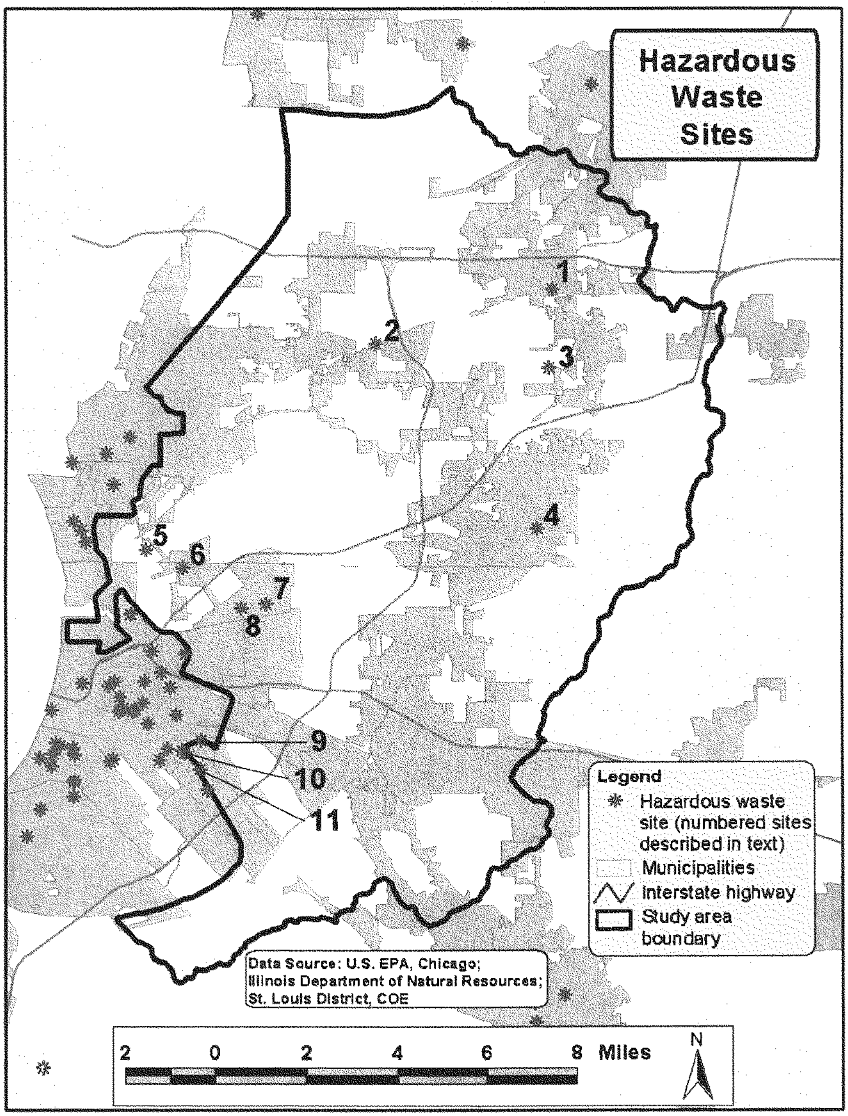
Thirteen hazardous waste sites occur within the Project area (Table 3-45). Of these, six occur in Madison County and seven in St. Clair County. Nine are CERCLIS sites, and four are archived sites. None of the sites in the Project area are NPL sites or proposed for listing on the NPL.

Figure 3-16 shows the location of hazardous waste sites in the Project area and vicinity. Most sites are outside the Project area to the southwest, in the vicinity of East St. Louis and Sauget. The location of these sites has been taken from information maintained by the EPA, and generally represents the business or street address of the site.

Table 3-45 Hazardous waste sites in the Project area.

SITE	EPA ID NO.	NAME	ADDRESS	CITY	COUNTY	STATUS
1	ILD984791665	KETTLE RIVER CREOSOLE WORKS	CENTER GROVE & COUGAR ROADS	GLEN CARBON	MADISON	Cerclis
2	ILD980606925	ILLINOIS PWR CO STALLINGS GAS TURBINE	ST HWY 162	STALLINGS	MADISON	Archived
3	ILD982070799	KOSYAK HORSE ARENA	WEST OF MARYVILLE	MARYVILLE	MADISON	Archived
4	ILD981528409	CENTRAL STATES BATTERY	6349 COLLINSVILLE RD	COLLINSVILLE	MADISON	Archived
4	ILD980677819	COLLINSVILLE/KEEL	ADDRESS UNREPORTED	COLLINSVILLE	MADISON	Cerclis
4	ILD980607006	ST. LOUIS SMELTING & REFINING CO.	CUBA LN	COLLINSVILLE	MADISON	Cerclis
5	ILN000508136	SAINT LOUIS AUTO SHREDDING DRUM DISPOSAL	INTERSECTION BEND ROAD & STATE HIGHWAY 203	MADISON CITY	ST CLAIR	Cerclis
6	ILT180014961	SCA MILAM LDFL	I-55 & RTE 203	EAST ST LOUIS	ST CLAIR	Cerclis
7	ILD059995423	SWIFT AG CHEM FAIRMONT CITY PLT	2501 NORHT KINGS HIGHWAY	FAIRMONT CITY	ST CLAIR	Cerclis
8	IL0000034355	OLD AMERICAN ZINC PLANT	JCT OF 45TH ST & COOKSON RD	FAIRMONT CITY	ST CLAIR	Cerclis
9	ILSFN0508010	ALCOA PROPERTIES	3000 E. MISSOURI AVENUE	EAST ST. LOUIS	ST CLAIR	Cerclis
10	ILD077117992	UNITED STEEL DRUM INCORPORTED	3105 MISSOURI AVENUE (HWY 15)	EAST ST LOUIS	ST CLAIR	Archived
11	IL0000146977	CHILDS PROPERTY	3607 E. MISSOURI AVE.	ALERTON	ST CLAIR	Cerclis

Figure 3-16 Project Area - Hazardous Waste Sites



3.18 SUMMARY

Urbanization has had a profound impact on the Project area since pre-development days. The ecosystem has been significantly disturbed and the Project area's flooding patterns, which historically helped create, develop, and sustain habitat quality, have been significantly altered in order to minimize agricultural and structural damages. Increased runoff and peak flows in the tributary streams has begun the process of stream bank erosion and destabilization, which if untreated will continue to degrade stream resources while sending increased levels of sediment to the floodplain. These factors and their secondary effects combined have created an ecosystem in need of attention and restoration.

The identification and evaluation of the Project area's existing conditions prepares the foundation for a look into the future under a couple of scenarios: first, the future assuming that there will be no project emanating from this study effort (future without project condition); and, secondly, the future as it is expected to look with a recommended plan implemented (future with project condition). The next Section discusses the future without project condition.

SECTION 4 - FUTURE WITHOUT PROJECT CONDITIONS

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SECTION 4 - FUTURE WITHOUT PROJECT CONDITION

This section of the report provides a definition of what is meant by the future without project condition and how and why it is developed. In the context of this Project, the term "plan" refers to the potential modifications and additions to the existing East St. Louis project, and not to the existing project or its components.

4.1 FUTURE WITH AND WITHOUT PROJECT COMPARISONS

The U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G, 1983) provide the policies and procedures for conducting Federal water resource planning studies. One requirement of the P&G is to evaluate the effects of alternative plans by comparing the most likely future conditions in the Project area with and without implementation of each plan. In order to make this comparison, forecasts of future conditions must be made for both with-project and without-project conditions.

The future without project condition describes the characteristics expected to occur in the Project area if none of the alternative plans are implemented. The without-project condition is also referred to as the "no action plan". The Federal regulations implementing the National Environmental Policy Act of 1969 also require that the no action plan be considered as an alternative in assessing the potential effects of all Federal actions.

Future with-project conditions describe what is expected to occur as a result of implementing each alternative plan that is being considered in a Federal water resources study. With-project future conditions are developed for each alternative plan.

The differences between the without-project conditions (i.e., the no action alternative) and the with-project conditions expected to occur with implementation of each "action" alternative are the effects, or impacts, associated with each plan. The formulation of alternative plans is described in Section 6. The evaluation of the environmental effects of the recommended plan is described in Section 7.

4.2 PLANNING HORIZON

The planning horizon encompasses the period of time beginning with the initiation of the Project, through the construction period, the environmental analysis period, and the expected useful life of the project. The environmental analysis period, also known as the period of analysis, is the period of time used to assess both the positive and potential negative effects of a project. The period of analysis does not usually extend to the end of the planning horizon, because many projects (e.g., levee systems) may last more than 100 years. Projecting future conditions over a time period this large is highly speculative. Therefore, the period of analysis used to assess the impacts of water resources projects is typically limited to no more than 50 years, or the duration of significant effects (whichever is shorter). A 50-year period of analysis has been selected for this Project.

4.3 CLIMATE AND WEATHER

No significant climatological changes are expected to occur over the 50-year planning period used for this Project.

4.4 ECOLOGICAL AND NATURAL RESOURCES

This section describes future natural resources and ecological conditions in the Project area if no action is implemented as a result of this Project. A 50-year period of analysis has been used in the forecast of future conditions.

The Project team regarded many future environmental changes to consist of trends representing a continuation of existing ecological problems. There was a need to express natural resource trends in a quantified fashion so that quantitative habitat evaluation methods required for the study could be employed to make comparisons between future without-project and future with-project conditions. Appendix A describes the two methods used in this Project to quantify resource conditions: the Habitat Evaluation Procedures and the Expert HydroGeoMorphic Approach. Because no previous studies were found which quantified environmental trends in the Project area, the Project team developed quantitative trends using the best available information. As a result, natural resource trends presented in this section are the result of the interagency biology team's best professional judgment.

4.4.1 Ecological Resources.

4.4.1.1 Forest. The amount of forest in the Project area has declined significantly since presettlement times. This trend is expected to continue. Given the projections for greater population growth in the Bluff Corridor, the rate of forest loss in tributary watersheds is expected to substantially exceed that on the floodplain in the American Bottom Corridor.

4.4.1.1.1 Forest in Tributary Watersheds. Future rates of upland forest loss are expected to vary by major watershed. Table 4-1 displays expected forest loss in the four major tributary watersheds at selected future points in time. These rates do not reflect any future implementation of tree preservation or "green space" requirements on development by local government as no formula has been established by planning entities within the Project area. The two central watersheds, Cahokia and Harding, are expected to show considerably greater rates of loss than the two peripheral watersheds to the north and south. Most existing upland development is concentrated in the Cahokia watershed (which supports the municipalities of Glen Carbon, Troy, Maryville, and Collinsville) and the Harding watershed (supporting Caseyville, Belleville, Fairview Heights). Outward expansion of residential and commercial developments into adjacent agricultural and forested areas is expected to lead to a reduction of about 75 to 80 percent of all forest in these watersheds (Table 4-1). Remaining forest is expected to be concentrated on the steepest slopes of upland ravines and along narrow creek bottoms. To the north and south, forest losses in the County Ditch and Powdermill watersheds are anticipated to be no more than half that of the central watersheds. Between these two small watersheds, Powdermill is expected to exhibit greater forest losses because land ownership there is mainly private, whereas public lands at Southern Illinois University at Edwardsville comprise a substantial portion of County Ditch watershed.

Table 4-1 Expected Rates of Forest Loss in the Four Major Tributary Watersheds.

Watershed	Future Cumulative Loss (percent) by Year		
	2010	**2020**	**2050**
County Ditch	5	10	20
Cahokia	25	50	75
Harding	10	30	80
Powdermill	5	20	40

Using the rates of forest loss in Table 4-1, and the amount of upland forest identified in the Illinois Land Cover Database (ILCD) of the early 1990s (about 19,600 acres), the projected total loss of forest over the next 50 years is 14,000 acres. This total loss is equivalent to an average annual loss of about 280 acres across all tributary watersheds, or about 3.6 acres per square mile per year.

4.4.1.1.2 Ecological Problems of Forest in Tributary Watersheds. Upland forests in the Project area are expected to exhibit further loss of ecological integrity due to additional fragmentation, habitat degradation, and introduction of exotic species.

4.4.1.1.3 Wildlife Habitat of Forest in Tributary Watersheds. Wildlife species diversity in shrinking areas of upland forest is expected to decrease and remaining species are expected to consist mainly of those adapted to human disturbances and suburban/urban conditions. Compared to mammals, reptiles and amphibians, the decline in bird species diversity is expected to be high, especially among breeding species.

To evaluate future quality of forest in tributary watersheds as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the fox squirrel, mink, and wood duck. According to projections of future conditions, average habitat quality of forest is expected to decline below the 0.5 level for the fox squirrel, remain below 0.5 for the mink, and continue to be unsuitable for the wood duck (Table 4-2). Indices potentially range from 0 (no quality) to 1 (optimum quality). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-2 Projected changes in habitat quality of forest in tributary watersheds of the Project area, expressed as habitat suitability indices (average and range) for three evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices > 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Fox squirrel	**0.54**	0 - 0.62	0.33	**0 - 0.38**	-0.21
Mink	0.40	0 - 1	0.40	0 - 1	0.00
Wood duck	0.04	0 - 0.17	0.03	0 - 0.09	-0.01

4.4.1.1.4 Forest in the Bottoms. Rates of loss presented here for forested wetlands and forested nonwetlands in the bottoms do not reflect any future implementation of tree preservation or "green space" requirements on development by local government. The interagency biology team assumed that the rate of loss for forested wetlands in the bottoms over the 50-year project life would be 25 percent on privately owned lands and no loss on publicly owned lands. Further explanation for these expected losses is provided below in the section on wetlands. Assuming all forested wetland in the Project area occurs on private property (which is not the case, but establishes a "worst-case" scenario), total losses over the 50-year project life would be about 730 acres, based on Illinois Wetland Inventory data gathered from the mid-1980s. The average annual loss would be about 15 acres, or somewhat less if public forested wetlands were included.

For forested areas in the bottoms that do not occur in wetlands, the rate of loss was assumed to be 75 percent on private property and no loss on public lands. A higher rate of loss is expected in this kind of forest for two reasons. First, no federal program, such as Section 404, provides protection to this kind of forest, and secondly, development of drier sites supporting such forest would be expected to be more feasible than at wetter sites. Using ILCD land use data, total loss of forested nonwetland in the bottoms would be about 3,280 acres, or about 66 acres per year.

4.4.1.1.5 Ecological Problems of Forest in the Bottoms. Additional fragmentation and habitat degradation caused by sedimentation and introduction of exotic species are expected to lead to further loss of ecological integrity in bottomland forests. In addition, forested wetlands will continue to exhibit hydrological regimes that depart from natural conditions either because changes in hydrology have resulted in stabilized water levels, or timing of floods have shifted; either of which may depart too drastically from any natural cycle to permit an adapted forest community to remain or develop on a site (Klimas 1988).

4.4.1.1.6 Wildlife Habitat of Forest in the Bottoms. Wildlife species diversity of bottomland forests is expected to decline with decreasing area of forest. However, because most forested nonwetland is already extremely fragmented, this effect should be most noticeable in forested wetlands.

To evaluate future quality of bottomland forest as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the fox squirrel, mink, great blue heron, wood duck, and slider turtle. Nonwetland bottomland forest was treated separately from wetland bottomland forest. According to projections of future conditions, average habitat quality of bottomland forest is expected to be below 0.5 for all species (Table 4-3). Declines in quality are expected for three species, the most notable being the great blue heron. Quality remains unsuitable for the wood duck, and for the mink in nonwetland forests. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-3 Projected changes in habitat quality of bottomland forest in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Nonwetland bottomland forest					
Great blue heron	**0.52**	0 - 0.52	0.10	0 - 0.1	-0.43
Fox squirrel	0.33	0 - 0.33	0.42	0 - 0.42	0.09
Mink	0.00	0 - 0	0.00	0 - 0	0.00
Wood duck	0.01	0 - 0.01	0.03	0 - 0.03	0.02
Wetland bottomland forest					
Great blue heron	0.45	0 - 0.62	0.24	0 - 0.46	-0.21
Mink	0.29	0 - 1	0.20	0 - 0.55	-0.09
Slider turtle	0.23	0 - 0.46	0.12	0 - 0.24	-0.11
Wood duck	0.02	0 - 0.04	0.03	0 - 0.06	0.01

4.4.1.2 Prairie. Prairies located on public lands were assumed to remain constant in area over the next 50 years. Those found on private lands would be reduced in extent by 75 percent due to development. Given that most prairies in the Project area are on public lands (and consist of restorations), the amount of prairie in the future is expected to remain relatively constant. There are no known plans for future restorations of prairie on public lands.

4.4.1.2.1 Ecological Problems of Prairie. The only known remnant prairie in the Project area is expected to experience further fragmentation. Continuing invasion by exotic species and habitat degradation related to railroad maintenance is expected. Unless additional plant species are added, most existing areas of prairie restorations will continue to show little floristic similarity to historic prairies because of their low native plant species diversity.

4.4.1.2.2 Wildlife Habitat of Prairie. Existing restorations will continue to be too small to attract many species of area sensitive grassland-adapted animals, including breeding birds. Although these areas of prairie may not decline in extent, anticipated development in their vicinity is expected to cause a small decline in diversity of species using them as habitat.

To evaluate future quality of prairie as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the eastern meadowlark. According to projections of future conditions, average habitat quality of restored prairie is expected to remain high for this bird (Table 4-4). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-4 Projected changes in habitat quality of prairie within the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices $\geq$ 0.5 shown in bold.

Species	**Existing (TY0)**		**Future Without Project (TY51)**		**Net Change, TY51-TY0**
	Average	**Range**	**Average**	**Range**	
Eastern meadowlark	**0.94**	0 - 0.94	**0.94**	0 - 0.94	0.00

4.4.1.3 Wetlands. Wetlands occurring on private lands are expected to decline in area by 25 percent over the 50-year project life whereas no loss is anticipated for those found in public areas. This assumption applies equally to all kinds of wetlands - forested wetlands, marshes, and scrub-shrub. Assuming existing wetlands in the Project area are represented by data from the Illinois Wetland Inventory of the mid 1980s, the amount of wetlands expected to be lost is about 1,850 acres, or about 37 acres per year. These data are overestimates because publicly owned wetlands are not included.

Wetland loss on private lands was assumed to occur even though two federal programs, Section 404 of the Clean Water Act and the "Swampbuster" provisions of the Food Security Act, offer wetlands protection. Expected losses would result from three sources: 1) future development in wetlands authorized under Section 404; 2) future agricultural conversions of wetlands by farmers that do not participate in agricultural subsidy programs administered by the U.S. Department of Agriculture; and, 3) future unauthorized development or farming activities in wetlands. Mitigation of wetland losses by wetland creation or restoration, often required as part of Section 404 authorizations, is not reflected in the assumed losses principally because of uncertainty about the location of future mitigation sites relative to the Project area.

4.4.1.3.1 Ecological Problems of Wetland. Continuing problems in marshes and scrub-shrub swamps include altered hydrologic regimes, addition of sediments and agricultural chemicals or urban runoff, encroachment by exotic plant species, and disturbance-tolerant native plant species dominating the local plant community. Continuing ecological problems associated with forested wetlands are discussed above and those associated with ponds are given below.

4.4.1.3.2 Wildlife Habitat of Wetland. Wildlife species diversity of marshes and scrub-shrub swamps is expected to decline to a small degree because of decreasing area of these habitats as well as increasing development surrounding wetlands.

To evaluate future quality of marshes and scrub-shrub wetlands as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the great blue heron, marsh wren, mink, slider turtle, and wood duck. According to projections of future conditions, average habitat quality of marsh and scrub-shrub wetlands is expected to decline for three of the five species, and be below 0.5 for three species (Table 4-5). The most notable decline in habitat quality is for the great blue heron. Quality remains unsuitable for the wood duck, and optimal for the mink. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-5 Projected changes in habitat quality of marshes and scrub-shrub wetlands in the Project area, expressed as habitat suitability indices (average and range) for five evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold, negative changes in red, positive changes in blue.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Great blue heron	**0.66**	0 - 1	0.30	0 - 0.87	-0.36
Marsh wren	**0.62**	0 - 0.7	**0.59**	0 - 0.71	-0.03
Mink	**1.00**	0 - 1	**1.00**	0 - 1	0.00
Slider turtle	0.29	0 - 0.55	0.18	0 - 0.31	-0.11
Wood duck	0.00	0 - 0.02	0.01	0 - 0.02	0.01

4.4.1.3.3 Functional Capacity of Wetlands. Sources of hydrology driving existing wetland functions are not expected to change in the future. Overbank flooding from the Mississippi River will continue to be excluded from the Project area and overflow from tributary streams will remain confined to floodplain channels of the interior flood control system under normal circumstances. On occasions when storms in tributary watersheds overtop the floodplain flood control system, overflow into adjacent wetlands is expected to continue occurring in a random manner with respect to location and season. Consequently, flooding in wetlands historically adapted to riverine overflows is expected to continue to come primarily from direct rainfall and local runoff. Flood depths under these circumstances are not expected to exceed 1 to 2 feet, which is only a fraction of maximum historic flood depths. Flood duration is not expected to exceed current periods of inundation, which probably varies from several days to several weeks. In those cases of wetlands where ponded water is "land-locked" or semi-permanent, the future development of forest or marsh plant communities is not expected because of prolonged hydroperiods. Periodic flood pulses characteristic of historic conditions, in which water sweeps across wetlands, are expected to remain absent.

The interagency biology team assessed future capacity of three separate wetlands to perform various functions. The same procedures that were used to assess existing capacity were employed (Expert HydroGeoMorphic Approach and draft functional capacity index models).

For connected depressional wetland sites, slight increases in capacity for all functions are projected at Elm Slough, but at Brushy Lake, moderate declines are expected (Table 4-6). At the isolated depressional site, two of the three applicable functions show a slight to moderate increase in capacity, and the third exhibits a decline. Evaluation procedures for these wetlands and functions are discussed in detail in Appendix A.

Table 4-6 Projected changes in functional capacity of wetlands within three sites, expressed as functional capacity indices for seven wetland functions. Indices potentially range from 0 (no capacity) to 1 (optimum capacity); indices ≥ 0.5 shown in bold, negative changes in red, positive changes in blue. NA indicates not applicable.

Wetland Functions	Existing (TY0)	Future Without Project (TY51)	Net Change, TY51-TY0
Isolated depressional wetland - Dobrey Slough (disturbed marsh, forested and scrub-shrub wetland)			
Detain floodwater	NA	NA	NA
Store surface water	**0.86**	**0.76**	-0.10
Cycle nutrients	**0.58**	**0.83**	0.25
Export organic carbon	NA	NA	NA
Remove & sequester elements as compounds	NA	NA	NA
Maintain characteristic plant community	**0.55**	**0.60**	0.05
Maintain wildlife habitat	0.27	0.31	0.04
Connected depressional wetland - Elm Slough (only deep marsh and scrub-shrub wetland)			
Detain floodwater	**0.58**	**0.62**	0.04
Store surface water	NA	NA	NA
Cycle nutrients	**0.73**	**0.74**	0.01
Export organic carbon	0.48	**0.57**	0.09
Remove & sequester elements as compounds	**0.73**	**0.78**	0.05
Maintain characteristic plant community	**0.66**	**0.68**	0.02
Maintain wildlife habitat	**0.62**	**0.64**	0.02

Table 4-6 Continued

Wetland Functions	Existing (TY0)	Future Without Project (TY51)	Net Change, TY51-TY0
Connected depressional wetland - Brushy Lake (only shallow marsh within Levee Lake INAI site)			
Detain floodwater	**0.53**	0.35	-0.18
Store surface water	NA	NA	NA
Cycle nutrients	**0.68**	**0.68**	0.00
Export organic carbon	**0.58**	0.38	-0.20
Remove & sequester elements as compounds	**0.56**	0.38	-0.18
Maintain characteristic plant community	**0.66**	**0.66**	0.00
Maintain wildlife habitat	**0.75**	**0.59**	-0.16

4.4.1.4 Lake and Pond. Future development in the Project area was not assumed to affect lakes and ponds directly. However, lakes and ponds receiving regular inputs of stormwater from the interior flood control system were assumed to decrease in surface area by 1.5 percent every 10 years, or a total of 7.5 percent during the 50-year project life. Reduction in area was expected because of the accumulation of sediment carried by stormwater originating from tributary streams. Lakes and ponds remaining constant in area were assumed to be those that are relatively isolated from stormwater carried by the interior flood control system. Examples of waterbodies experiencing future losses in surface area include Horseshoe Lake and Grand Marais Lake (lake 3) at Frank Holten State Recreation Area. With this assumed rate of surface area loss, about 155 acres at these two lakes would be converted into wetland or terrestrial habitats.

4.4.1.4.1 Ecological Problems of Lake and Pond. Ongoing siltation and habitat degradation will continue to cause problems at lakes and ponds. Not only does siltation cause loss of surface area, but it also causes a gradual decrease in average water depth. Since many natural lakes are only several feet deep, decreasing water depths may at some point threaten fish populations during periods of drought when water levels are low. Local watersheds carrying runoff into lakes and ponds are expected to become less agricultural and more urbanized. Major pollutants in storm water are expected to shift from agricultural chemicals to transportation related pollutants such as oil, antifreeze, and gasoline.

An overall lack of natural aquatic and emergent plant growth in these water bodies, the presence of fish species such as carp that uproot such plants, summer algal blooms that can cause fish mortality, and a general lack of habitat structure are problems that will continue to affect lakes and ponds.

4.4.1.4.2 Wildlife Habitat of Lake and Pond. Expected reductions in surface area of some lakes and ponds and continuing ecological problems probably will lead to small reductions in diversity of animal species using these communities as habitat. Increasing urbanization surrounding lakes and ponds is anticipated to also contribute to this effect.

To evaluate future quality of lakes and ponds as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the great blue heron, mink, slider turtle, and white crappie. According to projections of future conditions, average habitat quality of lakes and ponds is expected to decline for the great blue heron and slider turtle, and fall below 0.5 for three of the four species (Table 4-7). Quality remains unsuitable for the white crappie. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-7 Projected changes in habitat quality of lakes and ponds within the Project area, expressed as habitat suitability indices (average and range) for four evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Great blue heron	**0.61**	0 - 0.71	0.41	0 - 0.58	-0.20
Mink	**0.74**	0 - 1	**0.84**	0 - 1	0.10
Slider turtle	0.44	0 - 0.78	0.40	0 - 0.69	-0.04
White crappie	0.00	0 - 0	0.00	0 - 0	0.00

4.4.1.5 Streams. The area or extent of floodplain streams has been assumed to remain constant in the future. Periodic maintenance of the floodplain's interior flood control system, including cleanout of ditches and canals that carry storm water, is expected to maintain existing channel dimensions. Future development in the tributary watersheds is expected to directly affect headwater reaches of many tributaries, but not downstream reaches. In order to maximize the amount of developable land in the uplands, headwater streams are expected to be lost by either channelization or replacement by underground pipe over which fill material would be placed (with authorization under Section 404 of the Clean Water Act and appropriate mitigation for stream impacts). Additional channelization of floodplain streams is unlikely in the future. Future stream losses were not quantified.

4.4.1.5.1 Ecological Problems of Streams. Floodplain channels will continue to be affected by the lack of riparian vegetation, transport of sediment into channels, inflows of agricultural and urban runoff, and encroachment by exotic plant species, such as Japanese hops (*Humulus japonicus*). In the tributary watersheds, additional urbanization is expected to continue encroaching upon streams and their adjacent floodplains. Existing instability of tributary stream banks and channel bottoms is expected to continue and become more widespread without intervention. Habitat degradation of tributary streams will continue, despite new storm water regulations in the project area that affect new development.

4.4.1.5.2 Wildlife Habitat of Streams. Expected adverse changes in physical and chemical characteristics of streams are expected to be greater in tributary watersheds than on the floodplain. Consequently, the capacity of tributary streams to serve as habitat for fish and other wildlife is expected to decline to a greater degree than that of floodplain channels.

To evaluate future quality of floodplain streams as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the great blue heron, mink, slider turtle, black crappie, and wood duck. According to projections of future conditions, average habitat quality of floodplain streams is expected to decline for the great blue heron and mink, and fall below 0.5 for three of the five species (Table 4-8). Quality remains unsuitable for the wood duck. Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-8 Projected changes in habitat quality of lakes and ponds within the Project area, expressed as habitat suitability indices (average and range) for four evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Black crappie	**0.55**	0 – 0.79	**0.58**	0 - 0.79	0.03
Great blue heron	**0.54**	0 – 0.79	0.44	0 - 0.66	-0.10
Mink	**0.72**	0 – 0.87	**0.57**	0 - 0.88	-0.15
Slider turtle	0.27	0 – 0.45	0.25	0 - 0.37	-0.02
Wood duck	0.01	**0 – 0.16**	0.01	0 - 0.16	0.00

To evaluate future habitat quality of tributary streams, the team employed the Qualitative Habitat Evaluation Index procedure used by Ohio to assess its warm water streams. Projections of future habitat quality show a decline from existing conditions for the community of invertebrates and fishes that these streams support. Physical stream characteristics assessed for existing conditions yielded a habitat suitability index of 0.64, whereas the value for future conditions in 50 years was 0.55.

4.4.1.6 Cultural. Due to anticipated development, new cultural habitats consisting of residential, commercial, and industrial areas will arise from future losses of forests, prairies, and various wetlands. Similarly, these kinds of cultural habitats will come from future losses of agricultural land. To conduct the habitat assessment for this Project, the interagency biology team assumed that 75 percent of existing floodplain agricultural areas would be developed in 50 years. Therefore, the ongoing shift in cultural habitats, from agricultural to suburban and urban, is expected to continue.

4.4.1.6.1 Wildlife Habitat of Cultural Areas. Over the next 50 years, wildlife species using cultural habitats in the Project area are expected to gradually shift in composition from a mixture of agricultural and suburban-urban species to mainly suburban-urban species. The overall number of species is expected to decline. The interagency biology team assessed existing quality of old fields in the floodplain as habitat for the eastern meadowlark. In 50 years future quality of this habitat type would be reduced to zero because natural succession would have occurred and converted old fields to forest that has no suitability for this bird species.

To evaluate future quality of cultural areas (fields) as wildlife habitat, the interagency biology team employed the same methods used to assess existing habitat conditions for the eastern meadowlark. According to projections of future conditions, average habitat quality of floodplain streams is expected to increase slightly (Table 4-9). Evaluation procedures for these species are discussed in depth in Appendix A.

Table 4-9 Projected changes in habitat quality of cultural areas (fields) within the Project area, expressed as habitat suitability indices (average and range) for one evaluation species. Indices potentially range from 0 (no quality) to 1 (optimum quality); average indices ≥ 0.5 shown in bold.

Species	Existing (TY0)		Future Without Project (TY51)		Net Change, TY51-TY0
	Average	Range	Average	Range	
Eastern meadowlark	0.34	0 - 0.34	0.38	0 - 0.39	0.04

4.4.2 Natural Resources.

4.4.2.1 Plants. Future anticipated development would continue the ongoing destruction of vegetation of various natural communities. Some native plant species are expected to disappear from the Project area due to physical destruction. Those plant species escaping destruction would be confined to smaller and more isolated fragments of natural communities. Of these species, some are expected to eventually become locally extinct because of the inability to maintain viable populations. With the loss of some native species, the overall diversity of the local flora is expected to decline, and the proportion of the flora consisting of exotic species would increase. Abundance of many persisting native species is likely to decline also.

4.4.2.2 Invertebrates. Loss and fragmentation of natural habitats is expected to continue in the area due to development. Most habitats provided by existing lakes, ponds, and streams are not expected to disappear, however physical and chemical conditions will continue to deteriorate. Like most other groups, the composition of the invertebrate community will continue to shift towards those species (i.e. artificial container breeding mosquitoes, houseflies) adapted to cultural habitats, such as urban forests, residential areas, and industrial parks. The abundance of species not capable of using cultural habitats is expected to decline.

4.4.2.3 Fishes. Overall species composition and diversity of fishes in the future is not expected to differ much from existing conditions for several reasons. First, many existing fish species are generalists and tolerant of considerable fluctuations in water temperature, flow, turbidity, and dissolved oxygen. Secondly, most habitats provided by existing lakes, ponds, and streams are not expected to diminish in area because of development. Lastly, the future influx of fishes into the Project area from the Mississippi River will continue to be greatly impeded by the existing flood control system along the River and the closure of gravity drains during rising river stages. The abundance of some species would also decline with continuing deterioration of physical and chemical habitat conditions.

4.4.2.4 Reptiles and Amphibians. The number of reptile and amphibian species occurring in the Project area is expected to decline with increasing development and fragmentation of remaining habitats. Habitat fragments are expected to become increasingly isolated from each other, and the potential for movement between these habitats by reptiles and amphibians would become increasingly unlikely. Abundance of species not adapted to cultural environments is expected to decline.

4.4.2.5 Birds. Bird species diversity is anticipated to decline because of the expected loss of forest and wetland habitats. Composition of common species is expected to shift toward those adapted to cultural habitats such as urban forests, residential areas, and industrial parks. Fewer species of area sensitive birds will continue to use habitats undergoing further fragmentation. Nesting of breeding species in forest fragments is not expected to sustain local populations because of anticipated high levels of nest predation and nest parasitism. A decline in abundance of species not adapted to cultural habitats is expected.

4.4.2.6 Mammals. Additional loss and fragmentation of natural habitats is expected to cause mammal species diversity to decline. Like most other groups of vertebrates, composition of mammal species will continue to shift toward those kinds adapted to cultural habitats. The abundance of species not capable of using cultural habitats is expected to decline.

4.4.3 Endangered and Threatened Species. Some species of plants and animals are expected to decrease in abundance or perhaps become locally extinct due to anticipated future development and associated losses of natural vegetation in the Project area. The probable effects of future trends on listed species, either federally or state endangered or threatened, are discussed below. The current status of all listed species is described in Appendix B.

Diminishing upland forests would be expected to offer decreasing opportunities for some bird species, including the Mississippi kite (*Ictina mississippiensis*), brown creeper (*Certhia americana*), and veery (*Catharus fuscescens*). One mammal, the Indiana bat (*Myotis sodalis*), and three snakes, the timber rattlesnake (*Crotalus horridus*), great plains rat snake (*Elaphe guttata emoryi*), and flathead snake (*Tantilla gracilis*), would also be expected to become less abundant because of forest loss, assuming each is still present. No listed species of plants are expected to be similarly affected.

A decline of wetlands in the Project area, either forested or herbaceous, is expected to adversely affect numerous listed birds and some other species. Fewer nesting or feeding opportunities would be available to as many as twenty-one listed bird species known or likely to occur in the Project area. These birds include the pied-billed grebe (*Podilymbus podiceps*), American bittern (*Botaurus lentiginosus*), least bittern (*Ixobrychus exilis*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nyctanassa violaceus*), Mississippi kite (*Ictina mississippiensis*), bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), red-shouldered hawk (*Buteo lineatus*), king rail (*Rallus elagans*), common moorhen (*Gallinula chloropus*), piping plover (*Charadrius melodus*), Wilson's phalarope (*Phalaropus tricolor*), Forster's tern (*Sterna forsteri*), black tern (*Childonias niger*), brown creeper (*Certhia americana*), veery (*Catharus fuscescens*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*). Among reptiles and amphibians, the Illinois chorus frog (*Pseudacris streckeri illinoensis*) would be adversely affected by a loss of wetlands.

However, areas for protection of this species have recently been established within the Project area. The massasauga rattlesnake (*Sistrurus catenatus*) would potentially experience further declines from a loss of herbaceous wetlands, assuming it is still present within the Project area. Among mammals, the Indiana bat (*Myotis sodalis*) would potentially be adversely affected by declining areas of forested wetlands. Four listed plants would also be potentially adversely affected, and they include the decurrent false aster (*Boltonia decurrens*), small burhead (*Echinodorus tenellus*), mud plaintain (*Heteranthera reniformis*), and bead grass (*Paspalum dissectum*). The latter three species are only known from historic and not recent records, and it is assumed that they are still present within the Project area, since no comprehensive inventory has been performed showing that they are not present.

Anticipated future conditions of streams, lakes, and ponds are not expected to adversely affect any listed plant or animal species.

The expected loss of agricultural lands, including cropland and pastures, would adversely affect a number of listed birds restricted to open (nonforested) habitats. These include the northern harrier (*Circus cyaneus*), upland sandpiper (*Bartramia longicauda*), short-eared owl (*Asio flammeus*), loggerhead shrike (*Lanius ludovicianus*), and Henslow's sparrow (*Ammodramus henslowii*). No other listed species of plants, mammals, reptiles, or amphibians are expected to be similarly affected by the loss of agricultural lands.

4.5 POPULATION AND SOCIO-ECONOMIC CONDITIONS

4.5.1 Population. Within Madison County, the overall population is projected to grow by 20% over the next 50 years. Seventy five percent of that increase is expected to occur within the Bluff Corridor and 25 percent within the American Bottom Corridor. Specifically, the population growth is projected to be as follows:

Madison County:	2004 (Year 1) - 263,100
	2029 (Year 25) - 289,400
	2054 (Year 50) - 315,700

Within St. Clair County, the overall population is projected have a short-term decline. In the short-term it is anticipated that the population in the American Bottom Corridor will decrease at about the same rate that the population of the Bluff Corridor increases. Further, by the year 2029, the population of the American Bottom Corridor is expected to have stabilized (due to job increases) while the Bluff Corridor is expected to continue its current rate of growth to the year 2054. Population growth for selected years is as follows:

St. Clair County:	2004 (Year 1) - 253,000
	2029 (Year 25) - no change
	2054 (Year 50) - 291,000

4.5.2 Age. Over the next 25 years, the median age of the population within Madison and St. Clair Counties is projected to increase. For Madison County, the change is expected to be from 40.2 years of age for 2004 to 47.7 years of age for 2029. As the "baby boomer" generation ages, a proportionally greater percentage of the population in the 17-65 year old median age category is expected over the next 20 years by which time it will gradually decrease in that category as a proportional increase occurs in the over 65 age group.

4.5.3 Education. Due to an increasing median age of the population, Madison and St. Clair Counties are expected to experience a reduced percentage in primary and secondary school enrollments and an increased percentage of those that have completed 12 years of education.

4.5.4 Employment. Within the manufacturing industries, employment in Madison County is expected to decline in a manner similar to the state-wide and national trend from 1960 to 1990 or about -0.9 percent per year. For St. Clair County, the same assumption applies yielding a decline expected to be -1.4 percent per year on average.

In raw numbers, the projections for manufacturing workers are as follows:

Madison County:	2004 (Year 1) - 27,100
	2029 (Year 25) - 21,000
	2054 (Year 50) - 14,900
St. Clair County:	2004 (Year 1) - 11,900
	2029 (Year 25) - 7,700
	2054 (Year 50) - 3,600

For employment other than in manufacturing, increases are projected as below. It is assumed that the retail/ services jobs will be about equal to the total future jobs in the county (estimated population divided by about 2.8 people per job) minus the above estimated manufacturing jobs. Hospitals, colleges, the gaming industry, and Scott Air Force Base will be major components of this jobs category.

Madison County:	2004 (Year 1) - 66,800
	2029 (Year 25) - 82,300
	2054 (Year 50) - 97,800
St. Clair County:	2004 (Year 1) - 78,500
	2029 (Year 25) - 82,600
	2054 (Year 50) - 100,400

4.5.5 Income. Per capita income and median household income in St. Clair County are projected to continue to fluctuate in the future consistent with statewide trends, especially during the 1980-1994 time period. As in the past, manufacturing jobs are expected to pay earnings 1.5 times greater than services jobs and 3 times greater than retail/trade jobs. The percentage of all persons at the poverty level during the next 20-50 years is projected to remain fairly constant, but the rate for St. Clair County is assumed to remain half again higher than the prevailing statewide rate. Over the next 25 years, approximately 12 percent of the Madison County population is expected to be below the poverty level and approximately 18 percent in St. Clair County.

4.5.6 Financing. No financing projections were made for this Reevaluation study since this parameter fluctuates greatly with the state of the economy. However, an infusion of revenue from the gaming industry and allied enterprises is expected to ensure that basic city services such as trash removal, water and sewer service, street repairs, police and fire protection, will occur within riverfront communities.

4.5.7 Health. The overall annual mortality rate is anticipated to stay or drop slightly from its present rate of about 900-1,000 deaths per 100,000 people. It is assumed that heart disease, cancer and stroke will continue as the leading causes of mortality in the region. Improvements in diet and exercise will cause the cardio-vascular factor to diminish as a mortality factor. In the short-term, cancer may continue to increase as a mortality factor. New cancer cures and environmental quality initiatives may eventually contribute to a decline in the cancer rate. Drug and gambling addiction is likely to hold steady and more likely increase in response to a continued gaming industry presence.

4.6 LAND USE AND RELATED ITEMS

4.6.1 Future Land Use - Madison County.

4.6.1.1 American Bottom Corridor Plan. Madison County's land use proposals discussed below utilize the 2020 Plan's land use strategy, municipal land use plans, the Greenway Plan and the Madison County Long-Range Transportation Plan (MCLRTP). The county anticipates that the majority of its new industrial development will take place in the American Bottom corridor due to this zone's substantial existing infrastructure and availability of large suitable land tracts. The enterprise zones (including the newly established Southwestern Madison County Enterprise Zone, and the Gateway Commerce Center Enterprise Zone) are also anticipated to attract development to this corridor. With regard to specific future activities, the County supports: 1.) the protection and expansion of the Horseshoe Lake State Recreational area and the Cahokia Mounds State Park; 2.) the furtherance of the Southwestern Illinois Greenways Plan (SWIGP); 3.) the strengthening the downtown areas and the residential neighborhoods (including infilling and maintenance) of corridor municipalities as a way of slowing down the premature conversion of agricultural lands outside of those municipalities; and, 4.) wetlands retention areas to provide for surface drainage.

Specific planning corridor recommendations by the County include: 1.) the formation of planning and development partnerships to implement the corridor plan and its Enterprise Zones; 2.) the rezoning of areas for consistency with the corridor plan; 3.) the development of a storm water management system that includes facility improvements meeting County standards; 4.) the approval of only those subdivisions that provide an IEPA acceptable waste water system; 5.) the connection of un-sewered developed areas to the existing system; 6.) the protection of wetlands by avoiding their destruction; 7.) developing new wetlands via wetlands banking; 8.) preserving crop lands for specialty crops (e.g. horseradish); and, 9.) the implementation of the recommendations of the MCLRTP and the SWIGP.

4.6.1.2 Bluffs Corridor Plan. The land use proposals for the Bluffs Corridor reflect the components of the County's 2020 land use strategy, municipal land use plans, and the Transportation and Greenway Plans. This corridor is expected to experience a significant conversion of land to residential uses, along with supporting commercial and industrial development expansion near major highway areas. Aggressive residential growth is anticipated within 1.5 miles of the Bluff Corridor municipalities by the year 2020. Future commercial growth is expected to occur within the existing municipalities and along the I-55/70 corridor between I-70 East and U.S. Route 40. Industrial land uses are expected to be limited and within existing municipalities, or along I-55/70 from Troy to Edwardsville.

Agricultural lands will remain a significant form of large land use, but increasingly, these lands will be converted to other uses. Open space/greenways, recreation and transportation reflects the recommendations of the MCLRTP and the SWIGP. The Bluff Corridor strategy calls for open space preservation in new development areas, coordination of transportation and land use, community character enhancement, balanced land use and water resource management, and the minimizing of impervious surface in new developments.

Specific Madison County planning corridor recommendations include: 1.) the formation of development partnerships; 2.) the adoption of uniform standards and ordinances for water and sediment control; 3.) the application of open space standards in residential zoning; 4.) the creation of "green buffers" between communities; 5.) the creation of demonstration sub-watersheds; 6.) the incorporation of the 2020 expansion area into existing municipal plans; 7.) the incorporation of residential areas lacking sewers into the existing wastewater management system; 8.) the restriction of individual private sewage systems; 9.) the avoidance of destruction to existing wetlands; 10.) the development of new wetlands (via wetlands banking); 11.) the direction of new sewer system improvements to areas not presently served; and, 12.) the preparation of interstate interchange plans before the areas become developed.

4.6.1.3 County-wide Considerations. The Madison County land use strategy plan also identifies and recommends various methods and planning tools for its overall management effort. These methods and tools are: 1.) increasing county-municipal planning partnerships to work out problems; 2.) increasing county "in-house" planning capability for addressing land use problems; 3.) reviewing and revising county zoning and subdivision regulations; 4.) adopting strict stormwater/watersheds management standards;

5.) supporting beneficial flood control and ecosystem measures from the Corps of Engineers' East St. Louis and Vicinity project; 6.) working with other governmental entities to upgrade aging storm water drainage facilities in the bottoms, and to extend public water and sewer facilities; 7.) forming residential and agricultural zoning districts to manage location and support facilities consistent with the management plan; 8.) applying zoning and subdivision regulations to implement existing municipal commercial development plans, to reduce non-managed growth in agricultural areas ant their premature conversion to other land uses; 9.) guiding new development to non-environmentally sensitive areas (including the enterprise zones); 10.) extending infrastructure; 11.) banking wetlands; 12.) partnering; 13.) continuing efforts to install a network of bike trails while preserving open space and greenways; 14.) working with the new Metropolitan Park and Recreation District to further the trails concept; and, 15.) working in cooperation with the Madison County Transit (MCT) District to support the construction of a new Mississippi River bridge, extending MetroLink into Madison County, and completing road projects funded through the "Illinois First" program (e.g. IL-255 extension and widening Illinois Routes 157 and 159).

4.6.1.4 Madison County Land Use and Related Projections. The projections for land use and related items for Madison County follow:

Agricultural (Farm):	2004 - 274,800 acres; 2029 - 247,500 acres; 2054 -195,000 acres.
No. of Housing Units:	2004 - 112,400; 2029 - 134,900; 2054 - 157,400.
No. of Households:	2004 - 97,900; 2029 - 107,700; 2054 - 117,500.

4.6.2 Future Land Use - St. Clair County.

4.6.2.1 American Bottom Corridor Plan. St. Clair County has identified the American Bottom Corridor as having major opportunities for revitalization and diversification of the County's economic base. Advantages provided by this corridor include transportation (highway network, MetroLink, river access, St. Louis-Parks Airport) and its proximity to various state and federal parks. These attributes provide opportunities to develop the area along the lines of tourism and recreation as well as warehousing and distribution. The County recommends the use of creative and cooperative investment approaches to future development efforts.

In the northern portion of this corridor, the County seeks to stabilize and expand the economic base by improving entryways into the urbanized core and to provide a more positive image. Their plan is to open up public access to the Mississippi riverfront. This is intended to serve as a basis for evolving a future tourism and recreation-based economy. Their plan includes recommendations for providing strategic highway intersections, optimizing the use of MetroLink, recognizing rail, water, and highway transit opportunities, and improving linkages between urban portions of the corridor and downtown St. Louis.

Specific north corridor development recommendations include: 1.) the creation of a warehousing and distribution center in the vicinity of the National City stockyards with access from the interstates to Illinois Route 3 and Illinois Route 203 plus a river dock connection; 2.) the establishment of a national park between the Poplar Street Bridge and the Martin Luther King Bridge; 3.) the creation of a new commercial development zoning overlay which would be compatible with the adjacent Metro-Link infrastructure and with residences; 4.) the creation of a special highway interchange overlay to disperse highway service activity such as fast food restaurants, gas stations, and hotels subject to consistency approval by the Planning Commission.

In the south American Bottom Corridor section, St. Clair County recommends: 1.) to use the Downtown St. Louis-Parks Airport as a source of development opportunity; 2.) to encourage residential infill in the East Carondelet and Dupo areas; 3.) establish an air operations dependent industrial/business park in the vicinity of Parks Airport; 4.) create a regional commercial district (ideally an office park) near the intersection of I-255 and Mousette Road linked to wetlands mitigation and a wetlands banking program; 5.) establish zoning districts in the East Carondelet and Dupo areas for small homes in planned developments; and, 6.) establish a recreation/conservation area near Prairie Du Pont Canal.

4.6.2.2 Bluffs Corridor Plan. Within the Project area, this is the fastest growing area of St. Clair County. Within the Bluffs Corridor portion of the County, the overall vision is to seek orderly and coordinated growth with community development in areas where infrastructure presently exists or is planned. More specific development strategies include: 1.) the use of PUD regulations to ensure a quality housing design with open space provisions and a mix of housing types and densities; 2.) the use of development compacts to help ensure continuity and integrity of land uses through the zoning process; 3.) overlay zoning for Metro-Link station development; 4.) utility improvements and consolidations; 5.) special highway interchange overlay districts for various intersections with I-64; 6.) various roadway circulation improvements, such as improved linkage between south St. Louis County and the Scott Air Force Base joint-use area; and, 7.) special development strategies for a Scott Air Force Base joint-use area such as the implementation of enterprise and foreign trade zones, the establishment of a development compact, and the reservation of the site for light industrial/assembly uses, distribution and warehousing, aircraft research and development, aircraft modification shops, and business services/corporate office uses.

4.6.2.3 St. Clair County Land Use and Related Projections. The projections for land use and related items for St. Clair County follows.

Agricultural (Farm):	2004 - 232,300 acres; 2029 - 198,000 acres; 2054 -132,000 acres.
No. of Housing Units:	2004 - 113,600; 2029 - 133,400; 2054 - 153,300
No. of Households:	2004 - 97,600; 2029 - 104,900; 2054 - 112,300

4.7 WATER QUALITY

The surface water quality within the project area has a wide variety of impairments with causes originating from agricultural uses, urban-runoff, tributary stream bank erosion, point source discharges (industrial and public/private treatment works), and land development. The general trend in population and commercialization/industrialization is increasing within the project area. New stormwater ordnances and attention by the counties to EPA Phase II regulations address future problems. However, the degradation that has begun from past practices in the tributary streams will not be fixed without direct intervention. If action is not taken, tributary streams will continue to experience increasing destabilization of stream banks, putting heavier sediment loads into the system, and further degrading environmental quality. Based upon these increasing trends, surface water quality would most likely have additional impairment loads placed upon it over time. The surface water quality would degrade with an increased impairment load. Downstream receiving water would then have an increased impairment load which decreases water quality within those regions. The degrading water quality condition, with time, within the project area would result in a decreased amount of possible designated uses.

4.8 PHYSICAL FACILITIES AND OPERATIONS

The current capacity of the interior ditching system in the Bottoms area has been re-established through the recent channel cleanouts that were performed using either Corps of Engineers' Rehabilitation funding or FEMA funding. These cleanouts occurred after the 1995 through 1997 flooding. Under the future without project condition, continued sedimentation in the Bottom's channels and degradation of the bluff stream channels is expected. Any loss of channel capacity as a result of inadequate maintenance will reduce future flood protection. Degradation of bluff stream channels will continue to adversely impact existing infrastructure. It is assumed that the channel cross-sections attained after the recent Corps of Engineers' and FEMA cleanouts will be maintained by MESD or other responsible parties thereby continuing an expensive operation and maintenance program in the future.

4.9 OUTDOOR RECREATIONAL RESOURCES

4.9.1 Greenways/Trails. Greenways offer opportunities to creatively preserve open space in rapidly developing areas, protect important natural resources such as wetlands and wildlife corridors, and provide opportunities for outdoor activities such as bicycling and walking. Greenways and trails have been one of the top public concerns identified through the Statewide Comprehensive Outdoor Recreation Plan (SCORP) Public Participation program for years. Southwestern Illinois offers tremendous greenway opportunities. Currently, the Metro East region has three of the 16 National Millennium Trails designated in 1999 and there are three major greenway systems proposed for the region. The Millennium Trails program is an initiative of the White House Millennium Council in partnership with the U.S. Department of Transportation and the Rails-to-Trails Conservancy.

Millennium Trails will recognize, promote and support trails as a means to preserve open spaces, interpret history and culture, and enhance recreation and tourism. The greenways and Millennium Trails are shown by priority in Table 4-10. The majority of the systems are located in Madison County where they are expected to be expanded to form a comprehensive regional network.

The following priority regional greenways are listed alphabetically and represent critical greenway connections. Each is important to the development of a strong regional greenway system and meets at least four or more of the key function criteria listed above. Participants in the public involvement program also identified these greenways repeatedly as most important at the sub-regional planning sessions.

Table 4-10 Greenways/Trails.

	Proposed Greenways	County
1	Bluff Greenway and Trail	St. Clair and Monroe
2	Mississippi Levee Greenway and Trail	St. Clair and Monroe
3	Schoolhouse Trail Greenway	Madison

4.9.2 Future Facilities Needed. As urban growth continues, the demand for open space preservation and the development of recreational opportunities is expected to increase. Both counties future land use plans document these needs.

SECTION 5 – PROBLEMS AND OPPORTUNITIES

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5.1 INTRODUCTION

Water resource studies are initiated in response to actual and perceived water resource problems within a given geographic area. The purpose of a water resources study is to identify and diagnose the causes of these problems and to formulate potential solutions. The first step in the planning process is to identify problems and opportunities. This provides a focus for the planning effort and aids in developing objectives for the planning study. Planning objectives are statements which describe what a plan should achieve and communicate the intent of the planning study. Problems and opportunities can be viewed as local and regional water resource conditions that could be changed in response to public needs. This section of the report describes the problems and opportunities of the Project area and the planning objectives developed for the study.

The identification of problems and opportunities and the development of clear operational objectives was the initial challenge in the formulation process for the Project team. The identification of problems and opportunities began with the assessment of the information compiled for the preparation of Sections 3 (Existing Conditions) and 4 (Future Without Project Condition) of this Report, in addition to the input received during the public involvement process.

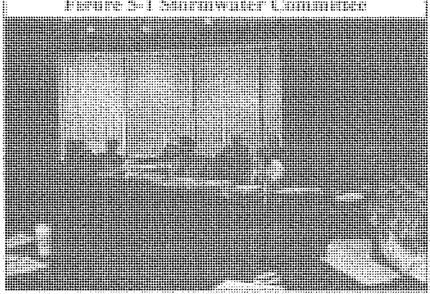
During the identification and validation process of problems facing the Project area, it became clear that there was a logical connection between these problems and the degradation of the natural ecosystem from a variety of causes. In every instance, there appeared to be a compelling reason to address Project area problems as environmental opportunities. As the Project team delved into the history of the area and the operation of the natural system during pre-settlement times, the picture that evolved provided a focus for the plan formulation process.

5.2 PUBLIC INPUT AND CONCERNS

In an effort to identify the concerns of the public in the affected area and to gain a clear understanding of solutions that would receive public support, the Project Team worked cooperatively with a number of significant public outreach efforts in addition to conducting the Corps' own public involvement process. Previous planning efforts conducted by the Corps and other agencies were reviewed and carried into this public scoping process in order to ensure long standing issues were accurately defined and addressed. The Corps, along with a number of other State and Federal agencies, participated as a technical resource on the Metro East Storm Water Committee which is a three county body representing St. Clair, Madison and Monroe Counties. This Committee is chaired by members designated by each of the County Boards and addresses issues related to stormwater. Ongoing Project activities were addressed and discussed monthly as a part of this forum. The Corps also served over several years as a technical resource to a number of planning efforts in the Project area that the Natural Resource Conservation Service (NRCS) conducted to identify solutions to various watershed problems. The NRCS, in a manner similar to the Corps, formulates their plans and projects through the process of identifying problems and potential solutions with public/stakeholder involvement.

On May 7, 1999, the Metro East Storm Water Committee adopted as their priority a compilation of public concerns developed from the numerous Resource Plans created over a 3-4 year period by the NRCS. A copy of this summary is contained in Appendix G. This summary groups concerns into three broad categories: natural resources, cultural resources and human resources concerns.

Figure 5-1 Stormwater Committee



The Corps also participated as a technical resource for the East West Gateway Initiative of the U.S. Environmental Protection Agency, Region 5. This was a public outreach project for Madison and St. Clair Counties that was organized to identify concerns related to the complex issues surrounding the impacts of urban sprawl. Public sensing sessions were done through a series of facilitated public workshops over a two-year period. The outcome of these workshops was the identification by the public of concerns over loss of greenspace, open space and habitat, flood damages, and erosion/sedimentation. Finally, dozens of requests from public action groups for presentations on Project formulation were accommodated over the period of the Project. In each instance, public comment was received and a free exchange of information occurred. Section 10 of this report provides additional information regarding public involvement during the planning process.

In order to initiate the formal environmental impact statement (EIS) process, a formal public scoping meeting was conducted in February of 1999. This event was well attended and the input from this, as well as other public involvement efforts, was used to guide the Project planning process.

5.3 PROBLEMS AND OPPORTUNITIES

5.3.1 Ecological Resources. A recent report on trends in Illinois' environmental and ecological conditions concluded, "Existing data suggest that the condition of natural ecosystems in Illinois is rapidly declining as a result of fragmentation and continual stress." (IDENR/NIF 1994b:iv). Over the last two centuries, the historic natural ecosystem of the Project area has been reduced to a fraction of what it once was. Ecological problems that are identified and addressed include loss of biodiversity, fragmentation of natural systems, loss of historic ecosystem disturbances, loss of habitat quality, and degradation of water quality.

5.3.1.1 Loss of Biodiversity. Much of the historical biodiversity of the Project area, consisting of numerous natural communities and their constituent plant and animal species, has been lost due to intensive economic development. The loss of much of the natural heritage within the Project area is illustrative of a larger pattern in Illinois – "the trend toward simpler natural systems" (IDENR/NIF 1994b:72). The once complex historical natural environment has been replaced with one that is fairly simple biologically. Spatial losses in the Project area due to habitat destruction are significant.

Only about 30 percent of the Project area, collectively, now consists of remnant forests, prairies, wetlands, lakes and ponds, and streams. Built-up areas, agriculture, and non-native grassland represent the remaining 70 percent, which supports low levels of biodiversity as compared to natural habitats. Losses also consist of declines in the diversity of natural communities. Some types of forest, prairie, and stream natural communities have disappeared entirely. The case of prairie losses is the most extreme. About 99.9% of the historic prairie is gone. Once extending over roughly 35,000 acres and consisting of seven distinct communities, only about 35 acres comprising two communities remain. Widespread natural disturbances, such as flooding and wildfire, added a temporal dimension to the spatial complexity of the historic ecosystem that is gone today. Biodiversity losses also include the loss of some native plant and animal species that once inhabited the Project area as a result of the presence of introduced or exotic species that can out-compete native plants and animals. This shift in species composition illustrates another broader pattern in Illinois – "the trend toward non-native species" (IDNR 1994:73). Continuing urbanization is expected to be the chief cause of future losses of biodiversity, especially to forests in the uplands.

Opportunities exist within the Project area to restore some of the lost and diminished components of the historic ecosystem. These include floodplain prairies, forests, marshes, and streams. Economic and agricultural activities prevent the re-creation of an entire stream traversing the floodplain, but there are locations where partial restorations could occur. Likewise, undeveloped areas exist where natural areas such as forests and prairies could be restored. Restoration of such features would replicate, albeit on a much reduced scale, the historic natural ecosystem.

5.3.1.2 Fragmentation of Natural Systems. As a result of development, natural areas within the Project area have become highly fragmented and remnants are generally too small to support all plant and animal species characteristic of functional ecosystems. The fragmented character of natural areas within the Project area is illustrative of a broader pattern in Illinois, which exhibits a "trend toward fragmented natural systems" (IDENR/NIF 1994b:74). Fragmentation is the transformation of continuous areas of natural ecosystems into smaller and smaller pieces as a result of development. Along with habitat destruction, fragmentation is considered by many ecologists to be among the chief causes of loss of biodiversity worldwide. Maintaining biodiversity for the long term in fragmented systems is problematic for several reasons. First, some plants and animals living in a formerly continuous but now fragmented system face higher risks of extinction because each species' population in a fragment consists of relatively few individuals. Second, fragments have higher edge-to-interior ratios, meaning that much of their area is near an edge and the interior or "core" area in small. Because a number of animals are area-sensitive and require large "core" areas to live in, fragments are often not large enough to fulfill their needs. Third, surrounding areas can influence fragments more than large, extensive areas. Human disturbances from adjacent urban or suburban areas can have a greater effect on fragments than large, continuous areas. Similarly, encroachment of adjacent woody vegetation into remnant prairies can transform fragments into wooded habitats quicker than large grassland remnants. Lastly, fragmented landscapes typically present barriers to the movement and dispersal of animals that travel by land, such as many mammals, reptiles, and amphibians. Structures like highways and railroad embankments or broad areas of unsuitable habitats that surround fragments of natural areas can inhibit the movement of some animals between fragments.

Requirements for the establishment and maintenance of self-sustaining and functional natural ecosystems in Illinois have yet to be defined. However, guidelines for forest and grassland establishment and management in Illinois are available to benefit native bird species that breed in these two habitat types (Herkert et al. 1993). Because some bird species are area-sensitive (they need relatively large continuous tracts of habitat for breeding), the size of a habitat area is an important determinant of the diversity of its breeding bird species. Robinson et al. (2000) recommend 500 acres as the minimal area for forest restoration or preservation efforts intended to benefit songbirds in Illinois. Areas smaller than 500 acres are not considered to be beneficial because such areas tend to support fewer area-sensitive species, the abundances of birds in these smaller areas is often low, cowbird parasitism on the young of resident bird species is often high, and nest predation by animals such as raccoons that tend to use forest edges is often more serious because of high edge-to-interior ratios (Robinson et al. 2000). For grasslands, Herkert et al. (1993:14) state that the minimal area for prairie restorations that are intended to benefit area-sensitive grassland breeding birds "should be at least 125 acres and preferably more than 250 acres in area." Tracts of forest or grassland greater than 1,000 acres are needed to attract all bird species that are most sensitive to habitat fragmentation (Herkert et al. 1993).

In addition to size requirements for forest and grassland establishment and management, Herkert et al. (1993) describe numerous other management guidelines that are either common to both habitat types or specific to each. Guidelines common to both include: 1) avoid fragmentation of existing habitats, and restore existing habitats, especially larger ones that support bird species of moderate and high sensitivity to fragmentation; 2) establish or restore circular or square habitat areas to minimize the edge-to-interior ratio; and, 3) either build onto existing areas of forest or grassland, or fill in gaps in existing habitats to create larger habitat areas.

Opportunities exist within the Project area to restore forested areas and to create prairie restorations that are large enough to support animals sensitive to habitat fragmentation, including birds.

5.3.1.3 Loss of Historic Ecosystem Disturbances. Remaining natural areas cannot be expected to retain much similarity to their former structure and function if periodic ecosystem disturbances are not introduced to mimic historic flooding and wildfire. Natural flooding and wildfire sustained the historic natural ecosystem. With the elimination of these natural forces, today's remaining natural areas cannot maintain much similarity with their former historic condition without intervention.

In this sense, the Project area's condition is representative of a broader pattern across Illinois - the "trend toward managed ecosystems" (IDENR/NIF 1994b:75). In the case of fire, the ecological benefits of conducting periodic controlled burns in remnant prairies, marshes, and those forested areas historically influenced by wild fire have been apparent to ecologists and natural resource managers for many years. Plant communities occurring in these habitats have adapted to fire. The managed burns maintain species composition and patterns of relative abundance in these plant communities.

Additionally, in forested areas, fire can maintain variably aged populations of tree species. Without fire, remnant prairies turn into wooded areas over time through the encroachment of trees from adjacent areas. The lack of natural fire in many upland forests and drier floodplain forests in Illinois has led to the overabundance of sugar maple (*Acer saccharum*) in areas where oaks and hickories once dominated. Sugar maple is not fire tolerant and in historic times, its abundance was kept relatively low by wild fire. With the suppression of wild fire, it frequently out-competes shade-intolerant species like oaks and hickories.

With regard to flooding, intensive efforts to economically develop the American Bottoms over the last 100 years have treated riverine overflows from the Mississippi River and tributaries as something to engineer out of the human environment. This form of natural disturbance has been nearly eliminated by construction of the main levee along the Mississippi River, the diversion of Cahokia Creek to the river, and the building of the interior drainage system on the floodplain. Consequently, remaining floodplain wetlands are no longer connected to their former dominant sources of hydrology. The source of hydrology for many wetlands is now limited to rainfall and local runoff and groundwater influences. In historic times, the seasonal ebb and flow of floodwaters established a complex web of linkages on the floodplain between wetlands, floodplain lakes and ponds, and river and creek channels. Now remaining wetlands are hydrologically isolated from each other by various kinds of development.

Fragmentation of natural areas and the loss of linkages between wetlands, streams and rivers in the Project area have reduced the ability of many wetlands to perform historic functions, such as to temporarily store overland flows of water, or to remove natural nutrients and other elements and compounds from floodwaters. The elimination of disturbance factors such as flooding and fire from much of today's environment has also diminished the ability of wetlands to serve as support systems for some plant and animal species. For example, the decurrent false aster (*Boltonia decurrens*), a federally threatened species, is an herbaceous plant that historically occurred in open habitats on the floodplain of the Illinois and Mississippi Rivers, such as wet prairies, shallow marshes, and the shores of rivers, creeks, and lakes. It is found within the Project area today in old or mowed fields, marshes, and at the edges of active fields, farm facilities, golf courses, and a railroad (USDOT 2000). The plant requires high levels of light to survive. Riverine flooding apparently benefits this species by disbursing seeds to new areas for colonization and suppressing the encroachment of woody vegetation that would create shady conditions. Likewise, wildfire would also have maintained open habitats in areas such as wet prairies and marshes.

Opportunities exist within the Project area to re-establish lost linkages between wetlands and tributary streams and re-introduce periodic flooding to existing floodplain natural areas. Such flooding could mimic the predevelopment flood pulse. Although the Mississippi River is no longer a feasible source, storm water from tributary watersheds could serve as the basis for the desired flood pulse. Prescribed fire is currently used to maintain some small prairie restoration areas within the Project area. Its use could be expanded into other natural areas to provide the same ecological benefits.

5.3.1.4 Loss of Habitat Quality. While habitat quality in the Project area ranges from poor to good, many areas of fish and wildlife habitat in the urbanizing Project area are poor to fair as a result of human activities and influences. This assessment is based on data gathered for this Project in the spring of 1999 by an interagency group of biologists studying 228 individual sites in floodplain (terrestrial, wetland, aquatic) and tributary stream (terrestrial) habitats.

These quality ratings represent the ability of sampled habitats to fulfill the food, cover, or reproductive needs of eight fish and wildlife species occurring in the Project area. These species, which include the black crappie, eastern meadowlark, fox squirrel, great blue heron, marsh wren, mink, slider turtle, and wood duck, were selected to serve as representative of a broad number of other species that are present or desirable and that also use forest, marsh, prairie, lake, stream, and cultural habitats. These animals, and the current quality of habitats they use, serve in this Project as the benchmark against which the expected effects of alternative solutions for ecosystem restoration can be compared. Further details about the habitat assessment method are found in Appendix A. According to the habitat assessment method employed in this Project, the absence or insufficiency of one or more measurable habitat characteristics judged to be important to a given species can reduce habitat quality below the optimum condition under which all requirements are fully met. Examples of habitat conditions for a few species follow for illustration.

Habitat quality for the wood duck was found to be consistently poor across the Project area. This species nests in natural cavities of mature trees in floodplain or upland forests and raises its young in floodplain marshes and shrub swamps. The primary factor leading to low habitat quality is the lack of natural tree cavities or artificial boxes in which to nest. This most likely is due to the lack of mature trees, rather than those tree species that produce suitable natural cavities. Because few mature stands of woods were noted in the floodplain, this suggests that tree cutting occurs frequently enough on a widespread basis to prevent attainment of mature timber. In the future without project condition, the assessment projected that habitat quality for this species is expected to remain poor.

Many of the remaining natural lakes and ponds do not have sufficient water depth to serve as over wintering sites for fish species. Likewise, these water bodies, as well as man-made borrow pits, often have either little to no submergent or emergent vegetation along their shores, or woody debris, all of which offer resting and feeding areas for young and adult fish. The floodplain ditches that have replaced historic streams are similar in simplicity. Woody vegetation is prevented from growing along these channels. The woody vegetation would otherwise offer shading and helps keep water temperatures during summertime from becoming too stressful to aquatic organisms. With regard to floodplain forests, tree species composition is often a small subset of the historic condition because valuable species like oaks and hickories were removed long ago for commercial purposes. Under the assessments of these types of habitats, the future without project condition is not expected to yield improved conditions, nor benefit the species using them.

With regard to the existing habitat quality for the fox squirrel, it is most often found to be good. This common species is most frequent in the tributary stream forests of the Project area. Optimal habitat consists of small stands of mature oaks and hickories having little understory vegetation that are interspersed with agricultural lands. Conditions close to these currently occur, for the most part. However, under the future without project condition, habitat quality of the remaining upland forests is expected to decrease because new development is expected to use much existing agricultural land and fragment existing wood lots into smaller pieces.

Opportunities exist within the Project area to make numerous improvements to habitat quality. Native plant communities can be restored in existing forests by introducing historically occurring tree species that are now lacking or underrepresented. Oaks can be planted in developed areas to benefit birds. Lakes and ponds can be improved for fishes by creating deep-water areas to serve as overwintering habitat. Emergent vegetation can be increased along the margins of these water bodies to benefit resident fishes, birds that feed in such areas, and enhance the production of macro invertebrates that serve as food sources for such animals. Buffer zones of natural vegetation can be added around the perimeter of natural areas to minimize human disturbances. Wetlands can be improved by restoring native grassland around them or by adding wooded buffers. Invasions of exotic plant species in the Project area can be controlled or eliminated. Existing narrow riparian zones along streams can be widened to benefit greater numbers of species. Connections or linkages consisting of natural vegetation can be established between various habitats to provide corridors for animal movements. Levels of sediment and chemicals carried by runoff into natural areas can be reduced.

5.3.1.5 Degradation of Surface Water Quality. The surface water quality within the Project area has a wide variety of impairments with causes originating from agricultural uses, tributary stream bank erosion, urban-runoff, point source discharges (industrial and public/private treatment works) and land development. In particular, sediment makes a significant contribution to the degradation of water quality that adversely impacts aquatic habitats, such as streams and lakes. Likewise, water quality is adversely impacted by non-point source water pollution that enters the tributary streams, the interior drainage system, and then on to the Mississippi River. Water passing over the land, either from rain, car washing, watering of crops, or lawns, picks up an array of contaminants including oil from roadways, agricultural chemicals from farmland, and nutrients and toxic materials from urban and suburban areas. This runoff is defined by the Water Resource Advisory Council as non-point source water pollution and finds its way into waterways either directly or through storm drain collection systems.

Figure 5-2 Alcal growth in floodplain channel due to excessive nutrient levels.

The general trend in population/urbanization/ industrialization and tributary stream degradation for the Project area and vicinity is increasing. Based upon this increasing trend, it is concluded that increased degradation of water quality will continue to be a problem. The adverse effects of this degraded water quality are not limited to large lakes or rivers but can be found in local streams, ponds, and natural areas.

Opportunities exist within the Project area to improve surface water quality for the benefit of restoring and protecting important aquatic habitat. Measures implemented in tributary stream watersheds could reduce impairments with upland origins and reduce sediment loads before they reach the bottoms via tributary streams. Natural areas such as existing or constructed wetlands could be protected from the debilitating affects of degraded water quality while serving as an additional filtration system to improve water quality before surface waters are released into the Mississippi River.

5.3.2 Erosion and Sedimentation. Erosional processes occurring in the Project area related to rain events, increased peak flows due to storm water runoff, and head cutting and rotational bank slumping in tributary streams are causing excessive sedimentation in the bottoms and degradation of tributary stream resources. Community leaders and the local people who participated in the public involvement program ranked sedimentation and erosion problems on a par with flooding problems. Urban sprawl and the loss of greenspace and open space were believed to contribute to both the flooding and sedimentation problems. Federal and State resource agencies that participated in the study expressed concern about the adverse environmental effects of the sediment and erosion problems.

In general, the runoff from the hillside creeks enters the canals in the Bottoms area at a high velocity capable of transporting heavy loads of sediment out of the bluffs. However, when these high velocity flows reach the Bottoms, the velocity of the water drops substantially because the gradient flattens and the water in the canal is no longer able to transport the sediment load. This sediment is then transported through follow-on storm events through the drainage canal system eventually finding its way to the Mississippi River or remaining captured in the canal system reducing its capacity.

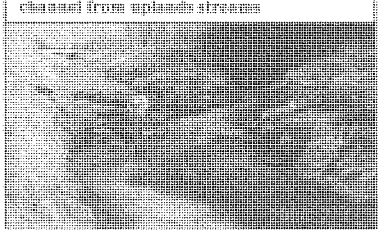


Figure 5-3 Sedimentation in floodplain channel from uplands stream

As documented in the Corps of Engineers' study of 1984, an analysis performed by the U.S. Department of Agriculture, Soil Conservation Service, determined that approximately 196,000 tons of sediment were being generated by the Cahokia Canal tributary drainage area, and approximately 78,000 tons of sediment per year from the Harding Ditch tributary drainage area. Very little sediment was found to originate from the bottomland sources because of the flat topography and sluggish runoff velocities. Studies performed in 1998 through 2000 by the Soil Conservation Service for the restudy effort determined that this is still a serious problem. The total existing gross erosion delivered by the tributary streams is estimated to be 202,700 tons per year. This analysis is discussed in Appendix E.

Sedimentation creates several serious problems in the bottomlands of the Project area. As sediment collects in the already undersized drainage channels, the flow area is reduced even further so that a given amount of runoff is more likely to overflow the channel or break through the spoilbank levees. To deal with this problem, the Metro-East Sanitary District and other agencies responsible for operating and maintaining the drainage systems have incurred greater maintenance costs.

Sediment has also degraded the environmental quality of numerous wetland and aquatic areas in the bottomlands, including Horseshoe Lake and the lake resources at Frank Holten State Park. At Frank Holten State Park, sediment presently accumulates in the lake adjacent to Harding Ditch.

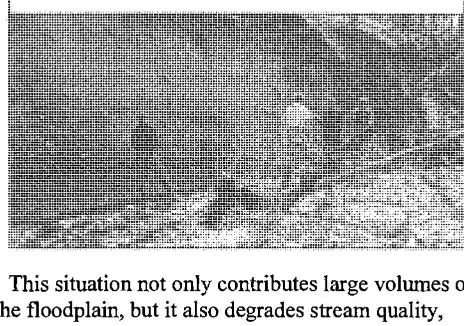
The other two lakes are completely separated from Harding Ditch to protect them from further degradation. Horseshoe Lake's location makes complete segregation impossible. Relief valve type flows from large rainfall events designed to travel into the Lake through a diversion channel from Cahokia Canal have been effectively eliminated by the formation of a sediment delta in Horseshoe Lake. This delta has become a bottomland forest over much of its area. Sedimentation of Horseshoe Lake has dramatically impacted its fisheries quality. It is now approximately two feet deep on average and provides less than desired habitat for aquatic resources. Sediment also has degraded the quality of tributary streams in the Project area. Aquatic habitat no longer supports the variety of species that were present during pre-settlement times. Urban development has increased the volume, duration, and frequency of stormwater entering the stream system and has affected the stability and habitat functions of streams. This degradation, once begun, will continue to adversely impact stream functions.

Sediment being left behind in drainage canals also contributes to loss of flood conveyance capacity. Following the severe flooding experienced by the area between 1996 and 2001, approximately $10,000,000 in federal, state and local funds have been expended in removing sedimentation from the interior drainage system. This is a continuing effort and expense.

Opportunities exist within the Project area to reduce sedimentation. Measures sited within the tributary watersheds would be located closest to the "problem" and address both the problem of sediment transfer to the floodplain and degradation of stream quality and function. Measures could also be implemented in the Bottoms to detain sediment separate from any action in tributary streams.

5.3.3 Tributary Stream Channel Instability. Many tributary stream channels in the Project area have responded to growing development in their watersheds with bank instability and head cutting. Increasing areas of developed, impermeable land surfaces in tributary watersheds have allowed greater amounts of storm water to pass through stream systems per unit time. These increased flows have led to channel instability by creating unstable bank lines. In addition, base flows in some watersheds have increased due to the addition of effluent from septic systems in some subdivisions. Increased base flow can also lead to channel bottom instability and headcutting. Head cutting in tributary streams and tributaries has contributed to some dramatic losses and destabilization of banks throughout the system. This situation not only contributes large volumes of sediment to the system that ultimately reaches the floodplain, but it also degrades stream quality, threatens bluff infrastructure, existing developments, and habitat quality.

Figure 5-4 Tributary stream channel instability



While this type of geological succession is not a new phenomena, after the initial investigation it became clear that it is happening at a faster rate in the Project area than would normally be expected of a natural system. Stream degradation will continue to worsen if not addressed, despite actions being taken today to address storm water runoff from new development. For this reason, solving these tributary stream problems on a systematic watershed basis became an important facet of the overall Project focus.

The NRCS has done several stream bank stabilization projects designed to protect existing infrastructure. Approximately $1,000,000 was expended in 1995 to fix a bank along East O'Fallon Drive. Little Canteen Creek was threatening the road, a primary sewer line, water line, utilities, and homes in several locations. As these banks continue to erode, homes, highways, and other infrastructure are impacted as is the quality of the stream and its aquatic resources.

An opportunity exists within the Project area to address the instability of tributary streams. For the purposes of this Project, this opportunity could beneficially address the sediment problem in a way that could provide increased and sustainable environmental viability for the tributary streams while protecting the floodplain from unwanted sediment deposition. These tributary streams represent a finite resource that once lost will not be able to be replaced. Their location within the urban area makes them an important environmental resource. The NRCS was brought in to analyze the problems associated with sediment and to explore opportunities to address this problem. Appendix E includes the detailed findings and recommendations from these analyses. For purposes of this Project, the ability to find solutions for loss of sediment from the tributary streams was viewed as an environmental opportunity to improve water quality and aquatic habitat. Evaluation of potential measures to reduce sediment and stabilize and restore tributary streams became a focus of the plan formulation process.

5.3.4 Flooding and Flood Damages. Flooding that currently occurs when storm water overtops the existing water conveyance system in the bottoms will continue to cause significant flood damages. As discussed earlier, the Project area bottomlands are protected from direct flooding from the Mississippi River by a series of levees and floodwalls. However, the Project area has a history of serious interior flooding which is caused by storms producing interior flows that exceed the capacity of the canals in the bottomlands area. Interior flooding associated with large rainfall events producing widespread damages across the floodplain occurred in the Project area as a result of the storms of August 1915, July 1942, August 1946, July 1952, June 1957, May 1961, and May 1995. Perhaps the most damaging event occurred in August 1946 when approximately 19 ½ inches of rain fell over Madison and St. Clair Counties during an eight-day period. This storm produced an average depth of 15.1 inches over the entire Project area. Flood damage from this event was estimated to be $6 million (approximately $56,800,000 in 2001 dollars) and the event was estimated to be more rare than the 100-year storm in terms of inches of rainfall.

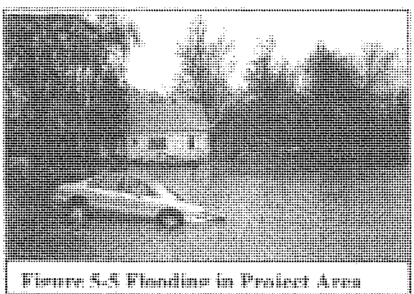


Figure 5-4 Flooding in Project Area

Flooding caused by a 14-inch rainfall over a two-day period in June 1957 caused approximately $4 million ($25,000,000 in 2001 dollars) in damages. This event and the 1995 event produced approximately a 100-year rainfall with average depths of over 8 inches across the Project area.

Between 1993 and 1996, the area experienced both widespread and specific drainage area flooding which prompted a federal disaster area declaration in each of these years involving millions of dollars.

Figure 5-6 Flooding in Project Area

In 1993, the declaration covered both Madison and St. Clair County while in the spring of 1994 it covered St. Clair County. In the spring of 1995 and the spring of 1996, the declaration covered Madison and St. Clair Counties. Since the Corps was not involved in any analysis of the Project area at the time these disasters occurred, information from disaster relief agencies is the only documentation of the devastation created by these flooding events available, but they appear to have been consistent with the type seen by the area with some frequency.

Most interior flooding in the bottomlands occurs from heavy runoff discharges from the tributary (bluff) areas. In May 1961, excessive runoff caused just this type of damage to the Project area. This type of flooding occurs when the capacity of the drainage canals is exceeded and/or when interior ponding in low-lying areas occurs when ponded water cannot get into the drainage canals quickly enough. Interior ponding occurs in low-lying areas (eg: old sloughs and shallow lake beds) within which surface water runoff collects. Most of these areas are undeveloped or partially farmed and the water that collects during most small rain events causes very little or minor crop damage. Infrequently, interior flooding can be indirectly impacted by the Mississippi River. This can occur either when the interior pump station capacity is insufficient to remove the run-off quickly enough from the drainage area when high Mississippi River stages prevent gravity flow or and when high river stages increase ground water levels decreasing absorption.

More frequent events affecting a specific drainage area create damages limited to a particular watershed. These problems are widespread across the area. These interior floods occur typically every two to five years.

Unlike the other problems identified in this Project, the problem of interior flooding has been the subject of numerous reports prepared by a number of different local, state and federal agencies. However, to date no definitive solution has proved to be economically viable to address the situation and as a result, the cycle of flooding and disaster relief continues. Nevertheless, an opportunity exists to address flood damage reduction as part of the efforts to restore the historic flood pulse to the Project area. This opportunity occurs because of the multi-faceted nature of the flood pulse restoration measures.

5.3.5 Cultural Resources. Literally hundreds of prehistoric and historic archeological resources are located throughout the Project area and are under constant threat from the pressures of development. The most well known site is the world-renowned Cahokia Mounds which is a World Heritage Site recognized by the United Nations. Despite the fact that more than 2,000 acres of the Cahokia Mounds site are publicly designated, more than one third of the site is still in private hands and is highly vulnerable to commercial or residential development.

Recent archaeological and archival investigations conducted at, or near Cahokia Mounds, reveal that the prehistoric site of Cahokia Mounds was built in the middle of a large prairie. This prairie, known by the early European settlers as Cold Prairie, undoubtedly supported a diverse group of animal and plant species that were important to the prehistoric residents of Cahokia and its surrounding villages.

Unfortunately, the conversion of the land for farming and urban development during the twentieth century have not only eliminated the former prairie habitat, but also has destroyed the physical remains of a significant percentage of the prehistoric settlement that once dotted the floodplain landscape surrounding Cahokia and throughout the Project area. Investigations have confirmed that the entire Project area was intensively utilized by successive waves of Native Americans for thousands of years prior to the arrival of European settlers.

The Project Team has concluded that if present growth rates throughout the Project area continue unabated during the twenty-first century, virtually all of the archaeological sites not currently in public ownership will be destroyed by commercial and residential development. If that is allowed to occur, the loss of the information contained in these sites will have a profound effect upon the ability of future generations to accurately interpret the prehistory of the Project area – one of the most significant prehistoric regions in all of North America.

An opportunity exists where feasible to incorporate the locations of archeological sites present in the Project area into the boundaries of the habitat areas developed for this Project. In this manner, the irreplaceable information contained within these sites will be protected and available for the benefit and enjoyment of future generations of all Americans. .

5.3.6 Outdoor Recreation. The area is fortunate to have both the Horseshoe Lake and Frank Holten State Park systems and a start in implementing a "rails to trails" program. However, as the Project area continues to develop, there will be a growing need for additional outdoor recreation areas. As the surrounding land becomes increasingly urban, additional pressure is placed on the wildlife areas managed in the Horseshoe Lake State Park. Each of the counties have plans to enhance their outdoor recreational resources to attempt to keep pace with the growing population and ever expanding interest in outdoors activities. Opportunities exist within the Project area to improve outdoor recreational opportunities through the restoration, protection and enhancement of existing ecosystem resources. Eco-education and related tourism is a new pastime of a society chiefly separated from natural areas and environmental resources. The opportunity also exists to adapt the existing flood protection system to meet outdoor recreational needs while the restoration and expansion of natural areas could create connectivity to augment and expand existing outdoor recreational opportunities.

5.3.7 Summary. As noted above, the main problems within the Project area are loss and degradation of ecological resources, excessive rates of sediment transfer from tributary watersheds to the floodplain (which contributes to degradation of water quality and aquatic habitats), and persistent recurring flooding that damages property. After looking at the cause and effect of these problems in depth, it becomes clear that they are inter-related and require a watershed-based focus in the search for potential opportunities and solutions. Natural ecosystem areas must be restored now in order to protect them from extinction on the floodplain. Likewise tributary streams must be restored now in order to protect them from being lost. Stormwater is the only viable floodplain hydrology source that remains to re-create and revitalize the natural ecosystem.

The beneficial uses of this water provide the possibility of identifying numerous environmental opportunities that could not otherwise be realized. An investigation of the pre-settlement hydrology of the area provides a picture of a vibrant natural ecosystem sustained by over-bank flooding coming from the Mississippi River as well as from the tributary watersheds. This investigation, coupled with an inventory of existing natural areas, provides a roadmap for restoration possibilities.

Ecosystem services are the "conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life" (Daily et al. 1997). They are essential to our civilization, in that we cannot replace them with existing technology. A principal service of natural ecosystems is the maintenance of biodiversity and the production of economically important goods. Examples of fundamental life support services are numerous, and include air and water purification, flood and drought abatement, soil generation and preservation and replenishment of soil fertility, and pollination of agricultural and native plants, among others (Daily et al. 1997). Society often takes these services for granted and views them as available at no cost. Yet, economic developments that modify or destroy natural ecosystems may diminish the flow of "free" services, and generate long-term costs that can exceed the short-term gains of development (Daily et al. 1997).

For the purposes of this Project, the interior flooding problems will be viewed as an ecosystem service opportunity, and the evaluation of the use of stormwater events to restore a flood pulse necessary to mimic pre-settlement ecosystem conditions as a foundation of the formulation process. In taking this approach the protection of restored floodplain resources from sediment being transported out of the tributary stream system and the improvement of the quality of water now carrying heavy sediment loads will be essential to consider in the development of alternative plans.

It is believed that through the identification of the ecosystem services gained from environmental restoration actions, the cost of ecological restoration activities can be competitive with other demands for limited public financial resources. By clearly demonstrating the many contributions to social well being that ecosystem restoration achieves, a restoration project can become the focal point of an area's master plan. From the onset of this Project, the potential mitigation of floods by the natural ecosystem has been highlighted as the most important service to provide social well-being for the Project area.

5.4 PLANNING OBJECTIVES

5.4.1 Introduction. Protection of the Nation's environment is achieved when damage to the environment is eliminated or avoided and important cultural and natural aspects of our nation's heritage are preserved. Various environmental statutes and executive orders assist in ensuring that water resources planning is consistent with protection. The objectives and requirements of applicable laws and executive orders are considered throughout the planning process in order to meet the Federal objective. The Federal objective for the relevant planning setting should be stated in terms of an expressed desire to alleviate problems and realize opportunities related to the output of goods and services or to increased economic efficiency consistent with protecting the environment. Water and related land resources project plans will be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. (Engineering Regulation 1105-2-100)

Specific objectives for this Project have been developed in response to the problems and opportunities identified during the scoping, public involvement, and early Project research efforts. The analysis of pre-settlement land cover and conditions in the Project area became the guide to establishing restoration planning targets for the Project. The comparison of historic land cover mapping with today's existing conditions provided insight into restoration possibilities.

In general, planning objectives are specific operational statements that provide the direction for the development of specific alternative plans. The planning objectives for this Project are identified below, in no particular order of importance. Planning targets were developed for each objective based on an analysis of pre-settlement conditions and existing conditions in order to provide information to the team during the iterative evaluation and assessment process. These planning targets served as guideposts for developing alternative plans, and for comparing the desired restoration to the level of restoration expected to be achieved through the implementation of any alternative plan.

5.4.2 Planning Objectives.

5.4.2.1 Planning Objective 1 - Restore Natural Areas.

Objective: Increase the overall spatial extent of under-represented natural communities by restoring and expanding existing natural areas wherever possible.

Planning target: Natural areas to be restored by the Project should contain ten percent of the historic amount of Mississippi River floodplain forest in the Project area (1,880 acres), five percent of the historic amount of floodplain prairie in the Project area (1,612 acres), and 100 acres of created (new) floodplain marsh. Floodplain forest is to consist of one-third existing forest (627 acres) and two-thirds new forest (1,253 acres).

This objective addresses losses in the Project area of forest and prairie, the two natural communities in the historic ecosystem that were most abundant spatially. The objective also addresses the fragmentation of today's natural communities, and focuses expansion efforts on enlarging existing natural areas. (The term "natural area" as used in the context of the Project objectives refers to natural habitats, as opposed to cultural habitats, like cropland or developed areas, and not the natural or relatively undisturbed areas recognized by the Illinois Natural Areas Inventory.)

The target for forest emphasizes the creation of new forest around existing forested areas. Because there is very little remnant prairie today, the target for prairie represents new prairie to be created by the Project. Unlike forest and prairie, the target for marsh was not based on an estimate of historic spatial extent because none was available.

The interagency team of biologists working on this Project established the planning target for this objective. The target was set using professional judgment without the benefit of any guidelines suggesting the area required for sustainable ecosystems located within urban settings.

Unfortunately, no such guidelines were available to the team. The combined area of forest, prairie, and marsh is about 3,500 acres, which represents about six percent of the floodplain Project area, excluding water. The team believed that the specified amounts of forest, prairie, and marsh were attainable in the Project area given remaining open space.

A plan formulated for this Project would achieve this objective if it were to incorporate 1,880 acres of new and/or protected forest, 1,612 acres of new prairie, and 100 acres of new marsh.

5.4.2.2 Planning Objective 2 - Restore Flood Pulse.

Objective: Reintroduce a flood pulse into floodplain natural areas that mimics the historic hydrological condition.

Planning target: The maximum flood pulse will not exceed the depth of the Mississippi River flood of 1844 at St. Louis, or 14 days in duration.

This objective addresses the loss of seasonal riverine overflows on the floodplain due to the construction of the Mississippi River levee and the channelization of tributary streams that has isolated most remaining floodplain wetlands from their principal historic source of hydrology, and has resulted in the reduction of the wetlands' capacity to perform various functions.

Like the first objective, the biology team developed the planning target for this objective using professional judgment. The team desired to restore a flood pulse that would mimic historic hydrological conditions on the presettlement floodplain. In terms of timing, restored flooding would vary from season to season and year to year. Depth and duration of restored flooding would also vary from one event to another. All events would exhibit a natural rise and fall, and there would be a continuum of events in terms of depth and duration, from shallow and brief to deep and prolonged.

Like the natural hydrological cycle, shallow flood events would occur more frequently than deeper ones. Controlled or managed flooding that follows a predetermined schedule in terms of timing, depth and duration was not desirable.

The biology team identified three biological concerns associated with reintroduction of surface flooding into study area wetlands. First, water used for this purpose would need to be relatively free of pollutants associated with agricultural runoff and urban storm water. Second, restored floodplain habitat resources would need to be protected against the introduction of large sediment loads coming out of the tributary streams. Third, because flooding of long duration (on the order of weeks and months) can kill submerged vegetation, introduced flood events, especially those of greatest depth, would need to recede in a shorter amount of time than what the Mississippi River once did, in order to maintain the integrity of plant communities occurring in existing wetland resources that are relatively scarce today. Without a limit, flood durations of weeks or months would have the potential to cause extensive mortality in plant communities, especially forested ones, much like what occurred infrequently in predevelopment times.

To address the second concern, the team decided to establish a limit to the duration of flood events introduced into floodplain wetlands. The team chose 14 days as the maximum duration based on best professional judgment. In other words, the duration of the rise and fall of a flood event would not exceed two weeks. Many wetland plant species can tolerate flooding of this duration without harm, especially if portions of individual plants are not submerged and remain exposed to air. Along these lines, the biology team believed that the introduction of a restored flood pulse as characterized here into study area wetlands would be incompatible with the long-term sustainability of local populations of threatened or endangered plant and animal species that are historically adapted to dynamic floodplain habitats.

In brief, the team desired to restore a flood regime as if the main levee along the Mississippi River was not present, and the river could overflow the floodplain once again. But because reestablishment of such a connection with the river could never occur in today's environment, other sources of water would need to substitute for what the Mississippi once did. As such, the team found it necessary to identify an upper bound to the continuum of restored flood events. Because there was no good estimate of the stage-discharge relationship of the Mississippi River at St. Louis under predevelopment conditions, the team chose the 1844 flood as the upper limit for depth of restored flooding. At its peak, this event inundated nearly the entire floodplain. Depending on local topography, flood depth often ranged from five to ten feet, and at some locations it exceeded 20 feet. The analysis of the 1844 flood indicates it was about a 30-year event and as such was determined to provide a reasonable upper limit based on best professional judgment.

A plan formulated for this study would achieve this objective if it were to incorporate restoration of a flood pulse having a maximum depth not to exceed that of the 1844 flood, and a maximum duration not to exceed 14 days.

5.4.2.3 Planning Objective 3 - Restore Habitat Quality.

Objective: Restore habitat quality in existing and re-created natural areas.

Planning target: Develop and maintain, at a minimum, moderate habitat quality for all evaluation species in restored natural areas.

This objective addresses the problem of generally low habitat quality within the Project area. The biology team desired to improve habitat conditions. Existing habitats incorporated into any plan, as well as new habitats created by a plan, would be improved if needed or modified to achieve at least "average" quality. The method to be used to assess habitat quality would be the same procedure employed to evaluate baseline or existing conditions within the Project area. Under the Habitat Evaluation Procedures (HEP), the team used nine wildlife species as indicators of conditions in a variety of existing terrestrial, wetland, and aquatic habitats (Appendix A). These same species, along with their habitat requirements, would be used to assess future habitat conditions, both with and without any project.

According to HEP, no habitat quality is represented by a habitat suitability index (HSI) of 0, and optimal quality by 1. The team defined average or moderate quality as an HSI of 0.5. Under this objective, an HSI of 0.5 or better was desired in all habitats used by the nine evaluation species. The team thought that this target was attainable.

A plan formulated for this Project would achieve this objective if it were to provide at least moderate habitat quality in all habitats used by the nine evaluation species.

5.4.2.4 Planning Objective 4 - Improve Water Quality.

Objective: Improve the quality of surface waters.

Planning target: Reduce levels of sedimentation in as many surface tributaries as possible.

This objective addresses the problem of degradation of surface water quality. Multiple sources of water quality impairment exist in the Project area, including agricultural uses, urban runoff, point source discharges (industrial and public/private treatment works) and land development. It was beyond the scope of this Project to address and develop measures to ameliorate all these sources of impairment. However, sedimentation resulting from head cutting and bank failures originating in tributary watersheds was within the scope of the Project and was found to be the source of much of the sediment carried by floodplain tributaries. The Project objective to restore connectivity between tributary streams and floodplain resources in order to restore a floodpulse made the issue of water quality directly related to the protection of restored habitat resources. Improving surface water quality prior to its being carried into restored natural areas was a basic requirement to ensure sustainability of resources.

In response, the planning team focused on reducing existing, excessive levels of sediment transported by surface tributaries. (Objective 5 addresses control of erosion from tributary watersheds.) Potential measures to do this could be implemented in tributary watersheds as well as on the Mississippi River floodplain. The planning target established for this objective was not a particular benchmark, but a relative one, i.e. reduce levels of sedimentation in as many surface tributaries as possible.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by spatial extent of surface tributaries in the Project area receiving improved water quality through reductions in sedimentation.

5.4.2.5 Planning Objective 5 - Reduce Erosion.

Objective: Reduce erosion in the tributary watersheds.

Planning target: Reduce the total amount of sediment reaching the bottoms by 70 percent.

This objective addresses the problem of erosion and sedimentation occurring in the Project area. Excessive levels of sediment are being transported from tributary watersheds to the floodplain.

The National Resources Conservation Service (NRCS) predicted that measures could be implemented in the tributary streams to reduce sediment loads to the floodplain by 70 percent (Appendix E). At this level of reduction, much sediment would be retained in the tributary stream system, but some sediment would remain suspended to minimize the potential for scouring to occur in floodplain channels once flows leave the bluffs. The Project team adopted NRCS' figure of 70 percent as the planning target for this objective.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by whether or not they reduce the amount of sediment reaching the bottoms by 70 percent.

5.4.2.6 Planning Objective 6 - Restore Tributary Streams.

Objective: Restore the stability of tributary streams in order to restore stream quality and aquatic functions.

Planning target: Stabilize banks and channel bottoms and create riffle and pool complexes in as many watersheds as possible.

This objective addresses the problem of unstable tributary stream channels and degradation of finite stream resources. Many streams in the tributary watersheds exhibit unstable bank lines and/or channel bottoms. One of the major sources of sediments transported to the floodplain is sloughing stream bank lines and head cutting. Stabilization of tributary streams would restore and sustain aquatic habitat conditions in the streams, minimize damages to private property and local infrastructure, and reduce the amount of sediment transported to the floodplain.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by whether or not they include measures to stabilize banks and channel bottoms and create riffle and pool complexes in tributary streams.

5.4.2.7 Planning Objective 7 - Restore Floodplain Streams.

Objective: Restore floodplain streams and associated riparian corridors.

Planning target: Recreate flowing floodplain streams with associated riparian corridors for a distance equivalent to 10 percent of the floodplain length of historic Cahokia Creek (four miles) and establish three miles of riparian corridor linkages between existing or proposed natural areas.

This objective addresses the loss of biodiversity, or more specifically, floodplain streams and their associated riparian habitats. Wooded or riparian forests adjacent to stream channels are ecologically important areas because they support a wide variety of plant and mammal, amphibian, reptile, and bird species. Streams themselves serve not only as sources of water for wildlife, but adjacent forest is often used as a travel corridor. Such corridors often serve as links between landscape features, including floodplain-floodplain and floodplain-upland linkages.

Design criteria for riparian zones to be established as wildlife habitat vary depending on the kind of animals to be benefited. Relatively narrow corridors (≤ 328 feet, or 100 meters) can support a number of small mammals and various amphibians and reptiles, whereas area-sensitive birds need much wider riparian zones (Burbrink et al. 1998, Fischer 2000). The biology team did not consider riparian zones wide enough to support area-sensitive bird species to be feasible in the Project area because of the intense land use pressures that are present. A riparian zone with a width of 328 feet (100 meters) was viewed as feasible by the team, and a zone less than 328 feet wide was considered to be of lesser suitability for wildlife.

The biology team established the planning target for this objective using professional judgment. The 4-mile channel restoration target was chosen based on an analysis of existing conditions and was considered to be attainable within the Project area. This target consists of incorporating existing remnants of floodplain streams with the reopening of historic channels that have been filled in by development. Adjacent to the restored streams, a riparian zone up to 328 feet wide would be created on both sides of the channel.

The team also set the 3-mile corridor target based on an analysis of existing urban conditions. Given the number of miles of existing floodplain ditches in the Project area, it also was considered to be achievable. The establishment of one or more landscape linkages would center upon these existing floodplain channels. A corridor would be created on both sides of the channel, with a width up to 328 feet on either side. The corridor would consist of one-third existing habitat, and two-thirds restored habitat. In other words, restored corridor habitats would be added to existing corridor habitats. Restored corridors could consist of forest or other natural types of vegetation.

A plan formulated for this Project would achieve this objective if it were to provide four miles of restored floodplain streams and establish three miles of riparian corridor linkages between existing or proposed natural areas.

5.4.2.8 Planning Objective 8 - Incidental Social Objectives

The interrelationship between problems and opportunities that was identified through the public involvement process dictated the need to identify and measure incidental Project contributions to the social well being of the area. As previously discussed, it was deemed important to quantify the ecosystem services that would be provided as a natural by-product of the restoration Project in order to ensure the public had a full appreciation of the many positive benefits to be realized from an ecosystem restoration project. Objectives designed to focus on these issues were developed to ensure that ecosystem services incidentally provided by the Project could be tracked and quantified.

Objective 8a - Reduce flood damages in urban and agricultural areas.

Planning target: To the maximum extent possible as an incidental occurrence of restoring a floodplain flood pulse.

This objective addresses the problem of flooding and resulting flood damages within the Project area. The three co-sponsors of this Project deem the measure of this objective essential: the Illinois Department of Natural Resources (Office of Water Resources); Madison County, Illinois; and St. Clair County, Illinois.

Stormwater remains the most viable source of water to restore the flooding regime in restored natural areas. A reconnection of this naturally occurring resource within the watershed to the floodplain restored natural areas would serve the purpose of restoring a flood pulse. As a result of this inseparable connection between flood pulse restoration and flood damage reduction, a sub-objective was created so it could be tracked and ultimately measured.

To gauge performance against this objective, plans formulated for this Project would be analyzed using a traditional risk-based flood damage reduction analysis to quantify incidental benefits.

Objective 8b - Enhance Outdoor Recreation.

Objective: Increase and enhance outdoor recreational opportunities within natural areas.

Planning target: Provide passive outdoor recreational opportunities at as many sites as possible.

This objective addresses the problem of a growing public need for outdoor recreational resources as the Project area continues to urbanize. Passive outdoor recreational opportunities that are compatible with the out-of-doors, preservation of green space, and protection of natural habitats would be incorporated into plans developed for the Project. Examples of such activities include hiking/walking, recreational fishing, outdoor education, photography, bird watching and nature study.

To gauge performance against this objective, plans formulated for this Project would be compared against each other by relative number of sites and their ability to create connectivity with existing outdoor recreation facilities.

Objective 8c - Protect Cultural Resources.

Objective: Protect cultural and archeological resources and enhance their values.

Planning target: Envelop known archaeological sites into Project lands rather than attempt to avoid them.

This objective addresses the problem of continuing loss of significant cultural resources to development and urbanization. The existing Cahokia Mounds State Historic Site includes only about 2,000 acres of land. Expansion of this public area to protect significant archaeological resources now located on private lands would safe guard these locations for future generations. Because prehistoric occupation of the Project area was extensive, incidental protection of cultural resources could result within the study area. A geospatial database of known archaeological sites, maintained by the Illinois State Museum and Illinois Historic Preservation Agency, can serve as an indicator of site presence or absence.

To gauge performance against this objective, the area of known sites incorporated within the boundaries of each plan would be compared.

5.5 PLANNING ASSUMPTIONS AND CONSTRAINTS

5.5.1 Assumptions:

- The existing levee system and interior flood control system will remain functional and operational.
- The existing pump station capacities are adequate and will not be impacted by Project recommendations.
- Pre-development conditions can be used to guide the development of ecosystem restoration plans in order to address multiple problems.
- Ecosystem restoration can provide incidental flood damage reduction and be competitive for scarce sponsor financial resources.
- Watershed based solutions will be essential based on the Project area characteristics and the limited remaining resources.

5.5.2 Constraints:

- Limitations within the Corps of Engineers' program prevent the investigation of problems associated with combined sewers under the flood control and environmental restoration authority and thus presents a constraint to this study's ability to address problems of combined sewer overflow, as expressed by the citizens in areas like East St. Louis.
- Limitations within the Corps of Engineers' program prevent the investigation of interior drainage problems impacting less than one square mile and thus presents a constraint to this study's ability to address floodplain flooding caused by the ponding of stormwater falling on the floodplain itself.
- Limitations established by the existing flood protection system and drainage canal system.
- Limitations of available land suitable for ecosystem restoration.

5.6 SUMMARY AND CONCLUSION

The primary focus of this Project is to develop a comprehensive, integrated solution to the ecosystem degradation that is adversely impacting the area. As discussed, the Project area problems are highly inter-related. Ecosystem degradation varies throughout the Project area due to changing land uses, the influence of sedimentation, the quantity and quality of surface waters and streams, and the inability of surface water to connect to natural areas. Similarly, throughout the Project area, there are varying levels of flood protection primarily due to land use changes that have occurred since construction of the existing flood protection project in the early 1900's.

As the focus on the need for flood protection has increased, the response has been to attempt to control available water resources in a ditch and channel system. The control of this important resource has in turn adversely affected the biodiversity of the area. As agricultural and urban developments continue, existing natural areas will be lost. Urban runoff will continue to adversely impact the quality of water resources and stability and functions of streams, and cause flood damages in the Project area, while making no positive contribution to the ecosystem.

The problems and opportunities identification process discussed in this Section has established linkages between opportunities for ecosystem restoration and problems associated with the loss of natural habitat, sedimentation and flooding. By focusing on watershed-based solutions to restoring natural areas and reconnecting them with the available hydrology (stormwater), it appears that significant improvements can be made to the ecosystem of the Project area. Next, the formulation process will focus on the development of alternative plans to address the planning objectives.

SECTION 6 PLAN FORMULATION AND EVALUATION

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SECTION 6 - PLAN FORMULATION AND EVALUATION

The East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project has been conducted in accordance with the procedures specified in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (1983); Guidance for Conducting Civil Works Planning Studies (ER 1105-2-100, 28 December 1990); and Ecosystem Restoration in the Civil Works Program (EC 1105-2-210, 20 April 1995). Plan formulation activities were conducted following the six step planning process described in Chapter 5 of ER 1105-2-100. Plan formulation efforts on the East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project included the following activities:

1. Specified the water and related land resource problems and opportunities of the project area. Identified planning goals and constraints to meet the Federal interests and address specific state and local concerns.

2. Inventoried forecast and analyzed the water and related land resource conditions in the project area. Developed future without-project conditions for the project area over the planning period (i.e., 50 years).

3. Identified and formulated structural and non-structural alternatives that met the problems and opportunities of the project area and contributed to Federal objectives. Alternatives were developed in an iterative process, with increasing level of detail as preliminary plans were screened and the final set of alternatives were developed.

4. Assessed the impacts of each alternative. The effects of each alternative that survived the initial screening process are presented and displayed.

5. Compared the alternative plans. The comparison of alternatives focused on the differences between each plan in terms of their beneficial and adverse impacts and contributions to the planning objectives.

6. Identified a preferred plan after considering the final set of alternatives and their effects, and receiving public input. Identified and selected the NER plan, unless an exception was granted.

The basis for formulation and selection of the preferred plan for the East St. Louis and Vicinity, Illinois Ecosystem Restoration and Flood Damage Reduction Project is fully documented below, including the logic used in the plan formulation and selection process.

6.1 PLAN FORMULATION AND EVALUATION METHODOLOGY

6.1.1 Plan Formulation. As a re-evaluation study, for an authorized project, the formulation process involved the analysis of previously preferred plans and the development of a new strategy that built on the previous lessons learned while taking full advantage of the added project purpose for environmental restoration. This allowed for a broader focus than those previously employed in order to seek viable solutions for identified problems and opportunities.

The purpose of this Section is to explain the formulation process used to re-evaluate the area. The process included the identification of potential restoration sites, evaluation and assessment of these sites, the identification of project action areas, the development of alternative plans within these distinct action areas, and the comparison of several plans enveloping all of these action areas. This method provided the information necessary to assess and evaluate alternatives within the project area in order to develop a recommended project plan.

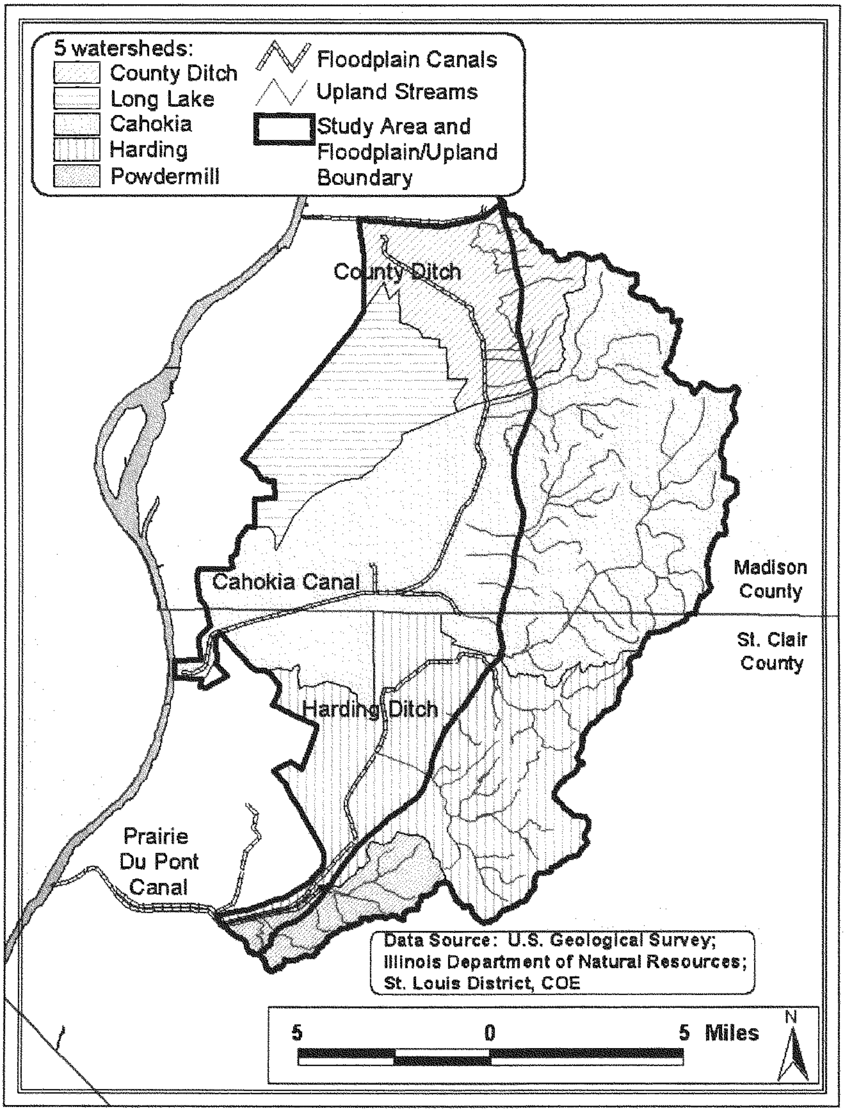
In order to ensure the broadest focus possible, it was necessary to assemble a team dedicated to the project that represented the full spectrum of Federal and State interests. The team assembled included the following: the U.S. Environmental Protection Agency Region 5, a cooperating agency in the preparation of this Project's Draft Environmental Impact Statement (DEIS), who not only contributed the efforts of many experts within their agency during the study process but also provided a dedicated member to the biology team; the Natural Resource Conservation Service, a cooperating agency in preparing the DEIS, who provided the efforts of experts within their State and local District Offices for the duration of the analysis while also providing a dedicated member to the biology team; the U.S. Fish and Wildlife Service, whose local office provided guidance through the process and the dedicated participation of a member to the biology team; the Illinois Department of Natural Resources, who provided engineering support and a dedicated member to the biology team; and the Corps' Engineer Research and Development Center (Waterways Experiment Station), who provided technical guidance and support throughout the environmental assessment and alternative/incremental analysis process.

The plan formulation process was a repetitive or iterative process that was initiated with the identification of potential sites, developing applicable measures for attaining project objectives for each site, and assessing each site's viability. Based on their relative inability to contribute to project objectives, less effective sites were removed after an initial screening. From this assessment and evaluation process, potential project action areas were identified, and they also were screened through an iterative process to identify and eliminate less effective action areas. Once project action areas were selected, an array of alternative plans for each was designed to achieve the planning objectives. Alternatives for each action area were then modified and re-evaluated as additional information was developed.

This process met the goals of the Corps' planning guidance, scoping requirements contained in the National Environmental Policy Act, and agency implementing regulations. Each iteration of this process provided an opportunity to refine and sharpen the planning focus based on more detailed technical investigation, and public and agency input. The biology team used results from incremental cost analyses to further refine the assessment process. From the final incremental cost analysis a final two-phase screening process was used to determine the Preferred plan.

6.1.2 Evaluation Methodology. The evaluation methodology progressed through a series of steps that took the analysis from the general to the specific. The first step involved the inventory of the entire project area to identify specific sites that had the potential based on location, existing habitat, soils, or hydrology to contribute to the project objectives. Based on the size and complexity of the project area (166 square miles) it was decided by the team to utilize the same watershed approach used in the 1984 study to assist in organizing the initial formulation process of "site" inventory. The pre-settlement hydraulic and biological conditions, coupled with an inventory of the remaining natural areas and analysis of the hydraulic alterations to the natural system, made the utilization of this watershed approach a logical initial organizing tool. Figure 6-1 shows the 5 major watershed drainage areas used to organize the floodplain and bluff drainage areas for analysis purposes. The primary screening tools used during the study were the Habitat Evaluation Procedures (HEP) for assessing quality of floodplain habitats, the Qualitative Habitat Evaluation Index (QHEI) for evaluating stream quality in the tributary watersheds, and the National Environmental Restoration (NER) cost effectiveness and incremental cost analysis procedures specified in EC 1105-2-210 for ecosystem restoration features, and the public and agency involvement process. There was an attempt to use the HydroGeoMorphic Approach to assess wetland functions to more objectively demonstrate the benefits of floodplain flood pulse restoration using storm water, however the model was not completed in time for such an analysis to occur for every action area. HGM models were applied at the Dobrey Slough, Brushy Lake and Elm Slough action areas. For the remainder of the areas, best scientific judgment was used to quantify these benefits. The process, findings and results of the plan formulation are presented below.

Figure 6-1 Project Area Watershed Divisions



6.2 PLANNING OBJECTIVES AND MEASURES

During the identification of problems and opportunities described in Section 5, seven primary planning objectives were developed to address the public's major concerns for environmental degradation, loss of open/green space, erosion control, and stream bank stability in the project area. Three incidental social planning objectives were identified as ecosystem services anticipated being a consequence of an environmental plan. These objectives were related to the public's desire for reduced flood damage, increased recreational opportunities, and protection of unique cultural resources.

Objective 1. Increase the overall spatial extent of under-represented natural communities by expanding existing natural areas wherever possible.
[Short name: Restore natural areas]

Objective 2. Reintroduce a flood pulse into floodplain natural areas that mimics the historic hydrological condition. [Short name: Restore flood pulse]

Objective 3. Restore and enhance habitat quality in existing and re-created natural areas.
[Short name: Restore habitat quality]

Objective 4. Improve the quality of surface waters. [Short name: Improve water quality]

Objective 5. Reduce erosion in the tributary watersheds. [Short name: Reduce erosion]

Objective 6. Restore the stability of tributary streams.
[Short name: Restore tributary streams]

Objective 7. Restore floodplain streams and associated riparian corridors.
[Short name: Restore floodplain streams]

Objective 8. Incidental Social Objectives (ecosystem services)

a. Reduce flood damages in urban and agricultural areas.
[Short name: Reduce flood damages]

b. Increase and enhance recreational opportunities within natural areas.
[Short name: Enhance recreation]

c. Protect cultural and archaeological resources and enhance their values.
[Short name: Protect cultural resources]

6.2.1 Measures. The Project Team identified and developed a number of measures that could be implemented in support of each objective. They are listed below by project objective.

Objective 1. Restore natural areas
Measures:
1-Obtain land (existing or new habitats)
2-Create habitats (forest, prairie, marsh)

Objective 2. Restore flood pulse
Measures:
1-Modify existing channels
2-Construct new channels
3-Divert surface flow into habitat areas
4-Construct earthen berms to contain flood pulse in habitat areas
5-Detain surface flow in habitat areas

Objective 3. Restore habitat quality
Measures:
1-Increase tree species diversity and abundance in existing upland and floodplain forests (implement tree stand improvements, or selective clearing and planting of underrepresented species, such as oaks)
2-Install nesting boxes in existing marshes and floodplain forest (i.e., wood duck)
3-Add flood pulse to existing floodplain wetlands, lakes, ponds, borrow pits
4-Remove standing water from areas of "drowned" forest
5-Create overwintering areas for fish in existing floodplain lakes and ponds
6-Add woody debris in floodplain lakes and ponds
7-Add shoreline plantings in existing floodplain channels, lakes, ponds, borrow pits
8-Augment base flow in existing floodplain channels with new pump station
9-Add riffle and pool complexes in tributary streams
10-Protect natural areas by restricting them to compatible uses

Objective 4. Improve water quality
Measures:
1-Construct buffer strips and tile outlet terraces to control erosion in upland agricultural areas
2-Construct in-stream sediment detention basins in tributary streams or on the floodplain to capture sediment
3-Create riffle and pool complexes in tributary streams to capture sediment and oxygenate the water
4-Construct in-channel grade control structures in tributary streams to prevent headcutting
5-Plant grassy or prairie buffers in floodplain swales to capture sediment

Objective 5. Reduce erosion
Measures:
1-Construct tributary sediment detention basins
2-Construct terraces in the uplands
3-Construct underground outlet & subsurface drains in the uplands
4-Construct water and sediment control basins in the uplands
5-Install critical area plantings in the uplands
6-Construct diversions in the uplands
7-Install filter strips in the uplands
8-Install grass waterways in the uplands
9-Stabilize banks of tributary streams
10-Install grade control structures in tributary streams
11-Create riffle and pool complexes in tributary streams
12-Allow for natural deposition of sediment on alluvial fans
13-Construct lowland dry sediment detention basins

Objective 6. Restore tributary streams
Measures:
1-Stabilize banks of tributary streams
2-Create riffle and pool complexes
3-Construct in-channel grade control structures
4-Implement bio-erosion control techniques

Objective 7. Restore floodplain streams
Measures:
1-Obtain land
2-Reconnect historic stream channel fragments
3-Plant natural vegetation
4-Create connectivity corridors between natural areas that are centered along existing streams, by planting natural vegetation
5-Create connectivity corridors between natural areas that are centered along existing ditches, by modifying existing ditch system (set back one or both levees) and planting natural vegetation within levees
6-Create connectivity corridors between natural areas that are centered along existing ditches, by planting natural vegetation outside levees

Objective 8. Incidental Social Objectives

8a. Reduce flood damages
Measures:
8a-1-Modify existing channels
8a-2-Construct new channels
8a-3-Divert surface flow into temporary storage areas
8a-4-Construct earthen berms
8a-5-Detain surface flow in temporary storage areas

8b. Enhance recreation
  Measures:
  8b-1-Construct trails
  8b-2-Provide interpretive areas
  8b-3-Provide signage
  8b-4-Provide access areas

8c. Protect cultural resources
  Measures:
  8c-1-Obtain selected sites
  8c-2-Plant historic natural vegetation
  8c-3-Add historic flood pulse
  8c-4-Provide interpretive areas

6.2.2 Planning targets. As described in Section 5.4.2, achievement of each of the eight planning objectives is to be measured by comparing plan outputs with a planning target established for each objective. These planning targets are as follows:

Planning Target 1. Restore natural areas

Restore ten percent of the Project area's historic amount of Mississippi River floodplain forest (1,880 acres), five percent of the Project area's historic amount of floodplain prairie (1,612 acres), and increase the amount of the Project area's existing floodplain marsh by100 acres.

Planning Target 2. Restore flood pulse

The maximum flood pulse would not exceed the depth of the Mississippi River flood of 1844 at St. Louis, or 14 days in duration.

Planning Target 3. Restore habitat quality

Develop and maintain, at a minimum, moderate habitat quality for all evaluation species used in the Habitat Evaluation Procedures in existing and re-created natural areas (moderate = 0.5 Habitat Suitability Index, no quality is represented by 0.0 HSI, optimal quality by 1.0 HSI).

Planning Target 4. Improve water quality

Reduce levels of sedimentation in as many surface tributaries as possible.

Planning Target 5. Reduce erosion

Reduce the total amount of sediment reaching the bottoms by 70 percent.

Planning Target 6. Restore tributary streams

Restore physical characteristics of streams in tributary watersheds, such as substrate, in-stream cover, channel morphology, bank and channel bottom stability, pool and riffle quality, and gradients, in as many watersheds as possible.

Planning Target 7. Restore floodplain streams

Restore flowing streams with associated riparian corridors on the Mississippi River's floodplain for a distance equivalent to 10 percent of the length of historic Cahokia Creek in the study area's floodplain (four miles), and restore three miles of riparian corridor linkages between existing or proposed natural areas.

Planning Target 8. Incidental Social Objectives (ecosystem services)

8a. Reduce flood damages
To the maximum extent possible within the flood pulse restoration target

8b. Enhance recreation
Provide passive outdoor recreational opportunities at as many sites as possible.

8c. Protect cultural resources
Expand, to the extent possible, the total public ownership of land within the Cahokia Mounds World Heritage Site, re-create the predevelopment environmental setting at Cahokia Mounds World Heritage Site, and incorporate archeological site boundaries into proposed project areas.

6.2.3 Constraints. In the development of restoration planning targets, which were based on the analysis of predevelopment conditions, the Project Team realized that planning targets needed to be balanced with constraints based on existing conditions. Urbanization in the area itself imposed many constraints on areas that could be considered for restoration. A number of different soils exist in the project area that are considered prime for the production of agricultural crops, and they are found not only on the Mississippi River floodplain but also in the tributary watersheds. Prime soils are those that produce the highest yields with the least amount of cost and effort, and with the least damage to the environment. Prime soils in the project area support the production of familiar row crops such as corn, soybeans, and wheat, but on the Mississippi River floodplain, they are often used to grow horseradish, a unique agricultural commodity for the region and nation. For over one hundred years, horseradish has been cultivated in the American Bottoms. Today about 60% of the world's supply is grown within the project area and immediate vicinity. Farmland in the project area is increasingly being converted to development and other nonagricultural uses. Additionally the desire to protect existing habitat quality, to avoid mitigation requirements, and to maintain the character of the project area resulted in the following project constraints and overall planning targets that would also be used to gauge restoration success.

Constraint 1: Avoid and minimize project-related impacts to wetlands and other natural habitats.

Target: No net loss of wetlands (forested wetland, marsh, prairie wetland), 100 acres maximum loss of upland forest.

Constraint 2: Minimize project-related impacts to prime and unique (specialized) farmland.

Target: Acquire for project-related purposes no more than 5% of all horseradish lands located in the floodplain portion of the Project area.

6.2.4 Assumptions. The planning team made several fundamental assumptions regarding the objectives. First, because a significant portion of the tributary watersheds that historically drained into the study area were diverted to the Mississippi River, restoration of a flood pulse would have to be made by using available surface waters. Second, the use of maps displaying predevelopment conditions would provide the key roadmap to the re-creation of floodplain natural systems.

6.3 IDENTIFICATION OF POTENTIAL RESTORATION SITES

The initial array of possible restoration sites for each watershed was developed based on insight provided by analysis of the pre-settlement land cover and hydrology, project restoration planning targets, public outreach, previous reports, identification of existing habitat sites and the knowledge of agency personnel. In this manner the Project Team developed a list of potential sites for the project area, which were organized and identified in relation to the five area watersheds.

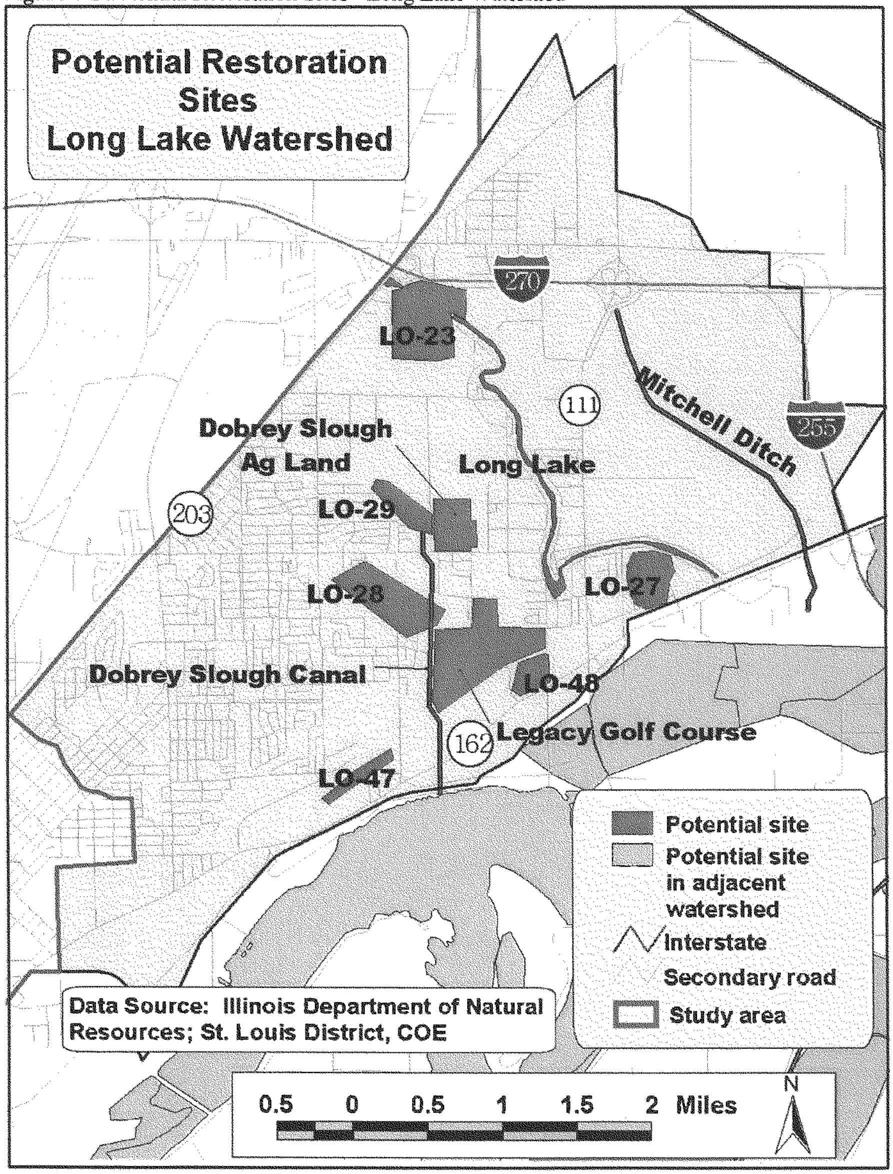
The following five watershed tables indicate the initial source of information for each site and provide the nomenclature used to identify each site within the watershed. For example LO represents the Long Lake watershed, CO – County Ditch, CA-Cahokia Canal, HA – Harding Ditch, and PO – Powdermill. Information sources were the Illinois Wetlands Inventory (IWI), Agency Personnel (AP), the Natural Resources Conservation Service's Wetland Inventory (NRCSW), the NRCS Upland Inventory (NRCS), various Reports (Rpts) and Public Involvement (PI).

The table for each watershed is accompanied by a figure showing the location of every site (Figures 6-2, 6-3, 6-4, 6-5, 6-6). Figure 6-7 displays all of the sites identified in all five watersheds.

Long Lake Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCSW	NRCS	Rpts	PI
Borrow Pits near Long Lake, south (LO-23)	X					
Borrow pit between Rte 162 and Long Lake (LO-27)	X					
Wetland along railroad track Granite City (LO-28)	X					
Dobrey Slough (LO-29)	X					X
Dobrey Slough Agricultural land east of tracks		X				
Wetland near Horseshoe Lake, Route 162, west (LO-47)	X					
Wetland West side of Lake Road Route 162, east (LO-48)	X					
Long Lake		X				X
Mitchell Ditch						X
Dobrey Slough Canal (concept)					X	X
Legacy Golf Course						X

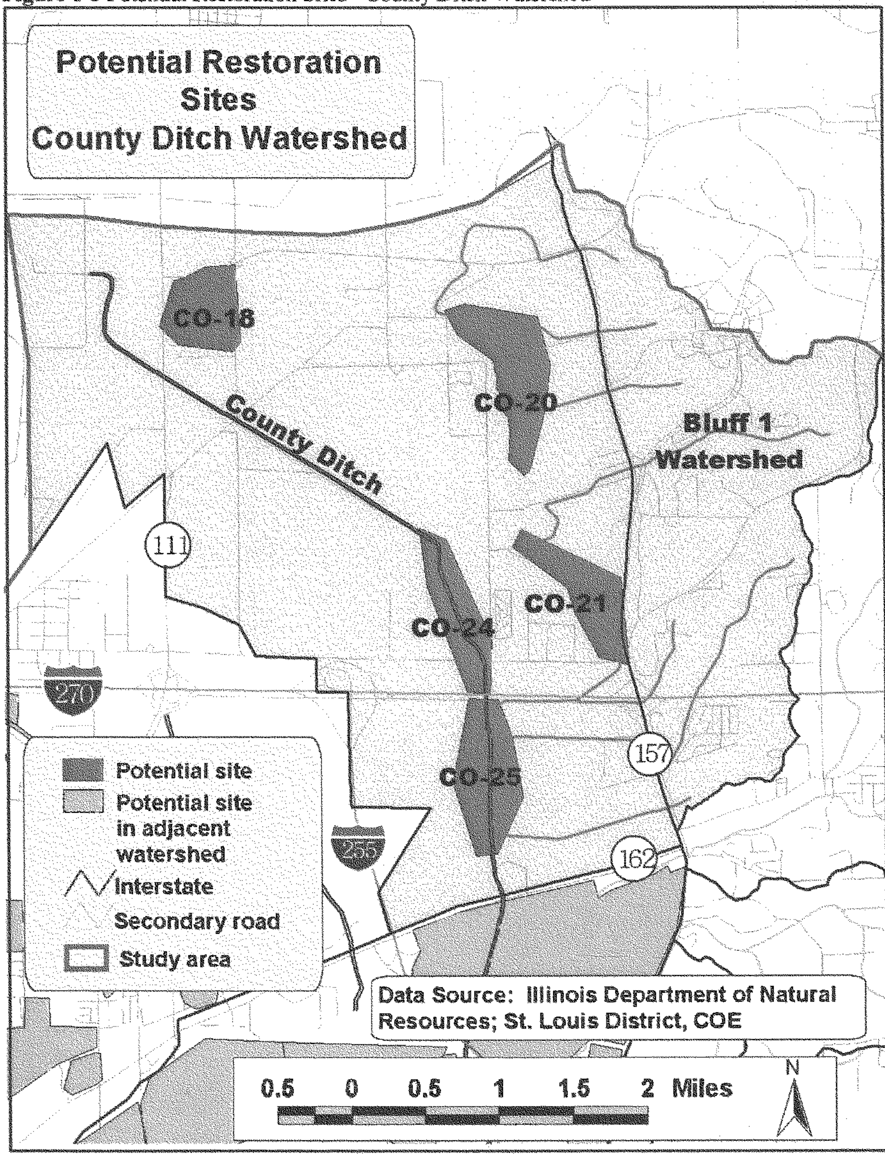
Figure 6-2 Potential Restoration Sites - Long Lake Watershed



County Ditch Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCSW	NRCS	Rpts	PI
Wetland near Rte. 111 (CO-18)	X					
Wetland along Old Cahokia Creek, north (CO-20)	X					
Wetland along Old Cahokia Creek, south (CO-21)	X					
Wetland along County Ditch, north (CO-24)	X					X
Wetland along County Ditch, south (CO-25)	X					X
County Ditch		X				X
Bluff 1 Tributary Watershed		X		X		

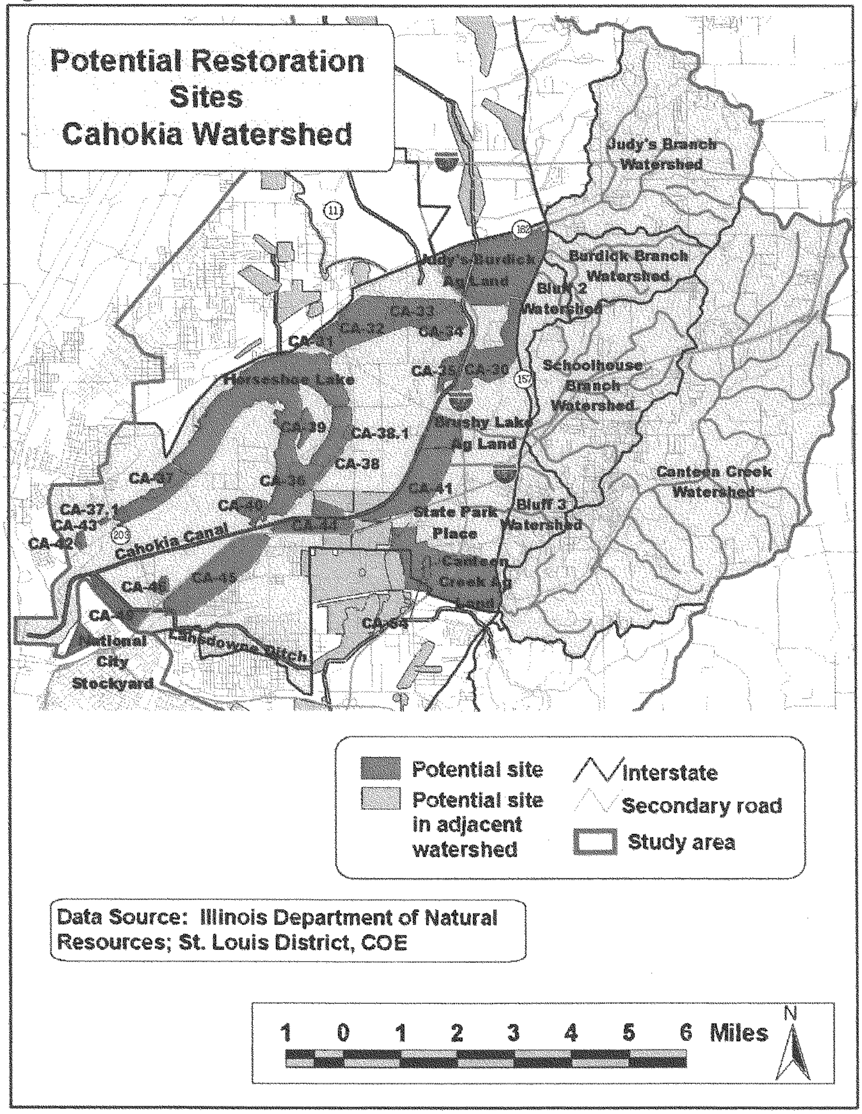
Figure 6-3 Potential Restoration Sites - County Ditch Watershed



Cahokia Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCSW	NRCS	Rpts	PI
Wetland McDonough Lake (CA-30)	X					
Wetland Edelhardt Meander Scar, Rte. 111 west (CA-31)	X					
Wetland Edelhardt Meander Scar, Rte. 111 east (CA-32)	X				X	
Agricultural land Edelhardt Meander Scar, middle (CA-33)		X				
Wetland Edelhardt Meander Scar, east (CA-34) Arlington Subdivision	X					
Wetland Edelhardt Meander Scar, south (CA-35) Arlington Subdivision area	X					X
Wetland Horseshoe Lake, delta at Cahokia Diversion Canal (CA-36)	X	X				
Wetland Horseshoe Lake, west fringe (CA-37)	X					
Wetland Horseshoe Lake, Rte. 203 east (CA-37.1)	X					
Wetland Horseshoe Lake, east fringe (CA-38)	X					
Wetland Horseshoe Lake, northeast fringe (CA-38.1)	X					
Wetland Horseshoe Lake, Walker Island (CA-39)	X					
Wetland, Milam mitigation site, Horseshoe Lake (CA-40)		X				
Horseshoe Lake	X	X			X	X
Wetland Brushy Lake (CA-41)	X	X			X	
Agricultural land, Brushy Lake North		X				
Wetland Eagle Park west (CA-42)	X				X	
Wetland Eagle Park east (CA-43)	X				X	
Wetland Cahokia Canal borrow pits along I-55/70 (CA-44)	X	X				
Wetland at Indian Lake, Fairmont City (CA-45)	X	X			X	
Wetland East of Route 203, North of I-55/70(CA-46)	X					
Wetland Lansdowne Ditch (CA-49)	X					
Lansdowne Ditch		X				X
Wetland Canteen Creek (CA-54)	X					
State Park Place		X				
Judy's Branch Watershed		X		X	X	
Burdick Branch Watershed		X		X	X	
Agricultural land Judy's/ Burdick		X				
Schoolhouse Branch Watershed		X		X	X	
Canteen Creek Watershed		X		X	X	
National City Stockyard						X
Cahokia Canal		X			X	X
Bluff 3 Watershed		X		X		

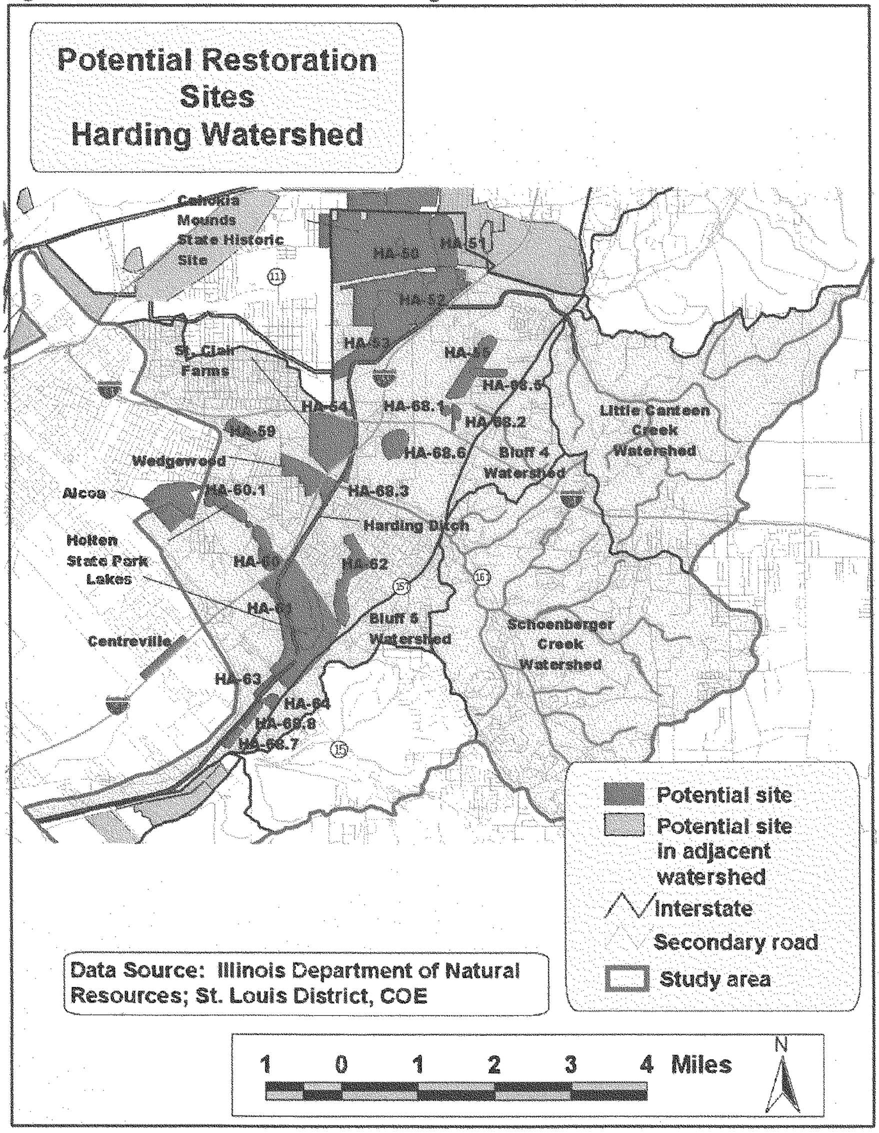
Figure 6-4 Potential Restoration Sites - Cahokia Watershed



Harding Watershed

SITE	Basis for Site Selection					
	IWI	AP	NRCS W	NRCS	Rpts	PI
Wetland Cahokia Mounds (HA-50)	X					
Cahokia Mounds State Historic Site		X				
Wetland Spring Lake meander scar, north (HA-51)	X					
Wetland Spring Lake meander scar, North of Forrest Blvd (HA-52)	X					
Wetland Spring Lake meander scar, south of Forest Blvd. (HA-53)	X					
St. Clair Farms		X				X
Farmed wetland along Harding Ditch, Bunkum Rd. (HA-54)			X			
Wedgewood						X
Centerville						X
Wetland Crooked Lake (HA-55)	X					
Wetland East St. Louis (HA-59)	X					
Wetland Holten State Park, north (HA-60)	X					
Wetland Holten State Park, northwest (HA-60.1)	X					
Wetland, Holten State Park, south (HA-61)	X				X	
Lakes 1 and 2, Holten State Park Lake	X	X			X	
ALCOA Site		X				
Wetland Canal No. 1, north (HA-62)	X					
Wetland Mary Spencer (HA-63)	X					
Wetland near Mary Spencer (HA-64)	X					
Farmed wetland North of Sterling Place City of Caseyville (HA-68.5)			X			
Farmed wetland by Crooked Lake (HA-68.1)	X		X			
Farmed wetland by Crooked Lake (HA-68.2)	X		X			
Farmed wetland along Harding Ditch, south (HA-68.3)	X		X			
Area along Harding Ditch, north near Centerville (HA-68.6)		X				
Area along Harding Ditch, south near Centerville (HA-68.7)		X				
Farmed wetland East of I-255 South of I-64 (HA-68.8)			X			
Little Canteen Creek Watershed		X		X	X	
Schoenberger Creek Watershed		X		X	X	
Bluff 2 Watershed				X	X	
Bluff 4, Bluff 5 Watershed		X		X	X	
Harding Ditch		X			X	X

Figure 6-5 Potential Restoration Sites - Harding Watershed



Powdermill Watershed

SITE	Basis for Site Selection					
	IWI	A P	NRCS W	NRCS	Rpts	PI
Wetland Mullen Slough (PO-66)	X	X				
Wetland Fishing Pond (PO-67)	X					
Wetland Canal No. 1 (PO/HA-67)	X	X				
Agricultural Land Mullens Slough		X				
Powder Mill Creek Watershed		X		X	X	
Bluff 6 Watershed		X		X		

Figure 6-6 Potential Restoration Sites - Powdermill Creek Watershed

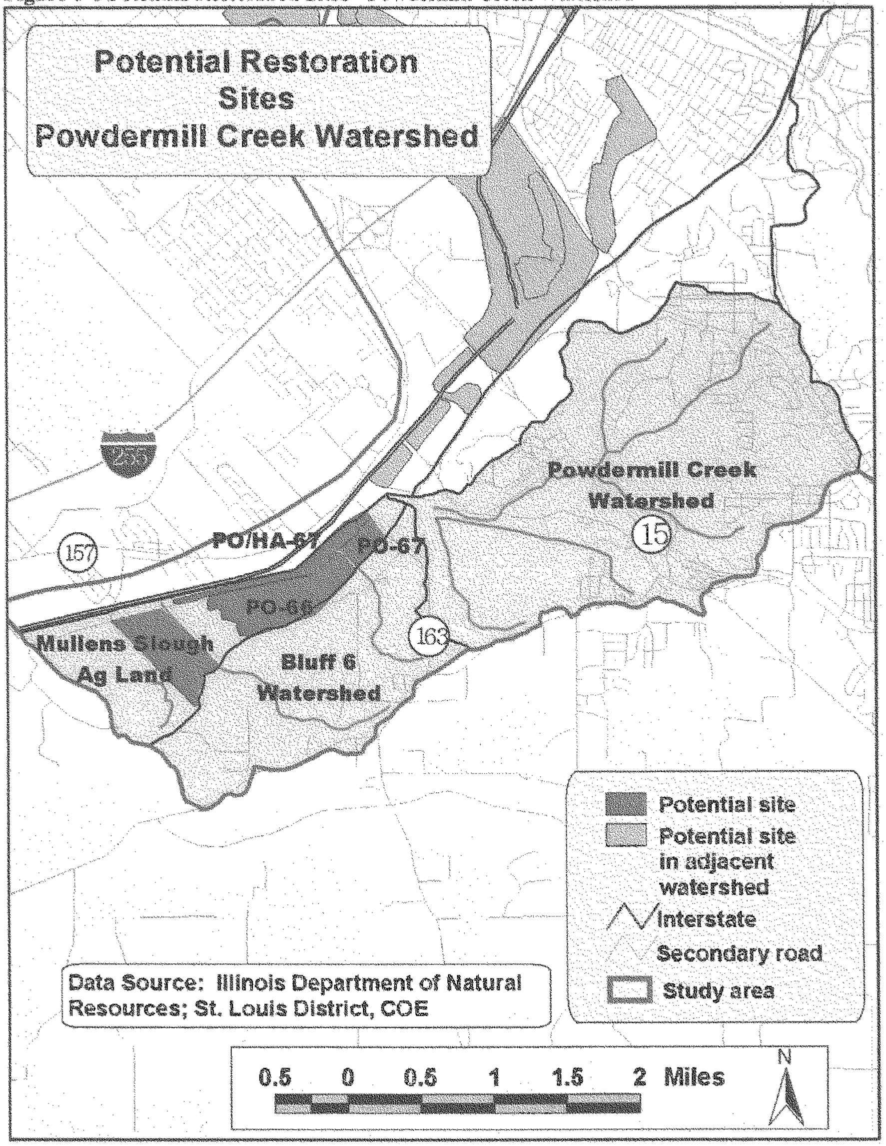
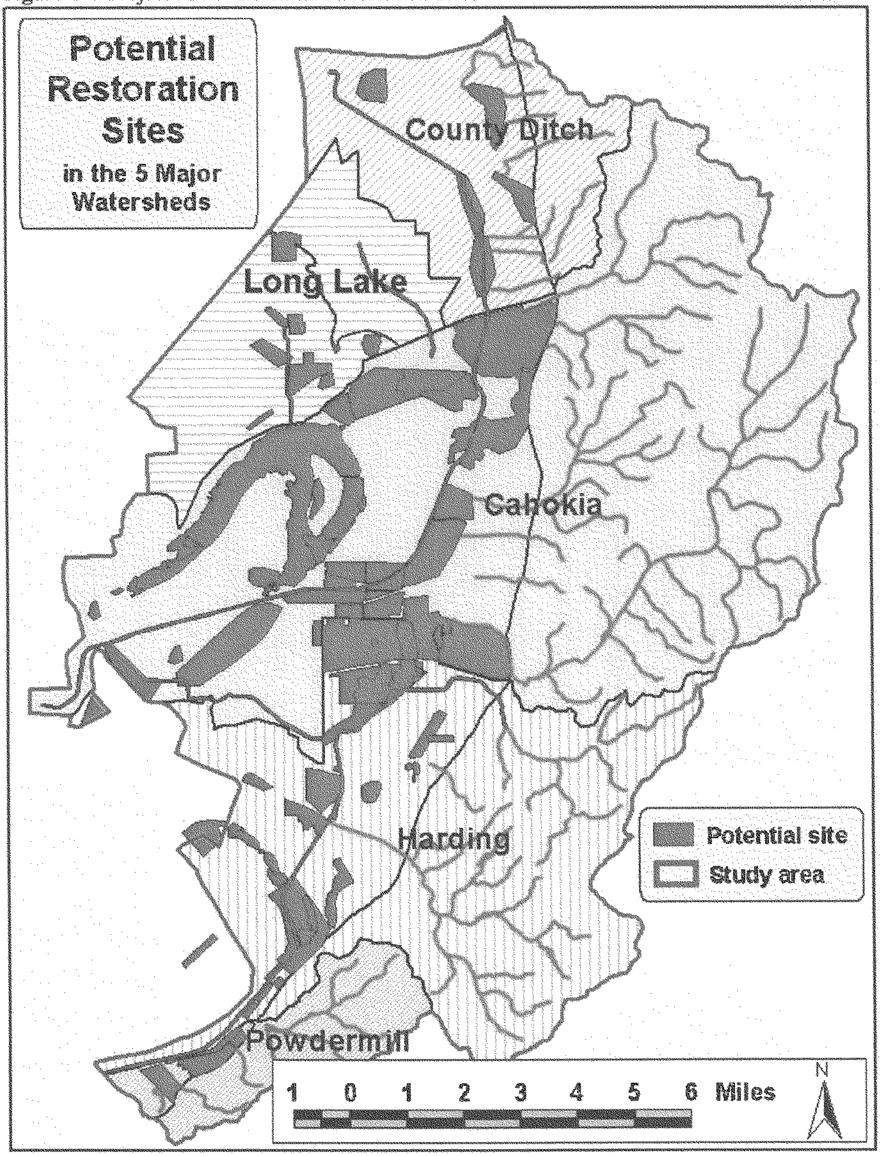


Figure 6-7 Project Area - Potential Restoration Sites



6.4 IDENTIFICATION OF POTENTIAL MEASURES

Figures 6-8 and 6-9 show sites visited in the spring of 1999 to establish baseline habitat conditions in the Project area. In all some 112 sites were evaluated using the HydroGeoMorphic Approach to assessing wetland functions (HGM), and 160 sites were evaluated using the Habitat Evaluation Procedures (HEP) as apart of the initial baseline assessment process. Floodplain sites and bluff sites were subjected to a baseline evaluation using HEP, and wetland sites were additionally assessed using HGM. Tributary or upland streams were assessed at 17 sites using the Qualitative Habitat Evaluation Index (QHEI) model. As mentioned previously, time and funding did not permit development of HGM models to assess functions in five different types of wetlands, as was originally planned, that would assist in quantifying the benefits gained from the use of storm water to restore a flood pulse. HGM models completed were used to assess three sites, Dobrey Slough, Brushy Lake and Elm Slough. Detailed information regarding the HEP, HGM, and QHEI sampling protocols is contained in Appendix A. The sampling procedures utilized to establish baseline conditions for each site were further used to establish baseline conditions for each watershed. The first hand experience gained from the HEP, HGM, and QHEI analyses at each site assisted in the identification of potential measures at these sites.

Figure 6-8 HGM Sample Sites

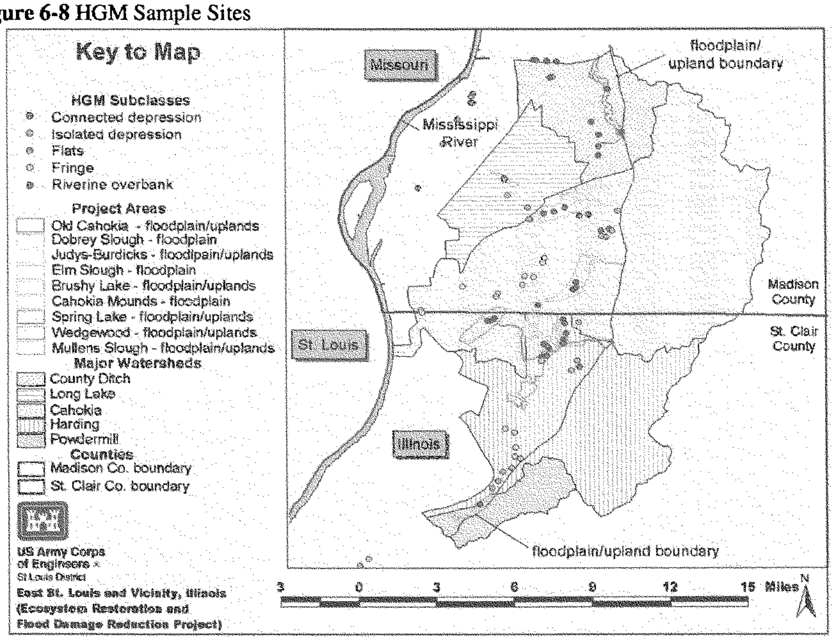
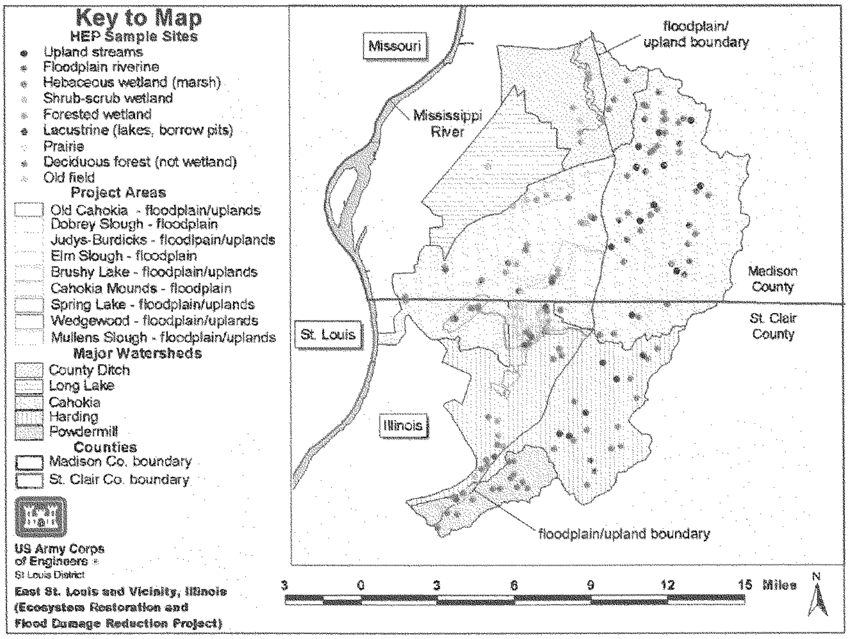


Figure 6-9 HEP Sample Sites



The following table displays the full array of objectives and measures that could potentially be applicable to each of the sites identified in the five watersheds. It forms the template for display of actual objectives and measures that could potentially be implemented at each site.

SITE	Potential Measures Applicable to Sites By Objective		
Site Name	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-8 Pump Station 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-5 Buffers in swales	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-5 Critical area planting 5-6 Diversion 5-7 Filter strips 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools 5-12 Natural deposition 5-13 Lowland detention **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-2 Connect channels 7-3 Stream corridor 7-4 In channel corridor 7-5 Along channel corridor	**Reduce flood damages** 8a-1 Modify channels 8a-2 New channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic vegetation 8c-3 Add flood pulse 8c-4 Interpretive areas

The following set of five tables identifies potential measures for each site. Sites are displayed within their respective watersheds.

Long Lake Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Borrow Pits near Long Lake, south (LO-23)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-6 Woody debris 3-7 Shoreline plants		
Wetland Borrow pit between Rte 162 and Long Lake (LO-27)	**Restore habitat quality** 3-1 Plant trees 3-6 Woody debris 3-7 Shoreline plants		
Wetland along railroad track Granite City (LO-28)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-6 Buffers strips		**Reduce flood damages** 8a-4 Build berm **Enhance recreation** 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Dobrey Slough (LO-29)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Long Lake Watershed – Continued

SITE	Potential Measures Applicable to Sites By Objective		
Dobrey Slough East Agricultural land	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build Berm 2-5 Detain flow		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Wetland near Horseshoe Lake Route 162, west (LO-47)	**Improve water quality** 4-6 Buffer strips		
Wetland West side of Lake Road Route 162, east (LO-48)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-10 Protect **Improve water quality** 4-6 Buffer strips		
Long Lake	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-5 Over wintering 3-6 Woody debris **Improve water quality** 4-6 Buffer strips	**Restore floodplain streams** 7-3 Riparian corridor	**Reduce flood damages** 8a-1 Modify channels
Dobrey Slough Canal			**Reduce flood damages** 8a-2 New channels 8a-3 Divert flow
Legacy Golf Course			**Reduce flood damages** 8a-1 Modify channels 8a-2 New channels 8a-3 Divert flow
Mitchell Ditch			**Reduce flood damages** 8a-1 Modify channels

County Ditch Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland near Hwy 111 (CO-18)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Enhance recreation** 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Wetland along Old Cahokia Creek, north (CO-20)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-8 Pump Station 3-10 Protect **Improve water quality** 4-2 Detention Basin	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg 8c-3 Add flood pulse
Wetland along Old Cahokia Creek, south (CO-21)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-8 Pump Station 3-10 Protect **Improve water quality** 4-2 Detention Basin	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse
Wetland along County Ditch, north (CO-24)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Reduce flood damages** 8-1 Improve Channel **Enhance recreation** 8b-1 Trails

County Ditch Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland along County Ditch, south (CO-25)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Reduce flood damages** 8-1 Improve Channel **Enhance recreation** 8b-1 Trails
County Ditch		**Restore floodplain streams** 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8-1 Improve Channel
Bluff 1, Watershed	**Restore habitat quality** 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion	

Cahokia Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland McDonough Lake (CA-30)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas
	Restore habitat quality 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-10 Protect **Improve water quality** 4-6 Buffer strips		

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland at Edelhardt Meander Scar, Rte. 111 west (CA-31)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes **Improve water quality** 4-6 Buffer strips		
Wetland at Edelhardt Meander Scar, Rte. 111 east (CA-32)	**Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect **Improve water quality** 4-5 Buffers in swales 4-6 Buffer strips		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Agricultural land, Edelhardt Meander Scar, middle (CA-33)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-3 Add flood pulse **Improve water quality** 4-5 Buffers in swales 4-6 Buffer strips		**Reduce flood damages** 8a-2 New channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage
Wetland at Edelhardt Meander Scar, east Arlington Subdivision (CA-34)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes **Improve water quality** 4-6 Buffer strips		

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland at Edelhardt Meander Scar, south Arlington Subdivision area (CA-35)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, delta at Cahokia Diversion Canal (CA-36)	**Restore habitat quality** 3-2 Nest Boxes 3-5 Over wintering		**Reduce flood damages** 8a-1 Modify channels
Wetland Horseshoe Lake, west fringe (CA-37)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes **Improve water quality** 4-5 Buffer strips		
Wetland Horseshoe Lake, Rte. 203 east (CA-37.1)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, east fringe (CA-38)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, northeast fringe (CA-38.1)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Horseshoe Lake, Walker Island (CA-39)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes None		
Wetland, Milam mitigation site Horseshoe Lake (CA-40)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Improve water quality** 4-6 Buffer strips		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Horseshoe Lake	**Restore habitat quality** 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants **Improve water quality** 4-6 Buffer strips		
Wetland at Brushy Lake (CA-41)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect **Improve water quality** 4-5 Buffers in swales	**Reduce erosion** 5-13 Lowland detention **Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse 8c-4 Interpretive areas
Agricultural Land Brushy Lake North	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow	**Reduce erosion** 5-7 Lowland detention **Restore floodplain streams** 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Wetland Eagle Park, west (CA-42)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-6 Buffer strips		

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Eagle Park, east (CA-43)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		
Wetland Cahokia Canal borrow pits Along I-55/70 (CA-44)	**Restore flood pulse** 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails
Wetland Indian Lake Fairmont City (CA-45)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect	**Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas
Wetland East of Route 203 North of I-5/70 (CA-46)	**Improve water quality** 4-6 Buffer strips		
Wetland Lansdowne Ditch (CA-49)	**Restore natural areas** 1-1 Obtain land **Restore flood pulse** 2-1 Modify channel Restore habitat quality 3-3 Add flood pulse		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build Berm 8a-5 Detain flow

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Lansdowne Ditch			**Reduce flood damages** 8a-1 Modify channels
Wetland at Little Canteen Creek (CA-54)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse **Improve water quality** 4-6 Buffer strip		**Reduce flood damages** 8a-4 Build Berm 8a-5 Detain flow
State Park Place	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow	**Reduce erosion** 5-7 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-2 Plant historic veg
Agricultural Land Canteen Creek	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow **Improve water quality** 4-2 Sediment basin	**Reduce erosion** 5-12 Natural deposition 5-13 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-2 Interpretive areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 10-3 Add historic flood pulse 8c-4 Interpretive areas

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Judy's Branch Watershed	**Restore habitat quality** 3-1 Plant trees 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels Enhance recreation 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Burdick Branch Watershed	**Restore habitat quality** 3-1 Plant trees 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Agricultural Land Judy's-Burdick	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build berm 2-5 Detain flow	**Reduce erosion** 5-7 Lowland detention **Restore floodplain streams** 7-2 Reconnect channels 7-3 Stream corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Schoolhouse Branch Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Canteen Creek Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools 5-12 Natural deposition 5-13 Lowland detention **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-2 Reconnect channels 7-3 Riparian corridor 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
National City Stockyard	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		**Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-4 Interpretive areas
Cahokia Canal			**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas

Cahokia Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Bluff 3 Watersheds	**Restore habitat quality** 3-10 Protect	**Reduce erosion** 5-1 Tributary detention 5-4 Water & sediment basins	
Bluff 2 Watershed	**Restore habitat quality** 3-10 Protect	**Reduce erosion** 5-1 Tributary detention 5-4 Water & sediment basins	

Harding Watershed - Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Cahokia Mounds (HA-50)	**Restore natural areas** 1-2 Create habitat		**Reduce flood damages** 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-2 Plant historic veg
Cahokia Mounds State Historic Site	**Restore natural areas** 1-2 Create habitat **Restore habitat quality** 3-10 Protect		**Protect cultural resources** 10-2 Plant historic
Wetland Spring Lake meander scar, north (HA-51)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-2 Nest Boxes 3-3 Add flood pulse **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Spring Lake meander scar, North of Forest Blvd (HA-52)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-4 Reduce water		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Spring Lake meander scar, South of Forest Blvd (HA-53)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse 8c-4 Interpretive areas
St. Clair Farms	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-3 Add flood pulse 3-10 Protect **Improve water quality** 4-6 Buffer strips	**Restore floodplain streams** 7-5 Along channel corridor	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse
Farmed wetland along Harding Ditch at Bunkum Rd (HA-54)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat	**Restore floodplain streams** 7-5 Connectivity corridor	

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wedgewood	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-2 Detention Basin	**Reduce erosion** 5-13 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-2 Plant historic veg
Centerville			**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow
Wetland Crooked Lake (HA-55)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-10 Protect **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-4 Build berm 8a-5 Detain flow **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Wetland East St. Louis (HA-59)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect		

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Holten State Park, north (HA-60)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Holten State Park, northwest (HA-60.1)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-1 Modify Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-2 Nest Boxes 3-3 Add flood pulse		**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Holten State Park, south (HA-61)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Holten State Park Lakes 1 and 2	**Restore habitat quality** 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow
ALCOA Site	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-1 Plant tree 3-7 Shoreline plants **Improve water quality** 4-5 Buffers in swales 4-6 Buffer strips		**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Canal No. 1, north (HA-62)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland Mary Spencer (HA-63)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		
Wetland near Mary Spencer (HA-64)	**Restore habitat quality** 3-1 Plant trees		
Farmed wetland North of Sterling Place, City of Caseyville (HA-68.5)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Improve water quality** 4-6 Buffer strips		**Reduce flood damages** 8a-4 Build Berm 8a-5 Detain flow
Farmed wetland by Crooked Lake (HA-68.1)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Improve water quality** 4-6 Buffer strips		**Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Farmed wetland by Crooked Lake (HA-68.2)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-2 Nest Boxes 3-10 Protect		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Farmed wetland along Harding Ditch, south (HA-68.3)	**Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes		**Protect cultural resources** 8c-1 Obtain sites
Area along Harding Ditch, north near Centerville (HA-68.6)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat	**Restore floodplain streams** 7-5 Connectivity corridor	

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Area along Harding Ditch, south near Centerville (HA-68.7)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat	**Restore floodplain streams** 7-5 Connectivity corridor	
Farmed wetland East of I-255 South of I-64 (HA-68.8)	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore habitat quality** 3-10 Protect **Improve water quality** 4-6 Buffer strips		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg
Little Canteen Creek Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-5 Critical area planting 5-6 Diversion 5-7 Filter strips 5-8 Grass waterways 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control **Restore floodplain streams** 7-1 Obtain land 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse

Harding Watershed - Continued

SITE	Potential Measures Applicable to Sites By Objective		
Schoenberger Creek Watershed	**Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-5 Critical area planting 5-6 Diversion 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control	**Reduce flood damages** 8a-3 Divert flow
Bluff 4, Bluff 5 Watersheds	**Restore habitat quality** 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins	
Harding Ditch		**Restore floodplain streams** 7-4 Riparian corridor 7-5 Connectivity corridor	**Reduce flood damages** 8a-1 Modify channels **Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas

Powdermill Creek -Table Potential Measures Applicable to Sites By Objective

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Mullen Slough (PO-66)	**Restore flood pulse** 2-3 Divert flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-3 Add flood pulse 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect	**Reduce erosion** 5-13 Lowland detention	**Reduce flood damages** 8a-1 Modify channels 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage 8b-4 Access areas

Powdermill Creek -Continued

SITE	Potential Measures Applicable to Sites By Objective		
Wetland Mullen Slough (PO-66) – Cont.	**Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool		**Protect cultural resources** 8c-1 Obtain sites 8c-2 Plant historic veg 8c-3 Add flood pulse 8c-4 Interpretive areas
Agricultural Land at Mullen Slough	**Restore natural areas** 1-1 Obtain land 1-2 Create habitat **Restore flood pulse** 2-3 Divert Flow 2-4 Build Berm 2-5 Detain flow		**Reduce flood damages** 8a-4 Build berm **Enhance recreation** 8b-1 Trails 8b-2 Interpretive areas 8b-3 Signage **Protect cultural resources** 8c-2 Plant historic veg
Wetland Fishing Pond (PO-67)	**Restore flood pulse** 2-3 Divert flow **Restore habitat quality** 3-5 Over wintering 3-6 Woody debris 3-7 Shoreline plants 3-10 Protect	**Reduce erosion** 5-13 Lowland detention	**Reduce flood damages** 8a-3 Divert flow 8a-4 Build berm 8a-5 Detain flow **Enhance recreation** 8b-1 Trails 8b-3 Signage
Wetland Canal No. 1 (PO/HA-67)	**Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-1 Plant trees 3-2 Nest Boxes 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool		**Reduce flood damages** 8a-4 Build berm **Enhance recreation** 8b-1 Trails 8b-3 Signage

Powdermill Creek -Continued

SITE	Potential Measures Applicable to Sites By Objective		
Powder Mill Creek Watershed	**Restore flood pulse** 2-1 Modify Channel 2-2 New Channel 2-3 Divert flow 2-4 Build berm 2-5 Detain flow **Restore habitat quality** 3-9 Riffle and Pool 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion 5-9 Stabilize banks 5-10 Grade control 5-11 Riffle/Pools **Restore tributary streams** 6-1 Stabilize banks 6-2 Riffle/Pools 6-3 Grade control 6-4 Bio-erosion control	**Enhance recreation** 8b-1 Trails 8b-3 Signage 8b-4 Access areas
Bluff 6 Watershed	**Restore habitat quality** 3-10 Protect **Improve water quality** 4-1 Control erosion 4-2 Detention Basin 4-3 Riffle and Pool 4-4 Grade Control	**Reduce erosion** 5-1 Tributary detention 5-2 Terraces 5-3 Underground outlet 5-4 Water & sediment basins 5-6 Diversion 5-8 Grass Waterways	

6.5 SCREENING OF SITES

Following the assessment and evaluation of measures by site, the team began evaluation of sites and site combinations based on location, topography, area hydrology, soils, and existing conditions to contribute to project objectives. This next iteration of assessment and evaluation addressed each site's ability to stand alone or work effectively in combination with others to achieve project objectives. Based on the large number of potential sites, the Biology Team agreed that in order to formulate viable alternative plans, the focus had to be on the identification of a few areas that could contribute in a meaningful way to project objectives. It was not feasible to develop a large number of small fragmented sites across the Project area that contributed to only to a few project objectives, and hope to achieve restoration-planning targets.

Therefore, it was determined by the team that sites or combination of sites needed to meet multiple objectives to have a chance of making a meaningful change in the existing conditions of the Project area. Sites were evaluated based on their ability to contribute individually or in combination to multiple project goals and objectives, and have potential to meet planning targets. In this way potential action areas were to be identified. The following table shows the sites across the project area and how they were evaluated.

Site	Site Evaluation	Result
Long Lake Watershed		
LO-23	This site, an 86-acre area of borrow pit lakes and wetlands, could address only 1 ecological objective. Site is surrounded on three sides by development. Site not able to be combined with other sites to increase benefits.	Not carried forward
LO-27	This site, a 40-acre borrow pit lake, could address only 1 ecological objective. Site is surrounded by urbanization and railroad tracks and is not able to be expanded. Site not able to be combined with other sites to increase benefits.	Not carried forward
LO-28	This site, a 30-acre wetland complex, could address 4 ecological and 1 social objectives. Site could be expanded into a somewhat larger environmental area but is ultimately restricted by homes and a railroad track. Site not able to be combined with other sites to increase benefits. Site is an urban wetland of moderate quality and could be protected by local action.	Not carried forward
LO-29	This site, a 15-acre wetland complex, could address 3 ecological and 2 social objectives. Site is restricted by homes on most sides but could be expanded into a larger environmental area. Site could be combined with Dobrey Slough East agricultural land to increase habitat benefits and provide incidental flood damage reduction.	Carried forward
Dobrey Slough East Ag land	This site, about 40 acres of farmland, could address 2 ecological and 3 social objectives. Site could be used in combination with LO-29 to increase habitat benefits and achieve incidental social objectives.	Carried forward
LO-47	This site, an 11-acre wetland complex, could address only 1 ecological objective. Site not able to be expanded because of surrounding development. Site not able to be combined with other sites to increase benefits.	Not carried forward
LO-48	This site, a 13-acre wetland complex, could address 3 ecological objectives. Site could be expanded to some degree to create a larger environmental area, but is restricted on three sides by roads and a railroad track. Site not able to be combined with other sites to increase benefits.	Not carried forward
Long Lake	This site, a 76-acre natural lake, could address 3 ecological, and 1 social objectives. Action at Long Lake itself is constrained by various factors: residential and urban development along lakeshore, number of impacted private residences, restricted nature of public access, and potential for lake bottom sediments to be contaminated. However, Long Lake has potential to be combined with CA-32 and CA-33 to achieve habitat restoration while providing incidental flood damage reduction.	Carried forward
Mitchell Ditch	This site, a 2.6-mile long man-made ditch, could address only 1 social objective. Surrounding land is mostly agricultural. Urban constraints and inability to meet economic benefit requirements for a flood damage reduction project make any action at this site a low priority. However, site could be combined with CA-32 and CA-33 to achieve habitat restoration and provide incidental flood damage reduction.	Carried forward

Site	Site Evaluation	Result
Long Lake Watershed - Continued		
Dobrey Slough Canal	This site does not exist, but is the concept to build a 1.9-mile long man-made ditch to carry stormwater from Dobrey Slough to Horseshoe Lake. It would address only 1 social objective (flood damage reduction). Urban constraints, IDNR water quality concerns for Horseshoe Lake, and the inability to meet economic benefit requirements for a stand-alone flood damage reduction project make action at this site infeasible.	Not carried forward
Legacy Golf Course	This site, a 200-acre development with man-made lakes, could address only 1 social objective. This site was briefly explored in combination with LO-28, but golf course landowners did not provide hydraulic system information for analysis.	Not carried forward
County Ditch Watershed		
CO-18	This site, a 109-acre wetland complex, could address 2 ecological and 1 social objectives. Site is segmented by a railroad track, and adjacent to a highway. Site has limited potential for expansion into a larger environmental area. Site not able to be combined with other sites to increase benefits.	Not carried forward
CO-20	This site, a 29-acre wetland complex, could address 5 ecological, and 3 social objectives. Site could be expanded into surrounding farmland to create a larger environmental area. Site could be combined with CO-21, Bluff 1 watershed, and Cahokia Canal to enhance achievement of ecological and social objectives.	Carried forward
CO-21	This site, a 60-acre wetland complex, could address 5 ecological, and 3 social objectives. Site could be expanded into surrounding farmland to create a somewhat larger environmental area. Site could be combined with CO-20, Bluff 1 watershed, and Cahokia Canal to enhance achievement of ecological and social objectives.	Carried forward
CO-24	This site, a 55-acre wetland complex, could address 2 ecological and 2 social objectives. Site could be expanded into surrounding farmland to create a somewhat larger environmental area. Site could be combined with CO-25 and County Ditch to increase environmental benefits.	Carried forward
CO-25	This site, a 67-acre wetland complex, could address 2 ecological and 2 social objectives. Site could be expanded into surrounding farmland to create a somewhat larger environmental area. Site could be combined with CO-24 and County Ditch to increase environmental benefits.	Carried forward
County Ditch	This site, a 5.6-mile long man-made ditch, could address 1 ecological and 1 social objective. Action at this site only to reduce flood damages would be a low priority because of the inability to meet economic benefit requirements. Site could be combined with CO-24 and CO-25.	Carried forward
Bluff 1 watershed	This site, a 2,895-acre tributary watershed, could address 3 ecological objectives. This site could be combined with CO-20, CO-21, and Cahokia Canal to address all three project objectives.	Carried forward

Site	Site Evaluation	Result
Cahokia Watershed		
CA-30	This site, a 348-acre wetland and aquatic complex, could address 5 ecological, and 2 social objectives. Site could be expanded to some degree to create a larger environmental area. Site could be combined with Cahokia Canal to increase benefits, but would be difficult due to urban constraints, especially connecting to Cahokia canal to create a floodplain creek flowing through the area from north to south. Site has relatively high ecological diversity, and should as a minimum be protected by local action.	Carried forward
CA-31	This site, a 41-acre wetland complex, could address 2 ecological objectives. Site is restricted by urban development, and not able to be expanded. Site not able to be combined with other sites to increase benefits.	Not carried forward
Bluff 2 watershed	This site, a 666-acre tributary watershed, could address 2 ecological objectives. This site could be combined with CA-30.	Carried forward
CA-32	This site, a 248-acre wetland complex, could address 3 ecological and 2 social objectives. Site is bordered by urban development on two sides, but could be expanded somewhat into adjacent farmland to create a larger environmental area. Site could be combined with farmland at CA-33 and Long Lake and Mitchell Ditch, to increase habitat restoration benefits and achieve incidental flood damage reduction.	Carried forward
CA-33	This site, about 125 acres of farmland, could address 4 ecological and 2 social objectives. Site could be combined with wetland at CA-32 and Long Lake and Mitchell Ditch, to increase habitat restoration benefits and achieve incidental flood damage reduction.	Carried forward
CA-34	This site, a 147-acre wetland complex, could address 2 ecological objectives. Site surrounded on three sides by urban development. This site is currently being developed as a subdivision.	Not carried forward
CA-35	This site, a 74-acre wetland complex, could address only 1 ecological objective. There is no potential for expansion. Site not able to be combined with other sites to increase benefits.	Not carried forward
CA-36	This site, a 96-acre wetland complex, could address 1 ecological and 1 social objective. Site created by sediment carried into Horseshoe Lake by Cahokia Canal. Site owned by IDNR, and already under a management plan. IDNR declined consideration of any action at this site.	Not carried forward
CA-37	This site, a 70-acre wetland complex, could address 2 ecological objectives. Site has limited potential for expansion to create a larger environmental area. Site not capable of being combined with other sites to increase benefits. Most of site owned by the Corps as mitigation for the new Lock and Dam 26.	Not carried forward
CA-37.1	This site, a 12-acre wetland complex, could address only 1 ecological objective. Site has limited potential for expansion to create a larger environmental area. Site not capable of being combined with other sites to increase benefits.	Not carried forward
CA-38	This site, a 13-acre wetland, could address only 1 ecological objective. Site owned by IDNR, and already under a management plan. IDNR declined consideration of any action at this site.	Not carried forward
CA-38.1	This site, an 8-acre wetland complex, could address only 1 ecological objective. Site owned by IDNR, and already under a management plan. IDNR declined consideration of any action at this site.	Not carried forward

Site	Site Evaluation	Result
Cahokia Watershed - Continued		
CA-39	This site, a 20-acre wetland complex, could address only 1 ecological objective. Site not able to be expanded or combined with other sites. Owned by IDNR who already has the site under a management plan. IDNR did not want to be considered in this planning effort.	Not carried forward
CA-40	This site, an 11-acre wetland complex, could address 2 ecological and 1 social objectives. Site could be expanded to some degree to create a larger environmental area. Site not able to be combined with other areas to create a larger environmental area. Already a wetland mitigation area.	Not carried forward
Horseshoe Lake	This site, a 2,245-acre natural lake, could address 2 ecological objectives. Improvements would require dredging lake bottom sediments collected in the lake over historic times. Much of site owned by IDNR, and already under a management plan. Likelihood of lake bottom sediments being contaminated from industrial dumping would impact any dredging plans. IDNR declined to be considered in this planning effort.	Not carried forward
CA-41	This site, a 311-acre wetland and aquatic complex, could address 6 ecological and 3 social objectives. Site is surrounded on three sides by development, but could be expanded into farmland to create a somewhat larger environmental area. Site could be combined with Brushy Agricultural land, Cahokia Canal, Schoolhouse Branch, and Schneider Ditch to enhance achievement of ecological and social objectives.	Carried forward
Agricultural Land Brushy Lake North	This site, about 325 acres of farmland, could address 5 ecological and 3 social objectives. Site is surrounded on two sides by development. Site could be combined with CA-41, Cahokia Canal, Schoolhouse Branch, and Schneider Ditch to increase habitat restoration benefits as well as enhance achievement of all social objectives.	Carried forward
Schoolhouse Branch watershed	This site, a 4,546-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Site could be combined with CA-41, Brushy agricultural land, Bluff 2 and Bluff 3 watersheds, and Cahokia Canal to increase ecological benefits as well as enhance achievement of all social objectives.	Carried forward
CA-42	This site, a 17-acre wetland, could address 3 ecological objectives. Site is surrounded by urban development on three sides, and is not capable of being expanded. Site not capable of being combined with other sites.	Not carried forward
CA-43	This site, a 6-acre wetland, could address only 1 ecological objective. Site is surrounded by urban activity, and is not capable of being expanded. Site not capable of being combined with other sites.	Not carried forward
CA-44	This site, a 204-acre wetland and aquatic complex, could address 2 ecological and 2 social objectives. Site is surrounded by urban development on three sides. Site not capable of being expanded. Site could be combined with Cahokia Canal to increase ecological benefits as well as achieve incidental flood damage reduction benefits.	Carried forward

Site	Site Evaluation	Result
Cahokia Watershed - Continued		
CA-45	This site, a 620-acre terrestrial, wetland and aquatic complex, could address 5 ecological and 2 social objectives. Site is surrounded by urban development. Site could be combined with Cahokia Canal and Lansdowne Ditch to increase ecological benefits and provide incidental flood damage reduction benefits. Site could also be combined with HA-53 in the Harding Ditch watershed (via Lansdowne Ditch, or a similar connection) to achieve the same kind of benefits.	Carried forward
CA-46	This site, a 24-acre wetland complex, could address only 1 ecological objective. Site is surrounded by urban activity, and is not capable of being expanded. Site not capable of being combined with other sites.	Not carried forward
CA-49	This site, a 119-acre wetland complex, could address 3 ecological and 1 social objectives. Site surrounded by urban development. Site could be combined with Lansdowne Ditch and Cahokia Canal to increase ecological benefits and provide flood damage reduction benefits. Area is in known area of contamination and not viable for recommendation here.	Not Carried forward
Lansdowne Ditch	This site, a 4.6-mile long man-made ditch, could address only 1 social objective. Channel improvements would require substantial impact to existing residential area. Action at this site only to reduce flood damages would be infeasible because of the inability to meet economic benefit requirements. Upper portion of the channel has potential to be combined with other sites to provide hydraulic connectivity with CA-45 and Cahokia Canal.	Carried forward
CA-54	This site, an 11-acre wetland, could address 3 ecological and 1 social objectives. Site is adjacent to a residential area. Site could be expanded into farmland to create a larger environmental area. Site able to be combined with HA-51, HA-52, and Canteen Creek to increase environmental benefits and achieve incidental flood damage reduction.	Carried forward
State Park Place	This site, a 215-acre existing residential area, could address 3 ecological and 2 social objectives. Site is located within Cahokia Mounds World Heritage Site. Site could be combined with Canteen Creek, CA-54, HA-51, and HA-52 to provide increased habitat restoration as well as achieve incidental flood damage reduction. Requires relocation of a significant number of homes.	Carried forward
Agricultural Land Canteen Creek	This site, about 565 acres of horseradish farmland, could address 4 ecological and 3 social objectives. Site is surrounded on all sides by development. Site could be combined with State Park Place, Canteen Creek and CA-54 to increase ecological benefits and enhance achievement of social objectives.	Carried forward
Canteen Creek Watershed	This site, a 14,538-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Size of channel improvements needed on floodplain for flood damage reduction alone would impact existing urban areas, identified areas of cultural significance, and requires the replacement of numerous bridges. Urban and cultural constraints and inability to meet economic benefit requirements for flood damage reduction make this a low priority as a stand-alone site. Site could be combined with State Park Place, CA-54, HA-51, and HA-52 to achieve multiple planning objectives. Site could also be combined with Harding Ditch and HA-53 in the Harding Ditch watershed to achieve the same planning objectives.	Carried forward

Site	Site Evaluation	Result
Cahokia Watershed - Continued		
Judy's Branch Watershed	This site, a 5,453-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Site could be combined with Judy's/Burdick agricultural land, Burdick Branch, and Cahokia Canal to increase ecological benefits and enhance achievement of social objectives.	Carried forward
Burdick Branch Watershed	This site, a 1,829-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 3 social objectives. Site could be combined with Judy's/Burdick agricultural land, Burdick Branch, and Cahokia Canal to increase ecological benefits and enhance achievement of social objectives.	Carried forward
Agricultural Land Judy's/Burdick	This site, about 500 acres of farmland, could address 4 ecological and 3 social objectives. Site is bounded by urban development on one side. Site could be combined with Judy's Branch, Burdick Branch, and Cahokia Canal to increase ecological benefits and enhance achievement of social objectives.	Carried forward
National City Stockyard	This site, a 51-acre terrestrial and wetland complex, could address 1 ecological and 2 social objectives. Site includes a historic remnant of Cahokia Creek, and is surrounded by urban development. Site not able to be combined with other sites to increase benefits. Public comment indicates site is very close to significant prehistoric cultural resources. A minor investment could enhance and protect the site for significant historical and cultural purposes. Cultural resource significance enhances site importance.	Carried forward
Cahokia Canal	This site, a 12.4-mile long man-made ditch, could address 1 ecological and 2 social objectives. Size of channel improvements required for flood damage reduction would impact existing urban areas, require the replacement of numerous bridges and enlargement of pumping capacity at North pump station. Urban constraints and inability to meet economic benefit requirement for flood damage reduction make this a low priority as a stand-alone site. However, site could be combined with Cahokia Canal borrow pits, CA-41 and Brushy Lake agricultural land, and Judy's/Burdick agricultural land to enhance ecological restoration while providing incidental flood damage reduction.	Carried forward
Bluff 3 Watershed	This site, a 1,026-acre watershed, could address 2 ecological objectives. Site could be combined with CA-41, Brushy Lake agricultural land, and Schoolhouse Branch, to increase ecological benefits.	Carried forward
Harding Watershed		
HA-50	This site, a 3-acre wetland, could address 1 ecological and 2 social objectives. Site consists of a prehistoric borrow pit, and is not expandable. Site not capable of being combined with other sites to increase benefits.	Not carried forward
Cahokia Mounds State Historic Site	This site, a 525-acre terrestrial complex (hay leases), could address 2 ecological and 1 social objectives. Site could provide for the planting of historic prairie vegetation to create a significant environmental area. Site not capable of being combined but site significance warrants further investigation.	Carried forward
HA-51	This site, an 85-acre wetland complex, could address 4 ecological and 1 social objectives. Site bordered by development on two sides, and not able to be expanded. Site could be combined with CA-54, Canteen Creek, HA-52, and HA-53 to achieve multiple benefits.	Carried forward

Site	Site Evaluation	Result
Harding Watershed - Continued		
HA-52	This site, a 243-acre wetland complex, could address 3 ecological and 2 social objectives. Site bordered by development on one side, and not able to be expanded. Site could be combined with CA-54, Canteen Creek, and HA-51 to achieve multiple benefits.	Carried forward
HA-53	This site, a 111-acre wetland and aquatic complex, could address 3 ecological and 3 social objectives. Site bordered on two sides by development. Site could be expanded to create a larger environmental area. Site could be combined with Harding Ditch, Canteen Creek, Little Canteen Creek, St. Clair Farms, and CA-45 to increase habitat restoration and attainment of ecological and social objectives.	Carried forward
St Clair Farms	This site, about 180 acres of farmland, FEMA buyout areas, and several existing residences, could address 5 ecological and 3 social objectives. Site bordered on three sides by development. Site could be combined with Harding Ditch, HA-53, and HA-54 to achieve multiple benefits including creation of a significant habitat restoration area that achieves all social objectives.	Carried forward
HA-54	This site, a 2-acre farmed wetland, could address 2 ecological objectives. Site is bordered by development on three sides. Site could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-53 and Harding Ditch to increase environmental benefits.	Carried forward
Wedgewood	This site, about 125 acres of FEMA buyouts and terrestrial and wetland habitats, could address 5 ecological and 3 social objectives. Site is encircled by development. Site could be combined with Harding Ditch and Schoenberger Creek to provide enhanced habitat restoration benefits and incidental flood damage reduction. Requires closing of an east/west artery (Summit Avenue) under I-255.	Carried forward
Centerville	This site, a small town, could address 1 social objective. Inability to meet economic benefit requirement for stand alone flood damage reduction makes any action at this site a low priority. IDNR is continuing to pursue solutions in this area outside of this project.	Not carried forward
HA-55	This site, a 41-acre wetland complex, could address 4 ecological and 2 social objectives. Site is bordered in part by development, but could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-68.5, HA-68.1, HA-68.2, and Bluff 4 to increase habitat benefits.	Carried forward
HA-59	This site, a 38-acre wetland complex, could address only 1 ecological objective. Site is bordered by development on three sides, but could be expanded into adjacent farmland to create a larger environmental area. Site could not be combined with other sites to gain environmental benefits.	Not carried forward
HA-60	This site, a 25-acre wetland complex, could address 3 ecological and 2 social objectives. Site is within Holten State Park, and could be expanded to a degree into adjacent recreational areas to create a larger environmental area. Site could be combined with HA-60.1, HA-61, Harding Ditch, and two other lakes in the state park to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward

Site	Site Evaluation	Result
Harding Watershed - Continued		
HA-60.1	This site, a 17-acre wetland, could address 3 ecological and 2 social objectives. Site is within Holten State Park, and could be expanded to a degree into adjacent recreational areas to create a larger environmental area. Site could be combined with HA-60, HA-61, Harding Ditch, and two other lakes in the state park to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward
HA-61	This site, a 432-acre wetland and aquatic complex, could address only 1 ecological objective. Site is within Holten State Park, and could be expanded to a degree into adjacent recreational areas to create a larger environmental area. Site could be combined with HA-60, HA-60.1, Harding Ditch, and two other lakes in the state park to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward
Holten State Park Lakes 1 and 2	This site, two natural lakes totaling 87 acres, could address 1 ecological and 1 social objectives. These lakes, Whispering and Wouldow Lakes, are in Holten State Park. Site is surrounded by recreational areas, and could be expanded to create a larger environmental area. Site could be combined with HA-60, HA-60.1, HA-61, and Harding Ditch to increase ecological benefits and achieve flood damage reduction benefits. Site owned by IDNR, and a management plan for the park is already in place. IDNR does not want to be considered in this planning effort.	Not carried forward
ALCOA	This site, a 240-acre former industrial area with some terrestrial and wetland areas, could address 3 ecological and 2 social objectives. Site is surrounded by development, and has numerous contamination issues, which eliminate it at this time from consideration. Work on this site is continuing under the Brownfield program.	Not carried forward
HA-62	This site, a 69-acre wetland complex, could address 1 ecological objective. Site is surrounded by development, and not able to be enlarged. Site could be combined with Bluff 5 to achieve increases ecological benefits.	Carried forward
HA-63	This site, a 9-acre wetland, could address only 1 ecological objective. Site is surrounded by development and not able to be enlarged. Site could not be combined with other sites. Site already addressed by resource agencies during recent clean out of Harding Ditch.	Not carried forward
HA-64	This site, a 14-acre wetland complex, could address only 1 ecological objective. Site is bordered by development on two sides, and not capable of being expanded. Site not able to be combined with other sites.	Not carried forward
HA-68.5	This site, about 20 acres of farmland and farmed wetland, could address 2 ecological and 1 social objectives. Site could be expanded to create a larger environmental area. Site could be combined with HA-55, HA-68.1, HA-68.2, and Bluff 4 to provide greater ecological benefits and achieve incidental flood damage reduction.	Carried forward

Site	Site Evaluation	Result
Harding Watershed - Continued		
HA-68.1	This site, about 14 acres of farmed wetland, could address 2 ecological and 2 social objectives. Site could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-55, HA-68.5, HA-68.2, and Bluff 4 to increase ecological benefits and achieve incidental flood damage reduction.	Carried forward
HA-68.2	This site, an 11-acre wetland complex, could address 2 ecological and 1 social objectives. Site could be expanded into adjacent farmland to create a larger environmental area. Site could be combined with HA-55, HA-68.5, HA-68.1, and Bluff 4 to increase ecological benefits and achieve incidental flood damage reduction.	Carried forward
HA-68.3	This site, an 8-acre farmed wetland, could address 1 ecological and 1 social objectives. Site is surrounded by development. Site not capable of being combined with other sites.	Not carried forward
HA-68.6	This site, a 15-acre terrestrial area, could address 2 ecological. Site is surrounded by development. Site not capable of being combined with other sites.	Not carried forward
HA-68.7	This site, a 12-acre terrestrial area, could address 2 ecological objectives. Site is surrounded by development. Site not capable of being combined with other sites.	Not carried forward
HA-68.8	This site, about 30 acres of farmed wetland, could address 3 ecological and 1 social objectives. Site could be expanded into adjacent farmland to create a somewhat larger environmental area. Site not able to be combined with other sites.	Not carried forward
Little Canteen Creek	This site, a 5,069-acre tributary watershed, could address 5 ecological and 2 social objectives. Site could be combined with Harding Ditch and HA-53 to meet all planning objectives. Combination could provide enhanced environmental benefits while providing incidental flood damage reduction.	Carried forward
Schoenberger Creek	This site, a 7,741-acre tributary watershed and its associated floodplain channel, could address 4 ecological and 1 social objectives. Site could be combined with Harding Ditch and Wedgewood to meet all planning objectives. Combination could provide enhanced environmental benefits while providing flood damage reduction	Carried forward
Bluff 4 watershed	This site, a 960-acre tributary watershed, could address 3 ecological objectives. Site could be combined with HA-55, HA-68.1, HA-68.2, and HA-68.5 to increase ecological benefits.	Carried forward
Bluff 5 watershed	This site, a 979-acre tributary watershed, could address 2 ecological objectives. Site could be combined with HA-62 to increase ecological benefits.	Carried forward
Harding Ditch	This site, a 10.9-mile long man-made ditch, could address 1 ecological and 2 social objectives. Site could be combined with Canteen Creek, Little Canteen Creek and HA-53, St. Clair Farms, and Wedgewood to meet all planning objectives.	Carried forward

Site	Site Evaluation	Result
Powdermill Watershed		
PO-66	This site, a 141-acre wetland (currently a lake called Mullens Slough), could address 4 ecological 3 social objectives. The site is surrounded by man-made features on all sides, and is not capable of being expanded. Site could be combined with PO-67, PO/HA-67, Mullens Slough agricultural lands, and Powdermill Creek and Bluff 6 to enhance ecological restoration and achievement of social objectives.	Carried forward
PO-67	This site, an 18-acre aquatic area (man-made fishing lake), could address 3 ecological and 2 social objectives. Site is surrounded by development. Site could be combined with PO-66, PO/HA-67, Mullens Slough agricultural lands, Powdermill Creek, and Bluff 6 to enhance habitat restoration.	Carried forward
PO/HA-67	This site, a 39-acre wetland complex, could address 3 ecological and 1 social objectives. Man-made features surround site, and is not capable of being expanded. Site could be combined with PO-66, PO-67, Mullens Slough agricultural lands, Powdermill Creek, and Bluff 6 to enhance habitat restoration and provide incidental flood damage reduction.	Carried forward
Mullens Slough Agricultural land	This site, about 31-acres of farmland, could address 4 ecological and 2 social objectives. Site is bounded by man-made feature on one side, and could be expanded into adjacent farmland to increase size of environmental area. Site could be combined with PO-66, PO-67, PO/HA-67, Powdermill Creek, and Bluff 6 to enhance ecological restoration.	Carried forward
Powdermill Creek	This site, a 840-acre tributary watershed and its associated floodplain channel, could address 5 ecological and 1 social objectives. Site could be combined with PO-66, PO-67, PO/HA-67, Mullens Slough agricultural lands, and Bluff 6 to enhance ecological restoration and provide incidental flood damage reduction.	Carried forward
Bluff 6 watershed	This site, a 1,178-acre tributary watershed, could address 3 ecological objectives. Site could be combined with PO-66, PO-67, PO/HA-67, Mullens Slough agricultural lands, and Powdermill Creek to enhance ecological restoration.	Carried forward

6.6 SCREENING OF POTENTIAL ACTION AREAS

Sites screened and identified to be carried forward as having potential for meeting project objectives were put through further engineering and biological analysis in order to identify the relative effectiveness of sites and site combinations. These analyses are detailed in the Hydraulic, Geotechnical, and Sediment Appendixes. At this point areas were again screened for having the ability to achieve multiple project goals and objectives and to make a significant contribution to attaining project planning targets. Habitat restoration and the ability to reasonably attain hydraulic reconnection for flood pulse restoration to enhance ecosystem functions were key to the assessment process. Those determined to have less potential were identified for removal. The action areas carried forward from this assessment were to be put through the alternative plan development process. The following table details this next iteration of assessment and evaluation that lead to the identification of action areas:

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
LO-29, Dobrey Slough Ag land	Connection of these sites provides the ability to enhance existing habitat and restore an historic wetland slough area. The re-introduction of a flood pulse for its ecosystem benefits to the ag land also provides incidental flood damage reduction for the surrounding urban area. The hydraulic analysis of the site supports area viability.	Carried Forward as Dobrey Slough
CO-24, CO-25, County Ditch	Further evaluation of these combined sites demonstrates limited potential. Cahokia canals backwater effect impedes drainage of local stormwater run off via County Ditch. Because no natural stream existed in or along the alignment of county ditch environmental enhancement of this manmade feature was determined to be a low priority. Hydraulic assessment indicates that if Cahokia Canal conveyance is improved backwater problems in County Ditch should be eliminated.	Not Carried Forward
CO-20, CO-21, Bluff 1, and Cahokia Canal	Further evaluation of these combined sites demonstrates that a quality habitat area can be re-created by restoring the historic creek and flood pulse function. This restoration also achieves incidental flood damage reduction. Area already has some existing habitat features and an interested local planning group. The hydraulic analysis of the site supports area viability.	Carried Forward as Old Cahokia Creek
CA-30, Bluff 2 and Cahokia Canal (McDonough Lake)	The tributary watershed that drains directly into McDonough Lake is quite small and does not deliver flows large enough to introduce a flood pulse or require consideration for flood damage reduction. Introduction of a flood pulse into these wetlands would provide substantial ecological benefits. The only source of water available to introduce a flood pulse would be from Cahokia Canal/ Judy's/ Burdick Branch. Opportunities to introduce a flood pulse into the McDonough area would come from either backwater from Cahokia Canal at the lower end or from Burdick Branch at the North end. A Burdick Branch connection could also provide an opportunity for restoration of an historic floodplain creek. Further evaluation of these options showed that connection to Cahokia Canal was infeasible because of the location of I-255 and connection via Burdick Branch would impact horseradish land, would require connection through a rapidly developing area and create induced flooding problems. The difficulty and expense of connecting these sites make it infeasible. While the team agrees the area should be protected this project did not appear to be a viable mechanism for achieving such protection.	Not Carried Forward

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
Long Lake, Mitchell Ditch, CA-32 and CA-33	Further evaluation of these combined sites determined that improving the connection between Long Lake and Mitchell Ditch with the existing wetlands at CA-32 would allow the re-introduction of a flood pulse to enhance environmental quality. Restoration of the adjacent ag land (CA-33) to historic wetland conditions allows for the creation of a core habitat area providing substantial ecological benefits. These combined sites also have potential to provide flood damage reduction. The hydraulic analysis of the combined sites supports area viability.	Carried Forward as Elm Slough
Judy's Branch, Burdick Branch and Judy's/Burdick ag land	Further evaluation of these combined sites demonstrates that a quality habitat area would result from their being associated with each other. The ag land identified provides an area for the restoration of historic prairie and a small remnant of the historic Cahokia Creek. The hydraulic analysis of the site further supports area viability and creates a diversion out of Cahokia Canal in a proximity that could assist in stopping backwater effects in County Ditch.	Carried Forward as Judy's/ Burdick Branch
CA-41, Brushy Ag Land, Bluff 3, School Branch	Further evaluation of these combined sites determined that restoration of the agricultural land to historic wetland condition in combination with existing wetland habitat allows for the creation of a core habitat area providing substantial ecological benefits. Creating a connection with School House Branch in combination with its improvement would allow the introduction of a flood pulse to enhance environmental quality and permit the restoration of a remnant of the historic Cahokia Creek through the site. These combined sites also have potential to provide flood damage reduction. The hydraulic analysis of the combined sites supports area viability. Part of area is already in public ownership.	Carried Forward as Brushy Lake
CA-44 and Cahokia Canal	Further evaluation of these combined sites demonstrates that there would be ecological benefits to making a hydraulic connection between the two sites. Such a connection would be simple to accomplish and would also provide additional temporary storage of floodwaters. Recommended for action by others.	Carried Forward as I-55/70 Borrow Pits
National City Stockyard	Further evaluation of this site demonstrates that there would be enhanced ecological benefits connected to the protection and restoration of this culturally significant site that is also located in a brownfield area. Recommended for action by others.	Carried Forward as National City Stockyard

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
Canteen Creek, CA54, HA51, HA 52 and Canteen Creek Ag Land (State Park Place)	The Canteen Creek watershed drains in the direction of these combined sites. As indicated in the previous screening process improvement to the floodplain portion of Canteen Creek is not feasible because of cultural resource and urban constraints. Restoring the residential area of State Park Place and adjacent Canteen Creek Ag land to wetlands and other natural habitats, coupled with re-introduction of a flood pulse would allow for the creation of a core habitat area providing substantial ecological benefits and providing incidental flood damage reduction. Additionally, land now designated as part of the World Heritage Site would be protected by removal from private ownership. After exhaustive evaluation of these combined sites it was determined that impediments of I-255, the loss of valuable horseradish production land and the displacement of a large number of residents eliminated these combined sites from further consideration. This left the Canteen Creek watershed, the largest of the bluff watershed open for consideration in conjunction with other site combinations.	Not Carried Forward
Cahokia Mounds and HA-50	Further evaluation of these combined sites demonstrates that quality habitat could be restored here. IHPAs opposition to permitting the re-introduction of a creek overflow on this portion of the World Heritage site eliminated CA-50 and any opportunity of restoring a flood pulse from consideration. The focus of restoration efforts on these publicly owned lands was directed to re-establishment of historic prairie.	Carried Forward as Cahokia Mounds
Canteen Creek, Harding Ditch, Little Canteen Creek, HA-53 and HA-52 (Spring Lake Action Area)	Initial evaluation proceeded under the assumption that Canteen Creek would connect to Harding Ditch and stormwater along with its sediment load would reach the dredged sand plant site within HA-53. From here clean water could back up into HA-53 and HA-52 to provide a flood pulse to enhance environmental quality. Hydraulic analysis showed this to be an infeasible scenario because Harding Ditch sediment load would drop out before reaching the dredged site, the necessity to close Forest Boulevard and IHPA's objection to placing water within the boundaries of the World Heritage Site. At this point with HA-52 no longer available, HA-53 was evaluated for its ability to be connected to St. Clair Farms.	Considered Further as Spring Lake

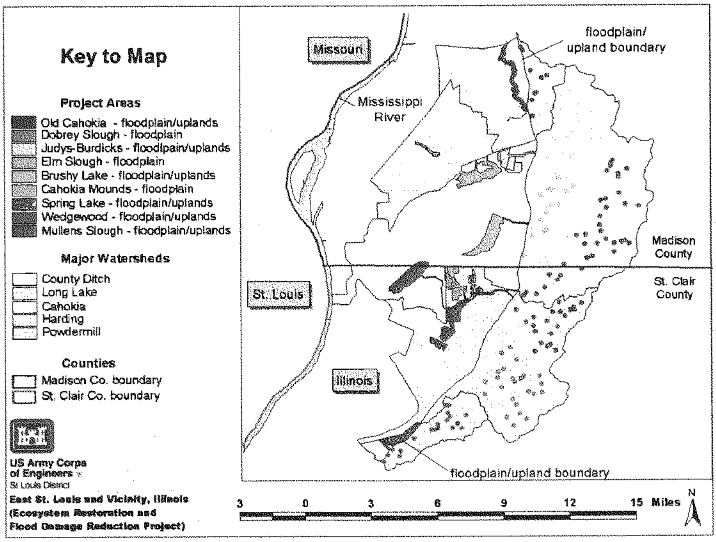
Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
Harding Ditch and St. Clair Farms (St Clair Farms Action Area)	As indicated in the previous screening process improvement to the Harding Ditch channel required for flood damage reduction would impact existing urban areas and require the replacement of numerous bridges and enlargement of the pumping capacity at South pump station. Urban constraints and inability to meet required economic benefits for flood damage reduction make this approach infeasible. The introduction of a flood pulse to the combined HA-53 and St. Clair Farms significantly improved ecosystem functions and provides incidental flood damage reduction. Under this scenario Harding Ditch would be an important component to ecosystem restoration objectives. The introduction of Canteen Creek to this scenario however, exceeds the desired depth and duration of a flood pulse, and requires enlargement of the flood protection features (Harding Ditch and South Pump Station) downstream of these sites that is not feasible.	Considered Further as Spring Lake
HA-53, Lansdowne Ditch, CA-45 (Indian Lake)	Because of the constraints downstream of combined HA-53 and St. Clair Farms sites, it was clear that Canteen Creek flows needed to be returned to the Cahokia watershed and the flood control system associated with it. Connection of HA-53 to an improved Lansdowne Ditch through Washington Park was evaluated as a method of connecting HA-53 and CA-45. This connection would allow the restoration of a flood pulse in CA-45 for its ecosystem benefits by permitting water to back up into Indian Lake from the south end via a connection to Lansdowne Ditch. The hydraulic analysis demonstrated that the size of the conveyance required through Washington Park was not feasible and could potentially induce flooding in the already existing urban area. The concept of connecting HA-53 near the upper end of Indian Lake via a new channel through Fairmont City was evaluated. The analysis of this connection proved to not only allow for the re- introduction of a beneficial flood pulse to Indian Lake but also make the re-creation of the historic Cahokia Creek channel through the site feasible. This connection additionally ensures the Cahokia and Harding watersheds remain balanced by returning Canteen Creek flows to the Cahokia Canal. In this manner the originally designed pump station capacity at the main line levee is not be exceeded and the possibility of inducing flooding is eliminated. The creation of this connection produces significant ecosystem benefits while providing incidental flood damage reduction.	Carried Forward with Canteen Creek, Little Canteen Creek Harding Ditch and St. Clair Farms as Spring Lake

Combined Sites (Potential Action Areas)	Site Evaluation and Screening	Results/ Action Area Name
HA-55, HA-68.1, HA-68.2, HA-68.5, and Bluff-4 (Crooked Lake)	The tributary watershed that drains directly into these combined sites (bluff 4) is relatively small. However, these sites form a natural low spot that collects this local runoff during larger events. Excess water from this area eventually makes its way into the Harding Ditch via a small pump. These sites serve a valuable storm water retention function for the area. While the improvement of these sites could provide environmental benefits the area is not able to be expanded greatly based on urban constraints. Relative to other sites investigated these combined sites would provide a less effective action area. The team agrees however that this natural ponding are should be enhanced by local action to improve environmental quality while protecting a natural stormwater detention site for the community.	Not Carried Forward
Harding Ditch, Schoenberger Creek and Wedgewood	During high flows the Schoenberger Creek currently spills out into East St. Louis neighborhoods. Harding Ditch does not have the capacity to accept and to carry this water away fast enough to prevent flooding. A connection with the FEMA buyout area of Wedgewood could introduce a flood pulse to the site to enhance ecosystem function and provide incidental flood damage reduction. However, the segmentation of the site by I-255 makes the closing of Summit Avenue the only viable method of introducing such a connection. Coordination with IDOT and East St. Louis indicated that this was a possibility so full evaluation of these combined sites was performed. The hydraulic analysis of the combined sites with the closing of Summit Road supports area viability.	Carried Forward as Wedgewood
Powdermill Creek, PO-66, Mullen's Slough Ag Land, PO-67, PO/HA-67, and Bluff 6	Further evaluation of these combined sites demonstrates that better utilization of the connection of Powdermill flows under Hwy 163 could re-introduce a flood pulse to the historic slough area. Environmental enhancement of the combined sites could provide substantial aquatic and terrestrial benefits and allowing the restoration of an historic prairie remnant. The hydraulic analysis of the combined sites further supports area viability.	Carried Forward as Mullen Slough

6.7 ACTION AREAS SELECTED FOR ALTERNATIVE PLAN DEVELOPMENT

With the selection of final action areas the formulation moved into a new phase of alternative development. In order to ease the identification process for the public, other agencies and the team historic or commonly known names were given to the action areas. In this way the public and others could easily identify with their geographic location. Figure 6-10 shows their location in the Project area and the following table summarizes their retention for alternative plan development. Dots displayed in Figure 6-10 show the location of sites where tributary stream sediment detention basins could be built, as determined by the NRCS.

Figure 6-10 Action Area Locations



Selected Project Action Areas	Results of Action Area Screening	Rationale
Dobrey Slough	Selected Action Area	Combined sites address 4 ecological and 3 social objectives. Provides acceptable potential for effective restoration and ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Old Cahokia Creek	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting several project planning targets, has existing habitat features. Interested local planning group. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Elm Slough	Selected Action Area	Combined sites address 4 ecological and all social objectives. High potential for effective restoration meeting several project planning targets, has existing habitat features. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Judy's/Burdick	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting several project planning targets. Ability to benefit from flood pulse introduction. Ability to meet social (ecosystem service) objectives.

Selected Project Action Areas	Results of Action Area Screening	Rationale
Brushy Lake	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting several project planning targets, has existing habitat features. Part of area in public ownership. Ability to benefit from flood pulse restoration. Ability to provide temporary flood diversion area. Ability to meet social (ecosystem service) objectives.
Cahokia Mounds State Historic Site	Selected Action Area	While the site only addresses 2 ecological and 1 social objective it has high potential for effective prairie restoration helping to meet project target by providing an increased level of bio-diversity.
Spring Lake	Selected Action Area	Combined sites address all planning objectives. High potential for effective restoration meeting numerous project planning targets, has existing habitat features. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
Wedgewood	Selected Action Area	Combined sites address 6 ecological and all social objectives. Coordination with IDOT and City eliminated highway constraint issues. Public land with existing habitat with potential to meet ecological needs. Acceptable potential for effective restoration meeting several project planning targets. Ability to benefit from flood pulse introduction. Ability to meet social (ecosystem service) objectives.
Mullens Slough	Selected Action Area	Combined sites address all planning objectives. Acceptable potential for effective restoration meeting several project planning targets, has existing habitat features. Ability to benefit from flood pulse restoration. Ability to meet social (ecosystem service) objectives.
I-55/70 Borrow Pit	Selected Area for Action by Others	Acceptable potential for effective restoration. Public ownership. Ability to benefit from partial flood pulse restoration. This site would be recommended to partner agencies for potential action or studied further under a separate plan.
National City Stockyard	Selected Area for Action by Others	Potential for restoration meeting habitat goals and protection of culturally significant area. This site would be recommended to partner agencies for potential action or studied further under a separate plan.

A characterization is provided for each of these eleven selected action areas, and it describes location, local topography and soils, principal natural communities and ecosystem disturbances during presettlement times, current conditions, and site-specific problems and opportunities. This information was essential to the alternative plan development process.

6.7.1 Dobrey Slough.

Location. This action area is in Madison County, in the north half of Nameoki Township (T3N, R9W). It is located north of Horseshoe Lake, near Granite City and Pontoon Beach. Pontoon Road forms the south boundary, and Maryville Road the west limit. The action area extends northwest to southeast over a distance of about 1.25 miles.

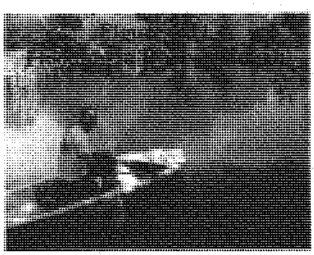
Components of Action Area. This action area is restricted to the floodplain because no tributary stream drains into or near Dobrey Slough. It envelops about 100 acres.

Surface Geology, Topography, and Soils of Floodplain. Dobrey Slough lays along the border of two geological features, a broad belt of old meander scars of the Mississippi River to the north, and a point bar to the south. It is a long, linear depression without any well-defined points of surface inflow or outflow. Ground elevations lie between 410 and 425 feet NGVD. Most of the lowest topography consists of Darwin silty clay loam and Darwin silty clay. Both soils are indicative of historic wetland conditions. Topographically higher soils include a variety of loams.

Predevelopment Natural Communities. Historic vegetation in this low area probably consisted of marsh, along with some woody species. The higher ground historically supported mesic prairie, which apparently surrounded most of the action area. Mesic floodplain forest broke this prairie perimeter on the north side of the slough.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic floodplain ecosystem. Flooding by overflow from the Mississippi River probably occurred about once every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 426 feet NGVD. At its peak, water depths over the action area would have ranged from about one to 16 feet. Rainfall and associated local runoff would have ponded in the historic slough very often, essentially any time a rain event occurred.

Existing Conditions. Residential areas built in the 1950s surround Dobrey Slough on most sides. Some of this development has encroached into the historic slough.



Remnant marsh is narrow, and often disturbed by mowing. A thin border of trees lies adjacent to some of the marsh. Surrounding undeveloped land consists of cropland.

There are no publicly owned lands within the action area.

Problems and Opportunities. Significant rainfall events, such as those that occurred in the mid-1990s, turn Dobrey Slough into a lake.

This surface water floods homes adjacent to the historic slough. A pump station located at the south end of the slough is not designed to handle more than small storm events. Also, groundwater levels under the influence of the Mississippi River can cause flooding to occur in the basements of some homes located on sandy soils.

The historic slough and adjacent woody vegetation is of low value to wildlife because it is fragmented, narrow in width, and in close proximity to existing development.

Opportunities exist within the action area to restore the historic marsh, create a larger natural area, and reintroduce periodic ecosystem disturbance in the form of flooding. The creation of this action area would reduce damages from surface flooding in the adjacent residential areas. Solutions would not address belowground flooding due to localized high groundwater conditions. The Illinois Department of Natural Resources is currently addressing groundwater flooding.

6.7.2 Old Cahokia Creek.

Location. This action area is in Madison County, in southwestern Edwardsville Township (T4N, R8W).

Components of Action Area. Remnants of the historic Cahokia Creek and its adjacent floodplain comprise the action area's floodplain component. This area generally lies parallel to the bluff, and extends north to south about 3.5 miles, from the Cahokia Creek Diversion Channel to the south side of I-270. Route 157 and Bluff Road lie to the east, and Sand Road to the west. It envelops about 450 acres.

Bluff 1 watershed, to the east of the floodplain component, is this action area's tributary component.

Surface Geology, Topography, and Soils of Floodplain. The floodplain portion of this action area is located on a terrace or elevated area in the Mississippi River's floodplain. Cahokia Creek meandered through this area from north to south until it was diverted to the Mississippi River via the diversion channel about 90 years ago. Ground elevations range from about 425 to 440 feet NGVD. Most of the soils adjacent to the creek consist of a variety of loams and sands. Further to the east, land gently slopes upward toward the bluff.

Predevelopment Natural Communities. In predevelopment times, mesic floodplain forest likely bordered the creek, and mesic sand prairie may also have been present. In the adjacent uplands, the tributaries that drained into Cahokia Creek were low to medium gradient creeks. Mesic floodplain forest grew in the narrow bottoms along the creek channels, and mesic upland forest was found along the base of the adjacent ravines.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this portion of the historic ecosystem. In the bottoms, flooding by overflow from the Mississippi River was rare because of the terrace's relatively high ground. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 428 feet NGVD, inundating only the lowest areas.

However, Cahokia Creek probably overflowed its banks at least annually. Extreme events probably did not exceed a couple of feet in depth or several days in duration. Flooding in the uplands was confined to creek bottoms. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. At this action area, diversion of Cahokia Creek to the Mississippi River eliminated the creek's tributary watershed of 260 square miles. As a result, the tributary drainage area associated with the historic creek channel was diminished to four square miles (Bluff 1 watershed). Four small ditches from the Bluff 1 watershed carry drainage west to the historic creek.

Within the floodplain component, cropland is the most prevalent kind of land cover. Most farmland is used for row crops and grass sod production. Horseradish is also grown in some fields. Riparian forest is the next most common land cover type. Narrow fragments of riparian forest remain along some remnants of historic creek channel. The remaining cover types are uncommon, and include the historic channel, ditches, grassland, and development. Portions of the historic creek have been filled over the years to facilitate agricultural activities. To the west of the floodplain component lie relatively small areas of residential development, mainly along Sand Road, but these are expanding.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists a known occurrence of the Illinois chorus frog in close proximity to the floodplain component. This amphibian is listed as state threatened. The database also lists four areas of "precision habitat" for this species in the vicinity of the floodplain component. These areas fulfill the species' life history requirements. Two of the four areas overlap with the action area. One is located near the middle, and the other near the southern end; both areas of "precision habitat" include lands on both sides of the historic creek channel.

The terrace where the floodplain component lies is rich with prehistoric cultural resources.

In the Bluff 1 watershed, forest accounts for about 30 percent of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 5,000 tons of sediment is currently delivered to the floodplain per year from this tributary watershed.

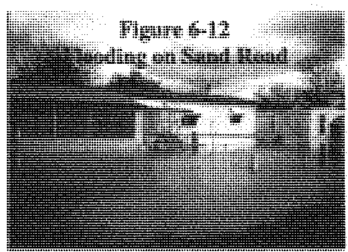


Figure 6-12
Flooding on Sand Road

Notable publicly owned lands within the action area include portions of the Southern Illinois University-Edwardsville campus.

Problems and Opportunities. Various ecological problems are present. First, storm water is also causing environmental degradation by carrying sediment and depositing it into the historic channel remnants and adjacent riparian forest.

Second, the several remnants of Cahokia Creek no longer function as a stream because they are isolated from each other. Third, most fragments of forest along the channel remnants do not function effectively as riparian corridors for wildlife because they are too narrow. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding of residential areas along Sand Road has occurred on a number of occasions over the last 10 years. Storm water from the Bluff 1 watershed is often the major source of flooding.

Opportunities exist within the action area to restore a portion of the historic Cahokia Creek to a flowing condition, establish a functional riparian corridor on both sides of the restored creek, reintroduce periodic ecosystem disturbance in the form of flooding and prescribed fire, and implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance would provide incidental flood damage reduction for the area west of the creek.

6.7.3 Elm Slough.

Location. This action area is in Madison County northeast of Horseshoe Lake. Most of it is in northeastern Nameoki Township (T3N, R9W), and the remainder is in northwestern Collinsville Township (T3N, R8W).

The action area extends east to west about 2 miles, and north to south about 1.5 miles. Route 162 bounds it on the north, I-255 on the east, and Route 111 on the west.

Components of Action Area. Because no tributary stream drains into the action area, it is restricted to the floodplain. It encompasses about 700 acres.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, named the Edelhardt Lake meander loop (White et al. 1984), constitutes the floodplain action area. The meander scar extends roughly east-west in this area. Long Lake, a narrow slough-like water body, historically traversed the meander scar in the eastern portion of the action area. Outside the action area, the lake connected with historic Cahokia Creek about one mile south.

Within the action area, ground elevations generally slope east to west, and range from about 415 feet NGVD along Long Lake, to about 405 feet NGVD close to Horseshoe Lake. Darwin silty clay loam and Darwin silty clay comprise most of the soils in the action area. Both are indicative of historic wetland conditions. Smaller areas of Beaucoup silty clay loam and Birds silt loam are present, and they too reflect historic wetlands. Small areas of nonwetland soils include a variety of silts and loams, and they tend to be located along Long Lake.

Predevelopment Natural Communities. In predevelopment times, the action area was dominated by forested wetland. Wet-mesic floodplain forest extended over most of the old meander scar. Lower ground to the west supported some wet floodplain forest. Shrub swamp probably occurred in the lowest elevations near Horseshoe Lake. North of the forested wetlands, prairie was found within the action area.

Predevelopment Ecosystem Disturbance Dynamics. Flooding was a primary force that periodically disturbed this area of the historic floodplain ecosystem. Seasonal fluctuations of Horseshoe Lake overflowed into the action area, and probably occurred annually on a repeated basis within the lower elevations. Overflow from the Mississippi River may have inundated the entire site about once every one to two years. The flood of 1844, the greatest on record, is estimated to have crested in this area at about 426 feet NGVD. At its peak in late June, water depths over the action area ranged from about 11 to 21 feet. Duration from beginning to end was several months.

Long Lake also spilled over its banks and sent floodwater into the action area, presumably on an annual basis. Depending on local conditions, it could flow in either direction. From the north, flooding consisted of "upstream" floodplain drainage, as well as floodwaters from Wood River. This tributary entered the American Bottom about 12 miles north near Alton, and was connected to or continuous with Long Lake, at least during periods of high flow created by storm events in its tributary watershed. Reverse flow in Long Lake occurred when floodwaters from Cahokia Creek came up from the south as backwater. Flooding from Long Lake probably was represented by shallow sheet flow that moved slowly down the old meander scar through the wet-mesic and wet floodplain forests, and eventually into Horseshoe Lake.

Wild fire typically did not affect the forested wetlands because of the usual high moisture levels in the ground surface, but it would have enveloped the prairie to the north.

Existing Conditions. Due to development of the floodplain, the action area, called "Elm Slough" by local residents, receives far less flooding than it did historically. Seasonal overflow from Horseshoe Lake is very minor compared to what it was historically. Overflow from the Mississippi River no longer exists. Long Lake rarely overflows its banks because it has been segmented and its watershed reduced, and the historic connection with Cahokia Creek is gone. Currently, periodic flooding of Elm Slough consists of storm water from Long Lake and Mitchell Ditch. The latter tributary drains a relatively small portion of the floodplain north of the action area and east of Long Lake. Storm water from both sources comes together on the south side of Route 162, and is carried into Elm Slough by a man-made ditch. This ditch enters Elm Slough about one mile west of where Long Lake used to traverse the old meander scar. Once in Elm Slough, storm water flows west for about 0.75 miles before reaching Route 111 and eventually Horseshoe Lake.

Over the last 60 years, most of the forested wetlands in Elm Slough have been converted into cropland. This conversion was facilitated by a drainage ditch that runs east-west through the historic slough. The ditch was created about 100 years ago in a failed attempt to divert Cahokia Creek into Horseshoe Lake. Farmland also constitutes most of the land south of Route 162 and north of the historical forested wetlands. Scattered residences are located in this area, and many are adjacent to Long Lake. Other agricultural lands lie just southwest of the action area, and various types of development occur just northwest and southeast. Some development has encroached into Elm Slough.

A relatively large fragment of forested wetlands (120 acres) remains in the west portion of the action area. It consists of about equal amounts of wet-mesic floodplain forest and wet floodplain forest. This block of forested wetlands provides for the needs of some species sensitive to habitat fragmentation; a pileated woodpecker, which has high sensitivity to forest fragmentation (Herkert et al. 1993), was observed here in the spring of 1999. The ditch that carries storm water from Long Lake and Mitchell Ditch enters this block of forested wetlands near its northeast corner. West of the forested wetlands and east of Route 111, there is a mixture of marsh and shrub swamp. These types of vegetation also occur in Long Lake within the action area. A narrow and often sparse riparian zone borders the lake.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists two known occurrences of state listed animal species in close proximity to the action area. The common moorhen, a state threatened bird, is known from a location just west of Route 111. The massasauga, a federally listed species of concern and state endangered snake, is known from a location to the southeast, on the west side of Cahokia Canal.

There are no publicly owned lands within the action area.

Problems and Opportunities. Various ecological problems are present. First, because of its relatively small area, the remnant of forested wetland has limited value for supporting many species highly sensitive to forest fragmentation, such as interior forest nesting birds. Second, wet-mesic floodplain forest within the action area contains low tree species diversity. Many of the native nut-bearing species, such as oaks and hickories, were commercially removed years ago, and the local seed source for regeneration is scarce. Third, over the past 10 years or so, much of the wet floodplain forest has died or is now dying from drowning; an increased pool level in Horseshoe Lake may be the cause. Fourth, strips of riparian forest along Long Lake do not function effectively as wildlife corridors because they are too narrow. Finally, within the action area, less than half of the remaining forested wetlands are subject to disturbance by flooding. Flood damages can occur in the vicinity of the action area. After large storm events, Long Lake north of Route 162 can spill over and flood numerous backyards and residences that border its banks.

Opportunities exist within the action area to enlarge the existing area of forested wetlands to support more species of highly area-sensitive animals, to reintroduce seasonal flooding as a periodic ecosystem disturbance over this larger natural area, to establish a functional riparian zone along a portion of Long Lake, and to replace "lost" tree species that once grew in this area. The reintroduction of periodic flooding as an ecosystem disturbance dynamic would provide incidental flood damage reduction "upstream" along Long Lake and Mitchell Ditch.

6.7.4 Judy's-Burdicks Branch.

Location. This action area is in Madison County, in the south half of Edwardsville Township (T4N, R8W), and north half of Collinsville Township (T3N, R8W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. It consists of Judy's Branch and Burdick Branch, and an area at their confluence with Cahokia Canal. This floodplain component extends east to west about 1.5 miles, and north to south about one mile. Route 162 bounds it on the north, I-255 on the southwest, and Route 157 on the east. It envelops about 600 acres.

To the east, the tributary component consists of the lower part of the Bluff 1 watershed, and Judy's Branch and Burdick Branch watersheds.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, the McDonough Lake meander loop (White et al. 1984), crosses much of the floodplain action area from northwest to southeast. Backswamp deposits make up the remainder of local geological features. Cahokia Creek meandered through this area from north to south until it was diverted to the Mississippi River about 90 years ago. The ground is relatively flat, and elevations vary from about 418 to 420 feet NGVD. Darwin silty clay, a soil indicative of historic wetland conditions, is most prevalent in this area. The east portion of the floodplain action area consists of an alluvial fan deposited by Judy's and Burdick Branches along the base of the bluff. It consists of various silt loams.

Predevelopment Natural Communities. The floodplain component lies at the south end of historic Rattan's Prairie, a 15,000-acre prairie once found in the northeast part of the American Bottom. Wet-mesic prairie most likely occurred on the Darwin soil. Drier prairie as well as mesic floodplain forest probably occurred on the alluvial deposits. In the uplands, Judy's and Burdick Branches had low to medium gradients. Narrow strips of mesic floodplain forest grew adjacent to their channels, and mesic upland forest along the base of adjacent ravine slopes.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this portion of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 426 feet NGVD. At its peak, water depths over the area ranged from about six to eight feet. Cahokia Creek would have overflowed its banks at least annually, as well as Judy's and Burdick Branches near their confluence with the creek. Because of the flat topography and clayish soils, shallow ponding of rainfall would have occurred in the wet-mesic prairie after significant storms. Flooding in the uplands was confined to creek bottoms. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. At this action area, diversion of Cahokia Creek to the Mississippi River about 90 years ago eliminated the creek's upland drainage area of 260 square miles. At about the same time, the historic creek was replaced by Cahokia Canal. Judy's and Burdick Branches still flow west, but enter Cahokia Canal. In the vicinity of this junction, these three waterways are canals, and are bordered on both sides by earthen berms to prevent overtopping.

Cropland is the most prevalent kind of land cover in the floodplain component. Most farmland supports row crops, and horseradish is grown in some fields, primarily on the alluvial deposits. Other lesser types of land cover include lacustrine or lake-like borrow pits, grassland, ditches, forested wetland, riparian corridor, and development. Stormwater rarely floods narrow strips of riparian forest along Judy's Branch and upper Burdick Branch. The entire historic channel of Cahokia Creek has been filled to facilitate agricultural activities. A relatively small area of residential development lies between I-270 and Cahokia Canal, and a few scattered residences lie along both tributaries.

In the tributary portions of Judy's and Burdick Branches, forest accounts for less than half of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 12,000 tons of sediment is currently delivered to the floodplain per year from the Judy's and Burdick Branch watersheds.

The alluvial area along the base of the bluff is rich with prehistoric cultural resources.

Notable publicly owned lands within the action area include Cahokia Canal.

Problems and Opportunities. Various ecological problems are also present. First, excessive levels of sediment transported by storm water from tributary streams can smother aquatic habitat and degrade water quality by increasing turbidity levels. Second, Cahokia Canal is not a functional riparian corridor for wildlife because periodic maintenance for flood control purposes removes any natural (woody) vegetation growing along its channel, and along its outside, most adjacent lands are either agricultural or developed. Third, strips of riparian forest along Judy's and Burdick Branches also do not function effectively as wildlife corridors because they are too narrow. Fourth, except for a small disturbed remnant along a railroad track to the north, historic Rattan's Prairie has disappeared. On the floodplain, flooding occurs infrequently when storm water overtops the Judy's or Burdick Branch channels. On such occasions, floodwater sheet flows south, mainly across farmland.

Opportunities exist within the action area to recreate a natural area on the floodplain, restore a portion of the historic Cahokia Creek within this area to a flowing condition, reintroduce periodic ecosystem disturbances in the form of flooding and prescribed fire, establish a floodplain-upland linkage for wildlife between the natural area and adjacent uplands via a riparian corridor along either Judy's or Burdick Branch, and implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance dynamic would also reduce Cahokia Canal backwater effects "upstream" in County Ditch.

6.7.5 Brushy Lake.

Location. This action area is in Madison County east of Horseshoe Lake. It is in southeastern Nameoki Township (T3N, R9W) and western Collinsville Township (T3N, R8W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. This area consists of Schoolhouse Branch, and an area of land located south of its confluence with Cahokia Canal. The floodplain component extends east to west about 3 miles, and north to south about 2 miles. Horseshoe Lake Road bounds it on the north, Route 157 and Fairmont Avenue on the east, I-55/70 and Canteen Creek on the south, and Cahokia Canal on the west. It envelops about 750 acres.

To the east, the tributary component consists of the Schoolhouse Branch and Bluff 3 watersheds.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, named Edelhardt Lake meander loop (White et al. 1984), comprises most of the floodplain component. Backswamp deposits make up the remainder of local geologic features, and they area located between the meander scar and the bluff. Within this old meander scar, Cahokia Creek meandered from north to south. Schoolhouse Branch joined Cahokia Creek at the north end of the action area. Ground elevations in the old meander scar range from about 405 to 420 feet NGVD. Most land is below 410 feet NGVD. Moderately higher ground occurs at the north and south ends of the meander scar. Most soils consist of Beaucoup silty clay loam, Birds silt loam, and Darwin silty clay loam. All are indicative of historic wetland conditions. Nonwetland soils are concentrated in the north and south ends of the action area, where elevations are higher, and they include a variety of silt loams. The east portion of the floodplain action area consists of an alluvial fan deposited by Schoolhouse Branch along the base of the bluff. It gently slopes upward to the bluff, and consists of other silt loams.

Predevelopment Natural Communities. Diversity of natural communities was high at this floodplain action area in predevelopment times. A floodplain stream, Cahokia Creek, meandered through it. A contact zone between forest and prairie was also present within the old meander scar. Extensive forest encircling Horseshoe Lake to the west met with prairie extending east from the bluff. Forest was more prevalent, and consisted of three kinds, mesic floodplain, wet-mesic floodplain and mesic upland forest. Mesic floodplain forest occupied higher ground at the north and south ends of the old meander scar, as well as at the base of the bluff along Schoolhouse Branch. Within the meander scar, wet-mesic floodplain forest occupied intermediate elevations, and wet floodplain forest lower elevations. A small core of shrub swamp occupied a low depression in the middle of the action area. A lake-like water body apparently occurred a short distance to the northeast. Prairie within the old meander scar probably consisted of wet prairie and wet-mesic prairie. All forests and prairies were wetlands except for the mesic forms. Most of the alluvial fan by the bluff supported mesic prairie. The tributary component of the action area consisted of low- to medium-gradient creeks. Mesic floodplain forest grew in the narrow bottoms along these creek channels, and mesic upland forest was found along the base of the adjacent ravines.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding affected the entire floodplain action area. Flooding by overflow from the Mississippi River probably occurred once every one to two years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 424 feet NGVD. At its peak, water depths over the action area ranged from roughly 5 to 15 feet. Cahokia Creek would have overflowed its banks several times annually. Additional flooding came from Schoolhouse Branch and Canteen Creek. The latter joined Cahokia Creek inside the old meander scar just outside the southern end of the action area.

Wild fire typically did not affect the forested wetlands because of the usual high moisture levels in the ground surface, but it would have enveloped the prairie. Wild fire was the dominant force that periodically disturbed the uplands.

Existing Conditions. Diversion of Cahokia Creek to the Mississippi River about 90 years ago eliminated the creek's drainage area of 260 square miles. At about the same time, the historic creek was replaced by Cahokia Canal. The canal is bordered on both sides by earthen berms to prevent overtopping. Schoolhouse Branch still flows west, but enters Cahokia Canal instead of the creek. Schneider Ditch, a tributary from the Bluff 3 watershed, enters the action area south of Schoolhouse Branch.

Development has notably reduced the extent and diversity of historical natural communities in the floodplain. Cropland comprises more than half the land in the old meander scar. After cropland, forested wetland is most common. Less well-represented habitats include meadow/grassland, scrub shrub wetland, mesic floodplain forest, open water, and emergent wetland or marsh. Much of historic Cahokia Creek has been filled, mainly for agricultural purposes. Portions of historic channel remain, but they are no longer connected to Cahokia Canal. Native prairie has disappeared, but a small restoration exists in the southwest corner between Cahokia Canal and Canteen Creek.

Lands bordering Schoolhouse Branch are mainly cropland. Sparse, narrow strips of riparian forest exist along either side of its channel. Horseradish is grown in fields adjacent to Schoolhouse Branch, and in fields adjacent to the old meander scar, as well as within it at the north end. A few scattered residences lie along Fairmont Avenue and Schoolhouse Branch. I-255 borders the northeast portion of the floodplain component.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists the Levee Lake INAI (Illinois Natural Area Inventory) site as occurring within this floodplain action area. This 230-acre tract was identified during the Inventory in the mid-1970s as important because it represented the largest remaining example of a wet floodplain forest/shrub swamp/pond complex in the American Bottom, and the shrub swamp and pond elements were of high quality (IDNR, 1978). Since the mid-1970s, creation of a ditch network for drainage of cropland adjacent to the Natural Area has permanently lowered the level of water in its wetlands. Consequently, the shrub swamp has diminished in size due to the encroachment of woody species, such as wouldows.

The floodplain action area provides for the needs of a variety of rare plants and animals, according to a biological survey conducted for this project. Of 51 animal species observed at the floodplain action area in 1998, four are on the Illinois list of state endangered species, and include birds that forage at the site - little blue heron, snowy egret, black-crowned night heron, northern harrier (Zambrana Engineering 1998). The decurrent false aster, a Federally and state threatened plant, may also occur at the site, as well as the Federally listed species of concern and state-endangered massasauga rattlesnake (Zambrana 1998). Because of the relatively large remaining natural habitat, represented chiefly by a block of 200 acres of forested wetlands, this floodplain action area is expected to provide for the needs of some species highly sensitive to habitat fragmentation.

In terms of ecosystem disturbances, flooding is very limited at the floodplain action area. The Mississippi River is isolated from its floodplain, and Cahokia Canal keeps storm water confined within its banks. Only Schneider Ditch from the Bluff 3 watershed occasionally carries storm water directly into the area. Prescribed fire is used to maintain the prairie restoration area only.

In the Schoolhouse Branch and Bluff 3 tributary watersheds, forest accounts for less than half of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 17,000 tons of sediment is currently delivered to the floodplain per year from these two tributary watersheds.

The alluvial area along the base of the bluff is rich with prehistoric cultural resources.

Notable publicly owned lands within the action area involve Metro East Sanitary District (Cahokia Canal and most of Levee Lake Natural Area) and the Illinois Historic Preservation Agency (in the southwest corner of the site).

Problems and Opportunities. Various ecological problems are present. First, flooding plays a very minor role as a periodic ecosystem disturbance in the action area. Second, habitat diversity is low. Cahokia Creek as a floodplain stream no longer exists, and native prairie has disappeared. Mesic floodplain forest is largely gone. Third, wet-mesic floodplain forest contains low tree species diversity. Many native nut-bearing species, such as oaks and hickories, that used to exist are gone, and the local seed source for regeneration is scarce. Fourth, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity level. Sediments from Schneider Ditch are being deposited within forested wetlands inside Levee Lake Natural Area. Fifth, Cahokia Canal is not a functional riparian corridor for wildlife. Periodic maintenance for flood control purposes removes any natural (woody) vegetation growing inside along its channel, and along its outside, a riparian zone is also often lacking where cropland is adjacent. Sixth, strips of riparian forest along Schoolhouse Branch also do not function effectively as wildlife corridors because they are too narrow. On the floodplain, flooding occurs infrequently when storm water overtops the Schoolhouse Branch or Schneider Ditch channels. On such occasions, floodwater sheet flows south, across farmland as well as developed areas.

Opportunities exist within the action area to enlarge the existing forest to support more species of area-sensitive animals, restore a portion of the historic Cahokia Creek to a flowing condition, reintroduce periodic ecosystem disturbance in the form of flooding, create a riparian zone adjacent to Cahokia Canal effective for wildlife, and implement measures designed to restore tributary stream and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance would also reduce Cahokia Canal backwater effects "upstream" of this action area.

6.7.6 Cahokia Mounds.

Location. This action area is in St. Clair County in northeastern Canteen Township (T2N, R9W).

It lies within Cahokia Mounds State Historic Site, southeast of Horseshoe Lake. The action area extends east to west and north to south about 1.5 miles. Collinsville Road bounds it on the north, State Park Place on the east, Forest Boulevard on the south, and railroad tracks on the west.

Components of Action Area. Because no tributary stream drains into the action area, it is restricted to the floodplain. It envelops about 525 acres.

Surface Geology, Topography, and Soils of Floodplain. Two geological features represent this action area. Two separate meander scars of the Mississippi River as well as adjacent point bars occur locally. Except for prehistoric mounds, ground elevations generally lie between 410 and 420 feet NGVD. Most land is at about 415 feet NGVD. Darwin silty clay loam, Darwin silty clay, and Fults silty clay comprise most of the soils. All are indicative of historic wetland conditions. Small areas of nonwetland soils include a few kinds of silt loam.

Predevelopment Natural Communities. Historic Cold Prairie, a 15,000-acre prairie once found in the southeast part of the American Bottom, enveloped the action area. When the General Land Office surveyors worked in this area in the early 1800s, they noted that most of this prairie was wet. Wet-mesic prairie probably formed most of the native grassland. Wet prairie and marsh probably occurred in localized depressions within the wet-mesic prairie.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic floodplain ecosystem. Overflow from the Mississippi River inundated the action area about once every ten years. The flood of 1844, the greatest on record, is estimated to have crested in this area at about 422 feet NGVD. At its peak in late June, water depths over the action area ranged from over five feet to less than 15 feet. Duration from beginning to end was a couple of months.

Flooding from Cahokia Creek or other upland tributaries to the east, such as Canteen Creek or Little Canteen Creek, apparently did not affect this area. The ground was either too high to be flooded by any of these tributaries, or "protected" from overland flooding coming from the east by a wide depression consisting of the east-most meander scar (Spring Lake meander loop). Rainfall and associated local runoff may have been important sources of wetland hydrology for the historic prairie.

Existing Conditions. The publicly owned Cahokia Mounds State Historic Site lies within the Cahokia Mounds World Heritage Site. The latter is one of only two sites established in the U.S. for the protection of internationally significant prehistoric cultural resources.

Most of the 2,200 acre State Historic Site includes various types of natural vegetation, such as old fields, forest, and marsh. Prairie restorations total less than 100 acres, and prescribed fire is used to maintain them. Most interpretive areas are grassy and periodically mowed. Over 500 acres of both grassy and old-field areas are leased for hay production.

Problems and Opportunities. No remnants of Cold Prairie exist today. Because of their small area, the existing prairie restorations at the State Historic Site have limited value for supporting breeding populations of many grassland bird species.

Opportunities exist within the action area to restore native prairie vegetation on areas currently used for hay production, and create areas of grassland capable of supporting more species of area-sensitive birds.

6.7.7 Spring Lake.

Location. This action area is in St. Clair and Madison Counties, and is the largest of this project. Most of it is in St. Clair County, in the north halves of Canteen Township (T2N, R9W) and Caseyville Township (T2N, R8W). In Madison County, the action area is also located in southwest Nameoki Township (T3N, R9W), eastern Collinsville Township (T3N, R8W), and western Jarvis Township (T3N, R7W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. Nearly all of it is in St. Clair County, either adjacent to Harding Ditch or Lansdowne Ditch. At its widest points, the floodplain component extends east to west about 6 miles, and north to south about 4 miles. The floodplain component consists of Harding Ditch, from Route 157 to St. Clair Avenue, as well as three major areas: 1) Cell 1, adjacent to Harding Ditch (about 375 acres, bounded by Forest Boulevard to the north, I-255 to the east, Bunkum Road to the south), 2) St. Clair Farms, also adjacent to Harding Ditch (about 180 acres, bounded by I-64 to the North, Harding Ditch and I-255 to the east, St. Clair Avenue to the south), and 3) Indian Lake, adjacent to Lansdowne Ditch (about 625 acres, bounded by I-55/70 to the north, Route 111 to the east, Collinsville Road to the south, Route 203 to the west). In addition to these three major areas, a small area north of Cell 1 is also included in the floodplain component. The floodplain component encompasses about 1,500 acres.

To the east, the tributary component consists of the Canteen Creek and Little Canteen Creek watersheds.

Surface Geology, Topography, and Soils of Floodplain. Four geological features comprise the floodplain components - old meander scars, point bars, chutes and bars, and backswamps. Various old meander scars represent most of their area. Two meanders scars, the Spring Lake and Rock Road meander loops (White et al. 1984), represent about half of Cell 1, and the remainder consists of point bars. The Rock Road meander loop represents most of St. Clair Farms, and a point bar makes up the rest. Horseshoe Lake meander loop constitutes nearly all of Indian Lake, and a chute and bar area comprises the remainder. Backswamp deposits comprise the area extending from the bluff to I-255, and along the bluff they are overlain by alluvial fans deposited by Canteen and Little Canteen Creeks.

Most undisturbed ground elevations at Cell 1 vary from about 410 to 415 feet NGVD, but some reach 420 feet NGVD. The same pattern occurs at St. Clair Farms. At Indian Lake, elevations range from about 400 to 405 feet NGVD. East of Cell 1, ground surfaces along Harding Ditch rise gently to the bluff.

According to the digital soil surveys of Madison and St. Clair Counties, nearly all undisturbed soils at Cell 1 consist of Darwin silty clay loam, Darwin silty clay, or Fults silty clay, which all reflect historic wetland conditions. Only a small undisturbed area does not reflect historic wetland conditions. At St. Clair Farms, extensive areas of Darwin silty clay and Darwin-Urban land complex indicate historic wetland conditions. Sandy soils on higher ground along the west side of the Rock Road meander loop at St. Clair Farms were not historically wetland. At Indian Lake, Darwin silty clay loam, Darwin silty clay, loamy fluvaquents, and McFain silty clay loam comprise nearly all of the area, and each reflects historical wetland conditions. Small areas consist of disturbed soils or water.

Predevelopment Natural Communities. Two centuries ago, the principal types of vegetation occurring in the three floodplain components appear to have been marsh (Cell 1), prairie (St. Clair Farms), and forest (Indian Lake). Native grasslands of Cold Prairie enveloped the areas of Cell 1 and St. Clair Farms, and forest surrounding Horseshoe Lake reached Indian Lake. Aquatic features consisting of ponds and floodplain streams were present at two of these sites.

At Cell 1, one water body was present, and probably consisted of pond and shrub swamp that was encircled by marsh. It eventually became known as Spring Lake. Wet-mesic prairie probably occurred on the slightly higher surrounding areas. Two tributaries, Little Canteen and Schoenberger Creeks, flowed into Spring Lake from the east. Floodwaters from these tributaries passed south and west within the Spring Lake meander scar to Spring Lake, and eventually west through a slough that is now Lansdowne Ditch.

At St. Clair Farms, wet-mesic prairie probably occupied most of the area. Mesic prairie was found along higher ground on the western edge. The map depicting land cover in the early 1800s shows a water body within St. Clair Farms, but later historic maps do not. Perhaps part of St. Clair Farms was marsh.

At Indian Lake, roughly the southwest half was a water body, and probably consisted of pond and shrub swamp. Cahokia Creek meandered through the northeast half. Wet and wet-mesic floodplain forests were found in the northeast half adjacent to the creek. An herbaceous border along the southeast side may have consisted of marsh and wet prairie.

The tributary component of the project area included low- to medium-gradient creeks. Mesic floodplain forest grew in the narrow bottoms along these creek channels. Mesic upland forest was found along the base of ravines adjacent to these tributaries.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years at Cell 1 and St. Clair Farms, and at least annually at Indian Lake. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 420-422 feet NGVD, depending on the floodplain component. At its peak, water depths over Cell 1 and St. Clair Farms ranged from roughly 5 to 10 feet, and at Indian Lake from 15 to 20 feet. Duration from beginning to end lasted for several months. In addition to the Mississippi River, repetitive flooding from Little Canteen and Schoenberger Creeks inundated much of the area of Cell 1 (Spring Lake) every year. Likewise, Cahokia Creek would have overflowed its banks several times a year in the area of Indian Lake. Because no floodplain channels of upland tributaries were located near St. Clair Farms, flooding from the bluffs apparently was not an important component of historic wetland hydrology. However, runoff from lands to the north and west apparently passed periodically through this low area on its way to Pittsburg Lake.

Periodic wild fire was also an important factor in disturbance dynamics in the floodplain. But among the three floodplain components, Indian Lake probably was least influenced because typically high moisture levels in the ground surface of its forested wetlands inhibited the passage of fire. Prairie and marsh would have burned, at least during dry periods. In the uplands, wild fire was also an important ecosystem disturbance factor.

Existing Conditions. Harding Ditch passes through Cell 1. This canal is bordered on both sides by earthen berms to prevent overtopping. An active sand plant occupies about half the area, and as a land cover type is considered development. Remnants of "Spring Lake" comprise most of the other half, and consist of a pond surrounded by marsh and forested wetlands. The rest of Cell 1 consists of cropland along the western boundary, and urban field, old field, and grassland.

The urban field consists of a residential neighborhood obtained by the Federal Emergency Management Agency (FEMA) as buyouts due to flooding in the mid-1990s. Nearly all of the buildings have been removed. As a cover type, this area is a mixture of scattered trees, shrubs, and open areas supporting weedy vegetation. A few scattered occupied residences occur within this component of the action area. Little Canteen Creek and Schoenberger Creek no longer flow through this area, but instead are diverted into Harding Ditch.

Harding Ditch also passes through St. Clair Farms. Most of the area is a FEMA buyout, or urban field. Cropland, the next most common land cover type, is used for row crops and horseradish. Some forested wetland occurs within the FEMA buyouts, and small areas of marsh, scrub-shrub wetland, and grassland are present. A few scattered occupied residences occur within this component of the action area.

Lansdowne Ditch borders the southwest corner of Indian Lake. This canal is also bordered on both sides by earthen berms to prevent overtopping. Several distinct areas of marsh and scrub-shrub wetlands comprise much of this area. Riparian forest occurs adjacent to remnants of historic Cahokia Creek. Some forested wetlands are found along the area's perimeter. Scattered borrow pits lie near I-55/70, and several areas of development are along the perimeter. Chief among these is a golf course along Collinsville Road. Rising levels of permanently ponded water have drowned trees in some forested areas, mostly at the north end by I-55/70. Cahokia Creek was replaced by Cahokia Canal over 90 years ago.

Among the three floodplain components, Indian Lake has the greatest potential to support area-sensitive animal species. Both Cell 1 and St. Clair Farms are physically smaller, and consist of a higher proportion of disturbed and fragmented habitats. The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists the Fairmont City INAI (Illinois Natural Area Inventory) site as occurring at Indian Lake. This site, represented by a roughly 40-acre area of marsh near the middle of this floodplain component, supports a population of a Federally and state threatened plant, the decurrent false aster.

Lands along Harding Ditch from the bluff to St. Clair Avenue are mainly agricultural, and some adjacent fields are used to grow horseradish. A 35-acre area north of Cell 1 within Cahokia Mounds State Historic Site Land consists of drowned trees due to permanent ponding by local beaver dams. Surrounding the three floodplain components, land use is mainly agricultural to the east of Cell 1 and St. Clair Farms, and a mixture of residential and commercial to the west.

In terms of periodic ecosystem disturbances, flooding of the floodplain action area is very limited. The Mississippi River is isolated from its floodplain, and Harding and Lansdowne Ditches usually keep storm water confined within their banks. Occasionally, flooding from Harding Ditch occurs, and usually enters a portion of Cahokia Mounds State Historic Site and Cell 1. Fire has been suppressed for many years.

In the Canteen and Little Canteen Creek watersheds, forest accounts for less than half the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 39,000 tons of sediment is currently delivered to the floodplain per year from these two tributary watersheds.

Prehistoric cultural resources are often found on alluvial soils along the bluff and adjacent to Harding Ditch.

Notable publicly owned lands include the FEMA buyouts at Cell 1 and St. Clair Farms are publicly owned.

Existing Problems and Opportunities. Various ecological problems are also present. First, Cell 1 and St. Clair Farms are not expected to provide for the needs of many area-sensitive species because of the fragmented nature of remaining habitats. Second, flooding and fire play a very minor role as periodic ecosystem disturbances in these three areas. Third, habitat diversity is low. Cahokia Creek as a floodplain stream no longer exists, and development has eliminated native prairie from the action area. Fourth, floodplain forests contain low tree species diversity. Many native nut-bearing species, such as oaks and hickories, that used to exist are gone, and the local seed source for regeneration is scarce. Fifth, Harding Ditch does not serve as a functional floodplain stream or riparian corridor for wildlife. Earthen berms adjacent to the ditch have eliminated any floodplain, and periodic maintenance for flood control purposes removes any natural (woody) vegetation growing inside along its channel; along it's outside, a riparian zone is also often lacking where cropland is adjacent. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding occurs when storm water overtops Canteen Creek and Harding Ditch. On such occasions, floodwaters can inundate farmland and mixed residential and commercial areas.

Opportunities exist within the action area to enlarge the existing areas of natural habitats to support more species of area-sensitive animals, restore prairie, restore a portion of the historic Cahokia Creek to a flowing condition, reintroduce periodic ecosystem disturbances in the form of flooding and prescribed fire, create a floodplain and riparian zone along Harding Ditch, replace "lost" tree species that once grew in this area, and implement measures designed restore tributary streams and floodplain environmental resources. The reintroduction of flooding as an ecosystem disturbance would also incidentally reduce Harding Ditch and Canteen Creek flood damages "upstream" of this action area.

6.7.8 Wedgewood.

Location. This action area is in St. Clair County, north of Frank Holten State Park. It overlaps portions of four townships: southeastern Canteen Township (T2N, R9W), southwestern Caseyville Township (T2N, R8W), northwestern St. Clair Township (T1N, R8W), and northeastern Stookey Township (T1N, R9W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. This area is at the confluence of Schoenberger Creek Ditch and Harding Ditch. It extends east to west and north to south about 0.75 miles. Metrolink railroad tracks bound it on the north, Harding Ditch on the east, the I-255 interchange at State Street on the south, and Kings Highway (Route 111) on the west. The floodplain component encompasses about 125 acres.

To the east, the tributary component consists of the Schoenberger Creek watershed.

Surface Geology, Topography, and Soils of Floodplain. The east half of the floodplain component lies within an old meander scar of the Mississippi River (Rock Road meander loop, White et al. 1984). A second local geological feature, a point bar, represents the west half. Ground elevations range from about 410 to 415 feet NGVD, and are generally lower in the east half. Soils consist of Darwin silty clay loam, Darwin silty clay, and Darwin-Urban land complex. All are indicative of historic wetland conditions.

Predevelopment Natural Communities. A contact zone between forest and prairie was present within the floodplain component in predevelopment times. Forest around Pittsburg Lake to the south met with native grasslands in Cold Prairie to the north. Prairie was more prevalent. Wet-mesic prairie and wet-mesic floodplain forest probably were the natural communities comprising these types of vegetation. Within the lowest elevations of the prairie, marsh probably occurred. All these natural communities were wetlands. The tributary component of the action area included low- to medium-gradient creeks. Mesic floodplain forest grew in the narrow bottoms along these creek channels, and mesic upland forest was found along the base of the adjacent ravines. Wet-mesic floodplain forest occurred along the lower portions of Schoenberger Creek.

Predevelopment Ecosystem Disturbance. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 421 feet NGVD. At its peak, water depths over the action area ranged from roughly 5 to 10 feet.

Because no floodplain channels of upland tributaries were located near this area, flooding from the bluffs apparently was not an important component of historic wetland hydrology. However, runoff from several square miles of lands to the north and west apparently passed periodically through this low area on its way to Pittsburg Lake. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. Most of the floodplain action area consists of residential areas obtained by the Federal Emergency Management Agency as buyouts due to flooding in the mid-1990s. Nearly all of the buildings have been removed. In these former neighborhoods, forested wetland is the predominant land cover. Because of local infrastructure and recent residential use, this forest is highly fragmented, and remaining blocks are no larger than about 20 acres. Other less well-represented cover types include urban old fields, marsh, scrub-shrub wetland, grassland, and development. Only one building currently in use is found within the action area. Surrounding lands are mainly residential.

Summit Avenue currently passes through the floodplain component in an east-west direction, and an interstate (I-255) embankment bisects its east half from north to south. The site's east border, Harding Ditch, is a major component of the flood control system, and is joined by Schoenberger Creek Ditch. Both canals are bordered on both sides by earthen berms to prevent overtopping. In terms of periodic ecosystem disturbances, flooding of the floodplain action area is very limited.

The Mississippi River is isolated from its floodplain, and Harding Ditch keeps storm water confined within its banks. Only runoff from surrounding neighborhoods occasionally floods portions of the area. Fire has been suppressed for many years.

In the Schoenberger Creek tributary watershed, forest accounts for about half of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 9,000 tons of sediment is currently delivered to the floodplain per year from this tributary watershed.

Nearly all of the floodplain action area is publicly owned (City of East St. Louis).

Problems and Opportunities. Various ecological problems are present. Because remaining forested areas are relatively small, they have limited value for supporting species that are highly sensitive to forest fragmentation, such as some interior forest nesting birds. Second, native prairie is completely absent. Third, wet-mesic floodplain forest within the action area contains low tree species diversity. Many of the native nut-bearing species, such as oaks and hickories, were removed years ago, and the local seed source for regeneration is scarce. Fourth, flooding and fire, the primary ecosystem disturbance factors from presettlement times, exert little to no influence on natural habitats existing today at the site. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding occurs when stormwater over tops Schoenberger Creek. On such occasions, floodwaters can inundate mixed residential and commercial areas.

Opportunities exist within the action area to enlarge the existing area of natural habitats to support more species of area-sensitive animals, to replace lost prairie, to reintroduce seasonal flooding as an ecosystem disturbance factor, to replace "lost" tree species that once grew in this area, and to implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of periodic flooding as an ecological disturbance factor would incidentally reduce flooding "upstream" along Harding Ditch and Schoenberger Creek Ditch.

6.7.9 Mullens Slough.

Location. This action area is in St. Clair County, southwest of Frank Holten State Park. It is in northern Stookey Township (T1N, R9W).

Components of Action Area. A portion of the Mississippi River's floodplain comprises the action area's floodplain component. This area is at the confluence of Powdermill Creek and Canal No. 1. At its maximum, it extends east to west about 2 miles, and north to south about 1 mile. Features that delimit its boundaries include railroad tracks along Powdermill Creek on the north, the bluff line on the southeast, and Canal No. 1 on the northwest. It envelops about 425 acres.

To the east, the tributary component consists of the Powdermill Creek and Bluff 6 watersheds.

Surface Geology, Topography, and Soils of Floodplain. Nearly the entire floodplain component lies within an old meander scar of the Mississippi River (Grand Marais meander loop, White et al. 1984). Backswamp deposits to the southwest make up the remainder of local geological features. Ground elevations across the area range from about 405 to 420 feet NGVD. Most ground lies between about 410 and 415 feet NGVD. The highest elevations are adjacent to the bluff, and the lowest are within Canal No. 1. In the digital St. Clair County soil survey, most of the floodplain action area is mapped as water. Small areas of undisturbed ground at the north and south end consist of either Beaucoup silty clay loam or Otter silt loam, which are indicative of historic wetland conditions. Most undisturbed soils consist of a variety of silty loams that do not reflect historic wetland conditions.

Predevelopment Natural Communities. The 1800 land cover map displays prairie, or at least non-woody vegetation, at the floodplain action area. Later historic maps depict a large water body in this area, which is the south end of Pittsburg Lake. This water body presumably was a large shallow pond with marsh at its borders. Within the action area, mainly mesic prairie and some wet-mesic prairie occurred adjacent to the pond. The areas of marsh and wet-mesic prairie were wetlands. In the uplands, Powdermill Creek and its adjacent tributaries had low to medium gradients. Narrow strips of mesic floodplain forest grew adjacent to their channels, and mesic upland forest along the base of adjacent ravine slopes.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic ecosystem. Flooding by overflow from the Mississippi River probably occurred once or twice every ten years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 419 feet NGVD. At its peak, water depths over the action area ranged from roughly 5 to 10 feet. Because Powdermill Creek and smaller adjacent upland tributaries emptied onto the floodplain, less dramatic but more frequent periodic flooding affected this area. Periodic wild fire was also an important factor in disturbance dynamics in the uplands as well as the floodplain.

Existing Conditions. About half the floodplain component consists of Mullens Slough, a large lake-like water body lying between the bluff and Canal No. 1. Until about 10 years ago, this area was cropland that drained into Canal No. 1 by gravity flow. The farmland turned into a lake when impaired drainage within the canal caused surface drainage to permanently pond in the fields. Water depths apparently range up to about six feet, and average about 3-4 feet. Little to no emergent or submergent vegetation exists in the lake. A variety of fish in the lake provide for recreational fishing. The location of Mullens Slough approximates the portion of Pittsburg Lake that existed in this area long ago.

Aside from the lake, forested wetland is the most prevalent land cover type, and it occurs in and along Canal No. 1. Other less well-represented cover types include cropland, grassland, scrub-shrub wetlands, creek channel, and development. Cropland is found southwest of Mullens Slough. Grassland consists of mowed areas adjacent to Mullens Slough and a man-made fishing lake within the action area.

The Biological Conservation Database maintained by the Illinois Department of Natural Resources lists the known occurrence of the bald eagle within the floodplain component near the south end of Mullens Slough. This bird is listed as Federally threatened and state endangered.

A few residences lie near the edge of the lake at the base of the bluff. Route 163 (Millstadt Road) bisects the action area near its north end. Canal No. 1, a component of the flood control system, represents the channel of Powdermill Creek after it reaches the floodplain. The canal is bordered on both sides by earthen berms to prevent overtopping.

Surrounding lands are mainly urban in the floodplain and rural in the uplands.

In terms of periodic ecosystem disturbances, flooding of the floodplain action area is very limited. The Mississippi River is isolated from its floodplain, and Canal No. 1 usually keeps storm water confined within its banks. Consequently, flooding from Powdermill Creek only occasionally enters the floodplain action area. Fire has been suppressed for many years.

In the Powdermill Creek and Bluff 6 tributary watersheds, forest accounts for about 45 percent of the land cover, and grassland, agriculture, and urban/built-up make up the remainder. Increased runoff from nonforested areas is affecting the stability of many stream channels. Headcutting and bank failure are common responses to increased runoff. Some land use practices related to farming and new development are also causing erosion, from which sediments are transported into the tributary stream system. As a result of these processes, the NRCS estimates that 6,000 tons of sediment is currently delivered to the floodplain per year from these two tributary watersheds. Canal No. 1 is choked with such sediments.

Cropland south of Mullens Slough is rich with prehistoric cultural resources on the higher elevations.
A small part of the floodplain action area is publicly owned (St. Clair County Soil and Water Conservation District). The Natural Resources Conservation Service has obtained permanent flood easements from landowners of Mullens Slough.

Problems and Opportunities. Various ecological problems are also present. First, Mullens Slough as fisheries habitat lacks deep water for overwintering, as well as vegetative cover or structural diversity for reproduction and rearing of young. Areas greater than 8 feet deep as well as woody debris and emergent or submergent plants are needed. Second, native prairie is completely absent. Third, because floodplain forest along Canal No. 1 is narrow and relatively small, it has limited value for supporting species that are highly sensitive to forest fragmentation, such as some interior forest nesting birds. Fourth, floodplain forest contains low tree species diversity. Many of the native nut-bearing species, such as oaks and hickories, were removed years ago, and the local seed source for regeneration is scarce.

Fifth, flooding and fire, the primary ecosystem disturbance factors from presettlement times, exert little to no influence on natural habitats existing today at the site. Lastly, excessive levels of sediment transported by storm water from tributary streams can smother aquatic and wetland habitats and degrade water quality by increasing turbidity levels. On the floodplain, flooding occurs infrequently when stormwater overtops Canal No. 1. On such occasions, floodwater can flow west, across farmland, mixed residential and commercial areas, and Route 163.

Opportunities exist within the action area to improve Mullens Slough as a fisheries resource, restore prairie, enlarge the existing area of natural habitats to support more species of area-sensitive animals, reintroduce seasonal flooding and prescribed fire as ecosystem disturbance factors, replace "lost" tree species that once grew in this area, and implement measures designed to restore tributary streams and floodplain environmental resources. The reintroduction of periodic flooding as an ecological disturbance factor would also incidentally reduce flooding along Canal No. 1.

6.7.10 National City Stockyard (Recommended for Action by Others)

Location. This area is in St. Clair County, in northeast East St. Louis Township (T2N, R10W).

It is located southwest of Horseshoe Lake, and north of I-55/70. Route 3 (St. Clair Avenue) bounds it on the east, railroad tracks on the south, and a former railroad yard to the northwest. The area extends north to south over a distance of about 0.6 miles.

Components of Area. The area is restricted to the floodplain; there is no tributary component. It envelops about 100 acres.

Surface Geology, Topography, and Soils of Floodplain. The area is within a geological feature consisting of chutes and bars along the Mississippi River. Cahokia Creek historically flowed through the area from north to south. Ground elevations apparently varied from about 405 to 415 feet NGVD with most of the area between 410 to 415 feet NGVD.

Predevelopment Natural Communities. Historic vegetation adjacent to the creek consisted of forest, most likely mesic floodplain forest. Prairie was found a short distance away to the southeast.

Predevelopment Ecosystem Disturbance Dynamics. Flooding and wild fire were primary forces that periodically disturbed this area of the historic floodplain ecosystem. Overflow from the Mississippi River may have inundated the entire site once or twice every five years. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 422 feet NGVD. At its peak, water depths over the area ranged roughly from 5 to 15 feet. Cahokia Creek probably overflowed its banks at least annually.

Existing Conditions. The area is near the former East St. Louis stockyards, and adjacent to a former railroad yard. The historic Cahokia Creek was replaced by Cahokia Canal about 90 years ago. A remnant of the historic creek lies within the area, and is isolated from Cahokia Canal. The channel remnant has been partially filled by the dumping of various materials along its historic bank line. It ponds rainfall and associated local runoff, and supports marsh vegetation.

Trees border some of the historic channel's banks. The ground surrounding the historic channel has been previously disturbed by various development activities. Vegetation in this area is typical of abandoned urban sites, and resembles an old field with scattered saplings. Previous archaeological investigations in the vicinity suggest that significant prehistoric cultural resources are present within this area. The area is within the East St. Louis mound group, a satellite community associated with the prehistoric settlement at Cahokia Mounds.

None of the area is publicly owned.

Problems and Opportunities. The urban area in which this area is located supports few environmental resources. Existing habitats in the area are of limited value to wildlife, and include a number of invasive plant species. Sediments in the bottom of the historic creek may be contaminated. Water fluctuations in the historic creek are rather static and limited to those created by rainfall.

An opportunity exists within the area to restore the remnant of Cahokia Creek as aquatic and wetland habitat. Fill and accumulated sediments would be removed to return the channel to its former dimensions. An abandoned road crossing would be removed from the channel. Forest would be planted in the area surrounding the historic channel.

6.7.11 I-55/70 Borrow Pit (Recommended for Action by Others)

Location. This area is in southern Madison County, in southeast Nameoki Township (T3N, R9W).

It is located southeast of Horseshoe Lake. The area is bounded by I-55/70 on the south, Sand Prairie Road on the east, Cahokia Canal and Canteen Creek on the north, and railroad tracks on the west. It extends west to east over a distance of about 0.75 miles.

Components of Area. The area is restricted to the floodplain; there is no tributary component. It encompasses about 115 acres.

Surface Geology, Topography, and Soils of Floodplain. An old meander scar of the Mississippi River, named Edelhardt Lake meander loop (White et al. 1984), crosses through the area and its vicinity in an east-west direction. Cahokia Creek historically flowed through this meander scar from east to west. Canteen Creek, a second tributary, joined Cahokia Creek in this area. Historical ground elevations were about 405 feet NGVD.

Predevelopment Natural Communities. Historical vegetation adjacent to the creek most likely consisted of forested wetlands consisting of wet-mesic and wet floodplain forest.

Predevelopment Ecosystem Disturbance Dynamics. Flooding was a primary force that periodically disturbed this area of the historic floodplain ecosystem. Flooding by overflow from the Mississippi River probably occurred at least annually. The 1844 flood, the greatest on record, is estimated to have crested in this area at about 423 feet NGVD.

At its peak, water depth over the area would have been close to 20 feet. Cahokia Creek probably overflowed its banks several times a year. Wild fire typically did not affect forested wetlands because of the usual high moisture levels in the ground surface.

Existing Conditions. Historic Cahokia Creek was replaced by Cahokia Canal about 90 years ago. The main feature of the area is a man-made borrow pit lake. Remnants of forested wetland border about half of the borrow pit lake. Various earthen embankments border the area. An earthen berm lies between the borrow pit lake and Cahokia Canal and Canteen Creek.

The area is publicly owned and part of Cahokia Mounds State Historic Site.

Problems and Opportunities. The borrow pit lake is isolated from Cahokia Canal and Canteen Creek. Water fluctuations are rather static and limited to those created by rainfall. In its present condition, the lake and adjacent wetlands cannot receive a "flood pulse" typical of predevelopment lakes, ponds, and forested wetlands in the American Bottom.

An opportunity exists within the area to introduce flows from either Cahokia Canal or Canteen Creek, and thereby reintroduce periodic ecosystem disturbance in the form of flooding. The reintroduction of flooding as an ecosystem disturbance dynamic would also reduce backwater effects "upstream" in Cahokia Canal and Canteen Creek.

6.8 ALTERNATIVE PLAN DEVELOPMENT

Preliminary alternative plans were next formulated for each action area. A variety of combinations of measures were developed at each site that could be evaluated for their effectiveness and cost efficiency in achieving project objectives.

By this stage of formulation the biological team had determined the combination of species that would be used to predict habitat outputs for the various alternative plans. Appendix A provides detailed information regarding the rationale and selection process for these predictor species, which are used to measure habitat outputs for the different combinations of measures in an alternative plan. The potential array of measures was developed based on analysis of pre-settlement land cover and hydrology, and project restoration planning targets. As described previously the selected action areas were initially screened for their existing habitat, soils, hydraulic connectivity and spatial area. In this manner the Project Team was able to develop a full array of ecosystem and social measures, for efficiency and effectiveness competition at each action area. In the development of alternative plans for each action area, several conclusions from engineering and biological analysis were used to assist in guiding the process. It had been determined during the action area screening process that each of the designated project action areas could receive hydraulic input with the potential to provide disturbance depths having limited durations that would be considered beneficial for biological purposes (defined as meeting Objective 2, Flood Pulse Restoration) and could accept storm water for flood damage reduction purposes (Objective 8a, Reduce Flood Damages).

Varying hydraulic events were analyzed at each site to determine the optimum for a site based on planning targets and cost factors. As noted previously the inability to finalize an HGM model for the Project area made it impossible to independently verify best scientific judgment. A more detailed discussion of this analysis is contained in Appendix A.

Tributary stream sediment detention measures recommended by NRCS were considered together within each watershed as an "all or nothing" unit for alternative development. This was necessitated by the inability to attribute improvements to the system in any smaller increments of action. This is in concert with the NRCS' study, which is further detailed in Appendix E. Based on the NRCS' analysis, land treatment measures such as filter strips, grass waterways and terraces on private land were eliminated in alternative plans. These measures proved to be unreliable because of their voluntary nature, and uneconomical because of the rapid urbanization projections for the bluff, which meant these measures would be temporary in nature. This analysis is further discussed in Appendix E.

Tributary stream and floodplain sediment detention measures were retained and analyzed during this iteration as a method for the removal of sediment for each action area that had a tributary stream connection. Appendix C and E provide more detail on tributary stream and floodplain sediment detention measure analysis that determined the acceptability of measures designed to meet the Planning Target established for Objective 5 (Reduce Erosion) and Objective 4 (Improve Water Quality).

The measures at this stage of formulation had attained more specificity based on additional hydraulic, geotechnical and sediment analysis performed. From these preliminary plans cost curves were developed for measures that were required at multiple sites. These cost curves were utilized to identify those measures providing a similar benefit that proved less effective because of their higher costs. This allowed for the initial reduction of alternative plans prior to running action area alternative plans through the HEP/ ICA analysis. The chart below shows the number of alternatives carried through to more detailed iterations of assessment and evaluation.

Watershed	Site Name	Alternative Counts		
		Generated	Dropped	Evaluated
County Ditch	Old Cahokia Creek	24	12	12
Cahokia	Judy's-Burdick Branches	40	20	20
Cahokia	Brushy Lake	30	24	6
Cahokia	Elm Slough	6	1	5
Cahokia/Harding	Spring Lake	126	117	9
Harding	Wedgewood	6	2	4
Harding	Cahokia Mounds	12	6	6
[illegible]	Mullens Slough	6	0	6
Long Lake	[illegible]	[illegible]	[illegible]	[illegible]
	Totals	256	185	71

6.9 ALTERNATIVE PLAN ASSESSMENT BY ACTION AREA

Planning level cost estimates were developed for each alternative plan within an action area. These estimates included lands, construction (including environmental treatments) and operation and maintenance costs and were annualized at the current interest rate over the 50-year project life. These estimates were to be used in the incremental cost analysis. Using this methodology the predicted average annual habitat unit benefits (effectiveness) could be compared to the predicted annualized costs (efficiency) in order to generate a comparison of alternative plans for assessment and evaluation purposes. Appendix A describes these procedures in detail and provides data on results obtained. This process resulted in the final set of alternatives for each action area that was carried through the final incremental cost analysis process.

6.10 FINAL ARRAY OF ALTERNATIVE PLANS

The screening process used on the alternative plans resulted in a final set of alternatives for each action area that were analyzed using the incremental cost effectiveness analysis process. The following is a recap of final alternatives that were competed through the incremental cost effectiveness analysis. Common measures are those measures common to all alternatives in a particular array and variable are measures are those that differ between alternative plans in an array. Appendix A provides complete detail on this process.

Dobrey Slough
The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages in the residential neighborhoods adjacent to Dobrey Slough, in the Long Lake watershed.

Dobrey Slough is a relatively small historic slough of the Mississippi River without any significant natural drainage ways going in or out of it. Historic vegetation of the slough apparently was non-woody.

Measures Under Evaluation: A total of 3 different alternatives were evaluated.

Common measures:

1. The establishment of a habitat area with the existing "slough" (marsh-based vegetation) serving as its core.

2. The restoration of existing marsh, and the creation of new marsh, inside the habitat area supported by utilization of the stormwater events delivered by local runoff. Excavation would be necessary to support the creation of the new marsh as well. In addition, modification of the existing drainage structures, located under the railroad embankment, would be necessary.

Variable measures:

1. The creation of a forested corridor, inside the habitat area, surrounding the existing marsh. Trees would be planted (where they currently do not occur) on the west side of the railroad embankment in undeveloped areas. The forested corridor would provide habitat, and serve as a filter strip to enhance water quality in the marsh. The width of the forested corridor was considered when developing alternatives. Three corridor size options [i.e., 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters)] were designed for this site. These corridor widths would be created on both sides of the channel/ditch.

Dobrey Slough Alternatives (n = 3 + No Actions)

Options	No connection to Uplands Croplands planted to marsh Both sites excavated No ditch Increase species diversity by planting seedling trees (hardmast spp) in existing trees (PFO) Marsh from croplands (natural succession)
100-m NEWFCORR	5A-X
75-m NEWFCORR	5A-Y
50-m NEWFCORR	5A-Z
Build ditch to Horseshoe Lake (GRASS)	5B-XYZ
	Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

-X = 100-m forested corridor strips (HSI weight = 1.0) along northern side of ditch

-Y = 75-m forested corridor strips (HSI weight = 0.75) along northern side of ditch

-Z = 50-m forested corridor strips (HSI weight = 0.50)

Old Cahokia Creek

The purpose of this action area is to restore a portion of Cahokia Creek on the floodplain to a free-flowing stream, with an adjacent forested corridor supporting natural plant and animal communities, and a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the "Bluff 1" watershed and to incidentally reduce flood damages in the bottoms in the County Ditch watershed, with a focus on Sand Road and vicinity.

Measures Under Evaluation A total of 18 different alternatives were evaluated.

Commonly shared measures:

1. The reopening of a portion of the Cahokia Creek channel on the floodplain. Segments of historic channel that were filled over the years would be reopened under these alternatives, and existing channel areas would be excavated to remove accumulated sediment to recreate a floodplain stream that once flowed from north to south.

2. The creation of a continuous forested corridor along the reopened channel. In all alternatives, trees would be planted on both sides of the creek where they currently do not occur.

3. The construction of an earthen hydraulic feature along the west side of the reopened channel. This feature, located along the west edge of the forest on the west side of the creek, would allow for a riverine overflow regime to be reestablished, while restricting overflow from the creek to the forested corridor and adjacent lands to the east.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 10 new tributary stream sediment detention basins in the "Bluff 1" watershed, and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in about 7 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in the new habitat restoration area itself.

2. Length of channel restoration – two lengths of channel restoration were considered. From the south end of the project area, the shorter channel option would extend north along the creek for a distance of approximately 2.9 miles. The longer channel option would extend the length of the diversion channel for a distance of approximately 4.2 miles.

3. Augmentation vs. no augmentation of stream flows – for the longer channel alternatives, a new pump station could be installed at the diversion channel, and would be used to augment low stream flows to enhance environmental returns.

4. Width of forested corridor – on each side of the creek, widths of approximately 165 feet (50 meters), 245 feet (75 meters) and 330 feet (100 meters) were considered.

Following the first Incremental Cost Analysis evaluation the long channel alternatives were eliminated from final competition. It was determined that these 6 alternatives were not acceptable based on the need for a pumping facility to support them. These alternatives were not carried into the final ICA analysis.

Old Cahokia Creek alternative Matrix

Options	Uplands On	Uplands Off (Sedimentation Expected)
	Restoration of the Cahokia Creek channel to recreate a floodplain stream Creation of NEWRIPAR in three widths = XYZ (100m, 75m and 50m) Construction of an earthen berm along Cahokia Creek All sediment detention basins = AGCROP converted	Restoration of the Cahokia Creek channel to recreate a floodplain stream Creation of NEWRIPAR in three widths = XYZ (100m, 75m and 50m) Construction of an earthen berm along Cahokia Creek No DETENTION Sedimentation expected = area dredged every
Short channel (~2.9 mi.) (extends north from I-270 along the creek)	2A-1-(0)-X	2B-1-(0)-X
	2A-1-(0)-Y	2B-1-(0)-Y
	2A-1-(0)-Z	2B-1-(0)-Z
	2A-1-(1)-X	2B-1-(1)-X
	2A-1-(1)-Y	2B-1-(1)-Y
	2A-1-(1)-Z	2B-1-(1)-Z
Long channel (~ 4.2 mi.) (extends all the way to the diversion channel)	2A-2-(0)-X	2B-2-(0)-X
	2A-2-(0)-Y	2B-2-(0)-Y
	2A-2-(0)-Z	2B-2-(0)-Z
	2A-2-(1)-X	2B-2-(1)-X
	2A-2-(1)-Y	2B-2-(1)-Y
	2A-2-(1)-Z	2B-2-(1)-Z

[shaded] Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

"2" denotes Old Cahokia Creek Site
A/B denotes presence/absence of an Uplands detention basin
1/2 denotes length of channel (1 = ~2.9 miles, 2 = ~4.2 miles)
(1)/(0(denotes presence/absence of pumping station
XYZ denotes width of ripirian corridor on each side of the creek
**Alternative dropped from the analysis due to design inconsistencies, biologically ineffective configurations and/or cost ineffectiveness

Elm Slough
The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable and to incidentally reduce flood damages within the Long Lake watershed. Much of the project area is an old meander scar of the Mississippi River, and forest was the predominant type of vegetation two centuries ago.

Measures Under Evaluation A total of 5 different alternatives were evaluated.

Commonly shared measures:

1. The creation of a 670-acre forested habitat area to utilize stormwater events delivered by Long Lake and Mitchell Ditch. Trees would be planted in areas where they do not currently occur. The construction of earthen hydraulic features around the perimeter of the habitat area would also be included in this option, as well as the simulation of hydrologic conditions (in a large area of the newly planted wetland forest), similar to those of the existing wetland forest. Excavation of an area about 175 acre in size, would be necessary to temporarily store water.

2. The replacement of the two "funnel-shaped" waterways referred to as Mitchell Ditch and Long Lake Ditch on the south side of Route 162. Stormwater from these two floodplain tributaries would be carried south into Elm Slough in a sheet-flow manner. Earthen hydraulic features constructed along the edges of these waterways would restrict stormwater to the habitat area. Culverts under Route 162, and the adjacent railroad embankments, would be modified as well.

3. Grassy vegetation would be planted inside the "funnel-shaped" drainage ways to act as filters that intercept sediment carried by stormwater.

Variable measures:

1. Replacement of under-represented tree species - three levels of management would be considered (i.e., simple vs. intensive activities). Simple improvements would focus on of selective thinning and planting of mast tree species in the existing forest. Intensive improvements would involve the removal of existing dead (drowned) timber, and the planting of appropriate tree species. The "No Action" management strategy defers improvements.

2. Presence or absence of a prairie-based vegetative buffer - the proposed buffer would be created at the location where sheet flows are anticipated to enter Elm Slough, in front of the main forested habitat area. The buffer would be designed to intercept sediment carried by flows from Long Lake and Mitchell Ditch.

Elm Slough- Continued

Elm Slough Alternatives (n = 5 + No Actions)

Options	No connection to uplands Croplands planted to forested wetlands Prairie Buffer Strips Used as Filter Strip	No connection to uplands Croplands planted to forested wetlands No Buffer Strip
No Treatment of Existing Forest	6A-1	6B-1
Simple Treatment	6A-2	6B-2
Intensive Treatment	6A-3	6B-3

(Shaded) Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

Prairie buffers (PBUFFER)
Wetter prairies with less depth due to sedimentation trapping.
Quality is higher when sediment captured in buffers
AGCROP converts to prairie

#2 (Simple) Treatments:
Planting trees in existing PFO

#3 (Intensive) Treatments
Combination of # 2 treatments & changing PSS innudated forest to PFO through a form of draining exercise

Riparian Corridor = Long Lake & Mitchell Ditch with PFO along sides & riverine in bottom

Judy's-Burdick

The purpose of this action area is to create an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Judy's, Burdick, and "Bluff 1" watersheds and to incidentally reduce flood damages in the bottoms within the Cahokia watershed. The floodplain component lies at the southern end of historic Rattan's Prairie, a 15,000-acre wet prairie once located in the northeast part of the American Bottoms.

Measures Under Evaluation A total of 16 different alternatives were evaluated.

Commonly shared measures:

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Judy's and Burdick Branches combined.

2. The modification of the existing levee, along the south side of Burdick Branch, to ensure delivery of stormwater events from the Judy's and Burdick tributaries into the new habitat area.

3. The creation of a 330-foot (100-meter) wide prairie buffer surrounding the perimeter of the habitat area's earthen hydraulic feature.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 28 new tributary stream sediment detention basins (23 in the Judy's Branch, 4 in the Burdick Branch, and 3 in the "Bluff 1" watersheds) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 32 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in a floodplain sediment detention basin within the new habitat restoration area.

2. Size of habitat area – given existing urban constraint, three options were considered to provide a variety of habitat options and hydrologic regimes (the "small" option would restore 131 acres, the "medium" option would restore 230 acres and a "large" option would restore 350 acres). Under the small and medium size, options, a moderate to extensive excavation activity would support the development of a new marsh. For the larger option, prairie would be created with little or no excavation needed.

3. Restoration of the historic Cahokia Creek channel within the habitat area – a channel would be excavated to replace the historic channel that has degraded over time with a floodplain stream similar to the one that once flowed from north to south across the site.

4. Create a 330-foot (100-meter) wide forested corridor along the north side of Burdick Branch extending from Cahokia Canal to Route 157.

	Uplands ON (no Detention basin)		Uplands OFF (Dentention basin needed)
Options	Prairie Only	Marsh Only	Prairie with Marsh Detention Basin
Small Site (131 ac)	3A-1-X	3B-1-X	3C-1-X
Medium Site (230 ac)	3A-2-X	3B-2-X	3C-2-X
Large Site (350 ac)	3A-3-X	3B-3-X	3C-3-X
Large Site (350 ac) - Horseradish Lands Excluded	3A-4-X	3B-4-X	3C-4-X
Small Site (131 ac) w/o NEWFCORR	3A-1-(0)	3B-1-(0)	3C-1-(0)
Medium Site (230 ac) w/o NEWFCORR	3A-2-(0)	3B-2-(0)	3C-2-(0)
Large Site (350 ac) w/o NEWFCORR	3A-3-(0)	3B-3-(0)	3C-3-(0)
Large Site (350 ac) w/o NEWFCORR - Horseradish Lands Excluded	3A-4-(0)	3B-4-(0)	3C-4-(0)

(shaded) Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

-X = 100-m forested corridor strips (100-m width needed for optimum conditions)

- (0) = No forested corridor strips present

Brushy Lake

The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Schoolhouse Branch and "Bluff 3" watersheds, and to incidentally reduce flood damages within the Cahokia watershed.

Much of the floodplain component is an old meander scar of the Mississippi River. Two centuries ago, Cahokia Creek flowed through this area, and forest was the predominant type of vegetation.

Measures Under Evaluation A total of 6 different alternatives were evaluated.

Common measures:

1. The creation of a 710-acre forested habitat area on the floodplain to utilize stormwater events delivered by both Schoolhouse Branch and Snyder Creek that would include planting of trees where they do not currently exist.

2. The restoration of the historic Cahokia Creek channel within the habitat area. Segments of channel that have been filled, would be reopened, and existing remnants would be excavated to remove accumulated sediments. These actions would recreate a floodplain stream similar to that which once flowed from north to south across the site.

3. Modification of the existing channels and levees of Schoolhouse Branch and Snyder Ditch to ensure delivery of stormwater events from these two bluff tributaries into the new habitat area. The current channel conditions (i.e., grassy side-slopes and earthen bottom) would be utilized.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 15 new tributary stream sediment detention basins (14 in the Schoolhouse Branch watershed and 1 in the "Bluff 3" watershed) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in about 25 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in a floodplain sediment detention basin within the new habitat restoration area.

2. Presence or absence of a prairie filter – under the Bottomland sediment detention option, a 330-foot (100 meter) wide vegetative buffer would be established in the habitat area outside the detention basin. The buffer would consist of prairie plantings to intercept sediment carried by stormwater overtopping the basin.

Brushy Lake - Continued

Brushy Lake Alternatives (n = 12 + No Actions)			
	Uplands ON (No Detention Basin)	Uplands OFF (Detention Basin Needed)	
Channel Type and Corridor Type Options	Croplands planted to forested wetlands, Corridor bringing water in, Always have riparian meander down the middle	Croplands planted to forested wetlands, Corridor bringing water in and Detention Basin, AGCROP converts to urban Grassland along berm, Always have riparian meander down the middle	Croplands planted to forested wetlands, Prairie buffer strip added around sediment basin, Corridor bringing water in and Detention Basin, Always have riparian meander down the middle, Quality of forest is higher due to capture of sediment in the buffers
Concrete Sides, Dirt Bottoms	4A-1-0	4B-1-0	4C-1-0
	4A-1-X	4B-1-X	4C-1-X
Concrete Channel	4A-2a-0	4B-2a-0	4C-2a-0
	4A-2a-X	4B-2a-X	4C-2a-X
	4A-2b-0	4B-2b-0	4C-2b-0
	4A-2b-X	4B-2b-X	4C-2b-X
Grass-lined	4A-3-0	4B-3-0	4C-3-0
	4A-3-X	4B-3-X	4C-3-X
Riparian/Meander	4A-4-0	4B-4-0	4C-4-0
	4A-4-X	4B-4-X	4C-4-X

Alternatives dropped from consideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.
All Detention Basins = degraded Marshlands
Prairie buffers surrounding marshlands are wetter prairies with less depth due to sedimentation trapping.
With detention basins, basins dredged every 3-5 years, no external dredging necessary. (outside detention basin, but still within project boundary).

Ditch Options Considered:
- -1 Ditch Option: Straight channel/concrete sides/dirt bottoms
- -2a Ditch Option: Straight, all concrete - Rectangular
- -2b Ditch Option: Straight, all concrete - Trapezoidal
- -3 Ditch Option: Straight, grassy-slopes, dirt bottom
- -4 Ditch Option: Meandering, riparian corridor

Forested Corridor Options Considered:
- -(0) = No FCORRIDOR
- -(1) = 100-m forested corridor strips (HSI weight = 1.0)

Spring Lake

The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Canteen and Little Canteen Creek watersheds, and to incidentally reduce flood damages within the Cahokia and Harding watersheds. The three floodplain areas lie in separate historic meander scars of the Mississippi River. Two centuries ago, the principal type of vegetation occurring in these areas appears to have been marsh (Cell 1), prairie (St. Clair Farms), and forest (Indian Lake).

Measures Under Evaluation A total of 9 different alternatives were evaluated.

Common measures:

1. The establishment of three floodplain areas, namely Cell 1 (370 acres), St. Clair Farms (180 acres) and Indian Lake (620 acres), as habitat areas that would utilize stormwater events from Canteen and Little Canteen Creeks with the construction of earthen hydraulic features around these areas, when necessary. At Indian Lake, remnants of Cahokia Creek would be reopened to create a flowing floodplain stream, and trees would be planted along both sides of the channel (where they currently do not exist), to create a continuous forested corridor 330 feet (100 meters) wide. Impaired drainage at the northern end would be improved and standing water removed, to allow the forest to become reestablished.

Spring Lake - Continued

2. The creation of a 330-foot (100-meter) wide forested corridor on both sides of Harding Ditch between Cell 1 and St. Clair Farms.

3. The re-establishment of forest in the dead timber area north of Forest Boulevard, within the Cahokia Mounds State Historic Site. The permanent standing water within a 35-acre tract of dead (drowned) timber would be drained and appropriate tree species planted under this option.

4. The construction of a new Canteen Creek relief channel to ensure that stormwater from the Canteen Creek watershed enters into the Harding Ditch system, and ultimately into the habitat areas. The channel would have concrete sides, a concrete bottom and earthen levies along both banks.

5. The modification of Harding Ditch, from Route 157 to Cell 1, and from Cell 1 to St. Clair Farms, in order to ensure the transference of stormwater events from Canteen and Little Canteen Creeks to the habitat areas. The channels would have grassy sides, an earthen bottom and an earthen levee along both banks.

6. The construction of a new "Fairmont City Ditch," from Cell 1 to Indian Lake, which would provide the hydraulic connection from Canteen Creek back to Cahokia Canal. The channel would have grassy sides, an earthen bottom and an earthen levee along both banks in low elevations.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 58 new tributary stream sediment detention basins (37 in the Canteen Creek watershed and 21 in the Little Canteen Creek watershed) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 99 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in the new habitat restoration area itself.

2. Presence or absence of a new "floodplain" along "Reach 3B" of Harding Ditch. By setting back the existing levees along a 2,000-foot long reach of Harding Ditch, a "floodplain" area would be re-established.

3. Vegetative cover across the habitat areas – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site. In Cell 1, a restoration marsh option that requires extensive excavation was compared to an option that produced a combination of marsh and forested habitat with minimal excavation required. In the St. Clair Farms area, an option that restores prairie and forested habitats to the site with no excavation activities was compared to the restoration of marsh habitat requiring minimal excavation. In "Reach 3B" of the Harding Ditch, a prairie restoration option implemented in the floodplain was evaluated. Throughout the evaluation of options, the habitat conditions in the Indian Lake area were held constant.

Following the first Incremental Cost Analysis evaluation the floodplain channel alternatives were eliminated from final competition. It was determined that these 6 alternatives were not acceptable based on their increased consumption of prime farmland. These alternatives were not carried into the final ICA analysis.

Spring Lake – Continued

Channel Type & Corridor Type Options	Uplands ON Sediment Trapped in Uplands			Uplands OFF Floodplain will act as Natural Sediment Basin		
	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to Prairie	Cell 1: Minimal excavation Cell 2: Expected to Dry Out St. Clair Farms: Excavation necessary, Planted to MARSH	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to NEWFOREST	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to Prairie	Cell 1: Minimal excavation Cell 2: Expected to Dry Out St. Clair Farms: Excavation necessary, Planted to MARSH	Cell 1: Extensive excavation Cell 2: Expected to Dry Out St. Clair Farms: Plant to NEWFOREST
Straight Channel with Concrete Sides	1A-1-X	1B-1-X	1C-1-X	1D-1-X	1E-1-X	1F-1-X
	1A-1-Y	1B-1-Y	1C-1-Y	1D-1-Y	1E-1-Y	1F-1-Y
	1A-1-Z	1B-1-Z	1C-1-Z	1D-1-Z	1E-1-Z	1F-1-Z
All Concrete Channel	1A-2a-X	1B-2a-X	1C-2a-X	1D-2a-X	1E-2a-X	1F-2a-X
	1A-2a-Y	1B-2a-Y	1C-2a-Y	1D-2a-Y	1E-2a-Y	1F-2a-Y
	1A-2a-Z	1B-2a-Z	1C-2a-Z	1D-2a-Z	1E-2a-Z	1F-2a-Z
	1A-2b-X	1B-2b-X	1C-2b-X	1D-2b-X	1E-2b-X	1F-2b-X
	1A-2b-Y	1B-2b-Y	1C-2b-Y	1D-2b-Y	1E-2b-Y	1F-2b-Y
	1A-2b-Z	1B-2b-Z	1C-2b-Z	1D-2b-Z	1E-2b-Z	1F-2b-Z
Straight Grass-lined Channel	1A-3-X	1B-3-X	1C-3-X	1D-3-X	1E-3-X	1F-3-X
	1A-3-Y	1B-3-Y	1C-3-Y	1D-3-Y	1E-3-Y	1F-3-Y
	1A-3-Z	1B-3-Z	1C-3-Z	1D-3-Z	1E-3-Z	1F-3-Z
Earthen Sides	1A-6-X	1B-6-X	1C-6-X	1D-6-X	1E-6-X	1F-6-X
	1A-6-Y	1B-6-Y	1C-6-Y	1D-6-Y	1E-6-Y	1F-6-Y
	1A-6-Z	1B-6-Z	1C-6-Z	1D-6-Z	1E-6-Z	1F-6-Z
Floodplain with Concrete Sides	1A-7-X	1B-7-X	1C-7-X	1D-7-X	1E-7-X	1F-7-X
	1A-7-Y	1B-7-Y	1C-7-Y	1D-7-Y	1E-7-Y	1F-7-Y
	1A-7-Z	1B-7-Z	1C-7-Z	1D-7-Z	1E-7-Z	1F-7-Z
Floodplain with Earthen Sides	1A-8-X	1B-8-X	1C-8-X	1D-8-X	1E-8-X	1F-8-X
	1A-8-Y	1B-8-Y	1C-8-Y	1D-8-Y	1E-8-Y	1F-8-Y
	1A-8-Z	1B-8-Z	1C-8-Z	1D-8-Z	1E-8-Z	1F-8-Z

Spring Lake – Continued

Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

All Alternatives: Indian Lake: Re-establish Old Cahokia Reach, Send flood pulse into area, Drain out through Landsdowne Channel to promote tree growth, Expect Golf Course to naturally suceed NEWMARSH/NEWFOREST
Forested Corridor Options:
-X = 100m forested corridor strips (HSI weight = 1.0)
-Y = 75m forested corridor strips (HSI weight = 0.75)
-Z = 50m forested corridor strips (HSI weight = 0.5)
Channel Options:
-2b Ditch Option: Straight channel/concrete sides/concrete bottoms/Trapezoidal shaped
-3 Ditch Option: Straight channel/grass-lined sides/dirt bottoms
-6 Ditch Option: Straight channel/Earthen sides/dirt bottoms
-7 Ditch Option: Straight Channel/grass-lined sides/dirt bottoms/Floodplain between setback levees and channel with PRAIRIE & RIPARIAN
-8 Ditch Option: Straight Channel/grass-lined sides/dirt bottoms/Floodplain between setback levees and channel with PRAIRIE & RIPARIAN

Wedgewood

The purpose of this action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resouces in the Schoenberger Creek watershed and to incidentally reduce flood damages within the Harding watershed. The area of the floodplain component is located in the southern portion of historic Cold Prairie that interfaced with forest.

Measures Under Evaluation A total of 4 different alternatives were evaluated.

Common measures:

1. The construction of a floodplain habitat area with an earthen hydraulic feature to utilize stormwater events delivered by Schoenberger Creek.

2. The modification of the existing levee, along the west side of Harding Ditch, to ensure delivery of stormwater events from Schoenberger Creek into the new habitat area.

3. The enclosure of Summit Avenue in the new habitat area, extending from Kings Highway on the west, to Harding Ditch on the east, to form a contiguous habitat area.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 24 new tributary stream sediment detention basins in the Schoenberger Creek watershed and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 36 miles of tributary streams, or sediment would be detained in the Bottoms in existing ditches and in a floodplain sediment detention basin within the new habitat restoration area.

2. Vegetative cover across the habitat area – a variety of habitat restoration options and hydrologic regimes alternations are under consideration at the site, wet supported by excavation activities.

Wedgewood - Continued

	Uplands ON (no Detention basin)			Uplands OFF (Dentention basin needed)		
Options	Prairie Only	Marsh Only	Newly Planted Forested Wetlands Only	Prairie with Marsh Detention Basin	Marsh with Marsh Detention Basin	Newly Planted Forested Wetland with Marsh Detention Basin
Small Site (112.9 ac) w/o NEWFCORR	9AB-1-(0)	9B-1-(0)	9C-1-(0)	9D-1-(0)	9E-1-(0)	9F-1-(0)
[shaded]	Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.					

9E & 9F ruled out because of cost of maintenance and re-vegetation is too high.
All Detention Basins = degraded Marshlands
All outside buffer strips = drier prairies. Where outside = outside the original 112.9 acres project boundary (does not refer to buffers surround n
Prairie buffer filter strips surrounding marshlands are wetter prairies with less depth due to sedimentation trapping. - Only used for 9D-9F Alte h
With detention basins, basins dredged every 3-5 years, external to basins dredged every 50 years for Uplands off.

Mullens Slough
The purpose of the restoration at the Mullen's Slough action area is to restore an area on the floodplain that supports natural plant and animal communities, with a flood regime as similar to presettlement (ca. 1800) conditions as practicable, to restore stream resources in the Powdermill and "Bluff 6" watersheds and to incidentally reduce flood damages within the Powdermill/Canal No. 1 watershed. In the floodplain, much of the project area lies in an old meander scar of the Mississippi River. The historic Pittsburg or Big Lake occupied this area, and Mullens Slough now lies within its footprint. Prairie once extended south and west of this historic backwater lake.

Measures Under Evaluation A total of 6 different alternatives were evaluated.

Common measures:

1. The establishment of a 310-acre floodplain habitat area to utilize stormwater events delivered by the Powdermill watershed.

2. The creation of overwintering fisheries habitat in Mullens Slough. To accomplish this, a series of deep pools (water depth greater than 8 feet) would be created (by excavation), to provide suitable conditions for winter survival.

3. The creation of islands in Mullens Slough. Material excavated to create overwintering habitat would, in turn, be placed in the slough to create a series of islands. These would be planted to prairie habitat.

Mullens Slough - Continued

4. The improvement of habitat structure in Mullens Slough. Woody debris would be added to the slough, and various aquatic plant species would be planted around its perimeter.

5. The restoration of historic floodplain prairie habitat. Within the new habitat area, prairie would be planted on a 31-acre floodplain area south of Mullens Slough.

6. The creation of a 17-acre marsh area (Cell 1). Stormwater from Powdermill Creek would be passed through this area on its way to Mullens Slough.

7. The improvement of tree species diversity in the existing forests along Canal No. 1 and Mullens Slough by selective thinning and planting of mast tree species.

Variable measures:

1. Tributary Stream Restoration vs. Bottomlands sediment detention – sediment would be detained by constructing 20 new tributary stream sediment detention basins (14 in the Powdermill watershed and 6 in the "Bluff 6" watershed) and creating a series of riffle and pool complexes to address channel destabilization and aquatic resource degradation in approximately 16 miles of tributary streams, or sediment would be detained in the Bottoms in a 17-acre detention basin (Cell 1) and in a second 23-acre detention basin (Cell 2) within the proposed habitat area.

3. Maintenance of prairie vegetation – three maintenance options were considered: Burning, Burning/Mowing, and Mowing.

	Uplands On	**Uplands Off (Sedimentation Expected)**
Options	**Cell 1**-DETENTION Marsh - low quality **Cell 2**-LACUST sediment trap for Cell 1 overflow, sedimentation will fill deep holes - 1/2 ft/10 yrs **Cell 3**-Excavate deep pools, sed. rate = 1/2 ft/10 yrs **Cell 4**-AGCROP to PRAIRIE **Cell 5**-In PFO sed. rate = 1/2	**Cell 1**-DETENTION Marsh - higher quality **Cell 2**-LACUST sediment trap for Cell 1 overflow, sedimentation will fill deep holes at a rate of 3 ft/10 yrs **Cell 3**-Excavate deep pools, sed. rate = 3 ft/10 yrs **Cell 4**-AGCROP to PRAIRIE **Cell 5**-In PFO sedsed. rate =
Prairie Treatment: (H) - BURN Mimicking Cahokia Mounds 8-1-(H)	7A-1	7B-1
Prairie Treatment: (VH) - BURN Mimicking Cahokia Mounds 8-1-(VH)	7A-2	7B-2
Prairie Treatment: (H) - BURN/MOW Mimicking Cahokia Mounds 8-2-(H)	7A-3	7B-3

All Alternatives will connect the cells - water flow will be from Cell 1=>Cell 2=>Cell 3=>Cell 4; and Cell 3=>Cell 5 at bottom of Cell 3

- **(H)**: Intensive Treatment Actions - Plant 50 acres per year (500 acres in 10 years)
- **(VH)**: Very Intensive Treatment Actions - Plant 100 acres per year (500
- **BURN**: Burning O&M Activities every 3 years in a rotational cycle
- **BURN/MOW** - Burn 1 time per 10 years & Mow 2-3 yrs every 5 years

Cahokia Mounds
The purpose of this action area is to restore an area on the floodplain that supports prairie plant and animal communities as similar to presettlement (ca. 1800) conditions as practicable. The project area lies within historic Cold Prairie, a 15,000-acre prairie once found in the southeast part of the American Bottoms.

Measures Under Evaluation A total of 6 different action alternatives were considered.

Variable measures:

1. Replacement of hay production areas with prairie plantings that would be completed within a 5 or 10- year time period. In terms of area, these rates corresponded to either ~105 or ~52.5 acres planted per year.

2. Three maintenance plans were designed to maintain the integrity of prairie plant communities by periodically removing dead plant materials.

a. Burning - the entire prairie would be burned every three years on a rotational cycle (a portion would be treated every year).

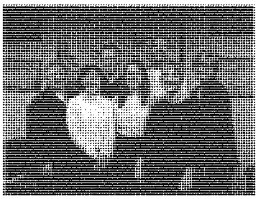
b. Burning and mowing - the entire prairie would be mowed once every two to three years, and burned once every ten years. Both treatments would be implemented on a rotational cycle.

c. Mowing only - the entire prairie would be mowed once every three years on a rotational cycle.

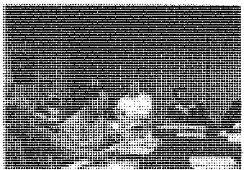
Options	Reestablish PRAIRIE from FIELD and AGCROP; Plant in various size increments per year (50, 25,10 acres/year) High Species Composition Necessary
BURN (Burning O & M Activities - every 3 years on a rotational cycle) Max HSI = 1.0	8-1-(VH)
	8-1-(H)
	8-1-(M)
	8-1-(L)
BURN/MOW (Burn 1 time per 10 years and Mow 2-3 yrs every 5 years) Max HSI = 0.90	8-2-(VH)
	8-2-(H)
	8-2-(M)
	8-2-(L)
MOWING (Mowing O & M Activities - every 3 years on a rotational cycle) Max HSI = 0.75	8-3-(VH)
	8-3-(H)
	8-3-(M)
	8-3-(L)
	Alternatives dropped from cosideration due to low biological productivity, cost ineffectiveness, and/or design inconsistencies.

- (VH) Very Intensive Treatment Actions; Plant 100 acres per year (500 acres in 5 years); High species composition (TY 11 HSI Higher than - (H) alternative)
- (H) Intensive Treatment Actions; Plant 50 acres per year (500 acres in 10 years); High species composition
- (M) Moderate Treatment Actions; Plant 25 acres per year (500 acres in 25 years); High species composition
- (L) Light Treatment Actions; Plant 10 acres per year(500 acres in 50 years); High species composition

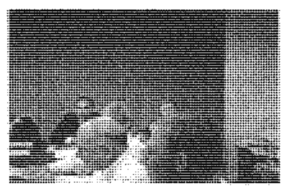
6.11 REVIEW AND EVALUATION OF INCREMENTAL COST ANALYSIS RESULTS (ICA)



The ICA results for each action area's array of alternative plans provided comparable information that could be used in the evaluation and assessment process of selecting a preferred plan. From this documentation a two-phase recommended plan selection process was facilitated by the WES project team members Kelly Burks and Tisa Webb. The Biological Team (Tim George, USACE, Ellen Starr, NRCS, Pat Malone, IDNR, Mary White, EPA Region 5, Brian Wiebler and Myra Myoshi USFWS) was assembled to evaluate incremental differences between plans in order to determine which alternative at each site achieved the best results in relation to project objectives and restoration planning targets. Each action area was addressed and ICA results systematically reviewed and compared in order to select the alternatives that would form the preferred plan. Following the Biology Teams assessment, the sponsor representatives (Dave Dietzel, Joe Parente, and Dick Worthen, Madison County, Pam Hogan, Bill Polka and Mike Mitchell, St. Clair County, Gerry Duff and Walter Greathouse Jr., MESD, Mel Allison and Rita Lee, IDNR, Debbie Roush, USACE) went through the full assessment and evaluation process to identify the Sponsor Representatives preferred plan.



Sponsor Representatives



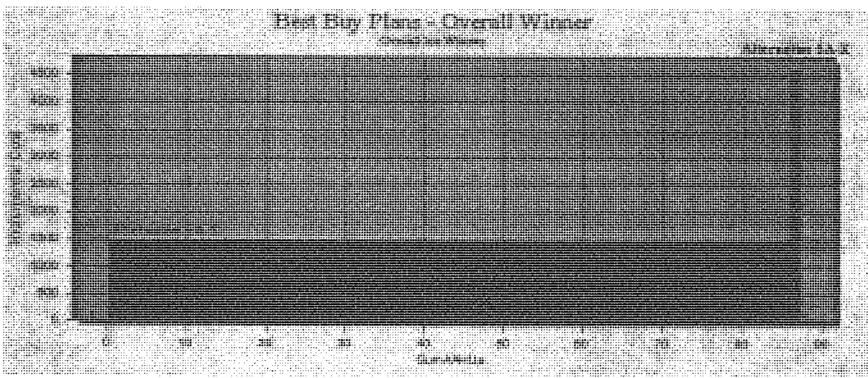
During this phase the Biology Team, and NRCS representatives from Madison, St. Clair County and the state office were present to answer questions and participate in discussions as appropriate. The following details the team assessments for each action area.

The process utilized to assess ICA results was to look at each action site's incremental output results, make an evaluation of these results and recommend an alternative that would be carried into the Preferred Project Plan. Comments received on the draft report indicated that additional benefit assessment was needed on the tributary streams in order to accurately characterize their existing, future without and future with project condition. It was determined that the Qualitative Habitat Evaluation Index (QHEI), developed by the Ohio EPA would provide the best tool to use in the assessment of tributary streams. The QHEI is a community-based model designed to provide a measure of the qualitative habitat corresponding to the physical features that affect fish and invertebrate communities. QHEI is further discussed in Appendix A where the analysis results are also displayed. The addition of this information required the re-calculation of the incremental cost analysis displayed in the draft report. Alternative outputs changed as a result of the inclusion of the QHEI assessment and the new analysis is provided in this final report. It should be noted that in no case did the originally recommended alternative change, nor did the incrementally cost effective alternative change; however the outputs and their incremental costs did.

6.11.1 Dobrey Slough

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
3	3	5A-Z	83	$121,700	$1,471
[redacted]	2	5A-Y	86	$128,100	$1,491
2	[redacted]	5A-X	87	$134,200	$1,539

Computation of Costs and Benefits. Costs and benefits for three Dobrey Slough alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 5A-Y as the most cost effective and incrementally effective alternative (ICA winner). This plan includes a restored marsh buffered in part by a 75-meter wide forested corridor. Alternative 5A-X, with a 100-meter wide corridor, was labeled as the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 5A-Y (ICA winner) provides 86 AAHUs at an average cost of $1,491 per AAHU, whereas alternative 5A-X (HEP winner) produces an additional increment of 1 AAHU at an average cost of $4,611 per AAHU. Of the three evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team did not consider the additional 25-meter corridor width of alternative 5A-X as ecologically significant, given that existing suburban development immediately surrounding much of the project area would prevent the establishment of a continuous, wider corridor. Therefore, the team chose alternative 5A-Y (ICA winner) as its preferred plan at this site. The proposed 75-acre floodplain habitat area, consisting of a restored marsh buffered by a forested corridor 75-meter wide near an existing subdivision, would provide significant ecosystem restoration benefits. The plan supports four primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, and improve water quality.

The proposed restoration of aquatic floodplain resources consisting of marsh and wetland forest habitats is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and several conservation initiatives for bird species of concern.

The alternative's proposed increase in marsh and wetland forest supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl.

The proposed increase of these aquatic habitats also supports the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more marsh and forest on the Mississippi River's floodplain from St. Louis to Cairo. The Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is expected to be supported by the alternative because quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, sedge wren, and marsh wren, are expected to benefit from the proposed marsh restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 5A-Y as the biology team's preferred plan at Dobrey Slough. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 5A-Y.

Given the rational described above, 5A-Y was advanced as the preferred alternative at Dobrey Slough.

6.11.2 Elm Slough

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
[redacted]		6A-2	745	$389,500	$523
2	3	6B-1	633	$372,100	$588
3	2	6B-2	633	$383,700	$606
0	4	6A-3	591	$398,100	$674
0	5	6B-3	476	$392,200	$824

Computation of Costs and Benefits. Costs and benefits for five Elm Slough alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative
6A-2 as the most cost effective and incrementally effective alternative (ICA winner), as well as the alternative producing the greatest number of habitat units (HEP winner). This alternative involves restoration of wetland forest in a floodplain habitat area by improving tree species diversity in existing wetland forest, restoring former wetland forest adjacent to existing wetland forest, and establishing prairie buffers between floodplain tributaries that are proposed to supply a restored flood pulse (Long Lake and Mitchell Ditch) to wetlands in the habitat restoration area.

Of the 5 evaluated alternatives, only one (6A-2) was determined to be a least cost plan, as shown in the bar chart below. Alternative 6A-2 produces 745 AAHUs at an average cost of $523 per AAHU.

Significance. The multi-agency biology planning team chose alternative 6A-2 (ICA and HEP winner) as its preferred plan at this site. The proposed 670-acre floodplain habitat area, consisting primarily of a restored wetland forest, would provide significant ecosystem restoration benefits. The plan supports four primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, and improve water quality. The proposed restoration of aquatic floodplain resources consisting of wetland forest habitat is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and several conservation initiatives for bird species of concern.

The alternative's proposed increase in wetland forest supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl.

The proposed increase of this aquatic habitat also supports the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more forest on the Mississippi River's floodplain from St. Louis to Cairo. The Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is expected to be supported by the alternative because quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, wood duck, American woodcock, cerulean warbler, prothonotary warbler, rusty blackbird, and Louisiana waterthrush are expected to benefit from the proposed wetland forest restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 6A-2 as the biology team's preferred plan at Elm Slough. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 6A-2.

Given the rational described above, 6A-2 was advanced as the preferred alternative at Elm Slough.

6.11.3 Old Cahokia Creek
Incremental Analysis of Alternatives

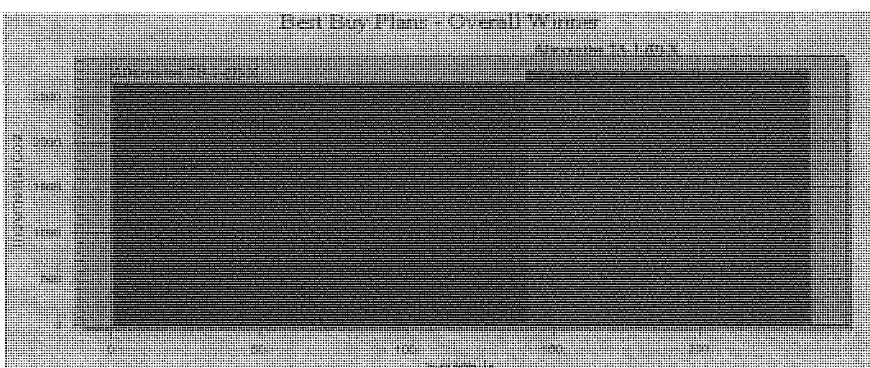
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	4	2B-1-(0)-X	141	$377,000	$2,671		
2	1	2A-1-(0)-X	238	$647,000	$2,723	97	$2,784
3	2	2A-1-(0)-Y	219	$621,000	$2,835	78	$3,128
4	3	2A-1-(0)-Z	185	$596,600	$3,217	44	$4,991
5	5	2B-1-(0)-Y	101	$350,000	$3,480	-40	
6	6	2B-1-(0)-Z	64	$326,300	$5,126	-77	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
2B-1-(0)-X	141	$377,000	$2,671	$377,000	141	$2,671
2A-1-(0)-X	238	$647,000	$2,723	$270,000	96	$2,798

Computation of costs and benefits. Costs and benefits for six Old Cahokia Creek alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 2B-1-(0)-X as the most cost effective and incrementally effective alternative (ICA winner). Alternative 2A-1-(0)-X was identified as the plan producing the greatest number of environmental outputs (HEP winner), and was second most cost effective. Under both alternatives, a floodplain habitat area of 314 acres would envelop 3.4 miles of restored floodplain stream and a 328-foot (100-meter) wide forested corridor along both sides of the restored creek channel. Under alternative 2A-1-(0)-X (HEP winner), restoration of floodplain aquatic habitat would be coupled with restoration of about seven miles of tributary streams in the Bluff 1 watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include ten sediment detention basins and creation of pool and riffle complexes.

The fundamental difference between these two alternatives is tributary stream restoration. Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 2B-1-(0)-X (ICA winner) provides 141 AAHUs at an average cost of $2,671 per AAHU, whereas alternative 2A-1-(0)-X (HEP winner) produces an additional increment of 96 AAHUs at an average cost of $2,798 per AAHU. Of the six evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 2A-1-(0)-X (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 2B-1-(0)-X (ICA winner). The incremental benefits provided by alternative 2A-1-(0)-X (HEP winner) accrue from restoration of tributary streams in a watershed that drains into the proposed floodplain habitat restoration area. This alternative takes a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated. The absence of tributary stream restoration in alternative 2B-1-(0)-X (ICA winner) would allow excessive levels of sediment carried by tributary streams in the Bluff 1 watershed to enter the proposed floodplain habitat area, and degrade aquatic floodplain resources restored by the plan.

Alternative 2A-1-(0)-X (HEP winner) would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watershed is expected to contribute to the goals of several national or regional interagency programs. These programs include the Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain stream and forest habitat under alternative 2A-1-(0)-X supports the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more forest on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force is expected to be supported by the alternative. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands as well as riparian corridors on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, wood duck,

American woodcock, black-crowned and yellow-crowned night-herons, and Louisiana waterthrush, are expected to benefit from the proposed floodplain habitat restoration, which supports the conservation efforts of the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

The proposed tributary stream restoration under alternative 2A-1-(0)-X would contribute to the Clean Water Action Plan, by restoring seven miles of streams in a small watershed (JN02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 2A-1-(0)-X as the biology team's preferred plan at Old Cahokia Creek. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 2A-1-(0)-X. The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 2A-1-(0)-X was advanced as the preferred alternative at Old Cahokia Creek.

6.11.4 Judy's-Burdick

Incremental Analysis of Alternatives

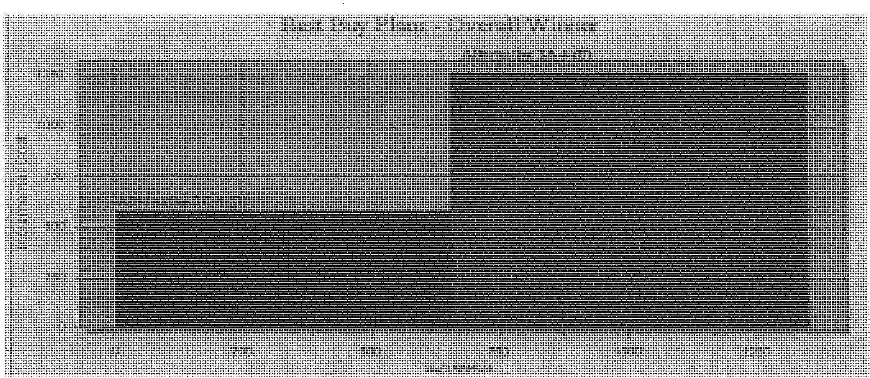
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	12	3C-4-(0)	655	$379,500	$579		
3	11	3C-4-X	660	$398,200	$603	5	$3,740
2	1	3A-4-(0)	1,350	$1,255,700	$930	695	$1,261
4	2	3A-4-X	1,342	$1,262,400	$941	-8	
5	13	3C-2-X	508	$645,700	$1,272	-147	
6	4	3A-2-(0)	1,156	$1,496,500	$1,294	501	$2,230
7	3	3A-2-X	1,163	$1,505,700	$1,295	508	$2,964
8	5	3B-2-(0)	1,132	$1,477,400	$1,305	477	$2,302
9	14	3C-2-(0)	484	$631,700	$1,305	-171	
10	6	3B-2-X	1,120	$1,493,300	$1,333	465	$2,395
11	8	3A-1-(0)	808	$1,721,100	$2,131	153	$8,769
12	7	3A-1-X	809	$1,735,100	$2,144	154	$8,803
13	9	3B-1-X	720	$1,724,600	$2,394	65	$20,694
14	10	3B-1-(0)	695	$1,706,200	$2,456	40	$33,168
15	15	3C-1-X	238	$888,700	$3,730	-417	
16	16	3C-1-(0)	227	$874,800	$3,850	-428	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
3C-4-(0)	655	$379,500	$579	$379,500	655	$579
3A-4-(0)	1350	$1,255,700	$930	$876,200	694	$1,262

Computation of Costs and Benefits. Costs and benefits for 16 Judy's-Burdick alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 3C-4-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 3A-4-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of wet prairie in a 507-acre habitat area would occur on the floodplain. Under alternative 3A-4-0 (HEP winner), the floodplain habitat area would include 0.8 miles of stream restoration, and would be coupled with restoration of about 32 miles of tributary streams in the Judy's and Burdick Branch watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 28 sediment detention basins and creation of pool and riffle complexes. Alternative 3C-4-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

The fundamental difference between these two alternatives is tributary stream restoration. Incremental differences between these two plans are displayed in the bar chart below. Alternative 3C-4-0 provides 655 AAHUs at an average cost of $579 per AAHU, whereas alternative 3A-4-0 produces an additional increment of 694 AAHUs at an average cost of $1,262 per AAHU. Of the 16 evaluated alternatives, both are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 3A-4-(0) (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 3C-4-(0) (ICA winner). The incremental benefits provided by alternative 3A-4-0 (HEP winner) accrue primarily from restoration of tributary streams in watersheds that drain into the proposed floodplain habitat restoration area. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

The absence of tributary stream restoration in alternative 3C-4-(0) (ICA winner) would allow excessive levels of sediment carried by tributary streams in the two watersheds to be captured in the habitat restoration area within a sediment detention basin. This basin would lessen the area of prairie restored in the habitat area.

Alternative 3A-4-(0) (HEP winner) would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain wet prairie under alternative 3A-4-(0) supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl. Prairie restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more prairie on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The alternative is expected to support the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, black-crowned and yellow-crowned night-herons, northern harrier, sedge wren, grasshopper sparrow, and Le Conte's sparrow, are expected to benefit from the proposed floodplain prairie restoration, which supports the conservation efforts of the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

The proposed tributary stream restoration under alternative 3A-4-(0) would contribute to the Clean Water Action Plan, by restoring about 32 miles of streams in a small watershed (JN02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 3A-4-(0) as the biology team's preferred plan at the Judy's-Burdick action area. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 3A-4-(0).

The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 3A-4-0 was advanced as the preferred alternative at Judy's-Burdick action area.

6.11.5 Brushy Lake

Incremental Analysis of Alternatives

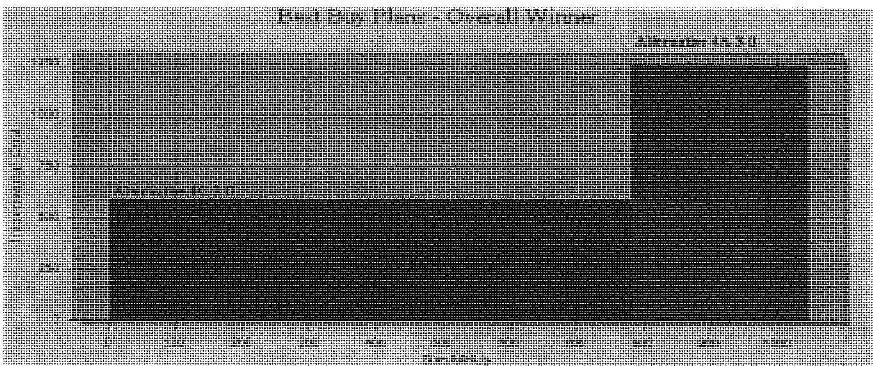
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	3	4C-3-0	782	$459,800	$588		
3	5	4B-3-0	759	$456,300	$602	-23	
2	1	4A-3-0	1,047	$787,300	$752	265	$1,237
5	4	4C-1-0	764	$888,200	$1,162	-18	
4	2	4A-1-0	1,029	$1,215,900	$1,182	247	$3,061
6	6	4B-1-0	741	$884,400	$1,193	-41	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
4C-3-0	782	$459,800	$588	$459,800	782	$588
4A-3-0	1047	$787,300	$752	$327,500	265	$1,237

Computation of Costs and Benefits. Costs and benefits for 6 Brushy Lake alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 4C-3-0 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 4A-3-0 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was also the second-most cost effective plan. Under both alternatives, restoration of forested wetland in a 717-acre habitat area would occur on the floodplain. Under alternative 4A-3-0 (HEP winner), the floodplain habitat area would include 3.5 miles of stream restoration, and would be coupled with restoration of about 25 miles of tributary streams in the Schoolhouse watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 15 sediment detention basins and creation of pool and riffle complexes. Alternative 4C-3-0 (ICA winner) would include a floodplain sediment detention basin within the habitat area, and no floodplain or tributary stream restoration.

The fundamental difference between these two alternatives is tributary stream restoration. The bar chart below displays the incremental differences between these two plans. Alternative 4C-3-0 provides 782 AAHUs at an average cost of $588 per AAHU, whereas alternative 3A-4-0 produces an additional increment of 265 AAHUs at an average cost of $1,237 per AAHU. Of the 6 evaluated alternatives, both were identified to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 4A-3-0 (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 4C-3-0 (ICA winner). The incremental benefits provided by alternative 4C-3-0 (HEP winner) accrue primarily from restoration of tributary streams in a watershed that drains into the proposed floodplain habitat restoration area. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

The absence of tributary stream restoration in alternative 4C-3-0 (ICA winner) would allow excessive levels of sediment carried by tributary streams in the watershed to be captured in the habitat restoration area within a sediment detention basin. This basin would lessen the area of prairie restored in the habitat area.

Alternative 4A-3-0 (HEP winner) would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain wetland forest under alternative 4A-3-0 supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl.

Wetland forest restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more forest on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The alternative is expected to contribute to the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force.

Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Bird species of concern, such as the mallard, wood duck, American woodcock, cerulean warbler, prothonotary warbler, rusty blackbird, and Louisiana waterthrush are expected to benefit from the proposed wetland forest restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

The proposed tributary stream restoration under alternative 4A-3-0 would contribute to the Clean Water Action Plan, by restoring about 25 miles of streams in a small watershed (JN02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 4A-3-0 as the biology team's preferred plan at Brushy Lake. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 4A-3-0. The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 4A-3-0 was advanced as the preferred alternative at Brushy Lake.

6.11.6 Cahokia Mounds

Incremental Analysis of Alternatives

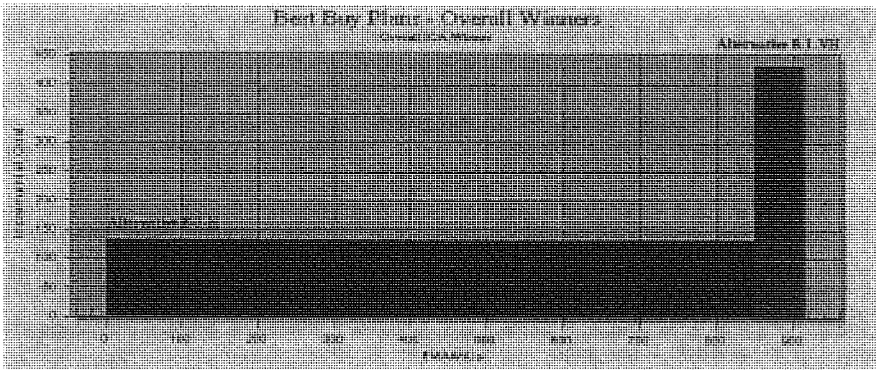
ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	2	8-1- (H)	849	$113,200	$133		
2	1	8-1- (VH)	915	$141,700	$155	66	$432
3	4	8-2- (H)	631	$115,900	$184	-218	
4	3	8-2- (VH)	710	$144,500	$204	-139	
0	5	8-3- (VH)	277	$146,100	$528	-572	
0	6	8-3- (H)	207	$117,300	$567	-642	

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
8-1-H	849	$113,200	$133	$113,200	849	$133
8-1-VH	915	$141,700	$155	$28,500	66	$432

Computation of Costs and Benefits. Of the six plans evaluated for Cahokia Mounds, the incremental cost analysis identified alternative 8-1-(H) as the most cost effective alternative (ICA winner). This plan restores 525 acres of floodplain prairie over a 10-year period, and uses burning for prairie maintenance. Alternative 8-1-(VH) was labeled as the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs).

This plan restores 525 acres of floodplain prairie over a 5-year period, and maintains prairie habitat by burning. Incremental differences in cost and output between these two plans are displayed in the bar chart below. Alternative 8-1-(H) (ICA winner) provides 849 AAHUs at an average cost of $133 per AAHU, whereas alternative 8-1-(VH) (HEP winner) produces an additional increment of 66 AAHU at an average cost of $432 per AAHU. Of the six evaluated alternatives, both plans are considered to be least cost plans that produce alternative levels of environmental output.



Significance. The difference in habitat units produced by plans 8-1-(H) (ICA winner) and 8-1-(VH) (HEP winner) reflects a five year difference in duration of prairie implementation, and the multi-agency biology planning team agreed that this difference was not substantial. The team chose alternative 8-1-(H) (ICA winner) as its preferred plan at this site. The proposed 525 acres of floodplain prairie restoration would provide significant ecosystem restoration benefits. The plan supports two primary study objectives: restore natural areas and restore habitat quality. The proposed restoration of aquatic floodplain resources consisting of floodplain prairie is expected to contribute to the goals of several national or regional interagency programs. These programs include the Upper Mississippi River System Environmental Management Program and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in floodplain prairie under alternative 8-1-(H) contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more prairie on the Mississippi River's floodplain from St. Louis to Cairo.

Bird species of concern, such as the mallard, northern harrier, sedge wren, grasshopper sparrow, and Le Conte's sparrow, are expected to benefit from the proposed floodplain prairie restoration, which supports the conservation efforts of the North American Waterfowl Management Plan and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 8-1-(H) as the biology team's preferred plan at Cahokia Mounds. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 8-1-(H).

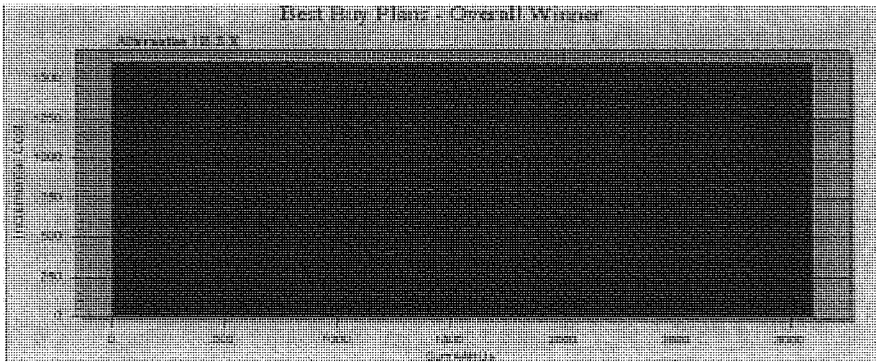
Given the rational described above, 8-1-(H) was advanced as the preferred alternative at Cahokia Mounds.

6.11.7 Spring Lake

Incremental Analysis of Alternatives

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
1	1	1B-3-X	3,105	$4,975,075	$1,602
2	2	1A-3-X	3,026	$4,985,891	$1,648
3	4	1E-3-X	1,901	$3,156,737	$1,661
4	3	1C-3-X	2,787	$4,971,933	$1,784
5	5	1D-3-X	1,746	$3,167,487	$1,814
6	6	1F-3-X	1,602	$3,153,528	$1,969

Computation of Costs and Benefits. Costs and benefits for 6 Spring Lake alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 1B-3-X as the most cost effective and incrementally effective alternative (ICA winner). Of the 6 evaluated alternatives, only 1B-3-X was determined to be a least cost plan, as shown in the bar chart below. It produces 3,105 AAHUs at an average cost of $1,602 per AAHU. A 1,364 acre floodplain habitat area consisting mainly of marsh and forested wetlands is to be established at three separate locations adjacent to Harding and Lansdowne Ditches. Under this alternative, the floodplain habitat area would include 3.1 miles of stream restoration, and would be coupled with restoration of about 99 miles of tributary streams in the Little Canteen and Canteen Creek watersheds, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 58 sediment detention basins and creation of pool and riffle complexes.



Significance. The multi-agency biology planning team accepted alternative 1B-3-X (ICA and HEP winner) as its preferred plan at this site. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

Alternative 1B-3-X would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, restore tributary streams, and restore floodplain streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the proposed increase in marsh and floodplain wetland forest under alternative 1B-3-X supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl. Marsh and wetland forest restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more marsh and forest on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams. The alternative is expected to contribute to the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff.

The proposed tributary stream restoration under alternative 1B-3-X would contribute to the Clean Water Action Plan, by restoring about 99 miles of streams in a small watershed (JNA01 and JMAC02) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 1B-3-X as the biology team's preferred plan at Spring Lake. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 1B-3-X. The study sponsors acknowledged and accepted the cost of this alternative, and recognized the environmental benefits it affords from tributary stream restoration.

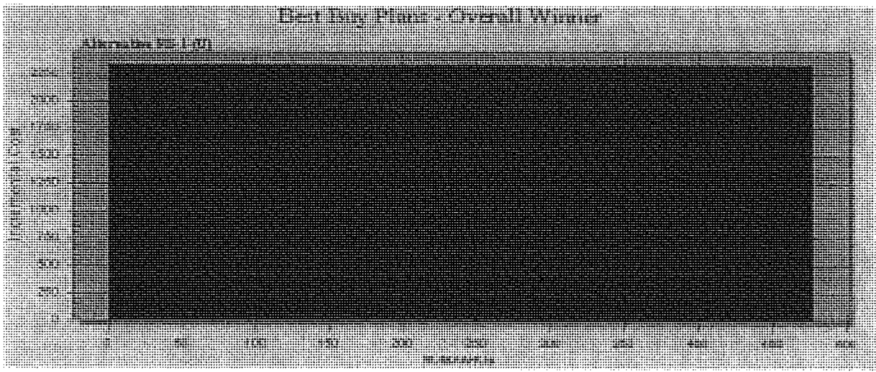
Given the rational described above, 1B-3-X was advanced as the preferred alternative at Spring Lake.

6.11.8 Wedgewood.

Incremental Analysis of Alternatives

ICA Ranking	HEP Ranking	Alternative	Output (AAHU)	Annualized Cost	Cost Per AAHU
1	1	9B-1-(0)	478	$1,115,000	$2,334
2	2	9A-1-(0)	371	$1,097,100	$2,959
3	3	9C-1-(0)	332	$1,093,700	$3,290
4	4	9D-1-(0)	-54	$388,538	($7,228)

Computation of Costs and Benefits. Costs and benefits for 4 Wedgewood alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 9B-1-(0) as the most cost effective and incrementally effective alternative (ICA winner). Of the 4 evaluated alternatives, only 9B-1-(0) was determined to be a least cost plan, as shown in the bar chart below. It produces 478 AAHUs at an average cost of $2,334 per AAHU. A 124-acre floodplain habitat area consisting of marsh would be established adjacent to Harding Ditch. This alternative also includes restoration of about 37 miles of tributary streams in the Schoenberger Creek watershed, which drain into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 24 sediment detention basins and creation of pool and riffle complexes.



Significance. The multi-agency biology planning team accepted alternative 9B-1-(0) (ICA and HEP winner) as its preferred plan at this site. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated.

Alternative 9B-1-(0) would provide significant ecosystem restoration benefits. The plan supports six primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, and restore tributary streams. The proposed restoration of marsh in the floodplain and streams in adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Acceptability. As a result of comments received during public review of the draft report, which occurred between 28 February and 7 May 2003, this Action Area was eliminated and is not carried forward into the Recommended Plan. Additional information is contained in Appendix G regarding this action.

Given the rational described above, no alternative was advanced for Wedgewood.

6.11.9 Mullens Slough.

Incremental Analysis of Alternatives

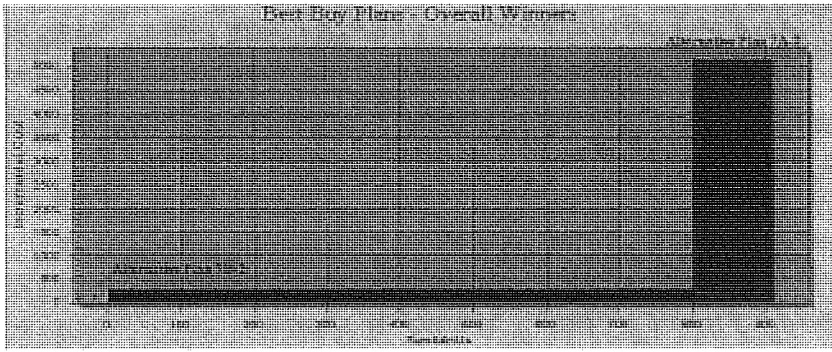
ICA Ranking	HEP Ranking	Alternative	AAHUs	Cost	Cost Per AAHU	Difference in Increment	Difference in Incremental Cost
1	4	7B-2	730	$234,700	$322		
3	5	7B-3	712	$233,900	$328	-18	
5	6	7B-1	695	$233,700	$336	-35	
2	1	7A-2	912	$794,400	$871	182	$3,079
4	2	7A-3	894	$796,900	$892	164	$3,432
6	3	7A-1	877	$794,200	$906	147	$3,816

Best Buy Alternatives

Alternative	Sum AAFCUs	Total Cost	Avg. Cost (AAFCUs)	Incremental Cost	Incremental Output (AAFCUs)	Incremental Cost Per Output
No Action	0	$0	$0	$0	0	$0
7B-2	730	$234,700	$322	$234,700	730	$292
7A-2	912	$794,400	$871	$559,700	182	$3,079

Computation of Costs and Benefits. Costs and benefits for 6 Mullens Slough alternatives are displayed in the table above. The cost analysis process (as presented in Appendix A) identified alternative 7B-2 as the most cost effective and incrementally effective alternative (ICA winner). Alternative 7A-2 was determined to be the "HEP winner" because it produced the greatest number of environmental benefits in terms of average annualized habitat units (AAHUs). This alternative was the second-most cost effective plan. Under both alternatives, a 312-acre floodplain area consisting of lake, prairie, and herbaceous wetland habitats is to be established adjacent to the confluence of Powdermill Creek and Canal No. 1. Under alternative 7A-2 (HEP winner), the floodplain habitat area would be coupled with restoration of about 16 miles of tributary streams in the Powdermill Creek watershed, which drains into the proposed habitat area. Tributary stream restoration would consist of measures to restore physical characteristics of stream habitat, and would include 20 sediment detention basins and creation of pool and riffle complexes. Alternative 7B-2 (ICA winner) would include two floodplain sediment detention basins within the habitat area, and no tributary stream restoration.

The fundamental difference between these two alternatives is tributary stream restoration. The bar chart below displays the incremental differences between these two plans. Alternative 7B-2 provides 730 AAHUs at an average cost of $322 per AAHU, whereas alternative 7A-2 produces an additional increment of 182 AAHUs at an average cost of $3,079 per AAHU. Of the 6 evaluated alternatives, both were identified to be least cost plans that produce alternative levels of environmental output.



Significance. The multi-agency biology planning team chose alternative 7A-2 (HEP winner) as its preferred plan at this site. This alternative represents a least cost plan with a higher output of environmental benefits than alternative 7B-2 (ICA winner). The incremental benefits provided by alternative 7A-2 (HEP winner) accrue primarily from restoration of tributary streams in watersheds that drain into the proposed floodplain habitat restoration area. This alternative would take a watershed approach to addressing problems identified in the project area. Inclusion of tributary stream restoration recognizes the fact that these streams are significant components of the ecosystem, and they provide important aquatic resources that, due to their location, cannot be replicated. The absence of tributary stream restoration in alternative 7B-2 (ICA winner) would allow excessive levels of sediment carried by tributary streams in the watershed to be captured in the habitat restoration area within a sediment detention basin. This basin would lessen the area of forested wetland restored in the habitat area

Alternative 7A-2 would provide significant ecosystem restoration benefits. The plan supports all seven primary study objectives: restore natural areas, restore flood pulse, restore habitat quality, improve water quality, reduce erosion, and restore tributary streams. The proposed restoration of aquatic resources in the floodplain and adjacent watersheds is expected to contribute to the goals of several national or regional interagency programs. These programs include the North American Waterfowl Management Plan, Upper Mississippi River System Environmental Management Program, Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Clean Water Action Plan, and several conservation initiatives for bird species of concern.

Specifically, the restoration of fringe wetlands around the lake under alternative 7A-2 supports the goal of the North American Waterfowl Management Plan and the Upper Mississippi River/Great Lakes Region Joint Venture for additional wetlands on the Mississippi River's floodplain in Illinois to benefit migratory waterfowl. Prairie restoration contributes to the Habitat Needs Assessment of the Upper Mississippi River System Environmental Management Program, which calls for more prairie on the Mississippi River's floodplain from St. Louis to Cairo, and increased habitat diversity such as in the form of floodplain streams.

The alternative is expected to contribute to the Action Plan of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Quality of surface waters introduced as a flood pulse into the proposed habitat area is anticipated to improve, which supports the Plan's recommendation of using wetlands on the Mississippi River's floodplain for retention of nitrogen carried by surface runoff. Numerous bird species of concern, consisting of various waterfowl, waterbirds, and shorebirds, are expected to benefit from the proposed aquatic restoration, which supports the conservation efforts of the North American Waterfowl Management Plan, North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, and Neotropical Migratory Bird Conservation Program to protect those bird species with declining or low population levels. Such bird species include the American wigeon, northern pintail, canvasback, least bittern, common moorhen, greater yellowlegs, Hudsonian godwit, and stilt sandpiper.

The proposed tributary stream restoration under alternative 7A-2 would contribute to the Clean Water Action Plan, by restoring about 16 miles of streams in a small watershed (JMA01) that Illinois has identified as a priority watershed for restoration. Bird species of concern, such as the black-crowned and yellow-crowned night-herons and Louisiana waterthrush, are expected to benefit from this tributary stream restoration, which supports the conservation efforts of the North American Waterbird Conservation Plan and Neotropical Migratory Bird Conservation Program.

Acceptability. As partners on the interagency biology planning team, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, and Illinois Department of Natural Resources supported alternative 7A-2 as the biology team's preferred plan at Mullens Slough. The sponsors of this study, representing the State of Illinois, Madison and St. Clair Counties, and the Metro East Sanitary District, concurred with the biology team's preference for alternative 7A-2. The study sponsors acknowledged and accepted the increased incremental cost of this alternative, and recognized the additional environmental benefits it affords.

Given the rational described above, 7A-2 was advanced as the preferred alternative at Mullens Slough.

6.12 REVIEW AND EVALUATION OF PLANS.

This section assesses performance of the Biological, Incremental, and Preferred Plans. These plans are comprised of one alternative from each of the proposed action areas. The Biological Plan consists of those alternatives that produced the greatest environmental outputs (HEP winners). The Incremental Plan consists of the cheapest, most cost effective and cost efficient alternatives (ICA winners). The Preferred Plan consists of those alternatives preferred by the biology team and study sponsors.

Evaluation of these plans included comparison with a No-Action Plan. Section 4 - Without Project Conditions addresses the effects of a No-Action Plan recommendation. The No-Action Plan is a "do nothing" scenario, and makes no contribution to any of the planning objectives. Several criteria have been used to assess performance of the Biological, Incremental, Preferred, and No-Action Plans.

First, the planning objectives and targets presented in Section 5 facilitate quantitative comparisons of effectiveness of the four plans. Second, comparison of costs and benefits using cost analysis was used as another quantitative tool to assist in the evaluation process. Lastly, qualitative indicators, including acceptability, completeness, efficiency, significance, and reasonableness of costs, allow for further assessment of these plans. The evaluation of plan performance against all of these criteria facilitates the selection of one of these plans as the Recommended Plan.

6.12.1 Effectiveness – Achievement of Planning Objectives.

Table 6-1 presents a summary of the effectiveness of the four plans. Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives. The Biological and Preferred Plans are more effective than the Incremental Plan in achieving the planning objectives. The table is followed by discussions of performance against each of the seven primary objectives and one social (incidental) objective.

Table 6-1 Summary of the performance of each plan with respect to each of the planning objectives their targets.

Objective	Target	Biological Plan	Incremental Plan	Preferred Plan	No-Action Plan
1 – Restore natural areas	Total area of habitat restored (acres)	4,885	4,440	4,830	0
2 – Restore flood pulse	% of action areas with depth of design flood < depth of 1844 flood	83	83	83	N/A
3 – Restore habitat quality	% of action areas with at least moderate habitat quality (average for 9 species)	75	60	76	N/A
4 – Improve water quality	Relative area affected	tributaries & floodplain	floodplain	tributaries & floodplain	N/A
5 – Reduce tributary erosion	% estimated sediment reduction	70	0	70	N/A
6 – Restore tributary streams	Total length of restored streams (miles)	178	99	178	N/A
7 – Restore floodplain streams	Total length of restored stream (miles)	10.8	9.7	10.8	N/A
8a – Reduce flood damages	Damages reduced by design event incidental to restoration of flood pulse (dollars)	$1,300,000	$1,300,000	$1,300,000	N/A
8b– Enhance outdoor recreation	Relative area affected	floodplain	floodplain	floodplain	N/A
8c – Protect cultural resources	Total area of known archaeological sites within action areas (acres)	999	990	989	N/A

Objective No. 1. Restore Natural Areas. Each of the three action plans establishes over 4,000 acres of restored and created habitats. Table 6-1 displays the area of various natural habitats established by each plan. This information comes from the Habitat Assessment in Appendix A. The Biological Plan affects the largest area, and the Preferred Plan is intermediate in size, or 55 acres less than the Biological Plan.

The Incremental Plan affects the smallest area, or 385 acres fewer than the Biological Plan. The greatest difference among the plans is the lack of riparian forest restoration along tributary streams in the Incremental Plan. Table 6-2 displays the area of restored habitats by natural community.

Table 6-2 Comparison of major plans showing area of restored habitats by natural community.

Natural Community	Area (acres)			
	Biological Plan	Incremental Plan	Preferred Plan	No Action Plan
Riparian forest - tributary streams	378	0	378	0
Floodplain nonwetland forest	131	131	131	0
Floodplain wetland forest	1,666	1,606	1,658	0
Prairie	1,158	1,074	1,111	0
Herbaceous wetland	857	951	857	0
Lake & pond	522	522	522	0
Stream	161	145	161	0
Cultural	11	11	11	0
Total Area	4,885	4,440	4,830	0

Based on the planning targets for this objective, the three action plans would achieve similar levels of expansion for each of four main types of natural communities. The three action plans would attain nearly 90 percent of the expansion target for forested wetland, and about 70 percent for prairie (Table 6-3). Targets for new marsh and restored floodplain streams would be exceeded by all three action plans. While the plans fall short of the targets for forested wetland and prairie, they should not be considered unsuccessful, as these targets were established for planning purposes and acted as benchmarks against which to compare plans. The planning team found that existing development on the floodplain acted as the greatest constraint on opportunities for expansion of existing habitats into larger contiguous areas. The desire to avoid horseradish fields also limited opportunities for habitat expansion. Targets for new marsh and restored streams were exceeded because they were relatively small compared to the targets for forested wetland and prairie, and more opportunities for marsh creation and stream restoration arose than were originally anticipated.

Table 6-3 Achievement of objective 1 (restore natural areas) by the major plans.

Natural Community	Target	Percent of Target Achieved			
		Biological Plan	Incremental Plan	Preferred Plan	No-Action Plan
Forested wetland (existing & new)	1,880 acres	89%	85%	88%	0%
Prairie (existing & new)	1,612 acres	72%	67%	69%	0%
Marsh (new)	100 acres	857%	951%	857%	0%
Restored channel (existing & new, excluding ditches)	3.0 miles	360%	323%	360%	0%

Objective No. 2. Flood Pulse. The three action plans do not differ in any substantial manner with regard to restoration of a flood pulse. All three action plans are designed to restore a flood pulse to habitats in the bottoms. The historic hydrological condition would be mimicked using storm water from the tributary streams. The amount of storm water to be used is the same for all three plans.

Under each plan, restored flood pulses would affect up to roughly 3,800 acres of habitats. All affected areas experienced historic flooding from the Mississippi River and tributary streams.

A flood pulse would be restored to seven action areas: Old Cahokia Creek, Judy's-Burdicks, Elm Slough, Dobrey Slough, Brushy Lake, Spring Lake, and Mullens Slough. Because the amount of storm water entering these action areas and the area of habitats to be flooded do not substantially differ from one plan to another, the three plans are expected to be very similar in regard to the depth and duration of a variety of flood pulses resulting from a range of storm water events.

The planning target for this objective is a flood pulse that does not exceed the depth of the Mississippi River flood of 1844 at St. Louis, nor extend for more than 14 days in duration. Table 6-4 displays estimates of flood depth during the peak of the 1844 flood event for the seven action areas, and estimated depth and duration of the design flood event at these same areas. The design flood event is the flood event of greatest depth to be directed into an action area. For some action areas, depth and duration of the design event have not been estimated because information is currently lacking.

The three action plans conform to the planning target at nearly all assessed action areas. Table 6-4 shows that the design event at six of seven (89 percent) assessed action areas would not be deeper than the flood of 1844. At all five action areas that were evaluated for duration, the length of design events would be less than 14 days.

Depth of design events are less than the 1844 event at most action areas because of two major constraints imposed by today's environment. First, the amount of water currently available to serve as a flood pulse is considerably less compared to historic conditions. Secondly, the interior flood control system and other floodplain development impose an upper limit to the depth of ponded storm water.

Table 6-4 Depth and duration of design flood events in action areas for the action plans, compared to the 1844 flood at St. Louis (all figures are estimates).

Proposed Action Area and Plan	Peak of 1844 Flood		Peak of Design Event, Three Action Plans			Depth of Design Event < 1844 Flood?	Duration of Design Event < 14 Days?
	Surface elevation, feet NGVD	Range of water depth across site, feet	Surface elevation, feet NGVD	Range of water depth (ponding) across site, feet	Total duration of ponding, hours (days)		
Old Cahokia Creek	428	0-3	431	0-6	140 (5.8)	no	yes
Judy's-Burdicks	426	6-8	424	4-6	15 (0.6)	yes	yes
Dobrey Slough	426	1-15	415	0-5	not estimated	yes	-
Elm Slough	426	10-20	410	0-5	60 (2.5)	yes	yes
Brushy Lake	424	5-20	412	0-7	20 (0.8)	yes	yes
Indian Lake (Spring Lake)	422	15-20	406	1-6	not estimated	yes	-
Cell 1 (Spring Lake)	421	1-10	416.5	6-7	120 (5.0)	yes	yes
Mullens Slough: all 3 plans	419	5-10	not estimated	0-4	not estimated	-	-

Depth of the design event exceeds the 1844 flood at one action area, Old Cahokia Creek. Here the difference is about three feet. This action area is unique because it is located on a natural floodplain terrace, much of which was elevated above the peak of the 1844 flood. Unlike the flood of 1844, the flood pulse of the design event would be detained upstream by an abandoned railroad embankment that crosses the historic channel of Cahokia Creek in the southern portion of the action area. Maximum depth of the design event (about 6 feet) would be similar to that of other action areas. Temporary detention of storm water upstream of the embankment would incidentally protect existing development to the south that lies adjacent to the action area. Under each plan, storm water for the design event would pass downstream of the embankment and remain confined to the restored channel.

Objective No. 3. Restore Habitat Quality. For this objective, the action plans were assessed against the planning target of achieving moderate habitat quality or better for each evaluation species in all restored habitats of the proposed action areas. Moderate habitat quality was considered to be a habitat suitability index of 0.5, based on a scale of 0 to 1, with 0 representing no quality and 1 optimal quality. Each plan's performance is based on the results of the Habitat Assessment described in Appendix A. The reference point in time for comparisons of habitat quality was target year 51, or the end of the 50-year planning period, for which the interagency planning team of biologists projected future habitat conditions.

As shown in Table 6-5, only two of the nine evaluation species achieve at least moderate habitat quality under all three action plans at all action areas with suitable habitat. They are the marsh wren, which uses herbaceous wetlands such as marshes, and the white crappie, typical of lakes and ponds. Two additional species, the black crappie and great blue heron, also exhibit the same degree of achievement of moderate habitat quality for each plan, although not at every action area.

For each of the remaining five species, the three action plans differ in the degree to which they provide moderate-quality habitats. The Incremental Plan ranks below the Biological and Preferred Plans in terms of the proportion of action areas averaged across all species with at least moderately suitable habitats. Compared to the Incremental Plan, the Biological and Preferred Plans achieve a greater percentage of action areas with moderate-quality habitat conditions.

Varying degrees of habitat specificity among the nine evaluation species probably explains why expected future habitat conditions are not reflective of at least moderate quality at all action areas. Some species are habitat specialists while others are habitat generalists. Using other words, a given type of habitat cannot satisfy the requirements of all species. For example, in this study the eastern meadowlark was associated only with prairies because it prefers grasslands, meadows, and pastures. The great blue heron, on the other hand, is a generalist because it uses a wide variety of habitats, including floodplain and upland forests, marshes, ponds and lakes, and streams. Although many of the proposed action areas contain a variety of habitats, habitat types used or preferred by all nine evaluation species are unlikely to be present at each action area.

Therefore, habitat specialists would tend to encounter less favorable habitat conditions than habitat generalists from one action area to the next. Similarly, an action area like Cahokia Mounds, where a 525-acre prairie restoration is proposed, would offer high quality habitat to a specialist like the meadowlark, but none to the great blue heron, which is not associated with prairies.

Table 6-5 Comparison of action plans showing percentage of proposed action areas having at least moderately (0.5) suitable habitat for nine evaluation species at the end of the 50-year planning period.

Evaluation species	**No. of action areas with suitable habitat, depending on plan (at most 9)**	**Percent of action areas with habitat suitability index ≥ 0.5 at target year 51**		
		Biological Plan	**Incremental Plan**	**Preferred Plan**
Black crappie	6	83	83	83
Eastern meadowlark	5 or 6	100	83	100
Fox squirrel	5 or 6	100	0	100
Great blue heron	8	63	63	63
Marsh wren	6 or 7	100	100	100
Mink	8	50	63	63
Slider turtle	8	25	13	25
White crappie	1	100	100	100
Wood duck	8	50	38	50
Average across all species		75	60	76

Objective No. 4. Improve Water Quality. The planning target for this objective is improvement of water quality for all surface waters comprising the interior flood control system. These features include stream channels in the tributary watersheds, and ditches, canals, and channels in the bottoms that carry tributary flow and local runoff to the Mississippi River. Water bodies connected to waterways in the bottoms, such as Horseshoe Lake, are also part of the flood control system.

The three action plans attempt to improve water quality by reducing sedimentation, a major source of water quality impairment in the project area. Sediment reduction measures proposed in the tributary watersheds include relatively small in-stream sediment detention basins as well as activities to stabilize channel banks and bottoms, including the creation of riffle and pool complexes. Measures proposed in the bottoms are limited to relatively large sediment detention basins. All plans incorporate measures that have been designed to achieve a minimum 70 percent reduction in sediment transported downstream into restored habitat areas.

As displayed in Table 6-1, the Biological and Preferred Plans meet this objective to a greater degree than the Incremental Plan. About 78 percent of the tributary watershed area that drains into the bottoms would be restored by measures incorporated into the Biological and Preferred Plans. Implementation of stream restoration measures in the tributary watersheds would improve water quality of tributary streams and many surface waters in the bottoms. These plans would address water quality as a structural component of the ecosystem by altering physical habitat. Expected improvement of substrate conditions, in stream cover, and pool and riffle complexes would lead to increased aeration, lower turbidity levels, and lower water temperature. Measures to restore physical habitat would also ensure the protection of restored habitat resources on the floodplain in a more complete and sustainable way.

Under the Incremental Plan, tributary stream restoration measures are lacking in 79 miles of tributary streams that would continue to experience degradation and loss of habitat quality. In the bottoms, only those surface waters downstream of the floodplain sediment detention basins would receive improved water quality and then only by the elimination of sediments. While protecting restored floodplain resources from sediment, the Incremental Plan does not address other important water quality issues that are a component of restoring a more natural hydrologic regime. Sediments would have to be periodically removed from floodplain detention basins, thereby increasing the operation and maintenance efforts for the project.

Objective No. 5. Reduce Erosion. Under this objective, the three action plans were evaluated against the planning target of reducing by 70 percent the total amount of sediment entering the bottoms from the tributary watersheds. In Table 6-1, only the Biological and Preferred Plans are displayed as meeting this objective. The desire to reduce erosion stems from the desire to protect restored habitat areas on the floodplain from the debilitating effects of receiving large sediment loads that have no means of being transported out of these areas once deposited. The three plans perform differently with respect to this planning target. The Biological and Preferred Plans would implement measures that retain sediment in the tributary watersheds, whereas the Incremental Plan would allow sediment to continue to enter the bottoms, where it would be captured in floodplain sediment detention basins in all but one action area.

Although sediment reduction measures incorporated into the three plans are designed to achieve 70 percent efficiency, only the Biological and Preferred Plans would contribute to the achievement of Planning Objective 6, the restoration of stream resources.

Objective No. 6. Restore Tributary Streams. In Table 6-1, the Biological and Preferred Plans are depicted as meeting this objective, and the Incremental Plan as not meeting it. The planning target for this objective is improvement of physical stream habitat and function in as many tributary watersheds as possible. The Incremental Plan incorporates measures to improve tributary streams at only one action area. It is a one-dimensional plan at the remaining 4 action areas with a tributary stream connection and segments these floodplain ecosystems from their tributary watershed. The Biological and Preferred Plans include the same set of various measures to stabilize channel banks and bottoms and include the creation of riffle and pool complexes. About 77 percent of the tributary watershed area, or 178 miles of tributary streams that drain into the bottoms, would be restored by the Biological and Preferred Plans using measures to stabilize channel banks and bottoms and restore pool and riffle complexes.

Objective No. 7. Restore Floodplain Streams. For this objective, the planning target consists of two parts - recreation of four miles of flowing floodplain streams with associated riparian habitat, and establishment of three miles of riparian corridor linkages between existing or proposed habitats. These linkages are to center upon existing floodplain channels, and have a width of 100 meters on each side of the channel.

With regard to the first part of the target, the Biological and Preferred Plans would both achieve 10.4 miles or 260 percent of the restoration target (Table 6-1). The Incremental Plan would attain 9.7 miles or 242 percent of the target. Under all three action plans, a 100-meter wide riparian corridor would be established on both sides of restored stream channels wherever possible. Proposed channel restorations exceed the target under all plans because opportunities to restore channels within the habitat areas of floodplain action areas had not yet been recognized at the beginning of the planning process when targets were established. Once this opportunity became evident at one site, it was recognized at a number of other locations.

Pertaining to the second part of the target, riparian corridors linking habitat areas were included in the early formulation of alternatives at several action areas. Such action areas include Judy's-Burdicks, Brushy Lake, and Spring Lake. At these sites, potential upland-floodplain linkages were identified along existing channels leading away from the bluff, such as Burdick and Schoolhouse Branches and Harding Ditch. In these instances, existing upland forest habitats in the bluffs could be linked with existing or proposed habitats on the floodplain. Potential linkages of habitats within the floodplain were also identified within the Spring Lake action area, including a corridor along Harding Ditch "upstream" of I-255 and between Cell 1 and St. Clair Farms, and one along a new ditch connecting Cell 1 and Indian Lake. Corridor widths of 50, 75, and 100 meters on each side of existing waterways were considered.

In contrast to the ecological benefits of creating linkages in an urban environment where such linkages have largely disappeared due to development, the planning team, including the interagency team of biologists, identified socio-economic concerns associated with the establishment of linkages. For linkages between the bluff and floodplain, concerns include the increased potential for collisions between wildlife and motor vehicles on Illinois Route 157 (the highway along the base of the bluff), and the high potential for the footprint of proposed riparian corridors to impact existing agricultural lands that support production of the specialty crop, horse radish. The proposed widening of Route 157 by the Illinois Department of Transportation from two to four lanes would increase vehicle traffic and the potential for collisions with wildlife. Also, existing development lies within the footprint of all potential corridors, including those within the floodplain. Such development would either have to be relocated, or remain in place with the corridor going around it, which would lessen the corridor's effectiveness to wildlife.

Given these concerns, the concept of riparian corridors was dropped from further consideration at successive stages of evaluation. Corridors along Schoolhouse Branch at Brushy Lake, Harding Ditch at Spring Lake (in the vicinity of Caseyville and near I-255), and the new Fairmont City ditch at Spring Lake. Corridors were carried forward to intermediate stages of evaluation but were eventually deleted. For the three action plans, there is one proposed linkage totaling 0.2 miles, or 7 percent of the 3-mile target.

Objective No. 8a. Reduce Flood Damages. The three action plans do not differ in any substantial manner with regard to the incidental reduction of flood damages. All three plans are designed to restore a flood pulse to habitats in the bottoms using water available from the tributary streams. Under each plan, restored flood pulses would affect up to roughly 3,800 acres of habitats and as a result provide incidental flood damage reduction to surrounding urban and agricultural areas. No plan removes acres from the existing 100-year flood plain.

Objective No. 8b. Enhance Outdoor Recreation. For this objective, the measure of performance is the relative geographic extent of outdoor recreational opportunities that would be created as part of the project. Recreational opportunities include walking/hiking/exercise, outdoor education, nature study, photography, and fishing. All three action plans provide the same recreation opportunity, which is a proposed bike trail along the restored floodplain stream at the Cahokia Creek action area.

Objective No. 8c. Protect Cultural Resources. The measure of performance for this objective is the area of known archaeological sites that occur within the boundaries of all action areas for each plan. A geographical database of identified archaeological sites, maintained by the Illinois State Museum, permitted the determination of area of sites. All three action plans encompass over 1,000 acres of known sites (Table 6-1). The Biological Plan, which affects the most land of the three plans, encompasses the greatest area of sites. The Incremental and Preferred Plans envelop about 10 fewer acres of known archaeological sites.

Details about known archaeological sites at each action area, such as total number and total area are not provided in this report so as to not jeopardize their integrity. The fact that roughly one-quarter of the entire area enveloped by the three plans has been identified as an archaeological site attests to the high concentration of prehistoric cultural resources in the project area.

6.12.2 Evaluation using Cost Analysis.

While the Incremental Plan produces the lowest output of habitat unit, its first cost is significantly less than either the Biological or Preferred Plans (Table 6-6). The Biological Plan has the highest first cost of the plans but produces the highest habitat unit outputs (Table 6-7). The Preferred Plan consists of alternatives chosen by the biological team and study sponsors, as described in Section 6.11 above (Table 6-8). They represent least-cost alternatives, whether the cheapest least-cost alternative or more expensive alternative providing additional benefits. The Preferred Plan has a first cost slightly lower than the Biological Plan with lower habitat unit outputs and significantly higher first cost and habitat unit output as compared to the Incremental Plan. However, this plan includes the restoration of an additional 79 miles of tributary streams that was deemed to be an essential component of watershed level restoration. The linkage of restored floodplain habitat areas to streams produces improved habitat outputs, quality and sustainability. Table 6-9 provides a comparison of the Biological and Preferred Plan to the Incremental Plan for the purposes of displaying the incremental differences in outputs and costs between plans.

Table 6-6 Cost Analysis for Incremental Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2B-1-(0)-X	141	$377,000	$2,671	X		5.65
Brushy: 4C-3-0	782	$459,800	$588	X		6.95
Judy's: 3C-4-(0)	655	$379,500	$579	X		5.68
Cahokia: 8-1-(H)	849	$113,300	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7B-2	730	$234,700	$322	X		3.51
TOTAL	**7093**	**$7,056,975**	**$995**	**8**	2	**$105.68**

*After relative value indexing **Based on planning estimates

Table 6-7 Cost Analysis for Biological Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-X	87	$134,200	$1,539		X	2.0
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3-(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(VH)	915	$141,700	$155		X	2.05
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	**8399**	**$9,124,875**	**$1,086**	**2**	**8**	**$136.57**

* After relative value indexing **Based on planning estimates

Table 6-8 Cost Analysis for Preferred Plan

Alternative	Output (AAHU)*	Annualized Cost**	Cost Per AAHU	ICA Winner	HEP Winner	Total Cost (millions)**
Dobrey: 5A-Y	86	$128,100	$1,491	X		1.92
Elm: 6A-2	745	$389,500	$523	X	X	5.84
Cahokia: 2A-1-(0)-X	238	$647,000	$2,723		X	9.69
Brushy: 4A-3(0)	1047	$787,300	$752		X	11.79
Judy's: 3A-4-(0)	1350	$1,255,700	$930		X	18.8
Cahokia: 8-1-(H)	849	$113,200	$133	X		1.68
Spring: 1B-3-X	3105	$4,975,075	$1,602	X	X	74.51
Mullens: 7A-2	912	$794,400	$871		X	11.89
TOTAL	**8332**	**$9,090,275**	**$1,091**	**4**	**4**	**$136.12**

*After relative value indexing **Based on planning estimates

Table 6-9 Summary of Cost Analysis of the Plans

Incremental Plan

Alternative	Total Output (AAHU)	Incremental Output (AAHU)	Total Annulaized Cost ($)	Incremental Annualized Cost ($)	Total Cost per AAHU	Incremental Cost per AAHU	ICA Winner	HEP Winner	Total Cost ($ millions)
Dobrey: 5A-Y	86		$128,100		$1,491		X		1.92
Elm: 6A-2	745		$389,500		$523		X	X	5.84
Cahokia: 2B-1-(0)-X	141		$377,000		$2,671		X		5.65
Brushy: 4C-3-0	782		$459,800		$588		X		6.95
Judy's: 3C-4-(0)	655		$379,500		$579		X		5.68
Cahokia: 8-1-(H)	849		$113,200		$133		X		1.68
Spring: 1B-3-X	3105		$4,975,075		$1,602		X	X	74.51
Mullens: 7B-2	730		$234,700		$322		X		3.15
TOTAL	**7,093**		**$7,056,875**		**$995**		**8**	**2**	**105.74**

Biological Plan as Increment above Incremental Plan

Alternative	Total Output (AAHU)	Incremental Output (AAHU)	Total Annulaized Cost ($)	Incremental Annualized Cost ($)	Total Cost per AAHU	Incremental Cost per AAHU	ICA Winner	HEP Winner	Total Cost ($ millions)	Incremental Increase in Total Cost ($ millions)	% Increase AAHU	% Increase Annualized Cost	% Increase Total Cost
Dobrey: 5A-X	87	1	$134,200	$6,100	$1,539	6100		X	2	0.08	1.16	4.76	4.17
Elm: 6A-2	745	0	$389,500	$0	$523	NA	X	X	5.84	0	0.00	0.00	0.00
Cahokia: 2A-1-(0)-X	238	97	$647,000	$270,000	$2,723	2783.51		X	9.69	4.04	68.79	71.62	71.50
Brushy: 4A-3-(0)	1047	265	$787,300	$327,500	$752	1235.85		X	11.79	4.84	33.89	71.23	69.64
Judy's: 3A-4-(0)	1350	695	$1,255,700	$876,200	$930	1260.72		X	18.8	13.12	106.11	230.88	230.99
Cahokia: 8-1-(VH)	915	66	$141,700	$28,500	$155	431.82		X	2.05	0.37	7.77	25.18	22.02
Spring: 1B-3-X	3105	0	$4,975,075	$0	$1,602	NA	X	X	74.51	0	0.00	0.00	0.00
Mullens: 7B-2	912	182	$794,400	$559,700	$871	3075.27		X	11.89	8.38	24.33	238.47	238.75
TOTAL	**8,399**	**1,306**	**$9,124,875**	**$2,068,000**	**$1,086**	**$1,583**	**2**	**8**	**136.57**	**30.83**	**18.41**	**29.30**	**29.16**

Table 6-9 -Continued

Preferred Plan as increment above the Incremental Plan

Alternative	Total Output (AAHU)	Incremental Output (AAHU)	Total Annulaized Cost ($)	Incremental Annualized Cost ($)	Total Cost per AAHU	Incremental Cost per AAHU	ICA Winner	HEP Winner	Total Cost ($ millions)	Incremental Increase in Total Cost ($ millions)	% Increase AAHU	% Increase Annualized Cost	% Increase Total Cost
Dobrey: 5A-Y	86	0	$128,100	$0	1491	NA	X		1.92	0	0.00	0.00	0.00
Elm: 6A-2	745	0	$389,500	$0	523	NA	X	X	5.84	0	0.00	0.00	0.00
Cahokia: 2A-1-(0)-X	238	97	$647,000	$270,000	2723	2784	X		9.69	4.04	68.79	71.62	71.50
Brushy: 4A-3-0	1047	265	$787,300	$327,500	752	1236	X		11.79	4.84	33.89	71.23	69.64
Judy's: 3A-4-(0)	1350	695	$1,255,700	$876,200	930	1261	X		18.8	13.12	106.11	230.88	230.99
Cahokia: 8-1-(H)	849	0	$113,200	$0	133	NA	X		1.68	0	0.00	0.00	0.00
Spring: 1B-3-X	3105	0	$4,975,075	$0	1602	NA	X	X	74.51	0	0.00	0.00	0.00
Mullens: 7A-2	912	182	$794,400	$559,700	$871	3075			11.89	8.38	24.93	238.47	238.75
TOTAL	**8,332**	**1,239**	**$9,090,275**	**$2,033,400**	**$1,091**	**$1,641**	**8**	**2**	**136.12**	**30.38**	**17.47**	**28.81**	**28.73**

Comparison of the plans shows the preferred plan to be acceptable with the increase in incremental output of 1,239 AAHU at an incremental cost of $1,641per AAHU. This plan includes the restoration of an additional 79 miles of tributary streams that provide a significant improvement in ecosystem outputs over the incremental plan.

6.12.3 Evaluation using Qualitative Criteria

In addition to effectiveness and cost comparisons, the Biological, Incremental, and Preferred Plans have been assessed using other criteria of a qualitative nature. They include acceptability, completeness, efficiency, partnership context, and reasonableness of costs. As stated above in the section on effectiveness, the Biological and Preferred Plans are more effective than the Incremental Plan in achieving the planning objectives.

Acceptability. The Preferred Plan is acceptable to state and federal resource agencies that were partners in this study, including the Illinois Department of Natural Resources, U.S. Fish and Wildlife Service, Natural Resources Conservation Service, and U.S. Environmental Protection Agency. However, the Incremental Plan is not acceptable to these agencies because it does not reflect a watershed approach to ecosystem restoration problems and opportunities. Although the Biological Plan does take a watershed approach, it is less acceptable than the Preferred Plan because several of its constituent alternatives are not the favorites of these agencies.

Completeness. All three plans provide and account for all necessary investments needed to ensure the realization of the planned restoration outputs. The Biological and Preferred Plans involve uncertainty concerning the functioning of one of the measures proposed for tributary stream restoration, whereas the Incremental Plan does not. It is unknown whether the proposed tributary sediment detention basins will attain a sediment trapping efficiency of 70 percent, as estimated by the Natural Resources Conservation Service. The Preferred and Biological Plans include an adaptive management plan to account for this uncertainty. A pilot program would be implemented in one small tributary watershed, and several tributary sediment detention basins would be constructed to monitor their efficiency. As part of this pilot program, the U.S. Geological Survey is currently monitoring baseline conditions of sediment transport through the tributary stream system within the Judy's Branch watershed.

Efficiency. The cost comparison analysis has determined that the Incremental Plan and Preferred Plan both represent cost effective means to address the study area's restoration problems and opportunities. The Biological Plan is not cost effective. The Preferred Plan provides an additional cost-effective increment of restoration output that the Incremental Plan does not, specifically the restoration of about 79 miles of tributary streams. Although the Natural Resources Conservation Service previously addressed small watershed restoration opportunities in the study area, it was unable to recommend a plan. No other agency or institution is able to produce the proposed restoration outputs in a more cost effective manner.

Partnership Context. One state and three federal natural resource agencies have partnered on this project in an effort to formulate and select a plan that was feasible from an implementation standpoint and met a broad spectrum of resource needs in this significant urban area. From the outset the desire to focus on watershed solutions within the context of agency authorities has been a primary goal. The Corps role in aquatic resource restoration along with our engineering capabilities to provide solutions to the underlying hydrologic problems of the project area has been key to plan formulation.

Each resource agency has voiced their desire that problems be addressed from a cause and effect perspective to the greatest extent practicable with the recommended measures being taken as close to the source of the problem as possible. The tributary stream system is a major area of concern for these agencies. To address this concern, the Corps ecosystem restoration approach of focusing on aquatic resources and their hydrologic processes within the watershed led to the solutions embodied in the Preferred and Biological Plan.

Reasonableness of Costs. As stated in ER1105-2-210, "The willingness of a non-Federal sponsor to share study and project costs and the general concurrence of the State and Federal resource agencies and environmental community are strong indicators of the reasonableness and worthiness of the recommended actions." While the planning level cost of the Preferred Plan (about $136 million) is about $30 million more than that of the Incremental Plan (about $105 million), the support from a broad base of experts has provided a strong indication that the Preferred Plan remains to be reasonable and worthy of action.

6.13 PLAN FORMULATION CONCLUSIONS

Of the three plans, the Preferred Plan is more effective in achieving the planning objectives. It is efficient because it consists of only "best buy" alternatives. The Preferred Plan is acceptable to state and federal resource agencies. It provides and accounts for all necessary investments needed to ensure the realization of the planned restoration outputs. Four state and federal agencies that partnered with the Corps during the study have indicated that the Preferred Plan best meets their desires and concerns. The plan is reasonable because non-Federal sponsors are willing to share study and project costs, and state and federal resource agencies support it. The Preferred Plan would provide significant restoration benefits to aquatic resources of national and regional institutional significance.

Based on these conclusions, the Preferred Plan is justified for selection as the Recommended Plan. Environmental consequences of this plan are discussed in Section 7, and details of this plan are further discussed and described in Section 8 - The Recommended Plan.

SECTION 7 – ENVIRONMENTAL CONSEQUENCES

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SECTION 7 ENVIRONMENTAL CONSEQUENCES

7.1 LAND COVER

Within the footprint of the recommended action areas, about 1,900 acres of forests, prairies, marshes and scrub-shrub wetlands, lakes and ponds, and streams would be protected, and approximately 2,800 additional acres created, for a total of about 4,700 acres. The loss of cultural natural communities, chiefly cropland, accounts for most of these gains. Further details concerning changes in cover types of natural communities within the footprint of the action areas are provided in Section 7.11. Figure 7-1 displays the boundaries of the recommended action areas with respect to land cover from the early 1990s.

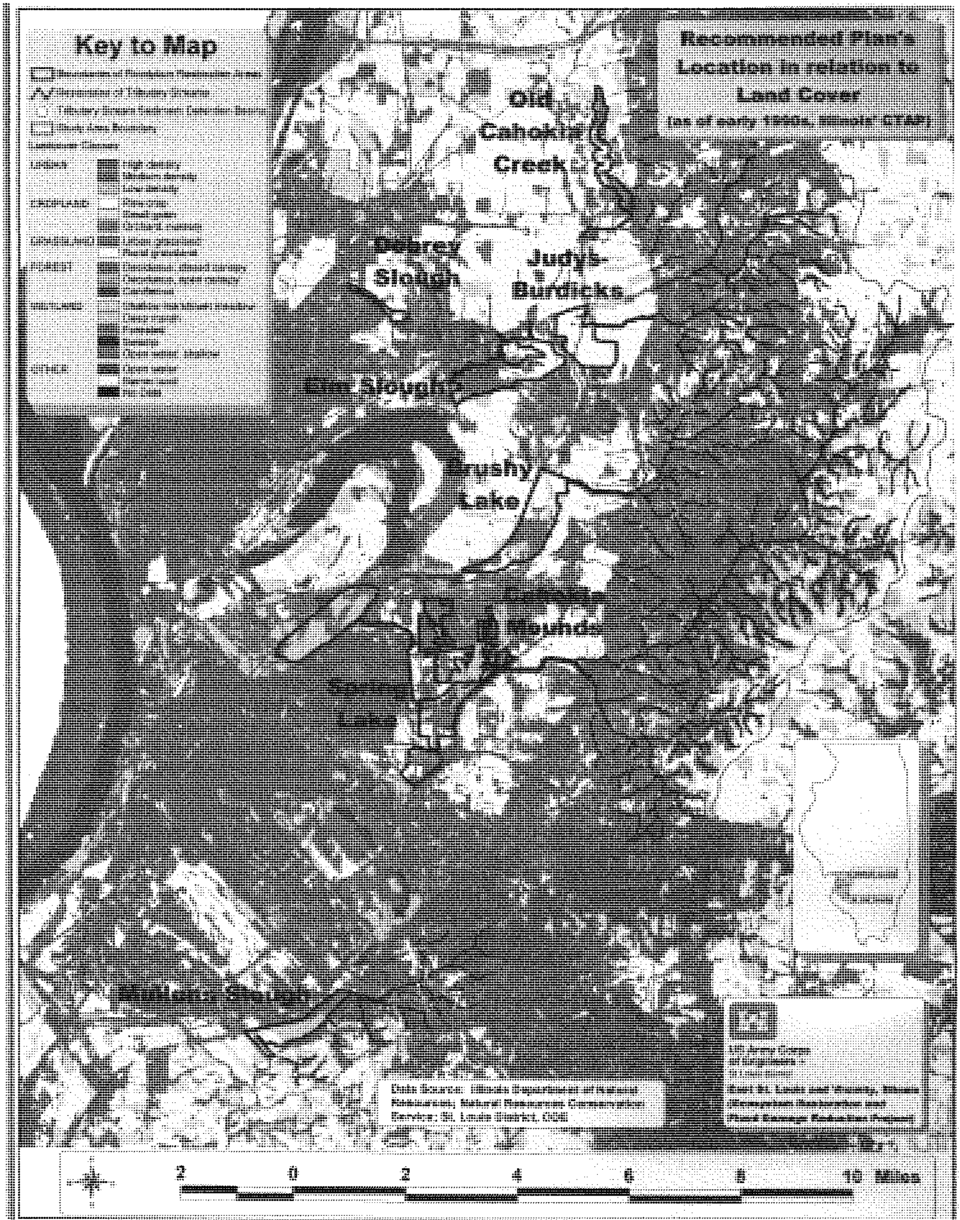


Figure 7-1 Recent Land Cover - Recommended Plan

7.2 LAND USE AND SOCIO-ECONOMIC IMPACTS

7.2.1 Agricultural Use. In this section, expected changes in agricultural use in the study area due to implementation of the recommended plan are described in terms of the amount of cropland affected, direct and indirect conversions of farmland, the suitability of affected soils, and the amount of horseradish lands affected. The results of interagency coordination on farmland impacts are also described.

7.2.1.1 Existing Cropland Affected. Less than one-third of the proposed Project area consists of existing cropland (1,651 acres, or about 31 percent). Proposed features in the tributary streams are not expected to affect farmland. Affected cropland occurs on the floodplain at seven of the eight proposed action areas: Judy's-Burdicks (460 acres), Elm Slough (380 acres), Brushy Lake (357 acres), Spring Lake (187 acres), Old Cahokia Creek (184 acres), Dobrey Slough (52 acres), and Mullens Slough (31 acres). This farmland would be replaced by natural habitats to be created by the proposed plan. In addition to the existing cropland, about 525 acres of lands leased for hay production at Cahokia Mounds State Historic Site would be restored to prairie.

Affected cropland is estimated to represent about 8 percent of all farmland found in the floodplain portion of the study area, or about 10 percent if the hay lease areas are included. This estimate assumes that total farmland in the floodplain portion of the study area is about 37 percent of current land cover, as reflected by the Illinois Land Cover Database (Table 3-3), which represents conditions from the early 1990s.

7.2.1.2 Direct and Indirect Conversions of Farmland. Proposed Federal actions need to be assessed for their potential to convert existing or potential farmland to nonagricultural use. Implementation of the proposed plan would directly convert about 3,874 acres of existing or potential farmland through the act of acquiring private lands for public use. This area of direct conversion was obtained by subtracting known publicly owned lands in the area of the proposed plan (1,373 acres) from the footprint of the proposed plan (4,916 acres). Portions of the Judy's-Burdick, Brushy Lake, Spring Lake, and Mullens Slough action areas include publicly owned lands.

An indirect conversion of about 27 acres has been identified at the Judy's-Burdick action area. Implementation of this action area would create an uneconomical remnant on the floodplain between the west side of the proposed habitat area and I-255. Within the Old Cahokia Creek action area, one or more crossings over the restored creek channel would be constructed to maintain equipment access to existing agricultural areas. No other indirect conversions have been identified, including in the uplands.

The sum of direct and indirect conversions is 3,901 acres. About 42 percent (1,651 acres) of this total consists of existing cropland. The remaining 58 percent (2,250 acres) represents potential cropland, and consists of existing natural habitats, such as wooded areas, marshes, and old fields.

7.2.1.3 Suitability of Affected Soils. With respect to the suitability of soils for the production of crops, about 53 percent of the footprint of the proposed plan would affect undeveloped soils that are not classified as prime by the Natural Resources Conservation Service (Table7-1). These classifications relate to the soils potential to produce crops. About 22 percent of the affected area consists of soils from the three conditionally prime categories. Developed soils and water comprise over 14 percent of the area affected by the proposed plan. Almost 12 percent is comprised of prime soils. About 91 percent of all affected areas are on the floodplain. Figure 7-2 displays boundaries of the recommended action areas in relation to prime farmland status.

Table 7-1 Prime farmland status of soils in the recommended action areas, by landform.

Prime Farmland Status	Floodplain		Upland		Study Area	
	Area (acres)	% Area	Area (acres)	% Area	Area (acres)	% Area
All areas are prime	590.3	12.0	18.7	0.4	609.1	12.4
Only drained areas are prime	396.2	8.1	3.6	0.1	399.9	8.1
Only areas protected from flooding or not frequently flooded during the growing season are prime	152.5	3.1	53.1	1.1	205.5	4.2
Only drained areas that are either protected from flooding or not frequently flooded during the growing season are prime	422.4	8.6	70.6	1.4	493.2	10.0
Not Prime – Undeveloped	2,460.9	50.1	296.9	9.0	2,757.8	56.1
Not Prime – Developed	90.1	1.8	3.7	0.1	93.8	1.9
Not Prime – Water	356.2	7.2	0.8	0.0	357.0	7.3
TOTAL	**4,468.7**	**90.9**	**447.4**	**9.1**	**4,916.1**	**100.0**

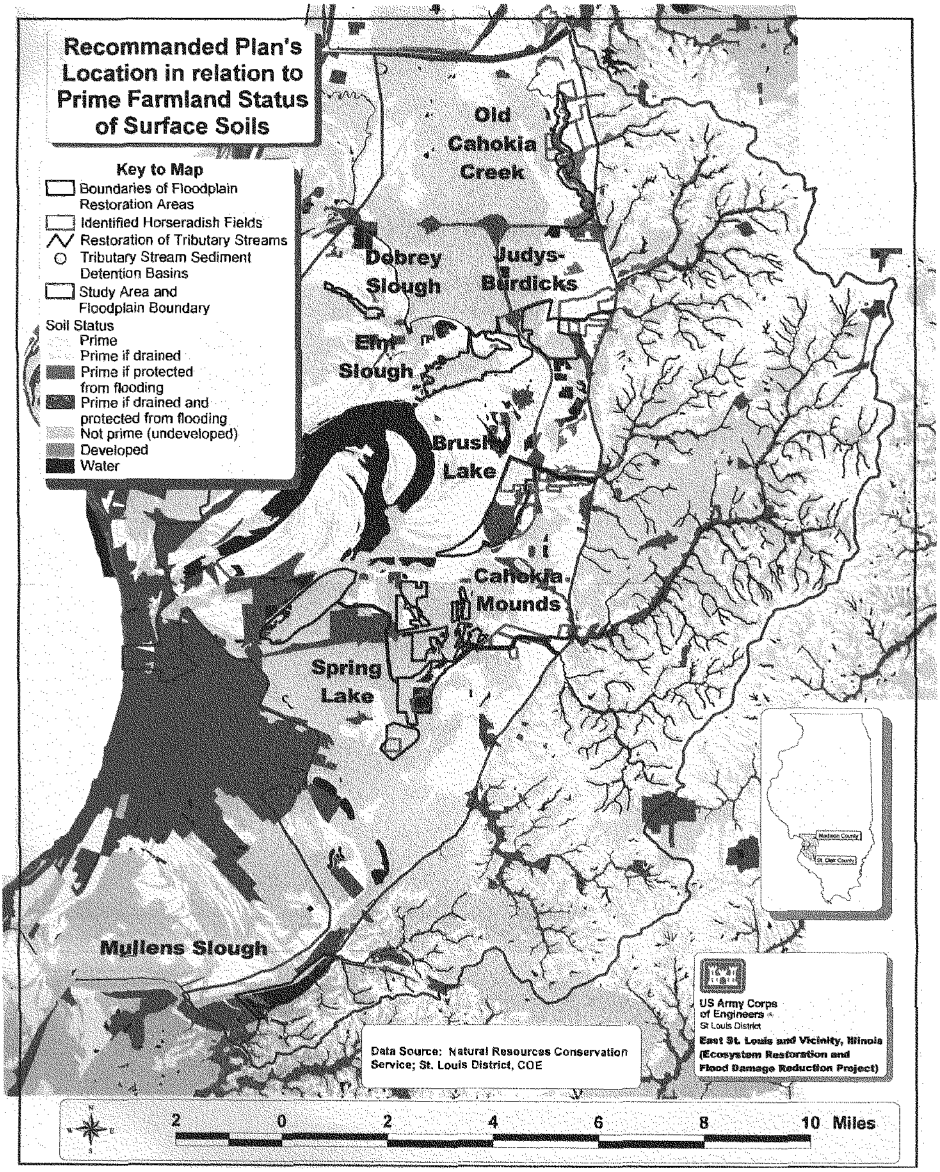


Figure 7-2 Prime Farmland Status of Surface Soils - Recommended Plan

7.2.1.4 Horseradish Affected. The selected plan would result in the loss of 309 acres of horseradish lands. Among proposed action areas, losses would occur at Brushy Lake (176 acres), Old Cahokia Creek (71 acres), Spring Lake (50 acres), and Judy's-Burdick (12 acres). Horseradish producers have examined all proposed action areas to ensure that all horseradish fields have been identified. Figure 7-2 displays boundaries of the recommended action areas in relation to identified horseradish fields.

At Brushy Lake, most of the affected fields are located at the north end of the floodplain environmental area (south of Horseshoe Lake Road and west of I-255), but a small amount occurs along Schoolhouse Branch where the existing channel would be widened.

At Old Cahokia Creek, losses of horseradish fields would occur toward the north end of the floodplain environmental area, where the 100-meter wide forested corridor on each side of the restored historic creek channel would extend into adjacent fields.

At Spring Lake, most of the affected horseradish land lies within the St. Clair Farms component of the floodplain environmental area. The rest of the affected area at Spring Lake consists of fields adjacent to Harding Ditch, which would be widened, and at the site of the proposed bypass channel to carry flows from Canteen Creek to Harding Ditch.

At Judy's-Burdick, most of the losses would occur along the southeast edge of the floodplain environmental area, where existing horseradish fields are found. Smaller losses would occur along Burdick Branch to allow for construction of an earthen berm along the south side of the existing channel.

Like the 1,537 acres of horseradish soils identified within the study area, the soils occurring within these 309 acres are also variable with respect to their prime farmland status as designated by the Natural Resources Conservation Service. In the affected area, 28 percent is considered prime, 48 percent is prime if drained, 3 percent is prime if protected from flooding or not frequently flooded during the growing season, 4 percent is prime if drained and protected from flooding or not frequently flooded during the growing season, and 17 percent is not prime. Compared to the 1,537-acre horseradish base, the affected area would be expected to be less productive on a per acre basis because it contains proportionally fewer prime soils and more soils that are not prime. A listing of the 27 different soils found in the affected area is provided in Table B.4 in Appendix B.

If 5,000 acres of horseradish lands are assumed to exist within the American Bottom, then the estimated loss of 309 acres represents about 6.2 percent of the total. Considering that the actual area of existing horseradish lands is unknown but is estimated to fall between 4,500 to 5,400 acres, then the overall loss resulting from the selected plan lies between 5.7 and 6.9 percent. This extent of loss is somewhat above the planning constraint of 5 percent (Section 6.2.3).

7.2.1.5 Interagency Coordination. To determine potential impacts to agricultural land and initiate compliance with the federal Farmland Preservation Act and Illinois Farmland Preservation Act, the proposed plan was forwarded to the Natural Resources Conservation Service (NRCS) and Illinois Department of Agriculture (IDOA) by the St. Louis District, in a letter dated July 11, 2001. Form AD-1006, Farmland Conversion Impact Rating, and supporting information accompanied this letter. In letter dated December 17, 2001, the Illinois Department of Agriculture responded to the St. Louis District with a farmland conversion impact rating of 121 of 300 possible points. This value was obtained by combining the relative value of the affected farmland (51 of 100 maximum points) with the Illinois Land Evaluation and Site Assessment (70 of 200 maximum points). Alternatives scoring 175 or fewer points have a low rating for farmland protection, those from 176 to 225 points a moderate rating for protection, and those above 225 points should be kept in agricultural use. The responses from NRCS and IDOA are included in the public involvement appendix (Appendix G).

The recommended plan has been assessed to have a low rating for farmland protection. It would not create any significant adverse effect on agricultural lands, including farmland used for horseradish production.

7.2.2 Socio-economic.

7.2.2.1 Political Boundaries of Recommended Plan. With regard to political boundaries, five of the eight recommended action areas are located entirely in Madison County, two lie completely in St. Clair County, and one straddles both counties (Table 7-2). In Madison County, action areas occur in four townships – Edwardsville, Nameoki, Collinsville, and Jarvis. In St. Clair County, there are three affected townships – Canteen, Caseyville, and Stookey. Fourteen municipalities are enveloped, as well as various unincorporated areas. Figure 7-3 displays affected municipalities, and Figure 7-4 shows affected townships.

Table 7-2 Location of all recommended action areas according to landform, county, municipality, and township.

Action Area	Landform	County	Municipality	Township
Old Cahokia Creek	Bottoms	Madison	Edwardsville, Glen Carbon, unincorporated	Edwardsville
	Upland	Madison	Edwardsville, Glen Carbon, unincorporated	Edwardsville
Dobrey Slough	Bottoms	Madison	Granite City, unincorporated	Nameoki
Judy's-Burdick	Bottoms	Madison	Pontoon Beach, unincorporated	Collinsville
	Upland	Madison	Edwardsville, Glen Carbon, Maryville, unincorporated	Edwardsville, Collinsville

Table 7-2 Continued

Action Area	Landform	County	Municipality	Township
Elm Slough	Bottoms	Madison	Pontoon Beach, unincorporated	Nameoki, Collinsville
Brushy Lake	Bottoms	Madison	Pontoon Beach, Collinsville, unincorporated	Nameoki, Collinsville
	Upland	Madison	Collinsville, Maryville, unincorporated	Collinsville
Cahokia Mounds	Bottoms	St. Clair	unincorporated, Caseyville	Canteen
Spring Lake	Bottoms	Madison, St. Clair	Caseyville, Washington Park, Fairmont City, unincorporated	Nameoki, Canteen, Caseyville
	Upland	Madison, St. Clair	Collinsville, Troy, Caseyville, Fairview Heights, unincorporated	Collinsville, Jarvis, Caseyville
Mullens Slough	Bottoms	St. Clair	Cahokia, unincorporated	Stookey
	Upland	St. Clair	unincorporated, Belleville	Stookey

Figure 7-3 Recommended Plan's Relation to Municipalities

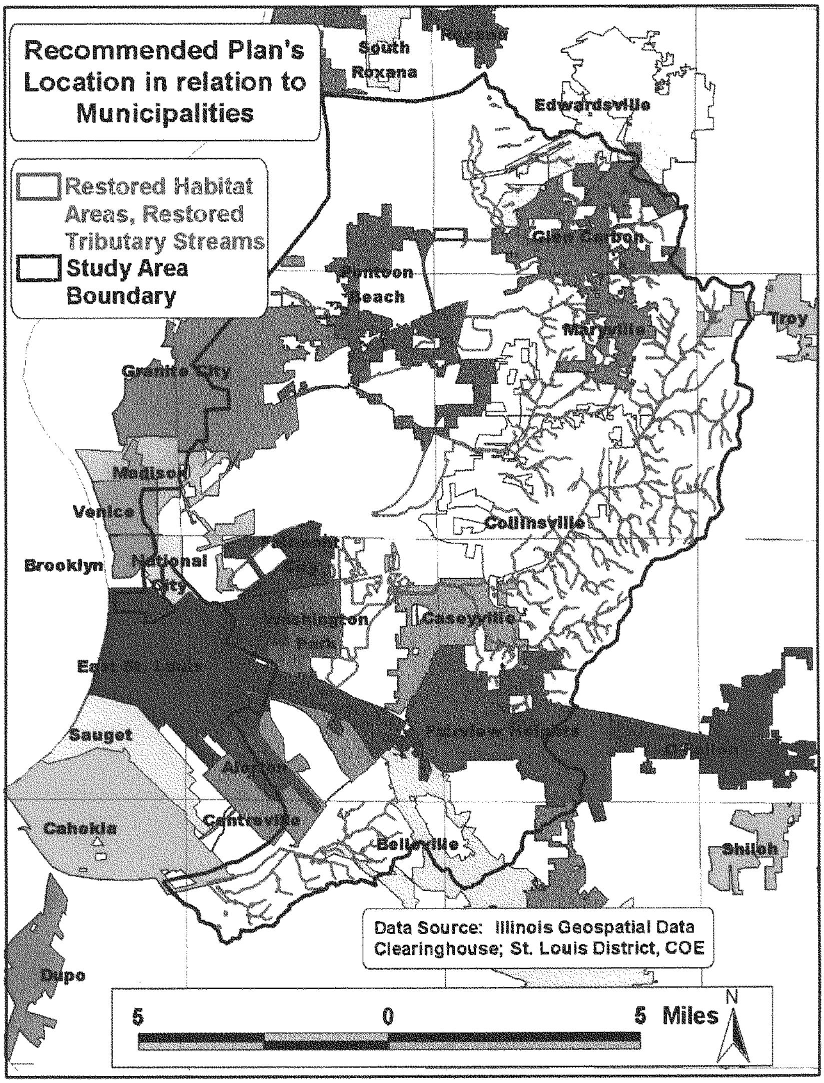
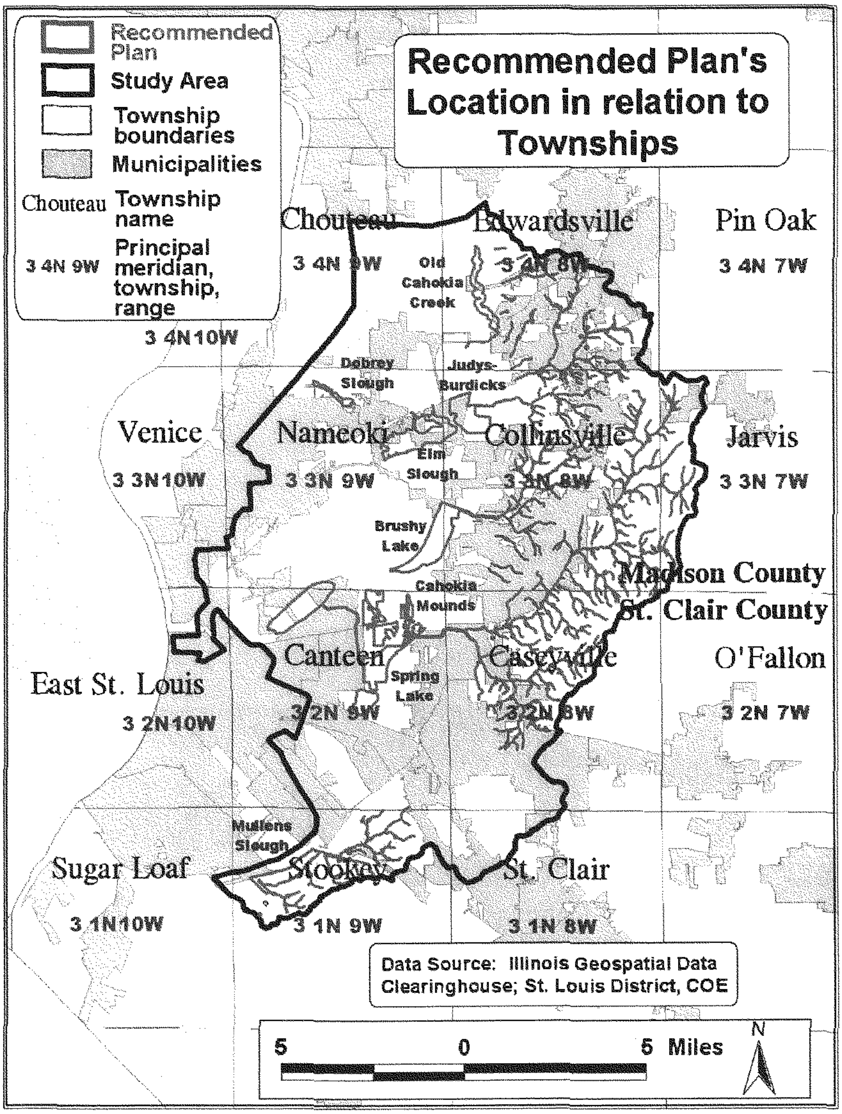


Figure 7-4 Recommended Plan's Relation to Townships



7.2.2.2 Economic Implications. While no areas are removed from the 100-year floodplain, incidental flood damage reduction benefits are realized from implementation of the plans evaluated. In order to quantify these ecosystem services to society a traditional risk based flood damage reduction assessment was completed for the recommended plan. The following details this analysis completed by the Vicksburg District and its results.

7.2.2.2.1 East St. Louis, Missouri, Project Area Flood Damage Analysis Report Introduction. This presents information pertaining to the economic evaluation of proposed water resource improvements in the East St. Louis, Illinois, urban area. The focus of the evaluation was to identify existing flood problems and the potential for implementing local flood protection measures. The discussion includes current flood damage impacts and flood damages prevented with an improvement plan in place.

Information and computations presented describe the methodology used in determining existing flood damages and benefits for with-project conditions. Existing project conditions reflect year 2000 conditions and all values are expressed in October 2000 price levels.

Expected flood damages for existing conditions and with proposed flood control measures in place were estimated utilizing risk and uncertainty guidance in EC 1105-2-205, Risk Analysis Framework for Evaluation of Hydrology/Hydraulics and Economics in Flood Damage Reduction Studies dated 25 February 1994. The specific purpose of this portion of the analysis was to quantify, to the extent possible, any uncertainties inherent in the flood damage evaluation that would aid in making a decision to invest in a flood protection project in the East St. Louis area.

7.2.2.2.2 Flood Damage Analyses. The economic evaluation of flood damages in the East St. Louis Project area included the comparison of the flood damage setting for "without-project" and "with-project" conditions. Without-project conditions, or existing conditions, reflect conditions expected to prevail in the absence of any alternative plan of improvement. With-project conditions reflect conditions in the Project area with a proposed flood control improvement in place.

To quantify the risk and uncertainty with this analysis, risk-based techniques were integrated into the Hydrologic Engineering Center Next Generation Flood Damage Analysis (HEC-FDA) computer program in the calculation of urban flood damages. Results of these analyses were used to identify and evaluate possible flood reduction measures according to the likelihood and variability of their effectiveness, implementability, and feasibility.

7.2.2.2.3 Project Area. This feasibility study is concentrated on identifying the major impacts from flooding in the East St. Louis area from Cahokia Canal and Harding Canal No.1. Based on flood damages incurred in recent years, the Project area was limited to the urban area impacted by flooding from these two channels. It is confined to the area that would be affected by the construction of water resource improvements.

The East St. Louis Project area is located in Madison and St. Clair Counties in the south-central portion of the State of Illinois, approximately 10 miles east of the city of St. Louis. The topography of the Project area is characterized by predominantly level to gently sloping land with over 2,300 structures susceptible to flooding.

7.2.2.2.4 Existing Data Collection. In the initiation of flood damage analyses, field investigations were conducted to determine the extent and character of flooding in the East St. Louis Project area. Comprehensive surveys were used to identify the type, number, elevation, and location of properties impacted by flooding. Land use information was also collected to assess the extent of flood impacts to agricultural production and data was assembled to determine the appropriate hydrologic conditions of the Project area. All of this information was correlated with flood frequency distributions and pertinent depth-damage, stage-area, and stage-damage data to estimate the extent of flood damages in the area. Preliminary evaluations indicated potential impacts to urban structures, automobiles, and agricultural properties within the area and confirmed the need for more detailed flood damage analyses.

Due to the incorporation of the new risk-based HEC-FDA program and unfamiliar applications, data from a similar area was utilized in the evaluation of contents values and depth-damage relationships. Based on the similar socioeconomic characteristics, data used in the risk evaluation of the Morganza to Gulf, Louisiana, Feasibility Study were deemed appropriate for use in the East St. Louis risk evaluation. The final report, dated May 1997, is entitled Depth-Damage Relationships for Structures, Contents, and Vehicles and Content to Structure Value Ratios (CSVRs) in Support of the Lower Atchafalaya Reevaluation and Morganza to the Gulf, Louisiana Feasibility Studies. It also provides risk-based information on expected values and standard deviations for selected residential and non-residential properties in its Project area.

7.2.2.2.5 Structural Surveys. A comprehensive field survey was conducted in June 2000 to identify each urban structure at risk in the affected area. Structure types and elevations were determined by an inventory of the study area, as well as local tax records and information provided by Madison and St. Claire Counties, Illinois.

Information gathered on each structure consisted of structure type, first floor elevation, type of construction and foundation, number of stories, structure dimensions, physical condition of the structure, and the location. Structures were differentiated by three damage categories – commercial, residential and farm. Each damage category was further broken down by occupancy type, however, due to the study area being primarily residential only those occupancy types for the residential damage category are presented in this analysis.

Results of the structural inventory prepared for the East St. Louis Project area are displayed in Table 7-3 by damage category and average structure value. In June 2000, there were 2,380 total structures located within the alignment of the East St. Louis Project area, including 2,325 residential, 36 commercial, and 19 farm properties.

Table 7-3 Average Structure Value by Structure Type, East St. Louis Project Area(October 2000 Price Levels)

DAMAGE CATEGORY	STRUCTURES (#)	AVERAGE STRUCTURE VALUE ($)
Residential	2,325	24,100
One-Story	1490	26,100
Two-Story	30	24,300
Mobile Home	805	16,800
Commercial	36	238,300
Farm	19	12,300
Total	**2,380**	**26,050**

7.2.2.2.6 Structure and Contents Valuation. Structure and contents values are major elements influencing the impact of depth-damage relationships and magnitude of flood damages to urban structures. For the purposes of estimating urban flood damages, a structure is defined as a building and any attached components, such as built-in appliances, shelves, carpeting, etc. The value of land is excluded in the determination of urban structure values. Contents represent furnishings and equipment, or all items within the structure that are not permanently attached.

Structural values for the East St. Louis Project area were estimated utilizing data provided by the tax assessor's offices of Madison and St. Claire Counties, Illinois, in July 2000. These values have been adjusted to reflect depreciated replacement values, which have been determined to be the correct measure of structure values for flood damage analyses. Pertinent structure values, including residential and nonresidential types, were applied to each affected structure within the alignment of the East St. Louis Project area.

In determining flood damages to contents within urban structures, contents are expressed as a percentage the structural value. For this analysis, contents values surveyed for the Morganza to the Gulf Study, New Orleans District, were utilized. New Orleans District personnel conducted on-site interviews for the computation of content-to-structure value ratios (CSVR) for each structure.

Structure Elevation

The first-floor elevation of each structure is utilized to determine the expected flood depths for each structure for each set of hydrologic conditions. Structure elevations for the East St. Louis Project area were derived from 2-foot contour blue-line aerial photography.

Depth-Damage Relationships
In quantifying the extent of flooding that occurs in an area, depth-damage curves are utilized. Depth-damage relationships, provided by the St. Louis District, for the Monarch-Chesterfield Study were used. These curves were deemed appropriate based on the proximity of the two projects and the similarities in the flooding and construction practices between the two areas. The depth-damage curves used in the Monarch-Chesterfield Study are St. Louis District depth-damage curves. They were primarily derived based on area depth-damage surveys from historical area floods. These curves depict a damage factor by flood depth and are differentiated by structure types, structure value, and type of flooding.

Hydrologic Data
Hydrologic data from historic flooding records were collected to develop hydrologic profiles, or water-surface elevations, for predetermined flood event at various points within the impacted area. These data were correlated with each frequency of flood occurrence to develop stage-frequency curves which were aligned with the appropriate structural data in determining susceptibility to flooding. Flooding depth data for each property were then integrated with depth-damage relationships to calculate the flood damages incurred by stage and frequency.

In assessing flood damages to agricultural properties, additional flood characteristics, such as duration, frequency, and time of year of flooding, were utilized in determining acres subjected to flooding. These were then correlated with agricultural land use and crop yield/distribution/ budget data to assess flood damages to agricultural production.

Agricultural Data
Basic land use information was collected for the Project area to identify potential agricultural properties impacted by flooding. The study area is comprised mostly of corn, soybeans and horseradish. However, due to the hydrologic conditions associated with the terrain, the agricultural areas drain very swiftly. The rainwater does not pond, thus stage-area and -duration are not of much consequence in regard to total flood damages. Based on the minimal impacts to cropland in the East St. Louis Project area, it was determined that no substantial damages or benefits would be gained through agricultural damage evaluation. Therefore, this category was dropped from further consideration.

7.2.2.2.7 Damage Categories.

Structures
In determining the number of structures flooded in the East St. Louis Project area, the HEC-FDA program, developed by the Hydrologic Engineering Center (HEC), was utilized. Within the program, eight different types of urban structures were evaluated using hydrologic profile data, structure alignments, first floor elevations, depth-damage relationships, and structure values to compute the depth of flooding, number of structures impacted, and damages by structure type and frequency flood event. Table 7-4 displays the number of structures damaged by flood frequency in the East St. Louis Project area.

Table 7-4 Total Number of Structures Flooded by Frequency a/, for Existing Conditions in the East St. Louis Project area

Flood FrequencyEvent (freq/yr)	Existing Number of Structures Flooded By Frequency By Structure Type			
	Residential	Nonresidential		Total
		Commercial	Farm	
2	71	0	7	78
5	139	1	7	147
10	391	10	7	498
25	496	18	12	526
50	848	19	12	879
100	1,063	20	12	1,095
500	1,482	23	12	1,517

a/ Total numbers are cumulative.

Results of feasibility flood damage analyses estimated that a total of 1,517 structures would experience damage during maximum flooding events and major flooding would begin to occur at the 2-year frequency flood event. Residential structures comprised the majority of the total structures flooded, comprising 98 percent. These results reflect the application of frequency flood events that have occurred in recent storms in an attempt to duplicate the extent of damages known to have occurred in the East St. Louis area.

To address the uncertainties associated with urban flood damage analyses, the existing structural database was integrated into the economic stage-damage section of the HEC-FDA program in developing stage-damage relationships applicable to the East St. Louis Project area. This portion of the program provides results of the flood damage analysis of an area for existing conditions in terms of existing damages by frequency and stage, including their corresponding uncertainties (or standard deviations).

Automobiles

The analysis of automobile damages involved determining the number of automobiles (units) impacted and the application of this data to a damage per unit value. To estimate the number of automobiles that were impacted by each frequency flood event, the average number of automobiles per household in the East St. Louis area was applied to the number of residences flooded by flood frequency. These values were applied to an average damage per automobile to derive overall damages.

The average damage per automobile used in the East St. Louis analysis was based on the average value of a used car. This value was estimated to be $10,750. For the uncertainty analysis done in the HEC-FDA program, the maximum value of an automobile was estimated to be $16,800, based on the average value of a new car before taxes, license, and shipping charges. The minimum value was estimated at $2,000, the average 10-year depreciation value of an automobile in the East St. Louis Project area.

To incorporate risk and uncertainty, the existing automobile database was entered into the economic stage-damage section of the HEC-FDA program to address the uncertainties associated with automobile damages in the East St. Louis Project area. Results included existing automobile damages by frequency and stage, including their corresponding uncertainties.

7.2.2.2.8 Risk And Uncertainty. Even though every attempt is made to ensure accuracy, a degree of uncertainty is implicit in many areas of planning for water resource projects. The uncertainty arises due to error in the data being measured or errors inherent in the methods used to estimate the values of certain critical variables. The potential for error exists throughout the traditional analysis because each of the variables has been assigned a single point value rather than a range of values. In order to compensate for possible error, risk-based analysis can be applied to the planning and design of water resource projects. This approach, which quantifies the extent of systematic risk, provides the decision-maker with a broader range of information. Thus, a decision can be made that reflects the explicit tradeoff between risks and costs.

The Risk-Based Approach
Based on risk and uncertainty procedures outlined in EC 1105-2-205, the HEC-FDA program was utilized in the analysis of urban flood damages in the East St. Louis Project area. The program not only analyzes the reliability and effectiveness of various project improvements, but also accounts for uncertainties associated with various economic and hydrologic parameters, such as structure and content values, structure elevations, depth-damage relationships, and stage-frequency data. The traditional concept of integrating flood depths, frequency, and damage data is still utilized in the determination of flood damages, except, with the risk approach, uncertainty is explicitly quantified.

With the risk-based approach, we can now analytically and mathematically handle the risk and uncertainty which was previously difficult. Sometimes the "true" values of key planning and design variables and parameters are not known with total certainty and are thus assigned a range of potential values. The likelihood of a parameter taking on a particular value can be best described by a probability distribution. Probability distribution may be described by its own parameters, such as mean and variance for a normal distribution, or minimum, maximum, and most likely for a triangular distribution. The risk-based approach to project formulation combines the risk and uncertainty methodology with statistical analysis so that the engineering and economic performance and associated reliability of a project may be expressed in the form of probabilities.

The Risk-Based Damage Analysis
The HEC-FDA program used in the economic evaluation of flood problems in the East St. Louis Project area incorporates two different analyses into one program -- economic stage-damage and hydrologic project analyses. The economic stage-damage portion of the program develops a stage-damage relationship and corresponding uncertainty for the existing hydrologic conditions. The hydrologic portion integrates stage-damage and -frequency relationships for various project improvements and determines average annual expected flood damages for existing and with-project conditions.

7.2.2.2.9 The Stage-Damage Analysis. The HEC-FDA program utilizes a simulation technique to incorporate risk and uncertainty into the calculation of flood damages for specified flood events. Multiple iterations were performed to select or sample from a full range of possible values for each variable identified as a source of uncertainty (e.g., structure values, contents values, first floor elevations, depth-damage relationships, stage-frequency, period of record, etc.). This routine was accomplished simultaneously for each economic and hydrologic variable.

HEC-FDA output results in a mean, or expected damage value, and probability distributions, which reflect a comprehensive picture of all possible outcomes of a flood damage scenario. The resulting stage-damage relationship and corresponding uncertainty are then integrated with the stage-frequency relationship and its corresponding uncertainty to determine the expected without- and with-project flood damages.

The HEC-FDA program involves the following input or output parameters:

Range of Values
The analysis is accomplished by considering the range of possible values (maximum and minimum values for each input variable in the flood damage calculation) and distribution of the likely occurrence of outcomes over a specified range. In the East St. Louis Study, a maximum and minimum value for each economic variable was entered to calculate any uncertainty error associated with elevation- or stage-damage relationships. The program also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-frequency curves.

Probability Distribution
A probability distribution is selected to represent the uncertainty inherent to certain critical variables in the flood damage evaluation. It defines the probability of the occurrence of an event in an infinite number of observations or trials.

Monte Carlo Simulation
The possible occurrences of each variable are derived through the use of Monte Carlo simulation, which uses randomly generated numbers to simulate the values of the selected variables from within the established ranges and distributions.

The Mean
The sum of all sampled values divided by the number of samples yields the expected value, or the mean. In flood damage analyses, the mean value represents the average damage expected to occur from the full range of possible values samples. Its corresponding standard deviation, which represents any uncertainties in key hydrologic or economic input parameters, is a measure of variability that is useful, not only for comparing sets of measurements, but also for describing a single set of measurements.

Standard Deviation
The corresponding uncertainty calculated for each mean is a representation of an estimate of error, or deviation. Error is the difference between the observed value and the most probable value. It is expressed by the standard deviation which best fits the variable. The standard deviation is the average deviation from the mean (i.e., the square root of the mean of the squared deviations).

7.2.2.2.10 Economic Uncertainty. In the East St. Louis Study, risk-based analysis was performed on four key economic variables – property values (structure and automobile), contents-to-structure value ratios, first floor elevations, and depth-damage relationships. The uncertainty associated with each of these variables was analyzed for its impact on the stage-damage curve. Applicable methodology incorporated into the risk and uncertainty analysis for each variable is discussed in the following paragraphs.

Structure Value
In order to determine the uncertainty associated with the structural valuation process, detailed field surveys were conducted to confirm structure values provided by local tax records. These estimates were incorporated into the HEC-FDA program to calculate the stage-damage with uncertainty for the Project area. Uncertainties incorporated into the analysis considered a possible error in value of plus or minus 7.5 percent for residential structures and plus or minus 6.5 percent for nonresidential. Specific input assumptions utilized as follows: a normal probability density function for all structures; the structure value as the mean; a standard deviation of 7.5 percent for residential structures and 6.5 percent for nonresidential structures.

Automobile Value
In analyzing the uncertainty associated with automobile damage, a triangular probability distribution function was used to determine the estimated error surrounding the values assigned to the automobiles in the inventory. The most likely value was assumed to be the average value of a used car ($10,750). The maximum value was assumed to be the average value of a new car before taxes, license, and shipping charges ($16,800). The average 10-year depreciation value of an automobile ($2,000) was used as the minimum value.

Contents Value
In analyzing the uncertainties associated with determining flood damages to contents within structures, the following assumptions were utilized: (1) a CSVR was computed to estimate the contents value (the mean); (2) a normal probability distribution function was used to describe the distribution of the sample observations around the expected mean; (3) a normal probability density function was used for each content category; (4) standard deviations for each applicable category were obtained from the Morganza to the Gulf Study, New Orleans District. Based on research conducted at the Institute of Water Resources, a normal probability density function was determined to best fit the national data on contents-to-structure value ratios

First Floor Structure Elevation
Risk and uncertainty analysis requires the input of a factor to indicate an estimate of error involved in obtaining first-floor structure elevations. More accurate derivation of floor elevations during field surveys would have less error, and less accurate surveys would have more errors. Estimates of error for various survey methods are presented in EC 1105-2-205. Structure elevations for the East St. Louis Project area were derived from 2-foot contour blue-line aerial photography. A standard deviation (estimate of error) of 0.7 feet was calculated for the uncertainty associated with this type survey. A normal probability density function was used to describe the uncertainty associated with this variable.

Depth Damage Relationships
Depth-damage relationships developed for the St. Louis area were used in the East St. Louis Study. These depict a depth-damage factor for residential and nonresidential structure categories. To account for the uncertainty associated with each increment of flooding, a normal probability density function was used.

7.2.2.2.11 The Hydrologic Analysis. The hydrologic analysis portion of the HEC-FDA program calculates the expected damages for existing hydrologic conditions and the type of with-project flood control improvements. This analysis is used to analyze the uncertainties associated with various hydrologic parameters in evaluating project alternatives such as levees, pumps, and channels. In the evaluation of flood control improvements in the East St. Louis Project area, the with-project plan of improvement was evaluated based on stage-frequency analyses. This data was integrated with the stage-damage and stage-frequency relationships and their corresponding uncertainties in determining expected annual damages for without- and with-project conditions. The results of this analysis are displayed in Table 7-5. The difference in total without- and with- project damages results in the total flood damages prevented, and represent the total project benefits for the East St. Louis Project area.

Hydrologic Uncertainty
Uncertainties in hydrologic/hydraulic (H&H) analyses are generally associated with stage and discharge. Some of this exists because of short record lengths, sampling errors, imprecise measurements of data, etc. Stages can also be affected by conveyance roughness, cross-section geometry, debris accumulation, etc. The uncertainties involved in the development of the hydrologic stage-frequency and stage-flow relationships are discussed in more detail in the Hydrology/Hydraulics appendix.

H&H
There were no gauge readings for the East St. Louis Project area, thus rainfall runoff modeling with a record length of 15 years was used for the area. This was indicated to be the maximum record length that could be utilized in this type of modeling. Based on this equivalent record length, the HEC-FDA program calculated the confidence limits surrounding the stage-frequency function.

Hydrologic Analysis Results
The HEC-FDA program integrated the results of the economic uncertainty analysis (elevation-damage curve with error) with the results of the hydrologic/hydraulic uncertainty analysis (stage-frequency curve with error) to produce the without-project and with-project expected annual damages for the alternative plan of improvement. Finally, the program compared the without-project damages to the with-project damages, in order to produce the flood damages prevented from the implementation of the proposed alternative

Table 7-5 Total Expected Annual Flood Damages for Existing and with Project Conditions, East St. Louis Project Area, (October 2000 Price Levels)

Damage Category	**Total Expected Annual Flood Damage**		**Damage Reduction (%)**
	Existing Conditions ($000)	**With-Project Conditions ($000)**	
Structure Damages	1,299	337	74
Automobile Damages	654	250	62
Total Urban Flood Damages	**1,953**	**587**	**70**

7.2.2.2.12 Summary Of Expected Damages. The results of the risk-based flood damage analysis of the East St. Louis Project area are presented in Table 7-6 along with project effectiveness (i.e., percent damage reduction). Risk-based analyses were performed in determining the total existing without- and with-project damages cumulated for both structures and automobiles.

Total existing expected flood damages, which are the total annual damages for expected to occur without flood reduction measures in place, were estimated at $1,953,000 for the total East St. Louis Project area. In comparison, expected annual flood damages for with-project conditions were estimated to be $587,000. Total damages include expected annual flood damages to structures and automobiles. For existing conditions, structure damages account for 67 percent of the total damage.

7.2.2.2.13 Summary Of Inundation Reduction Benefits. The evaluation process of the East St. Louis Feasibility Study involved the formulation and assessment of flood control improvements for one improvement in the determination of without- and with-project flood damages, flood damage prevented, and inundation reduction benefits with the flood control improvement plan in place.

7.2.2.2.14 Total Expected Annual Benefits. The total expected annual benefit from with-project improvements in the East St. Louis area is presented in Table 7-6. Inundation reduction benefits are calculated based on the difference between the expected flood damages for existing without- and with-project conditions as computed within the risk-based framework. Total expected benefits in the East St. Louis Project area were estimated to be $1,366,000.

Table 7-6 Total Expected Annual Benefits With Project Improvements, East St. Louis Project Area, (October 2000 Price Levels)

Benefit Category	**Total Expected Annual Benefits ($)**
Structure Damages Prevented	962,000
Automobile Damages Prevented	404,000
Total Expected Annual Benefits	1,366,000

The mean benefits are shown in Tables 7-7. The table also shows the mean inundation reduction benefits at the 25, 50, and 75 percentiles. The percentiles reflect the percentage chance that the actual benefits will be greater than or equal to the indicated benefit amount.

Table 7-7 Mean Benefits and Probability Indicators with Project improvements, East St. Louis Project Area, (October 2000 Price Levels)

Mean Benefits	**Probability Damaged Reduced Exceeds Indicated Values**		
	25%	**50%**	**75%**
$1,366,000	$1,767,000	$1,136,000	$731,000

7.3 TOPOGRAPHY/DRAINAGE/FLUVIAL GEOMORPHOLOGY

The topography of the affected area will be impacted slightly by the raising and lowering of ground elevations in localized areas with the construction features of the project. Containment berms that will be used to guide, direct and contain flood pulse flows will produce high points varying at different sites from approximately 2-8 feet above the ground surface. Likewise modifications made to the existing drainage system will lower elevations in localized areas to match existing channel flow lines. These changes do not significantly impact the topography of the overall study area.

Through implementation of the recommended plan, fluvial geomorphology characteristics that were lost by the filling and channelization of the pre-settlement flood plain streams by urbanization will be restored at specific sites through the re-creation of some 10.8 miles of floodplain streams. This restoration of natural stream resources on the floodplain will re-introduce an ecosystem component lost from the floodplain since the early 1900s.

7.4 GEOLOGY AND SOILS

While no systemic changes to the soils or geology of the area will result from implementation of the recommended plan, only localized changes to surficial soils will result. These changes are considered beneficial as they will result from a reduction in the erosional effects experienced by bluff streams. Erosional deposition currently experienced on the floodplain will also be reduced as a result of measures recommended by the plan by retaining soils in the bluffs.

7.5 CLIMATE AND WEATHER

No impacts to climate and weather are anticipated as a result of implementation of the recommended plan.

7.6 AIR QUALITY

Assessment of air quality impacts was conducted by the USEPA, Region 5, as a cooperating agency. A detailed discussion of air quality, including anticipated impacts, is included in Appendix F. The methodology for the general conformity analysis for the recommended plan consists of the following steps: 1) determine pollutants of concern based on attainment status of the Air Quality Control Region (AQCR); 2) define the scope of the recommended plan, including timing and location of emission sources; 3) calculate emissions based on the scope; 4) review net emission changes for threshold levels and regional significance; and 5) determine conformity for applicable criteria pollutants.

7.6.1 Pollutants of Concern. The area affected by the recommended plan is in moderate nonattainment status for ozone (outside an ozone transport region), as described in Section 3.8. Consequently, direct and indirect emissions of Volatile Organic Compounds (VOC) and Nitrous Oxides (NOx) (precursors to ozone) resulting from the recommended plan are subject to the conformity determination. Portions of the recommended plan will take place in the Particulate Matter (PM10) maintenance area. The following analysis focuses only on these three pollutants. The analysis encompasses the year during which the total direct and indirect emissions are anticipated to be the greatest.

7.6.2 Scope of Recommended Plan. The recommended plan will affect the total amount of emissions from two categories of sources. The emissions associated with construction activities and the burning of herbaceous vegetation have been included in the analysis.

With respect to construction activities, off-road mobile construction and demolition vehicles will be involved in six principal activities: clearing and grubbing, floodplain earthwork, tributary stream sediment detention basins, stream bank stabilization, topsoil placement, and environmental plantings and seeding. Although the types and number of construction and demolition equipment are preliminary, the number and types of equipment have been estimated and the emissions analysis assumes the highest number of vehicles to be working at one time and during the one year period that is used for the analysis. A representative year was estimated to have 248 working days, and it accounts for weekends, holidays, and weather days.

Although the General Conformity regulations do not require a worst-case situation to be analyzed, it is appropriate to use this analysis in this situation since the exact equipment requirements have not been specified. Table 7-8 displays these work activities and the anticipated construction equipment, along with expected duration of operation.

Table 7-8 Anticipated work activities, duration, and construction equipment to be used during a representative construction-phase year.

Construction Activity	Time (%)	Days/ Year	Anticipated Construction Equipment
Clearing and Grubbing	10	25	2 Bulldozers, 1 Hydraulic Excavator, 1 Tub Grinder, 2 Chainsaws, and 1 Water Truck
Floodplain Earthwork	50	124	2 Bulldozers, 1 Hydraulic Excavator, 6 Scrapers, and 1 Water Truck
Sediment Detention Dams	25	62	2 Bulldozers, 1 Hydraulic Excavator, 14 Dump Trucks, 1 Vibratory Roller, and 1 Water Truck
Stream Bank Stabilization	10	25	1 Hydraulic Excavator, 1 Bulldozer, 6 Dump Trucks, and 1 Water Truck
Topsoil Placement	3	7	2 Bulldozers, 6 Scrapers, and 1 Water Truck
Environmental Plantings & Seeding	2	5	1 Small Backhoe and 1 No-Till Planter
All Activities	100	248	

With respect to vegetation burning, the principle operations/maintenance activity affecting air quality that will occur once the projects are constructed is periodic prescribed burns within prairies and marshes in floodplain action areas. These burns will be used to maintain the biological integrity of these plant communities. A total of about 1,800 acres of such natural habitats will be managed in this manner. Each year about 600 acres of these habitats will be burned, such that on a rotational cycle every area would be burned once during a 3-year period. Burns will be conducted in the late fall and early spring when plants are dormant.

7.6.3 Expected Emissions. The recommended plan will cause temporary increases in exhaust emissions from machinery and equipment during construction activities. Table 7-9 summarizes the anticipated emissions from these construction activities. Emission factors were obtained from either "A Compilation of Air Pollutant Emissions Factors Fourth Edition (USEPA, AP-42, September 1985, revised July 1993) or "Nonroad Engine and Vehicle Emission Study - Report (USEPA, November 1991) which give emission factors for various types of heavy construction related motorized equipment.

Table 7-9 Summary of anticipated air emissions from proposed construction activities.

Construction Activity	Hours/ Year	Emissions (tons/year)		
		VolitileOrganic Compounds (VOC)	Nitrogen Oxides (NOx)	Particulate Matter PM10)
Clearing and Grubbing	1,400	0.651	1.872	0.256
Floodplain Earthwork	9,920	2.485	18.960	3.798
Tributary Stream Sediment Detention Dams	9,424	1.798	18.832	1.282
Stream Bank Stabilization	1,800	0.386	3.643	0.311
Topsoil Placement	504	0.134	0.976	0.201
Environmental Plantings & Seeding	80	0.020	1.100	0.019
Total Emissions per Year		**5.480**	**45.380**	**5.870**

With regard to prescribed fires, the USEPA issued interim Air Quality Policy on Wildland and Prescribed Fires in May 1998 to address the air quality goals and national air quality standards while improving the quality of ecosystems through the increased use of fire. Under the Policy, Federal prescribed fire projects are considered to conform with the state implementation plan if they are managed under a certified basic smoke management program. The program must require regional coordination (cooperation of all jurisdictions in an airshed) when authorizing fires and real time air quality monitoring at sensitive receptors, when warranted, in addition to the basic program components. If the recommended plan were approved, a smoke management plan would be developed for the action areas where prescribed burning is proposed for vegetation management. Development of such plans would include coordination at the local and regional levels.

7.6.4 Review of Emission Changes. Construction emissions for VOCs, NOx, and PM10 are below the 100 tons per year de minimis level for each pollutant. The area is a moderate ozone nonattainment area and the emissions of VOCs and NOx from the project show conformity by being below the de minimis levels set by the General Conformity regulations. Portions of the area are maintenance for PM10 and the PM10 analysis is below the 100 tons per year de minimis level for a PM10 maintenance area. This also demonstrates conformity. The analysis in Table 7-8 included the entire project, not only the portions that are within the PM10 maintenance area. Thus the emissions in Table 7-9 represent higher emissions than would be expected in the townships that are maintenance for PM10.

With regard to regional significance, the recommended plan must also meet the test of being not regionally significant. Regionally significant is defined in the general conformity regulations as being more than 10% of the total emissions in the nonattainment or maintenance area. The emissions for just the Illinois portion of the St. Louis ozone nonattainment area total 156 tons per day of VOCs and 173 tons per day of NOx. To convert to tons per year, 261 workdays have been used for one year. This conversion to an annual rate is needed because the ozone inventory is based on a ton per summer weekday emission rate. This results in 3,393 tons per year of VOC and 4,515 tons per year of NOx. Ten percent of these figures are 339 tons per year of VOC and 451 tons per year of NOx. Therefore, because the project is less than 10% of the total emissions for the area for both VOCs and NOx, the recommended plan is not regionally significant.

7.6.5 Conformity Determination Results. The recommended plan has minimal air quality impacts. Expected levels of pollutants are below the de minimis levels set for a moderate ozone nonattainment area and for a PM10 maintenance area. Also, the recommended plan is not regionally significant in terms of air quality impacts.

7.7 NOISE

The recommended plan will have a temporary impact on noise in the study area during certain construction activities. However, as the area has an urban characterization with the multiple transportation arteries that transect the Project area, the type of construction required of the project will have a negligible contribution to the overall noise character of the area.

7.8 SURFACE WATER/FLOODPLAIN MANAGEMENT

This plan accomplishes improved management of surface water on the floodplain to the benefit of habitat restoration areas. By restoring floodplain zones that have historically received surface water the plan accomplishes the goal of restoring and improving plant and animal diversity in the ecosystem while providing surrounding areas with relief from the damaging effects of runoff. This plan provides for floodplain management using natural means and taking advantage of environmental opportunities to solve the age-old problem for the bottoms. However, this plan provides benefits beyond the floodplain by managing sediment in the bluff tributaries to improve stream functions while providing infrastructure protection to the surrounding communities. This look to solutions for sediment transport in the bluffs likewise provides benefits to the floodplain by diminishing the adverse effects of sedimentation on ecosystem quality and on the existing flood control system.

The recommended plan will have an incidental impact on the reduction of flooding caused by inadequate channel capacity of the existing flood control system through diversion and temporary detainment of runoff in restored natural areas. The Old Cahokia Creek site will reduce flooding along Sand Road from hillside runoff in the Southern Illinois University-Edwardsville area. The Spring Lake site will reduce flooding in the Collinsville, Caseyville, and state Park Place areas by preventing flows from spilling out of Little Canteen and Canteen Creeks. The Dobrey Slough site will reduce flooding by providing for the temporary storage of runoff until it can be pumped into the existing stormwater system. The Elm Slough site will reduce flooding in the Long Lake area of Pontoon Beach and the Mitchel Ditch agricultural area, both upstream of Illinois Highway 162, by allowing water to more efficiently leave these areas during rainfall events. It is believed that adverse impacts of ponding from rainfall will be reduced in the area draining into County Ditch by the elimination of the backwater effect from the Cahokia Canal system.

7.9 CHANGES TO STORMWATER MANAGEMENT ASSOCIATED WITH EACH ACTION AREA

Old Cahokia Creek Site: Under existing conditions, excess flow from the hillside streams overwhelms the remnants of the Old Cahokia Creek channel and sheet flows to the west, flooding residences along Sand Road. The proposed project as well as fulfilling the main objective of restoring the old creek channel and forested buffer will eliminate flooding along Sand Road.

Judy's/Burdicks Site: Under existing conditions, Judy's and Burdick Branches spill out of their banks onto adjacent farmland. Under the proposed project, the spill out of the two creeks is confined in a bermed area providing environmental benefits on the former farmland.

Brushy Lake Site: Under existing conditions, overflows from Schoolhouse Branch and Snyder Ditch flow into Brushy Lake. Under the proposed condition, the environmental benefits of the Brushy Lake area will be increased by restoring a flood pulse using flows up to the design event from Schoolhouse Branch.

Spring Lake Site: Under existing conditions, the Spring Lake area stores local runoff and Harding Ditch overflows, and this water is unable to drain back into Harding Ditch. Under the proposed project, all flow from Harding Ditch will be temporarily detained in Spring Lake, which will enhance environmental benefits for that area.

Elm Slough Site: Under existing conditions, Elm Slough receives runoff from the Long Lake and Mitchell Ditch areas. Outflow from these areas is limited because of the small culvert sizes that allow flow to enter Elm Slough from the north side of Illinois Highway 162. The proposed project will restore a flood pulse to enhance the environmental quality of Elm Slough by increasing flows from Long Lake and Mitchell Ditch to the area. This will incidentally reduce flooding in the Long Lake and Mitchell Ditch areas.

Dobrey Slough Site: Under existing conditions, a railroad embankment segments Dobrey Slough. The proposed project will reconnect the slough and create an excavated wetland area in the historic slough that will be charged by localized storm water runoff. As a result flood damages experienced during intense rainfall events will incidentally be reduced.

Mullens Slough Site: Mullens Slough will improve environmental benefits to an already wet area. No changes to stormwater management are associated with this project site.

7.10 WATER QUALITY

Implementation of the recommended plan would protect restored floodplain resources from receiving debilitating levels of sediment and provide a means to naturally attenuate some of the water quality impairments identified for the surface water within the study area. Agricultural and urban runoff would be retained in designed ecosystem retention areas. This increased retention time would allow for natural attenuation of portions of nutrient and organic loading from sources of impairment. Loading of known water quality impairments to the current drainage system and lakes within the study area would, therefore, decrease and potentially provide a sufficient reduction such that natural attenuation can further reduce the impairments prior to discharge to downstream receiving waters.

A broader view of the potential benefits of the ecosystem restoration project reveals the potential for reduction in the amount of nutrients and sediments being passed to the Mississippi River and ultimately to the Gulf of Mexico. Currently the Gulf of Mexico west of the Mississippi River Delta is experiencing a severe oxygen deficiency on a seasonal basis. The major contributor to this undesirable water quality condition is wide spread algae blooms which deplete oxygen levels and upset the natural food chain and result in significant loss of fish and other aquatic organisms. This condition is commonly referred to as the "Hypoxia Problem of the Gulf of Mexico". Algae blooms are dependent, among other things, upon the availability of nutrients (i.e., nitrogen and phosphorus compounds), and studies have shown that the Mississippi River delivers about 935,000 metric tons of nutrients to the Gulf of Mexico annually. The proposed ecosystem restoration and flood damage reduction project in East St. Louis and vicinity can potentially decrease the impact on the hypoxia problem within the Gulf of Mexico and the Mississippi Delta area. Decreased sediment loading to the Mississippi River would also be realized by implementing the project. Future monitoring, consisting of sampling and testing, would be required to determine the actual impacts and benefits.

7.11 ECOLOGICAL RESOURCES

This section describes future natural resources and ecological conditions in the study area if the recommended plan were implemented. Like future-without conditions, a 50-year period of analysis has been used in the forecast of future conditions with the recommended plan. In this section, the areas (acres) of communities to be affected by the recommended plan were taken from the habitat assessment in Appendix A.

7.11.1 Communities. The recommended plan's effect on the extent of natural community classes and individual natural communities is described using comparisons from two different points in time. An "early" comparison in the 50-year period of analysis contrasts post-construction conditions with existing conditions. The other comparison represents conditions in 50 years, and contrasts the recommended plan with projected future conditions 50 years in the future without a project. In Appendix A, Habitat Assessment, more detailed comparisons were made using five points in time (target years 0, 1, 11, 21, and 51).