105th Congress, 1st Session – – – – – – – – – – – – – – House Document 105–81

LAS CRUCES, NEW MEXICO

COMMUNICATION

FROM

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

TRANSMITTING

A REPORT ON THE FLOOD DAMAGE REDUCTION PROJECT FOR LAS CRUCES, NEW MEXICO, PURSUANT TO PUB. L. 104–303, SEC. 101(A)(20) (110 STAT. 3665)

MAY 7, 1997.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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41–556 WASHINGTON : 1997

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

25 APR 1997

REPLY TO
ATTENTION OF

Honorable Newt Gingrich
Speaker of the House
of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

Section 101(a)(20) of the Water Resources Development Act (WRDA) of 1996 authorized a flood damage reduction project for Las Cruces, New Mexico. The Secretary of the Army supports the authorization and plans to implement the project through the normal budgetary process.

The authorized project is described in the report of the Chief of Engineers dated June 24, 1996, which includes other pertinent reports and comments. This report is in partial response to a resolution adopted by the Senate Committee on Environment and Public Works on April 6, 1986.

The authorized flood damage reduction project consists of eight inlets which will collect flood waters and transport those flood waters through a concrete diversion channel to two existing detention basins for temporary storage. The rectangular diversion channel will be constructed by enlarging a 1,934-foot-long section of an existing irrigation channel. Facilities will be provided to maintain the irrigation function of the canal. The existing non-Federal Gallagher and Willoughby detention basins would be enlarged to accommodate a total flood storage volume of about 180 acre-feet. The two basins will be connected by a 380-foot-long concrete channel. The project will collect and temporarily store water from floods up to and including the 100-year event. Flooding will be reduced for a total of about 1,850 structures, with about 705 of those structures being removed from the 100-year floodplain. Expected average annual flood damages will be reduced by about 37 percent. The authorized project also includes the planting of native vegetation and creation of shallow ponds within the detention basins. No fish and wildlife mitigation is required.

The views of the State of New Mexico, the Department of the Interior and the Federal Emergency Management Agency are set forth in the enclosed communications.

Based on October 1995 price levels, the estimated total cost of the authorized project is $8,278,000. Federal and non-Federal costs, based on cost sharing provisions of WRDA 1986, are about $5,494,000 and $2,784,000, respectively. In addition, in accordance with Section 202(c) of WRDA 96, the non-Federal sponsor will be required to develop, implement and enforce a flood plain management plan for the project area.

The Office of Management and Budget advises that there is no objection to the submission of this report to the Congress. A copy of its letter is enclosed in the report.

Sincerely,

H. Martin Lancaster
Assistant Secretary of the Army
(Civil Works)

Enclosure

CF: (w/o enclosures)
CECW-AR
CECW-B
CECW-PC (Please provide a copy of letters to SWD for their files. Also, please provide copies to SPD and Albuquerque District. SPD is the new Division command for Albuquerque District.
CECW-PM
Office of Management and Budget (ATTN: Rick Mertens)
ASA(CW), Dola
SACW: File, Read, Sign
Prepared: Cliff Fitzsimmons/CECW-PC/Apr 17, 97
Revised: Jim Smyth/OASA(CW)/Apr 22, 97
SA7021108

COMMENTS OF THE OFFICE OF MANAGEMENT AND BUDGET

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

31 JAN 1997

The Honorable H. Martin Lancaster
Assistant Secretary of the Army
for Civil Works
Pentagon - Room 2E570
Washington, DC 20310-0103

Dear Mr. Lancaster:

As required by Executive Order 12322, the Office of Management and Budget has completed its review of your August 6, 1996 report on the flood damage reduction project for Las Cruces, New Mexico.

Our review has concluded that your recommendations are consistent with Administration policies. The Office of Management and Budget does not object to your submitting this report to Congress.

Sincerely,

T. J. Glauthier
Associate Director
Natural Resources,
Energy, and Science

COMMENTS OF THE STATE OF NEW MEXICO

STATE OF NEW MEXICO
DEPARTMENT OF FINANCE AND ADMINISTRATION
STATE BUDGET DIVISION
Bataan Memorial Building, Suite 190 ☐ Santa Fe, New Mexico 87503
(505) 827-3640 ☐ FAX (505) 827-3861

GARY E. JOHNSON
GOVERNOR

DAVID W. HARRIS
SECRETARY
PAULA M. KLISTAN
DIRECTOR

May 30, 1996

Mr. Fritz Blake
Albuquerque District
U.S. Army Corps of Engineers
P.O. Box 1580
Albuquerque, NM 87103-1580

Subject: New Mexico State Clearinghouse review of the Interim Feasibility Study for the Las Cruces New Mexico Local Protection Project

Dear Mr. Blake:

The New Mexico State Clearinghouse has reviewed the Interim Feasibility Study for the Las Cruces New Mexico Local Protection Project and is in support of the flood control study and the proposed measures to reduce the flood threat within the study area. If I can be of further assistance in this matter please call me at (505) 827-3872.

Sincerely,

Robert Peters
New Mexico State Single Point of Contact

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

APR 18 1996

ER 96/40

Mr. David B. Sanford, Jr.
Chief, Policy Review and
Analysis Division
ATTN: CECW-AR (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3861

Dear Mr. Sanford:

The Department of the Interior has completed its review of the proposed Chief of Engineers report and other pertinent reports for the Las Cruces, New Mexico Local Protection Project.

We have no comments on the proposed report and no objections to the project as planned.

Sincerely,

Willie R. Taylor
Director, Office of Environmental
Policy and Compliance

COMMENTS OF THE FEDERAL EMERGENCY MANAGEMENT AGENCY

Federal Emergency Management Agency
Region VI
Federal Regional Center
800 North Loop 288
Denton, TX 76201-3698

February 6, 1996

Mr. David B. Sanford, Jr.
Chief, Policy Review and Analysis Division
ATTN: CECW-AR (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3861

Dear Mr. Sanford:

Thank you for your January 8, 1996, letter providing an interim feasibility report including environmental assessment and engineering appendix for the Las Cruces, New Mexico Flood Control Project. The study examined several flood control alternatives to provide flood protection to the central and downtown areas of Las Cruces.

According to our records, the City of Las Cruces is currently participating in the National Flood Insurance Program (NFIP) with an effective Flood Insurance Rate Map (FIRM) dated September 6, 1995. The city has been participating in the NFIP since 1970, and has adopted the appropriate floodplain management regulations for issuing permits within the identified floodplain.

The proposed project is considered to be "development" under the NFIP regulations found in 44 CFR 59.1. Therefore, in addition to any permits required by the U.S. Army Corps of Engineers and the New Mexico Office of Emergency Planning and Coordination, the activities must also be permitted by the City of Las Cruces in accordance with the provisions of the city's flood damage prevention ordinance. Since the proposed alteration to the flood area appears to be significant, the community may wish to develop and submit a request for a Letter of Map Revision to their current FIRM to the Federal Emergency Management Agency (FEMA).

If we can be of further assistance, please contact this office by writing to the address above, or by calling (817) 898-5380.

Sincerely,

Kathy R. Hand
Hazard Mitigation Specialist

LAS CRUCES, NEW MEXICO

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

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

REPLY TO
ATTENTION OF:

CECW-PC (10-1-7a)

24 JUN 1996

SUBJECT: Las Cruces, New Mexico

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on Las Cruces, New Mexico. It is accompanied by the report of the district and division engineers. These reports are in partial response to a resolution by the Committee on Public Works and the Environment of the United States Senate adopted on April 6, 1986. The resolution directed a review of prior reports on El Paso, Texas, and vicinity, to determine if constructing additional flood control measures, providing conservation storage in existing reservoirs, modifying detention basins within the Rio Grande basin, or other water resource development measures may be appropriate. Preconstruction engineering and design activities for Las Cruces, New Mexico, will be continued under authority of the April 6, 1986, resolution.

2. The reporting officers considered several alternative plans to reduce the potential for flooding in the Las Cruces, New Mexico, area. The recommended plan consists of constructing a concrete lined channel with floodflow collection inlets at eight locations, and expanding two existing detention basins for temporary storage of floodwater. The proposed project will accommodate the 1 percent chance flood, regulate runoff from a 2.25-square-mile urban drainage area, remove approximately 705 homes and businesses from the 100-year floodplain, and reduce local expected average annual flood damages by 37 percent. The recommended plan is the national economic development plan. No environmental mitigation is required.

3. At the October 1995 price level, the estimated first cost is $8,278,000. Estimated Federal and non-Federal costs , based on cost sharing provisions of the Water Resources Development Act of 1986, are $5,494,000 and $2,784,000, respectively. Average annual costs, reflecting a 50-year period of economic analysis, a 7.625 percent discount rate, and including annual operation, maintenance, repair, rehabilitation, and replacement costs estimated as $16,000, are $725,000. Equivalent annual benefits are estimated at $1,859,000, net benefits are $1,134,000, and the ratio of benefits-to-costs is 2.6.

4. Washington level review indicates that the proposed plan conforms to applicable Federal laws and regulatory requirements, is a complete and functionally adequate project, and is in compliance with other relevant Federal and U. S. Army Corps of Engineers regulations. The report has been coordinated with appropriate Federal, State, local, and public interests. There are no objections to the proposed plan at this time.

5. The Administration has initiated the development of a new cost sharing policy for flood damage reduction projects. I recommend that improvements for flood damage reduction in the city of Las Cruces, New Mexico, be authorized subject to cost sharing that is consistent with Administration policy. This recommendation is also subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including the following requirements:

a. 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;

b. 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;

c. 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;

d. Grant 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;

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 in a manner that will not cause liability to arise under CERCLA;

j. Participate in and comply with applicable Federal floodplain management and flood insurance programs in accordance with section 402 of Public Law 99-662;

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

l. Not less than once each year, inform affected interests of the limitations of the protection afforded by the project;

m. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by 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; and

o. Comply with all applicable Federal and Commonwealth 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."

6. 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 nor 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 sponsor, the State of New Mexico, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

PAT M. STEVENS IV
Major General, USA
Acting Chief of Engineers

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

In compliance with a United States Senate Resolution dated April 6, 1986, this report presents the results of a flood control study within the Las Cruces, New Mexico metropolitan area. The study was cost-shared with city of Las Cruces, acting as the local sponsor.

The study area is composed of the Las Cruces urban area. The flood threat identified during the study consists from a 14 square mile drainage area located below the existing Las Cruces Dam, which was constructed by the Corps of Engineers in 1976. Following the construction of the dam, extensive urbanization occurred downstream of the dam, which covered the existing arroyos and natural watercourses that carried flood flows to the Rio Grande. As a result of this urbanization, the potential for severe flooding exists in the downtown and central areas of Las Cruces from overland flows that pond water within the city.

The value of damageable property within the 100-year floodplain of the study area is currently estimated at $303,700,000. The potential damages from a 100-year event are $56,700,000. Average annual damages within the study area are estimated to be in excess of $5,000,000.

Various structural and non-structural measures to reduce the flood threat within the study are were investigated to determine the most cost-effective, viable, and desirable solution. Of the alternatives investigated, the only solution found to be feasible, implementable, and acceptable was the enlargement of the existing Willoughby and Gallagher detention basins, and the modification of the Las Cruces lateral near Main Street to carry both irrigation and flood waters.

Total cost of the selected plan is estimated at $8,278,000 of which $2,784,000 would be a non-Federal cost, as prescribed in the Water Resources Development Act of 1986. The project would accrue average annual benefits of $1,859,000, and has a benefit/cost ratio of 2.5:1. While the project will not reduce the exeedance frequency when flood damages will begin, it will remove approximately 705 structures from the 100-year floodplain and reduce average annual flood damages within the study area by 37%. The selected project, which is the National Economic Development Plan, enjoys strong local support from the City of Las Cruces, New Mexico. The City Council passed a unanimous resolution in support of the project on October 17, 1995.

This feasibility study has identified a project that meets the economic and environmental criteria for Federal participation. The report identifies Federal and non-Federal responsibilities based on the flood damage reduction cost sharing policy established by Public Law 99-662. The Administration has proposed changes to that policy which would preclude Federal participation in the identified project. Congress took exception to that proposal and the Administration is reconsidering the policy. Consequently, National flood damage reduction policy is uncertain until agreement is reached between the Administration and Congress. Based on the project's inconsistency with the Administration's proposed policy no recommendation for implementation as a Federal project is within the report. However, this report will be submitted for Washington level review and a determination of consistency with policy will be made based on the flood damage reduction policies in effect at that time.

SECTION 1

1-01 INTRODUCTION This report presents the results of a cost-shared feasibility investigation to determine if Federal participation in the construction of flood control measures to reduce potential severe flood damages in the Las Cruces Metropolitan area is warranted.

The impetus for this study was largely due to the rapid growth which is taking place within Dona Ana county and the Las Cruces Metropolitan Area. As a result of this rapid growth, the runoff from arroyos is increasing and adding to the flooding potential within the study area.

This chapter outlines the study authority, purpose and scope of this feasibility study, study participants, and prior studies performed for this study area.

1-02 STUDY AUTHORITY This study was conducted in response to the authority contained in the following United States Senate Resolution on Environment and Public Works dated April 6, 1986, as quoted below:

> **RESOLVED BY THE COMMITTEE OF ENVIRONMENT AND PUBLIC WORKS OF THE UNITED STATES SENATE,** *that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13,1902, is hereby requested to review the report on the Chief of Engineers on El Paso County, Texas, published as House Document 207, 89th Congress, 1st Session, and other pertinent reports with particular reference to providing a plan for development, utilization, and conservation of water and related land resources at and in the vicinity of El Paso, Texas. Such studies are to include appropriate consideration of the need for additional flood control measures, provision of conservation storage in existing reservoirs, detention basins within the Rio Grande basin, and other water resource development measures as may be appropriate.*

The cited authorizing legislation, includes Hudspeth and El Paso counties in Texas and Dona Ana and Otero counties in New Mexico. Two studies have been completed under the above authorizing legislation. The first study, was the El Paso and Vicinity Regional Appraisal Study. Because of the large geographic scope of the study authorization (over 16,000 square miles), an initial appraisal study was undertaken to identify areas where reconnaissance studies could be undertaken, and where the potential for Federal involvement past the reconnaissance phase of planning was likely. This study, which was completed in 1989, investigated several potential areas for reconnaissance studies, however no potentially favorable study areas were identified.

Prior to the initiation of the appraisal study, two areas located within the study authority were deemed to have flooding problems that were of a significant enough nature to warrant reconnaissance studies without being included in the initial appraisal analysis. These areas are Socorro to Clint, Texas and Las Cruces, New Mexico. The reconnaissance study for the Socorro to Clint, Texas study area was completed in April 1990. No economically justified flood control alternatives were identified as a result of that study.

This feasibility study was completed following a reconnaissance study and report that was completed in May 1991, and was conducted in response to the aforementioned authority. The reconnaissance study identified a severe flooding problem within the Las Cruces area, a feasible plan that would reduce that flooding, and a local sponsor that was willing to participate in a cost-shared feasibility study (the City of Las Cruces).

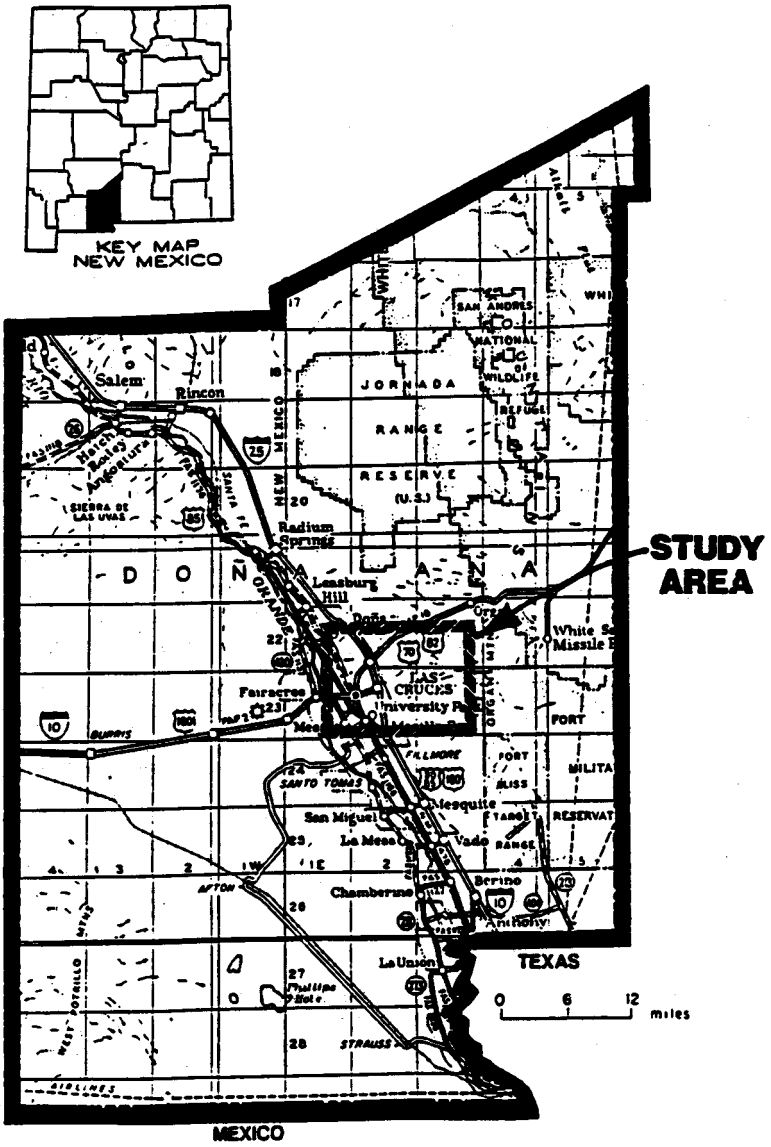
The location of the study area, in relation to the entire Rio Grande Basin is presented in Figure 1-1.

1-03 PURPOSE AND SCOPE The primary purposes of this study were to determine the feasibility of providing flood protection measures and to investigate possible environmental, water quality, and recreation enhancements within the Las Cruces area. The study was requested by the City of Las Cruces.

From the Corps of Engineers' perspective, the key Federal concern for water resources lies in controlling and minimizing urban flood damages, while protecting the nation's environment. Prevention of agricultural flood damages or intensification of agricultural crop yields, hydropower, water supply development, and recreational and environmental enhancement, are additional purposes which can be incorporated into a multiple purpose project which has flood control as the primary purpose.

In accordance with current regulations, flood control investigations performed under the General Investigations authority are divided into two separate phases. The first phase, known as the reconnaissance phase, concentrates most of its efforts in the area of problem identification; identifies at least one potentially viable plan with a Federal interest, and assess the support for the plan from local sponsor. The reconnaissance study for this project was completed in May 1992. The reconnaissance report concluded that an engineeringly, economically, and environmentally justified project could be identified that would reduce the flood potential within the study area. The second phase, know as the feasibility phase, immediately follows the reconnaissance phase, and it is used to arrive at the best plan to solve the identified problem(s).

This report presents the results of the feasibility study, which was cost-shared with the city of Las Cruces on an equal basis. The report presents the results of all analysis completed during the feasibility study phase. The objectives of the study are to:



Vicinity Map - Doña Ana County, Las Cruces, New Mexico

(1) Reduce the potential for severe flooding in the study area so as to maximize National Economic Development benefits.

(2) Preserve and maintain environmental attributes of the study area to the maximum extent possible.

(3) If possible, expand recreational opportunities in conjunction with flood control.

1-04 STUDY PARTICIPANTS This study was conducted by the Albuquerque District of the United States Army Corps of Engineers and the City of Las Cruces, New Mexico. Coordination was maintained throughout the study with state, county, and local government officials, the Elephant Butte Irrigation District, the Bureau of Reclamation, and the U.S. Fish and Wildlife Service. Several public meetings were held to inform private citizens and the news media informed of the status and results of the study. Local real estate brokers were consulted to verify property values and sales within the project area.

1-05 PRIOR STUDIES AND REPORTS Several reports have been published by the Corps of Engineers, other Federal agencies, and state and local agencies which document water resource problems and opportunities within the Las Cruces area. Listed below are studies which were used as references in the preparation of this report.

PRIOR CORPS OF ENGINEERS REPORTS

U.S. Army Corps of Engineers, Las Cruces Local Protection Project, Las Cruces Dam, New Mexico, Rio Grande and Tributaries, Design Memorandum No. 1; Albuquerque District; June 1964.

U.S. Army Corps of Engineers, Special Flood Hazard Information, Alameda and Las Cruces Arroyos, Las Cruces New Mexico, Albuquerque District; June 1971.

U.S. Army Corps of Engineers, Report on Hydrologic Investigation, Flood Insurance Study, Las Cruces, New Mexico, Albuquerque District; March 1981.

U.S. Army Corps of Engineers, Tellbrook Arroyo, Reconnaissance Study, Las Cruces, New Mexico, Albuquerque District; June, 1988.

U.S. Army Corps of Engineers, El Paso and Vicinity, Regional Appraisal Report, Albuquerque District, October 1989.

U.S. Army Corps of Engineers, South Central New Mexico Regional Frequency Study,

Albuquerque District; April 1990.

U.S. Army Corps of Engineers, Las Cruces, New Mexico, Reconnaissance Study, El Paso and Vicinity, Texas and New Mexico, Albuquerque District; May 1991

OTHER REPORTS

Gordon Herkenhoff and Associates Inc., Storm Drain Master Plan for the City of Las Cruces, Dona Ana County, New Mexico, March 1972.

Charles F. Horne and Associates, Flood Control Study, City of Las Cruces, New Mexico, April 1972.

Greiner Engineering Sciences, Inc., Storm Drainage Master Plan for the City of Las Cruces, Dona Ana County, New Mexico, July 1985.

SECTION 2

2-01 STUDY AREA DESCRIPTION: This section describes the study area within the Las Cruces Metropolitan area and outlines its major features with respect to various categories pertinent to the study. The categories include socio-economic characteristics, history, geography, climate, precipitation, geology and soils, environmental setting, cultural resources, and flood control measures. The Las Cruces Metropolitan area is located in parts of Townships 22 and 23 South, Range 2 East in central Doña Ana County, New Mexico, approximately 44 miles north of El Paso, Texas, and 200 miles south of Albuquerque, New Mexico. The city lies within the Rio Grande Valley at an elevation of approximately 3,900 feet. A general map of the study area is presented as Plate 1.

2-02 SOCIO-ECONOMIC CHARACTERISTICS

2-02.1 Population: The current population of Las Cruces is estimated at 67,000. Table 2-1 presents population growth of Doña Ana county and Las Cruces from 1860 to the present.

TABLE 2-1
POPULATION GROWTH OF LAS CRUCES

Year	Doña Ana Co.	Las Cruces	% of County
1860	6,239	768	12.3
1890	9,191	2,340	25.5
1900	10,187	2,906	28.5
1920	16,548	3,969	24.0
1940	30,411	8,385	27.6
1960	69,948	29,347	49.0
1980	96,340	46,999	46.8
1990	135,510	62,126	46.6
1995	145,614	67,400	46.3
2000	156,837	72,615	46.3

2-02.2 Income: The per capita income of Las Cruces in 1992 was $11,379, a 6.9% increase over 1989 ($10,640). This compares with a 1992 national per capita income of $18,696. Of the 319 Metropolitan Statistical Areas (MSA) used by the Bureau of Economic Research, Las Cruces ranks 316th in per capita personal income.

2-02.3 Employment: The economy of Las Cruces is based on government (White Sands Proving Grounds), education (New Mexico State University), agriculture, tourism, and manufacturing. Local employment opportunities have not kept pace with the population growth, forcing many residents of the Las Cruces urban area to commute to the industrial center of El Paso, Texas, 45 miles to the south.

2-03 HISTORY OF THE AREA: Las Cruces, the seat of Doña Ana County, was settled on the east bank of the Rio Grande in 1848. Doña Ana County was created in 1852 and

extended across the southern part of the State from the Texas boundary to the California boundary. In 1855, the New Mexico Territorial Government added the lands of the Gadsden Purchase to the county. During subsequent years the county was reduced in size by the creation of the Territory of Arizona in 1863, and further subdivided to form new counties until 1901, when the present boundary was established.

The name Las Cruces (the crosses) originated from an 1830 Apache massacre of about forty travellers near the site of the town and the resulting field of crosses that covered the area. Merchants and freighters established the first Las Cruces business community in the 1850's, when the neighboring community of Mesilla was claimed by the Mexicans and a new trading station was needed. Las Cruces College was founded in 1880 on land several miles south of the town. The college became the New Mexico College of Agriculture and Mechanical Arts in 1889 and grew during the twentieth century as New Mexico State University, now the second largest university in the state. The prosperity of Las Cruces, closely related to the agricultural wealth of the Mesilla Valley, was enhanced by the 1920's with the construction of Caballo and Elephant Butte dams 60 and 75 miles, respectively, upstream on the Rio Grande.

The two reservoirs allowed for an expanded irrigation canal and drainage system throughout the Mesilla Valley and provided an efficient and orderly water distribution system during the long growing season. Mesilla Valley quickly became one of the richest agricultural areas in the state, producing cotton, pecan nuts, and vegetables. There was a rapid increase in the rural population between 1920 and 1940. The steady income from agricultural exports for the farmers and many farm laborers directly benefitted the commercial development of Las Cruces. The population boom of the city in the late 1940's was the result of the establishment of the nearby White Sands Missile Range; Las Cruces serves as a convenient residential area for the Federal employees of the missile range. Since the 1950's, the Las Cruces area has continued to develop. The greater Las Cruces area is one of the fastest growing areas in the Southwest. About one-fourth of the population growth consists of retirees.

2-04 PHYSICAL CHARACTERISTICS

2-04.1 Geography: The Rio Grande, one of the principal rivers in the southwestern United States, is an interstate and international river of importance. From its source on the eastern side of the Rocky Mountains in south central Colorado, the Rio Grande flows eastward for about 150 miles to near Alamosa, and then southward across the Colorado-New Mexico state line. Continuing southward the river nearly bisects New Mexico from north to south, crossing the New Mexico-Texas state line near El Paso. From El Paso, the river flows generally southeastward and forms the international boundary between the United States and Mexico. The total watershed area is 335,500 square miles.

The city of Las Cruces is located in the Mesilla Valley of the Rio Grande in Dona Ana County, south-central New Mexico. The river valley is a flat plain about five miles wide flanked on the west by a sloping plain which, in a distance of three miles, rises about 575 feet to a relatively flat mesa. On the east, an alluvial outwash plain rises gradually

from the valley edge at an average rate of 150 feet per mile for a distance of about ten miles, then rises quite steeply for about three miles to the crest of the Organ Mountains. The Organs are a part of a long chain of tilted mountains that extend southward from the southern end of the Rocky Mountain chain in north central New Mexico. They attain an elevation of 9,012 feet at the highest point, Organ Needle, and are about 17 miles in length from north to south, with a maximum width of about nine miles.

The principal central business district of Las Cruces, as well as a substantial portion of an older, established residential area is situated on the valley floor on the east side of the Rio Grande, at the foot of the alluvial outwash.

2-04.2 Climate: The climate in the vicinity of Las Cruces is classified as semi-arid continental, characterized by fairly hot summers, mild, winters, and short temperate spring and fall seasons. The average frost free season is 201 days usually beginning early in April and lasting through October. The average temperature at Las Cruces is 59.6 degrees and the recorded temperature extremes are 109 degrees and -8 degrees Fahrenheit. The prevailing winds are from the west, and the average wind velocity is 6.4 miles per hour. The average annual precipitation at the New Mexico State University Weather Station is 7.89 inches, and the maximum recorded during a 24-hour period was 6.49 inches in August 1935. About 60 percent of the annual precipitation occurs during the four-month period of July through October, with the greatest amounts falling during July and August when small-area intense thunderstorms are most prevalent. The average snowfall in the Las Cruces area is 2.4 inches.

2-04.3 Precipitation: There are three Weather Bureau stations in and adjacent to the study area: New Mexico State University, Jornada Experiment Station, and Orogrande. The State University Station has a long-term record which was begun by the U.S. Army at Fort Filmore in 1851, continued periodically at various locations for about 40 years, and maintained without interruption until 1892, when the station was relocated to New Mexico State University. Precipitation during the summer months is generally in the form of thundershowers of short duration, resulting from convective or orographic lifting or an inflow of warm moist air originating in the Gulf of Mexico. Occasionally precipitation occurs as the result of an invasion of tropical Pacific air. Frontal activity is most prevalent in this area during the winter and early spring months and, if moist air is present, is accompanied by rain or snow of light-to-moderate intensity.

2-04.4 Meteorological Influences: Las Cruces lies in a transitional zone between the Gulf of Mexico and Pacific rainfall provinces, with attendant complex meteorological conditions further complicated by the presence of mountainous areas. There have been no major flood-producing storms experienced during the winter months, primarily because the semi-permanent high-pressure area over the Great Basin in Utah inhibits the inflow of moist Pacific air. During the summer months, intermittent flows of warm moist air from the Gulf of Mexico, both surface and aloft, penetrate the Las Cruces area, and under certain concurrent upper air circulation patterns, produce severe thunderstorms.

2-04.5 Geology and Soils: The ascending plain between Las Cruces and the

Organ Mountains comprises the south tip of the ancient Jornada del Muerto Basin. The plain is mantled by thick deposits of surficial material deposited during the Quaternary period as the result of mountain erosion, and such deposition is continuing at the present time. The soils range from deep to shallow, are generally sandy and contain silt, clay and considerable quantities of fine-to-medium gravel.

The Organ Mountains are an elongated fault block, the center of which is a Tertiary batholith of monzonite which is carved into jagged outlines. Formations in the mountains dip to the west and rage from Pre-Cambrian to Tertiary in age and are generally composed of crystaline intrusives and extrusive igneous rocks with smaller amounts of limestones, shales and sandstones. Soils in the Organ Mountains are shallow, rocky, or completely absent. At the edge of the plain the canyons are narrow, deep, and rocky, with sparse vegetation. Erosion of the coarse granites produces large quantities of sand and gravel found at the lower levels and on the plain. These granites also weather quite readily into clay and quartz grains. This is the source of much of the clay and sand found in the plain.

The soils of the project area are of the Glendale-Harkey association which are deep, nearly level, well drained soils that formed in alluvium; on flood plains and stream terraces of the Rio Grande. Typically, these soils are in shallow depressions on the flood plains and are comprised of many soil types through accumulation and may have a surface layer of clay or loam. The soils are used for irrigated crops, pasture, community development, and as wildlife habitat and rangeland. Because engineering structures are planned, a detailed on site investigation has been made due to the variability and complex pattern of the soils. The water table is generally at a depth of 5 to 15 feet.

2-05 ENVIRONMENTAL SETTING: The study area lies within the Chihuahuan desert biotic community. Types of vegetation vary with altitude, water supply and grade. The upland species are typical Chihuahuan Desert scrub species, with cultivated crops and ornamental vegetation in the urban areas, and deciduous riparian woodlands at the lowest elevations. Dominant upland plant species include creosote bush, four-wing saltbush, honey mesquite, soaptree yucca, and prickly pear. Grasses include alkali sacaton, sand dropseed, three-awn, and bush muhly. Urban areas typically contain introduced species including exotic grasses such as bermuda and rye grass; garden fruits and vegetables; exotic native and ornamentals such as chinese elm, fruitless mulberry, New Mexico locust, juniper, prickly pear, agave; and native hybridized species such as Rio Grande cottonwood and hybrids. Riparian areas of the valley have a principle overstory of Rio Grande cottonwood, Russian olive, coyote willow and salt cedar, with understory species including tall goldenrod, Mexican devilweed, spike dropseed, giant dropseed, and salt grass. Croplands surrounding the riparian areas typically produce cotton, alfalfa, beans, chile and pecans.

The existing channel is frequently maintained through mowing. There is little vegetation in the basins other than a scattered weed and grass species. Vegetation along the edges of the channel and the basins is typical upland species with a few scattered trees.

Mammalian wildlife is limited by the proximity of urban residences and their tolerance of human activity. Animal diversity is also low due to the lack of permanent or perennial sources of surface water. Mammals likely to inhabit the Las Cruces area include the desert pocket gopher, kangaroo rats, several species of mice, the white-throated woodrat, spotted ground squirrel, striped skunk, desert cottontail rabbit, and black-tailed jackrabbit.

Reptiles that are likely to inhabit the Las Cruces upland and floodplain areas include western box turtle, western banded gecko, lizards such as the greater earless lizard, fence lizard, tree lizard, and Texas horned lizard, Chihuahuan spotted whiptail, snakes such as the western hognose snake, Texas blind snake, gopher snake, kingsnake, massasauga, black-tailed rattlesnake, and western rattlesnake. Amphibians likely to be present are plains spadefoot toad, western spadefoot toad, Couch's spadefoot toad, Woodhouse's toad, great plains toad, green toad, and red-spotted toad.

Resident and migrant birds within the Las Cruces upland and riparian areas include warbler species such as the yellow-rumped and the orange-crowned; sparrows such as the white-throated and white-crowned, solitary vireo, mourning dove, scaled quail, roadrunner, red-winged blackbird and the rufous-sided towee. Golden eagles, turkey vultures, American kestrels, red-tailed hawks, prairie falcons, sharp-shinned hawks, and Cooper's hawks may use these areas, especially riparian areas, for foraging.

Fish species are generally absent in the project area due to the intermittent nature of the storm drains and irrigation ditches. Fishes that may find temporary habitat in these ditches and drains include gizzard shad, threadfin shad, grass carp, red shiner, common carp, river carpsucker, yellow bullhead, and mosquito fish.

The U.S. Fish and Wildlife Service (USFWS), under authority of the Endangered Species Act of 1973, as amended; the New Mexico Department of Game and Fish (NMDGF), under the authority of the Wildlife Conservation Act of 1974; and the New Mexico Energy, Minerals and Natural Resources Department, under authority of the New Mexico Endangered Plant Species Act and Rule No. NMFRCD 91-1 maintain lists of species which have been classified as Threatened or Endangered based on present status and potential threat to future survival. Five Federally Endangered taxa were considered by the USFWS as having the potential to occur at the project site: Bald eagle (Haliaeetus leucocephalus), American peregrine falcon (Falco peregrinus anatum), whooping crane (Grus americana), black-footed ferret (Mustela nigripes), and Sneed's pincushion cactus (Coryphantha sneedii var. sneedii). The southwestern willow flycatcher (Empidonax traillii extimus) is proposed for listing as a federally endangered species. Habitat within the project area is not suitable for any of these species.

Detailed information regarding the environmental setting of the study area and effects of the proposed action and alternatives can be found in the attached Environmental Assessment and appendices.

2-06 CULTURAL RESOURCES: A cultural resource inventory and survey was conducted

of approximately 160 acres within the study area. No cultural resources were found in the north-central portion of the study area. Two archeological sites, one prehistoric and one historic, were located and recorded in agricultural fields associated with the southern portion of the study area. The historic site (LA 100876), an early 20th century farm house, is considered potentially eligible for inclusion in the National Register of Historic Places. Should the site be affected, subsurface testing would be required to determine its actual eligibility status. During the 1980's, the house and associated outbuildings were razed. The prehistoric site (LA 100875), a possible Formative Period habitation site, is potentially eligible for inclusion in the National Register of Historic Places. Coordination with the New Mexico State Historic Preservation Office has been accomplished.

2-07 RECREATIONAL RESOURCES: Las Cruces is within New Mexico Planning District 7, which includes Doña Ana, Socorro, and Sierra Counties. Within this region, Las Cruces is the major population and economic center. The 1991 Statewide Comprehensive Outdoor Recreation Plan of New Mexico identifies high priority future needs for Region 7 as follows: bicycle paths, picnic areas, playgrounds, playfields, historic trails, jogging areas, nature study areas, tourism services, and swimming pools. The Recreation Master Plan for Las Cruces identifies multi-purpose open space parks, trails, and bike paths. The current plan in the project area is that the maintenance road provided along the diversion channel and along the eastern boundary of the two basins will serve as a bicycle/walking/jogging trail. Trail signs and a cross-walk across Chestnut Avenue would be provided.

2-08 EXISTING FLOOD CONTROL STRUCTURES: Four major arroyos (Las Cruces, Alameda, Sandhill, and Fillmore) enter the city limits from the east after crossing an alluvial plain from points originating in the Organ Mountains. In 1976, the Corps of Engineers completed construction of the Las Cruces Local Protection Project, which consists of a compacted earth embankment that controls flood flows up to and including the Standard Project Flood on both the Las Cruces and Alameda arroyos. Discharges from the dam are conveyed downstream in an outlet channel to the Dona Ana Drain and then to the Rio Grande. Total project cost was $6,505,000. The project is operated and maintained by the city of Las Cruces. Table 2-2 presents the pertinent features of the Las Cruces Dam.

TABLE 2-2
PERTINENT FEATURES OF THE LAS CRUCES DAM

	Las Cruces Dam
Drainage Area (contributing) sq. mi.	28.9
Reservoir:	
Flood Control Storage, acre-feet	7,883
Sediment Storage, acre-feet	320
Spillway Crest storage, acre-feet	8,203
Maximum Pool, acre-feet	13,200
Embankment:	
Type	Earthfill
Height above streambed, feet	67
Crest length, feet	15,570
Spillways:	
Type (unlined earth channel with stabilizers)	2
Design Discharge, cfs	30,400
Bottom Width (channels and weirs)	200
Outlet Works:	
Type	Uncontrolled
Size (concrete conduit)	3'x 3'
Design Discharge	233
Outlet Channel:	
Length, feet	11,879
Bottom Width, feet	8
Lining	Dumped rock
Outlet Channel Extension:	
Length, feet	13,200
Bottom Width, feet	10-20

Following construction of this dam, the Las Cruces and Alameda arroyos below the dam became poorly defined as urbanization altered their natural flow paths. The lack of natural arroyos and extensive development below the Las Cruces Dam causes the downtown commercial and residential area of the city, which is relatively flat, to flood from localized storm runoff. Irrigation laterals, groundwater drains, and elevated railroads, streets, and highways run perpendicular to the natural flow paths, creating barriers to the flow and adding to the flooding problem.

Throughout the city, there are small detention basins designed to capture overland runoff, with design capacities for controlling the 10-25 year storm events. The most notable of these basins for the purpose of this study are Gallagher and Willoughby basins just north of the downtown area, and Frenger Pond, located in the southwestern section of the city.

SECTION 3

3-01 PROBLEM IDENTIFICATION This section investigates the problems and needs of the Las Cruces metropolitan area and identifies the need for additional flood protection and recreational development. During the reconnaissance study, the local sponsor identified two areas of concern within the study area. First, the urban area to the west of the existing Las Cruces Dam, and second, the Tortugas Arroyo, in the southern portion of the study area. During the reconnaissance phase, investigations of the Tortugas Arroyo revealed that the 100-year event will be contained by a Soil Conservation Service dam located in the upper reaches of the Tortugas watershed and flood damages within the area would be minimal. The Rio Grande flows through Las Cruces to the west of the downtown area. No flood threat from it is anticipated. Existing levees along the Rio Grande through the study area provide 100-year protection and are maintained by the International Boundary and Water Commission. As a result, problem identification and project formulation for this feasibility study concentrates on the downtown urban area of Las Cruces, west of the Las Cruces Dam.

3-02 HISTORICAL FLOODING Flooding in Las Cruces predominately occurs in the late summer months (August-September). Several flooding events have occurred in the Las Cruces area over the past fifty years. The three most significant events are summarized below.

FLOOD OF AUGUST 29-30 1935

This flood was the result of a severe thunderstorm centered over the lower reaches of Las Cruces and Alameda arroyos. The storm dissipated without moving out of the area. The rain gage at the State University showed 6.49 inches of rain fell between 11:05 PM, August 29th, and 2:40 AM, August 30th. It is documented that flood waters began flowing from the east mesa arroyos into Las Cruces at about 1:00 AM, August 30th, and within one hour most of the downtown area of the city was inundated. Later that same morning some of the flood waters had dissipated by way of a drainage ditch running through the city to the south; however, a considerable amount of water ponded in the north and west sections of the city. Sixty-two houses and eighty-five private garages were totally destroyed. Ninety-nine homes were severely damaged. One school under construction and two other schools received severe damage. The basements of a large number of commercial enterprises in the business district were flooded. Damages (updated to Oct. 1994 prices) are estimated at $5.6 million.

FLOOD OF SEPTEMBER 21, 1941

On this date the city of Las Cruces suffered flooding from an intense thunderstorm which was almost as intense as the storm of August 1935. Heavy rains began falling at approximately 1:00 PM and continued until 4:30 PM, at which time the storm began to recede and the rain finally stopped at about 6:30 PM. The State University gage showed rainfall of 4.85 inches in 24 hours. The storm was very extensive on the east side of the Rio Grande, and was once again centered over the lower reaches of the Las Cruces, Alameda, and Tortugas arroyos. Runoff from the arroyos began at about 4:30 PM and reached their peaks at 10:00 PM. From the statements of local residents, the flooding was about equal to the flood of August 1935.

FLOOD OF 22-23 AUGUST 1987

This is the most recent flood within the study area. During the evening of August 22, 1987, four to five inches of rain fell within the study area causing considerable damage throughout the city. No damage estimates for this event are available.

3-03 HYDROLOGIC ANALYSIS Hydrologic investigations were undertaken during the feasibility study to evaluate the magnitude of frequency discharges and volumes that occur in the city of Las Cruces. Information not included in the Reconnaissance Report, but included in this report, are the computation of the Probable Maximum Flood, the Standard Project Flood, and the project hydrology for the selected plan.

A significant technical difference incorporated in this phase is the use of a 24-hour storm for hydrologic modeling as opposed to the 6 hour storm used in the Reconnaissance Study. Also, 1991 ortho-photo contour mapping for portions of the study area are available and utilized.

It should also be noted that for this feasibility report, a risk-based analysis was used in determining hydrologic, hydraulic and economic parameters and values. The basis and background for this type of analysis is presented in Appendix B, Risk based Analysis.

3-03.1 WATERSHED DESCRIPTION The area modeled in this study consists of the urban area of Las Cruces, New Mexico. The city is situated at the mouth of an alluvial fan located in south-central New Mexico in the Rio Grande's Mesilla Valley. The mean elevation in the city is approximately 3,900 feet above mean sea level (NGVD). The city is currently populated by over 60,000 people and is one of the fastest growing cities in the southwest., The total drainage area studied is approximately 14 square miles. This drainage area was divided into numerous sub-basins to aid in the analysis. These basins range in size from 0.17 mi^2 to 1.57 mi^2 and have slopes ranging from 0.028 ft/ft to 0.0008 ft/ft. Four major arroyos (Alameda, Las Cruces, Sandhill, and Fillmore) enter the city limits from the east after crossing an alluvial plain from points originating in the nearby Organ mountains. In 1976 the Corps of Engineers completed construction of the "Las Cruces Local Protection Project" which consists of a compacted earth embankment that controls flooding up to the Standard Project Flood on both Las Cruces Arroyo and Alameda Arroyo. Below the Corps dam the Las Cruces and Alameda arroyos are poorly defined as urbanization has eradicated their natural flow paths. The lack of natural arroyos below the dam causes the central area of the city, which is relatively flat, to flood from localized storm runoff. Irrigation laterals, groundwater drains, and elevated railroads and streets run perpendicular to natural flow and add to the problem by creating barriers to flow. The area studied, along with locations of existing flood control works, sub-drainage areas and concentration points shown on Plate 6.

3-03.2 AVAILABLE GAGE DATA Very little stream flow data are available in the immediate vicinity of the study area. In fact, the only recorded stream flow data are for the Las Cruces Arroyo between 1957 and 1966. Historical data for the arroyo are available back to 1935 with the highest flow of 2,630 cfs occurring in 1941. When the gage was in place, the drainage area above it was 13.5 mi^2. This area is now controlled by the Las Cruces Dam.

There are three Weather Bureau stations in the vicinity of the study area: New Mexico State University (NMSU), Jornada Experiment Station, and Orogrande. The gage at NMSU has a rainfall record for daily totals dating back to 1892. The maximum rainfall recorded during a 24 hour period was 6.49 inches in August of 1935. A summary of significant storms recorded since 1959 at the gage is shown in Figure 3-1. Hourly data for this gage is not available prior to 1959.

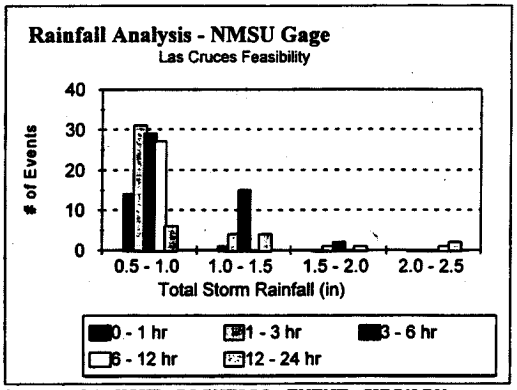


Figure 3-1 - 24 HOUR RAINFALL EVENT SUMMARY

Further analysis of these storms show that 75% of the rainfall during any one particular event occurs within the first hour of the event.

3-03.3 MODEL DEVELOPMENT The hydrologic model for the urban study area is divided into 29 sub-areas to: 1) provide flood discharge and volume data at many locations and 2) track the flow of flood waters through the poorly defined flow paths in the city. HEC-1 was used to develop the hydrologic models for the study. Existing flood control facilities are incorporated into the models. The HEC-1 models are designed to simulate the surface run-off response resulting from rainfall which occurs over the city by representing the area as an interconnected system of hydrologic and hydraulic components.

3-03.4 FREQUENCY RAINFALL The analysis of the rainfall data at the NMSU gage showed that for rare events a storm duration of greater than 6 hours is appropriate. This, coupled with the fact that the Reconnaissance Report concluded that any feasible project in the study area will be volume intensive, led to the selection of a 24 hour storm duration for HEC-1 rainfall.

The hypothetical point precipitation for the 10%, 2%, and 1% chance events was obtained from the National Oceanic and Atmospheric Administration (NOAA), Precipitation Frequency Atlas of the United States, volume IV. The 0.2% chance rainfall was determined by plotting a depth-frequency curve for the 10%, 2%, and the 1% rainfalls and extending

it to determine the 0.2% amount. No areal reductions are applied to the rainfall amounts as the sub-areas under investigation range in size from 0.17 to 1.57 mi^2 and the total area being studied in the city is approximately 14 mi^2. Table 3-1 lists the rainfall amounts, in inches, used in the models.

Table 3-1
Rainfall Amounts Used in Analysis

FREQ	RAINFALL (in)
0.2 %	4.4
1 %	3.4
2 %	3.0
10 %	2.1

The 24 hour rainfall for each frequency was distributed into 5-minute time increments following the procedure outlined in the NOAA atlas. The data was arranged into a realistic storm pattern with the maximum increment placed at the end of the 7th time period of the storm and the remaining increments placed, in blocks of three, so that they ascend in magnitude to the peak and then descend in magnitude to the end of the storm. The rainfall hyetograph used in the HEC-1 models is shown in Figure 3-2.

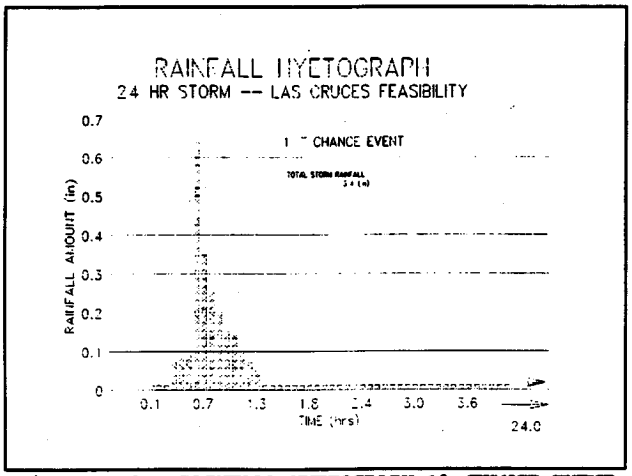


Figure 3-2-- RAINFALL HYETOGRAPH 1% CHANCE EVENT

3-03.5 URBANIZATION To account for the urbanization in the city of Las Cruces, a weighted percentage of impervious cover was computed and no infiltration losses were assumed in these areas. This percentage was compiled by assigning a coefficient to each possible land use and multiplying this coefficient by the percentage of that land type in the sub-area. Table 3-2 lists the coefficients used for this analysis.

Table 3-2
Impervious Coefficients

LAND USE	IMPERVIOUS COVER
LOW DENSITY RESIDENT	.25
MED DENSITY RESIDENT	.30
HIGH DENSITY RESIDENT	.35
BUSINESS-COMMERCIAL	.65
LIGHT INDUSTRIAL	.55
HEAVY INDUSTRIAL	.60

The coefficients listed in Table 3-2 are identical to values used in the Flood Insurance Study (FIS) conducted for the city in 1981. These percentages were determined from visual inspection of aerial maps for the city dated 1979 and 1991. For the portions of the city where 1979 mapping was used, it was supplemented with a field inspection to arrive at current conditions. For future conditions it was assumed that open space (not including land designated for recreation) is fully developed according to its zoned land use. The HEC-1 models reflect future conditions.

3-03.6 INFILTRATION LOSSES The block loss method is used to account or infiltration losses in the HEC-1 models. Two different loss functions are used: 1) the initial loss which must be satisfied before any runoff occurs and 2) a constant loss in inches per hour which continues after the initial loss has been satisfied. The intense convective nature of summer thunderstorms in the city led to the use of the same loss rate for each frequency event. Loss rates for the Standard Project Flood and Probable Maximum Flood are discussed in their respective sections of this appendix.

A constant loss rate of 0.20 inches per hour was utilized for the hydrologic models. This value was derived from the calibration of a 1954 storm near Soccoro, NM. The transposition of this data to the Las Cruces area is appropriate, as the areas are geographically and climatologically similar. This value has been used extensively in the Las Cruces area and in El Paso, TX.

The initial loss rate function was utilized to calibrate the HEC-1 models. To do the calibration we developed an HEC-1 model with thirteen sub-areas in the eastern half of the

city and adjusted the initial loss rate for these sub areas until computed peak discharges matched peak discharges predicted by the South Central New Mexico Regional Frequency Analysis[1] (SCNMRFA). The sub-areas selected for this calibration have similar physical characteristics to the basins used in SCNMRFA. This calibration HEC-1 model was set up to reflect natural conditions (no urbanization) since that is what SCNMRFA predicts for. We computed the mean of area weighted means for each frequency event. To determine the initial loss rate to be used in the models, the mean of the means of the 10%, 2%, and the 1% chance events was calculated. This value is 1.37 inches.

3-03.7 HYDROLOGY RESULTS The results of the pre-project hydrology for the city are shown in Table 3-3. Flows and volumes for the four different frequencies, as well as the SPF and PMF, are given at each concentration point. Blocks of concentration points indicate the separate networks of flooding which occur within the city (concentration points are shown on Engineering Appendix, Plate 6. The results show that a substantial flooding problem exists within the city. This problem arises from the lack of conveyance of flood waters in the flat, central part of the city. Runoff from localized storms occur in the sub-areas above Main Street and El Paseo Drive. This runoff combines with floodwater from the basins in the flat part of the city to cause a slow-moving inundation of a significant portion of the city. The flood waters eventually drain to the south through irrigation drains. Detailed descriptions of the hydrologic analysis undertaken can be found in the Engineering Appendix, Section IV.

3-04.1 FUTURE WITHOUT PROJECT CONDITION HYDRAULIC FLOOD PLAIN ANALYSIS: Intense localized thunder storms occur over the city resulting in runoff from the eastern half of the city accumulating in the central and western half of the city. This accumulation is due to the lack of flood water conveyance to the Rio Grande from this extremely flat part of the city. Many man-made obstructions and development over the original conveyances magnify the problem. The analysis breaks this flooding problem into five reaches within the study area. Each reach will be described under separate headings. The September 1990 version of the computer program HEC-2 was used to do the hydraulic analysis for flood plain determination. This program was developed by the Hydrologic Engineering Center in Davis, CA and is widely accepted in the profession for flood plain determination. HEC-2 calculates water surface profiles for steady, gradually varied flow. The computational procedure is based on the solution of the One-Dimensional Energy Equation with the energy loss due to friction evaluated with Manning's equation. This procedure is generally known as the Standard Step Method. The effects of obstructions and alterations in the flood plain, which are evident in this study, can be accounted for by adjusting model parameters.

3-04.2 BASIC INFORMATION: Ground topography and cross sections for the flood plain analysis were obtained by digital means from aerial photography flown in 1991 and 1992. Orthophoto contour maps from the same photography were used as work maps. These maps have a scale of 1" = 200', with a contour interval of 1' in the extremely flat valley areas and 2' in the eastern half of the city.

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[1]South-Central New Mexico Regional Frequency Analysis, U.S. Army Corps of Engineers - Albuquerque District, 1990

The city of Las Cruces also has developed a digital base map of the city as part of a Geographic Information System (GIS) currently being developed for Las Cruces. We made extensive use of this map to illustrate flow paths and show flood plain limits at a scale reasonable for this report.

Digital Terrain Models (3-D computer files of the existing ground surface) of the study area also are used to generate representations of water flow patterns and to obtain cross sections for the HEC-2 computer models. A Flood Insurance Study (FIS) was completed for urban Las Cruces in 1980. This study, conducted by the Albuquerque District, defined and presented limits of flooding within the study area. The FIS was used to define the flow paths for this analysis, and also for verification and calibration where appropriate.

3-04.3 ASSUMPTIONS: Due to the nature of flooding in the study area (a non-riverine, fully urbanized flood plain) it was necessary to make assumptions for certain parameters in the HEC-2 models. The main assumption was the selection of roughness factors (Manning's "n"). Very little criteria or guidance is available for selecting Manning's values in a fully urbanized flood plain. Therefore, we decided to use a method developed by the Los Angeles District, Corps of Engineers. A summary of this method is provided in the following paragraphs.

Table 3-3

DISCHARGES & VOLUMES AT CONCENTRATION POINTS IN LAS CRUCES												
LOCATION	10 %		2.0 %		1.0%		0.2 %		SPF		PMF	
	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft	cfs	ac-ft
CP-AB	95	12	446	31	610	41	831	64	1254	158	7918	513
CP-D	192	18	331	32	441	39	682	56	853	113	5228	345
CP-E	61	7	130	13	175	16	274	24	335	53	2095	167
CP-F	186	20	325	35	422	42	638	61	755	120	4496	362
CP-Y	410	112	1121	184	1510	204	2392	297	3567	719	26059	2340
CP-AA	144	18	302	33	398	41	619	61	780	130	4815	402
CP-G	91	11	186	21	244	26	378	36	464	81	2839	251
CP-H	119	17	299	36	405	46	644	69	790	162	5052	516
CP-U	859	190	1912	325	2571	378	4055	549	4765	1106	32788	3530
CP-T	877	197	1952	341	2615	398	4124	580	4891	1178	33142	3756
CP-R	864	205	1915	349	2553	422	4020	618	5039	1273	31773	4067
CP-Q	856	214	1837	373	2513	440	3940	643	5097	1320	31409	4208
CP-Z	73	10	207	22	283	29	472	46	591	113	3722	365
CP-X	167	24	346	47	464	59	733	88	875	194	5334	610
CP-V	196	34	465	69	601	88	902	132	1318	362	7141	958
CP-W	89	22	203	45	271	58	426	87	596	198	3203	619
CP-S	65	6	131	12	177	15	281	22	340	48	2114	151
CP-I	274	27	442	46	571	55	850	77	986	145	5814	432
CP-J	645	71	1154	124	1516	151	2295	216	2766	435	16598	1322
CP-K	638	122	1750	194	2601	267	4052	365	4633	758	29826	2419
CP-L	231	25	403	43	520	52	792	74	927	146	5530	442
CP-L1	366	67	699	107	969	128	1581	178	1681	338	11658	1028
CP-M	319	30	500	49	647	59	978	83	1168	157	6936	466
CP-P	374	83	1066	146	1542	180	2535	261	3101	525	19832	1660
CP-N	86	9	248	22	344	29	557	45	718	110	4584	357
CP-O	336	36	686	73	922	92	1446	137	1786	301	11011	944

In the HEC-2 model the NH card (Manning's "n" input) is used to describe the effective roughness coefficient across the flood plain. For a typical residential street, including conveyance up to the right-of-way line, an effective "n" value of 0.03 is selected. For the portion of the cross section obstructed by buildings and other obstructions, an artificially high "n" value is recommended. This "n" value should be computed by weighing the width of conveying streets in the cross section against the entire width of the cross section. For clarification an example is shown in Figure 3-3.

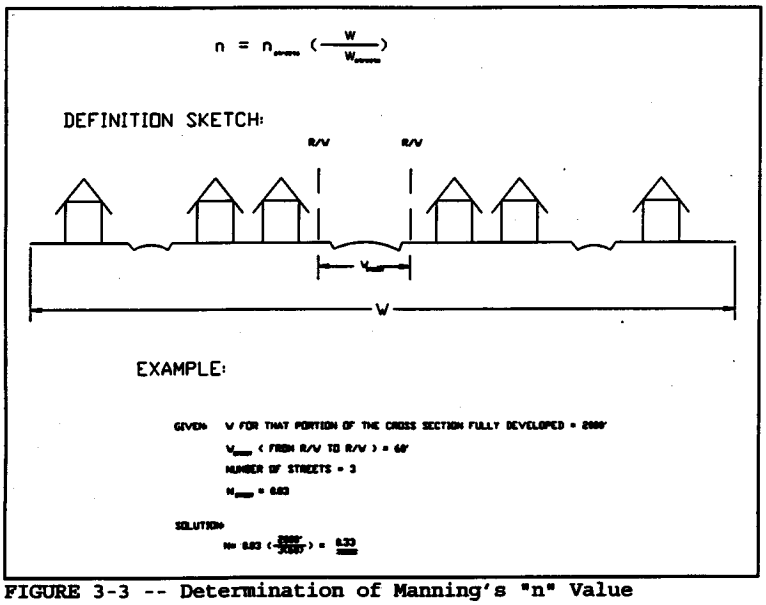


FIGURE 3-3 -- Determination of Manning's "n" Value

This method conservatively neglects the flow through and around buildings. We did not block out the obstructions in the cross section data, using GR, X3, or ET data, in order to avoid a divided flow condition. HEC-2 has difficulty balancing water surface elevations between cross sections when there is divided flow.

The second assumption made was the selection of loss coefficients for expansion and contraction. Values used are within the range of recommended values in the HEC-2 user's manual.

The final assumption we had to make was the selection of flow rates for each reach in the study area. The results of the future without project condition HEC-1 models developed

for this study were used. The varying flows within the reaches are described in the following paragraphs.

3-04.4 REACH DESCRIPTIONS

The location of the flow paths described below is presented as Plate 2.

FLOW PATH NO. 1 Madrid Ave. - Three Crosses Avenue.

Subareas A and B are concentrated along Main Street and Madrid Road. The upstream end of this flow path begins at this location. Flow proceeds west down Madrid Ave and south down Main Street. The flow which goes down Madrid Ave contributes to this flow path. At the intersection of Madrid and the Las Cruces Lateral a portion of the flow turns northwest, this flow continues in this direction as the Las Cruces Lateral Levee forms a barrier to flow. This flow continues until it reaches the Las Cruces out fall channel. After inundation in this area, the flow will eventually drain to the Rio Grande through the outlet channel. The average slope of this flow path is 0.0034 ft/ft. Table 3-4 shows the frequency flows and Manning's "n" values for this flow path.

Table 3-4

LOCATION SECTION #	FREQUENCY FLOW (cfs)				MANNING' S "N"
	10 %	2 %	1 %	.2 %	
1-15 THRU 1-6	160	600	810	1140	.23
1-6 THRU 1-1	100	450	610	830	.23

FLOW PATH NO. 2 Villa Mora Avenue

This flow path begins at the intersection of Villa Mora and Solano. Flow proceeds west down Villa Mora to the Las Cruces Lateral. At this junction there is a drop inlet and 72" pipe which sends flow into Gallagher Pond. Once the capacity of this pipe is exceeded flow over tops the lateral and contributes to the inundation of the valley below. Subarea D and 1/2 of subarea E contribute to this flow path. The other 1/2 of the flow from subarea E flows into cross streets between Villa Mora and Chestnut Street. This flow continues west until it meets the Las Cruces Lateral where it gets diverted north to Villa Mora and/or south to Chestnut. From these locations it crosses the lateral and contributes to valley flooding. We used Manning's Equation to determine the division of flow at street intersections. The average slope of this flow path is 0.015 ft/ft. Table 3-5 shows Manning's "n" values and frequency flows for this area.

Table 3-5

LOCATION	FREQUENCY FLOW (cfs)				MANNING'S "N"
	10 %	2 %	1 %	.2 %	
2-7 THRU 2-1	220	400	530	820	.33

FLOW PATH NO. 3 **North Alameda Avenue**

This flow path begins at the intersection of Madrid Ave and Alameda Blvd and proceeds south on Alameda until Picacho Ave. This flow path, along with flow paths 4 and 5, account for the majority of the floodplain located in the study area. This flow path collects the discharges from subareas A through G and Y. Flow is contained on the west by the Arroyo Lateral and on the east by the higher elevations. The gentle slope (0.0004 ft/ft) of the natural ground causes low velocities in this reach. These low velocities delay the flood hydrograph, which causes attenuation of peak flows. The flow in this reach drains to the south and west through laterals and drains and to the south along flow path No. 4. Table 3-6 shows Manning's "n" values and frequency flows for this flow path.

Table 3-6

LOCATION	FREQUENCY FLOW (cfs)				MANNING'S "N"
	10 %	2 %	1 %	.2 %	
3-7 THRU 3-6	410	1120	1510	2390	.35
3-6 THRU 3-5	350	900	1225	1800	.35
3-5 THRU 3-4	290	780	1050	1510	.35
3-4 THRU 3-1	95	450	610	830	.35

FLOW PATH NO. 4

This flow path begins where flow path No. 3 leaves off and proceeds in a southwesterly direction. Discharges for this reach come from flow path No. 3 and subareas H through K. The flow path meanders through side streets until it reaches the intersection of Main Street and Avienda De Mesilla. After this intersection the flow proceeds south down Main, crossing under Interstate 10 and finally terminating at the Park Drain. The Park Drain transports the flood flows to the Rio Grande. This path flows through numerous residential areas, as well as a substantial portion of the business district in Las Cruces. The gentle slope of the natural ground once again results in low velocities and attenuated flood hydrograph peaks. Table 3-7 shows Manning's "n" values and frequency flows for this flow path.

Table 3-7

LOCATION SECTION #	FREQUENCY FLOW (cfs)				MANNING' S "N"
	10 %	2 %	1 %	.2 %	
4-15 THRU 4-13	700	1850	2500	3950	.44
4-13 THRU 4-11	700	1900	2600	4000	.44
4-11 THRU 4-7	900	1950	2600	4100	.30
4-7 THRU 4-1	900	1950	2600	4100	.22

FLOW PATH NO. 5

The initial discharge is caused by a flow split from flow path No. 4 at the intersection of South Main and Avienda De Mesilla. Flow path Nos. 4 and 5 are divided by the Las Cruces Lateral Levee. Flow path No. 5 proceeds in a south easterly direction crossing the intersection of Boutz Road and El Paseo, going through Frenger Park, crossing University Ave, and finally rejoining flows from flow path No. 4 on the east side of Interstate 10. The inundation from this flow path affects mainly residential areas, with some business and commercial flooding near University Ave. Table 3-8 shows Manning's "n" values and frequency flows for this flow path.

Table 3-8

LOCATION SECTION #	FREQUENCY FLOW (cfs)				MANNING' S "N"
	10 %	2 %	1 %	.2 %	
5-8	1200	2900	4300	6950	.24
5-7 THRU 5-4	975	2650	4000	6350	.24
5-4 THRU 5-2	640	1750	2600	4050	.34
5-1	200	600	1000	2000	.38

As a result of the hydraulic analysis outlined above, 500-, 100-, 50, and 10-year floodplains were developed to determine the without-project future conditions. The 100-year floodplains resulting from this analysis are presented as Plate 3. A more detailed presentation of the 100-year floodplain in presented on Plates 4-4 through 4-7, Hydrology Section, Engineering Appendix.

3-05 ECONOMIC ANALYSIS

3-05.1 AREA OF CONSIDERATION: The five flow paths identified during the hydraulic analysis are displayed on Plate 2. The damages are determined using the flow paths, depths, and frequencies presented that resulted from the hydrology and hydraulic analysis described above.

3-05.2 GENERAL COMPUTATIONAL PROCEDURES: Each surveyed property is assigned to a category (residential, commercial, public, transportation facilities, utilities, irrigation facilities, agriculture) with as many sub-categories as necessary to represent accurately a property's propensity to sustain flood damage. Each category has an associated depth-damage relationship for a structure and contents, expressed as a cumulative percentage of value for each foot of inundation. The depth-damage relationships are primarily derived from the flood insurance rate review study of 1991. Other curves are derived from historical data when available, or from insurance companies, data from other Corp's Districts, direct interviews with builders and owners, and projects with similar characteristics.

The elevation of each property (determined from field investigations) is compared to the elevation of each reference flood (500-, 100-, 50-, and 25 year) to compute the depth of inundation at that location. Each property category is then tabulated in terms of the number of units, average value per unit and aggregate value within consecutive inundation depth ranges for each reference flood level.

For each category, the aggregate value of property at each flood depth is combined with the depth-damage relationship to compute the total single event damages for each level of flooding. Repeating this process gives the discharge-damage relationship for all categories. This is combined with discharge-frequency data to produce the damage-frequency curve. The area under the damage-frequency curve is computed to derive the probable annual damages for each category.

The following paragraphs present a summary of the future without scenario for the study area. Details of the economic investigations can be found in Appendix A Economic Analysis

3-05.3 VALUE OF PROPERTY: A survey of flood prone properties was initially conducted in 1991 to assess the potential magnitude of flood damages within the floodplains. In 1992-1993 new aerials and a resurvey was conducted. Property categories surveyed include residential, commercial, public, transportation facilities, and utilities. Table 3-9 displays the total value of property within the 500-year, 100-year, 50-year and 10-year floodplains. There is approximately $322 million in property in the 500 year floodplain. Tables 4-4.4 in the economic appendix display the value of property by each flowpath.

TABLE 3-9
VALUE OF PROPERTY FLOODED BY EVENT
ALL FLOWPATHS
($1,000, JUNE 1995 VALUES)

	FLOOD EVENT			
LAND USE	500 YR	100 YR	50 YR	10 YR
Residential Structures	88,160	80,984	53,642	33,326
Residential Contents	44,024	40,436	26,821	16,663
Apartment Structures	9,744	9,744	8,884	4,294
Apartment Contents	4,972	4,972	4,542	2,247
Commercial Structures	66,776	64,025	44,322	36,612
Commercial Contents	43,323	42,185	28,017	20,073
Public Structures	25,899	25,749	18,319	8,569
Public Contents	10,647	10,607	7,727	2,917
Vehicles	29,120	25,018	17,878	10,654
TOTAL	322,655	302,614	210,152	135,355

Residential property values are estimated from three sources. The primary source, Marshall and Swift Valuation Appraisal Manuals, was used to estimate construction and depreciation values of most of the structures. Second, local Realtors and sales records were consulted regarding sale prices of structures and vacant land, as well as data regarding structure ages. Third, a local appraiser was contacted and his evaluations and sales data used in estimating values.

Commercial and public facilities were inventoried by field survey utilizing the Marshall and Swift Valuation Service.

Content values are estimated from several sources. Residential content values are held at 50% of the structure value. Local insurers contacted estimated greater than 55% of the structure is the norm. Commercial and public content values are estimated primarily from similar studies.

Vehicle estimates were determined using in-house data and published surveys.

Future population growth is included in analysis of values. Estimates were made based on available space, zoning, city growth rates, and local planners input.

Agricultural values are estimated based on existing crop production. These change over time as some of the agricultural land is converted to urban uses.

Emergency costs include the costs of evacuation, reoccupation, disaster relief, and other similar expenses. The amount of emergency costs incurred are dependent upon factors including number of residences damaged, evacuated, etc. Factors utilized in this study are based on flooding in Great Bend, Kansas, and Carlsbad, New Mexico where the depths of flooding were similar to those estimated here.

Minimal crop damage will be sustained during flood events. This was estimated at significantly less than $1,000 average annual damages.

Table 3-10 presents the number of damageable structures located within the 10-, 50, 100-, and 500 year floodplains for the study area.

Table 3-10
NUMBER OF PROPERTY UNITS FLOODED BY EVENT
ALL FLOWPATHS

	FLOOD EVENT			
LAND USE	500 YR	100 YR	50 YR	10 YR
Residential Structures	2,080	1,783	1,277	812
Apartment Structures	31	31	29	25
Commercial Structures	254	240	188	149
Public Structures	85	85	81	32
Vehicles	4,160	3,566	2,554	1,522

3-05.4 POTENTIAL FLOOD DAMAGES: Table 3-11 displays single occurrence damages that could be expected for the 500-, 100-, 50- and 10- year floods, for all flowpaths. Damages begin at approximately the 5 year event.

TABLE 3-11
MEAN SINGLE OCCURRENCE DAMAGES BY
LAND USE AND FLOOD FREQUENCY
ALL FLOWPATHS
(X $1,000, JUNE 1995 VALUES)

	FLOODPLAIN			
LAND USE	500 YR	100 YR	50 YR	10 YR
Residential Structures	18,848	13,889	9,206	3,948
Residential Contents	12,021	9,306	6,077	2,371
Apartment Structures	1,689	1,244	871	377
Apartment Contents	1,510	1,031	620	249
Commercial Structures	13,587	10,265	6,354	3,409
Commercial Contents	19,785	13,214	7,583	2,817
Public Structures	5,043	3,485	1,935	663
Public Contents	3,339	2,071	1,069	337
Vehicles	2,485	1,312	851	178
Emergency	1,174	838	526	215
TOTAL	79,481	56,655	35,092	14,564

3-05.5 AVERAGE ANNUAL DAMAGES: Average annual damages are represented by the area under the damage-frequency curve. The total average annual damages are currently estimated at $5,059,300. These are presented by land use in Table

3-12. Average annual damages by flow path, damage category, and flood event are presented in the Economics Appendix.

TABLE 3-12
AVERAGE ANNUAL DAMAGES AND RESIDUALS
BY LAND USE
ALL FLOWPATHS
(X $1,000, JUNE 1995 VALUES)

LAND USE	AVERAGE ANNUAL DAMAGES
Residential Structures	1289.4
Residential Contents	814.9
Apartment Structures	128.8
Apartment Contents	94.3
Commercial Structures	1033.2
Commercial Contents	1083.6
Public Structures	273.6
Public Contents	156.0
Vehicles	110.8
Emergency	74.7
TOTAL	$5,059.3

3-06 EXPECTED FUTURE WITHOUT CONDITION: Without implementation of flood control measures within the study area, Las Cruces will remain susceptible to a severe flood threat from overland flows. Existing average annual damages in the study area are currently estimated at $5,059,300. Over 2,000 structures located within the 500-year floodplain will remain susceptible to flooding of depths up to 5 feet. Potential damages from a 100-year event are estimated at over $56,000,000. Homes and businesses outside of the existing flood plain will also be affected as a result of any flooding because of the disruption of basic services which will occur during and following a flood event.

SECTION 4

4-0 PLAN FORMULATION: This section discusses the plan formulation process used to investigate the flooding problems and needs for the Las Cruces Metropolitan study area as defined in the previous section.

4-01 PLANNING OBJECTIVES: Planning objectives are an expression of public and professional concerns about the use of water and related land resources resulting from the analysis and future conditions in the study area. These planning objectives were considered in the development of alternative plans for their evaluation of the 1996-2046 period of analysis.

The primary purpose of the reconnaissance level investigation was to develop a viable flood control plan that would substantially alleviate the flooding problems within the study area. Additional flood control alternatives as well as the associated environmental, water quality, and recreational developments for these alternatives have been investigated during the feasibility study.

Based on the problems and needs as discussed in Section 3, the following specific planning objectives were considered in the plan formulation process.

1. Reduce the flood hazard and damage to existing properties within the flood plains of the Las Cruces study area to a level which would protect against possible loss of life and hazards to health and safety and is acceptable to the majority of the study area's population, thus, helping to constitute an acceptable plan for the non-Federal sponsor(s).

2. Preserve, conserve, or enhance the environmental and cultural resources of the study area and mitigate for any adverse impacts to the existing natural environment and identified cultural resources caused by any economically feasible flood control plan.

3. Maintain existing open spaces and maximize public recreation opportunities within the study area.

4-02 PLANNING CONSTRAINTS: In the development of flood damage reduction plans, the following constraints or limitations were considered in direct plan formulation efforts in that beneficial impacts could be maximized and adverse impacts could be minimized.

1. The project should be limited to the study area within the Las Cruces Metropolitan area.

2. Flood control projects which solve problems in one area but compound them in other areas should be avoided.

3. If irrigation facilities are used for flood control purposes, the irrigation function of the facilities should be maintained.

4. Total benefits must equal or exceed total costs for a plan to be implementable by the Federal Government or the U.S. Army Corps of Engineers.

5. The project must comply fully with the spirit and the letter of all environmental laws and regulations including the National Environmental Policy Act of 1969 (NEPA).

6. The project must have a non-Federal Sponsor.

4-03 PLAN FORMULATION AND RATIONALE: Plan formulation and rationale used to develop effective long term solutions to the flood problems of the study area consisted of identifying alternative measures with consideration given to the economic, social, and environmental impacts of each alternative.

The following paragraphs discuss the technical, economic, environmental, and social criteria used to develop the alternatives formulated to meet the stated objectives of the study.

4-04 TECHNICAL CRITERIA: In order to develop a plan that would satisfy the primary objective of reducing flood damages with the study area, the following technical criteria were adopted for use in developing, evaluating, and comparing alternative plans.

1. The plan should be effective and efficient with regard to alleviating the specified problems and achieving the specified goal and opportunities.

2. The plan must be technically feasible using established engineering methods and procedures applicable and appropriate within this region.

3. The plan should be adequate to provide a project life of at least 50 years.

4. Existing project facilities should be used to the maximum extent possible.

5. The plan is to be complete within itself and not require additional future improvements other than normal operation, maintenance, rehabilitation, replacement and repair.

6. The plan must designed using engineering criteria taken from appropriate Corps of Engineers engineering and design manuals and regulations related to flood control alternatives.

4-05 ECONOMIC CRITERIA: Economic feasibility of a plan is displayed as a relationship of benefits-to costs, the benefit/cost ratio. Identified as benefits are the monetary savings due to damages prevented, reduction in the cost of emergency services, and the reduced

disruption of the local economy. These project benefits are subsequently annualized to represent a yearly benefit applicable for the life of the project. The project cost, which includes the construction or first cost, the interest on the first cost during construction, the operation and maintenance costs, and the interest to amortize the project cost over the life of the project, are also annualized such as to represent an annual project cost applicable for the analysis period of the project. The annual benefits and the annual costs are then related in a ratio of benefits to costs. To be economically feasible, a plan must have benefits which equal or exceed costs, i.e., a benefit/cost ratio equal to or greater than 1.0.

Plans formulated to provide for flood protection and other water resource needs should be designed to make a contribution to the national water resource development goal of National Economic Development (NED) and be consistent with protecting the nation's environment as established in the Water Resources Council, Economic and Environmental Principles and Guidelines, for Water and Related Land Resources Implementation Studies, March 10, 1983. The NED goal is to enhance the value of the nation's output of goods and services and thereby improve national economic efficiency. To be consistent, with protecting the nation's environment, the quality of certain natural and cultural resources and ecological systems would require enhancement by management, conservation, preservation, creation, restoration, or improvement. In the plan formulation process, the plans that yield the greatest net benefits are the plans that make the greatest contribution to the NED objective.

To meet the Federal guidelines for planning water resource projects, the following economic criteria were followed.

a. All plans must be economically feasible, which dictates that the plan's flood reduction benefits must exceed the cost of the plan unless the deficiency is the direct result of cost incurred to obtain positive environmental quality contributions.

b. The plan selected should be the plan which reasonably maximizes benefits over costs consistent with protecting the nation's environment and has the greatest net benefits (the NED Plan), unless the Assistant Secretary of the Army (Civil Works) grants an exception. Such an exception may be granted for a locally preferred plan when economically justified and at the additional expense of the non-Federal sponsor.

c. Each separable unit or purpose of a given alternative plan must provide benefits at least equal to its costs.

d. Alternative plans should be evaluated using current price levels, a 50-year period of analysis, and the current Federal discount rate for water resource projects as determined by the Department of Treasury.

e. Annualized costs include the cost of operation, maintenance, repair, and replacements.

4-06 ENVIRONMENTAL CRITERIA: Plans formulated under Federal directives must be consistent with enhancing the existing environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of natural and cultural resources and ecological systems in the proposed project area. Structural and non-structural measures must be evaluated in accordance with guidelines established by the National Environmental Policy Act of 1969 (Public Law 91-190), as amended and the Principles and Guidelines.

The following environmental and social criteria were considered:

a. Protect against possible loss of life, property, and hazards to the health and safety of area residents.

b. Preserve, maintain, or enhance community cohesion and desirable community and regional growth.

c. Preserve and/or enhance social, educational, and aesthetic values as well as historical and cultural attributes of any sites within the project area.

4-07.1 ALTERNATIVES INVESTIGATED: Several flood control alternatives were investigated to achieve the planning objectives discussed previously. The addition of alternative plans to be investigated and the final design revisions for any selected plan reflect the normal revisions inherent in the planning process. The primary focus of the feasibility study was to determine the most cost effective viable flood control alternative, that are acceptable to the officials and citizens within the Las Cruces Metropolitan area. Other allied purposes such as the preservation of open space, preservations local environmental qualities, including fish and wildlife resources, development of recreational facilities, improvement of water quality, and other related planning objective purposes were also investigated. For the study area, the possible alternatives for flood damage reduction in urban areas can be divided into two broad categories -- nonstructural and structural measures. A general description of the flood control measures considered for Las Cruces, New Mexico is discussed in the following paragraphs. For this feasibility study, the term "alternative" refers to the project area and/or a plan investigated to relieve flooding which was defined by the Corps of Engineers and the City of Las Cruces. Structural alternatives were initially investigated since they would provide an immediate and substantial flood control improvement within the area. Non-structural alternatives have also been evaluated.

From the analysis completed for this feasibility study, it was determined that a flooding problem exists in the City of Las Cruces resulting from storms centered over the city. The analysis also showed that the flow of the flood waters does not follow any particular path in the city but resembles a sheet flow centered along the low points of the flow paths. This results in an increase in flood stage that is faster than the flow of the water. For a 100-year event, the magnitude of water that must be addressed in this project is approximately 3300 cfs at the largest analysis point, which corresponds to a storage of 410 acre-ft. The difficulty of finding a solution is because the underlying terrain does not

have enough grade to effectively transport water to the river. In some areas of the city, the elevation nearly equals that of the river. This problem is further compounded because there is no identifiable point where the flood waters can be intercepted. Collection of the flood water is an issue that is not easily rectified. Since there is no identifiable flow path of the flood waters and most of the city is urbanized, traditional diversion structures are not feasible.

The proposed flood control alternatives for the city of Las Cruces are located in generally two areas of the city. These areas being generally just to the north of the downtown area were the flow paths for the floodplain begin, and in the southern area of the floodplain were ponding occurs. Because of the intense development within the study area, no alternative was investigated that control all of the runoff from the drainage area. A channel to intercept all of the runoff in the city was investigated during the reconnaissance study, however because of the high cost associated with the alternative (over $40 million) and the city's objections to the alternative, it was not considered seriously during the feasibility phase. The structural alternatives that were investigated were separable elements that were located in the few areas where development has not yet occurred. The following paragraphs briefly describe the non-structural and structural alternatives that were screened during the formulation process. During the initial screening process all alternatives investigated were analyzed to control the 100-year event.

4-07.2 Non-structural Measures: Non-structural measures attempt to avoid flood damages by exclusion or removal of damageable properties from flood prone areas. These measures do not effect the frequency or level of flooding within the flood plain; rather they effect flood plain activities. The technique of controlled land use is particularly helpful in planning future development, but of limited use in already highly developed areas.

The full range of non-structural measures considered include the following:

- Floodproofing/Raising of Structures
- Permanent Evacuation Within the Flood Plain
- Flood Plain Management: Zoning within the 100-year flood plain, modification of subdivision regulations and building codes, and/or transfer of development rights
- Flood Warning Systems

The following paragraphs describe each of these non-structural measures in more detail.

Floodproofing: Consideration of floodproofing within the flood plain includes such measures as valving sewer lines, providing watertight coverings for door and window openings, sump pumps to drain seepage, sealing of cracks, steel bulkheads on brick walls (flood shields) to close off entrances, constructing levees and floodwalls around individual buildings or groups of buildings, and coating walls of structures with a waterproof membrane. Floodproofing is more easily applied to new construction and more applicable where flooding is of short durations, low velocity, infrequent, and of shallow depths. Floodproofing is also appropriate in locations where structural flood protection is not feasible or were collective action is not possible. Flood proofing would normally require

major modifications to existing structures.

TABLE 4-1
Applicability of Non-Structural Methods

Depth of Flooding	Residential	Commercial	Industrial
0 to 3 feet above basement floor	FP	FP	FP
3 feet above basement floor of first floor elevation	FP,RA	FP	FP
3 to four feet above first floor elevation	RA	FP	FP
More than 4 feet above first floor elevation	RA,PE,RE	FP,RA,PE,RE	FP,PE

Abbreviations: FP-Floodproofing RA-Raise Structure
PE-Permanent Evacuation RE-Relocate Structure

Raising Structures In-Place: This measure attempts to avoid flood damages by elevating damageable property and/or raising an existing building in-place at least one foot above the 10-year flood level and providing a raised access road and escape route from the structure. Structures on slab foundations are very expensive and difficult, if not impractical, to raise in-place.

Temporary Enclosures: This measure was determined to be infeasible due to the inability to place shields on structures within the available warning time of 25-30 minutes, and the ineffectiveness of using temporary enclosures on adobe structures (water creeps up the walls of the structures through capillary action and melts the walls away). Assuming a flood warning system were installed within the study area, many occupants would not be at home or would, and properly so, evacuate the area before attaching the temporary closures to the businesses or homes.

Permanent Evacuation Within the Flood Plain: This measure involves the permanent evacuation of people and demolition or relocation of their structure(s) to above the 10-year flood plain elevation. The alternative is also known as the "Buyout Plan". The practicality of evacuation depends on several factors, some of which are:

(1) frequency and severity of flooding,
(2) value of the property and its importance in the community,
(3) acceptability of residents to move out of the flood plain, and, the
(4) need for areas of a more compatible flood plain use.

Studies have shown that evacuation and relocation alternatives are most effective in the 0-10 year frequency flood plain. This alternative requires the acquisition of all privately owned lands, dwellings, and related improvements. The dwellings and structures would be removed, residents relocated to flood-free housing, and the land converted to parks, recreation fields, natural areas, or other uses consistent with periodic flooding. The benefits for this type of alternative would be the reduction in emergency costs, administrative costs of disaster relief, flood insurance subsidy, and potential flood damages to public property (such as roads and utilities). In addition, the value of the new use of the vacated land may be claimed as a benefit.

Flood Plain Management: Effective flood plain management is dependent on developing enforceable regulations to insure that flood plain uses are compatible with the flood hazard. Several means of regulation are available, including zoning regulations, sub-division regulations, and building codes.

Zoning Regulations permit prudent use and development of the flood plain in order to prevent excessive property damage, expenditure of public funds, inconvenience, and most important of all, loss of life, due to flooding.

Sub-division Regulations guide the division of large parcels of land into smaller lots. The regulation requires the sub-division developer to show compliance with sub-division regulations, zoning ordinances, the local land uses or master plans, and other regulations. A sub-division ordinance with special reference to flood hazards would require installation of adequate drainage facilities, prohibit encroachment in floodway areas, and require the placement of critical streets and utilities above a selected flood elevation - normally one foot above the 100-year flood plain elevation. For the past several years, the city of Las Cruces has vigorously enforced flood plain regulations to insure that structures are built either out or above the 100-year flood plain.

Building codes specify the building design and construction materials. They can be used both for construction of new buildings or repair of flood damaged structures. Building codes can reduce potential damages by setting specifications to require proper anchorage of buildings; restrict materials which deteriorate when exposed to water; require water tightness on exterior walls; require valves on sewer lines; or require placement of certain utilities such as heaters, air conditioner, etc. at elevations which would reduce area flood damages. Flood plain management would be most effective in controlling future development of the flood plain, thereby assuring that the existing flood problems do not become worse. However, flood plain management cannot, by itself, significantly alleviate existing flooding conditions within an existing flood plain.

Flood Forecasting/Temporary Evacuation: Flood warning and temporary evacuation involve the determination of imminent flooding, implementation of a plan to warn the public, and organization of assistance in the evacuation of persons and some personal property. Notification of impending flooding can be by radio, siren, individual notification, or by more elaborate means such as remote sensors to detect water rise levels and automatically warn

residents. These measures normally serve to reduce the hazard to life and damage portable personal property. Flood warning and emergency evacuation should be considered as part of any flood control plan. This alternative could also include the use of flood forecasting to revise current flood control operating plans of existing flood control structures to provide additional flood control protection. The following assumptions were used to determine the benefit/ cost ratios for potential non-structural measures. Costs were develop for several non-structural alternatives on a per/structure basis. Table 4-2 presents an estimated cost per structure for several alternatives

Table 4-2
Cost per Structure for Non- Structural Alternatives
(June 1995 Prices)

Non-Structural Measure	Commercial	Residential
Ring Levee	$14,625	$13,755
Floodwall	$38,134	$32,210
Raising Existing Structure	$70,576	$55,464
Relocation	$69,010	$51,680

The following assumptions were made in determining the cost per structure of the various non-structural alternatives.

(1) Average commercial structure size - 2500 square feet
(2) Average residential structure size - 1450 square feet
(3) 10-year mean flood depth is 2 feet above grade. Non-structural measures were analyzed to provide 10-year protection.
(4) Commercial structures were no elevated above grade. Residential structure were elevated 6 inches above grade.

The following Table presents the total cost of various non-structural measures for property's within the 10-year floodplain.

Table 4-3
Total Costs - 10 Year Non-Structural Measures
(June 1995 Prices)

Non-structural measure	206 Commercial Structures	812 Residential Structures	Total Cost
Ring Levee	$ 3,013,000	$11,169,000	$14,182,000
Floodwall	$ 7,856,000	$26,158,000	$34,014,000
Raise Existing Structure	$14,538,000	$45,037,000	$59,575,000
Relocation	$14,216,000	$41,964,000	$56,180,000

Once the total costs for the various non-structural measures were determined, an economic analysis of the alternatives was undertaken to determine the feasibility of providing 10-year level of protection within the study area. The following table presents the results of that economic analysis.

Table 4-4
Benefits and Costs - Non-Structural Measures
June 1995 Prices, 7 3/4%

Non-structural measure	Total Cost	Average Annual Cost	Average Annual Benefits	B/C Ratio
Ring Levee	$14,182,000	$1,126,000	$728,000	0.6:1
Floodwall	$34,014,000	$2,700,000	$728,000	0.3:1
Raise Existing Structure	$59,575,000	$4,730,000	$785,000	0.2:1
Relocation	$56,180,000	$4,460,000	$920,000	0.2:1

As result of the analysis of the non-structural measures to provide 10-year protection, further non-structural analysis was not undertaken. The city of Las Cruces, acting as the local sponsor for the project was informed of the analysis of non-structural measures and concurred in the District's findings.

4-07.3 Structural Measures: Structural measures consist of structures designed to control, divert, or exclude the flow of water from flood prone areas to the extent necessary to reduce damages to property, hazard to life or public health, and general economic losses. Because of the nature of the flooding problem and the almost completely urbanized nature of the study area, structural measures that could be implemented are very limited. The structural measures considered most appropriate in dealing with the character of the flood problems encountered in the study area were as follows:

- Detention, including Modifications to Existing Structures

Detention Structures: This measure would consist of constructing one or more structures or modifying existing structures to provide flood control storage to detain peak flood flows and lessen downstream damages. The feasibility of this measure depends heavily on the volume and timing of the flood flows and the associated cost of constructing/modifying an existing embankment and spillway. Additional costs may also be incurred to mitigate for adverse environmental impacts.

Structural Alternative 1 - This alternative involves the expansion and modification of two existing detention basins and a irrigation lateral located to the north of the Las Cruces downtown area. The alternative consists of using the Las Cruces Lateral (currently used for irrigation). This alternative will collect approximately 170 acre-feet of the 410 acre-feet of flood waters from a 100-yr. event. The sub-drainage areas that would be controlled are A, B, C, D, E, F, G, Y, AA, AND AB (see Engineering Appendix, Section 4,

Plate 4-2). The alignment of this alternative would utilize the Las Cruces Lateral beginning at Madrid Street and continuing for approximately 3,600 feet to a point adjacent to Willoughby Pond. The lateral in this reach was sized to carry the 100-yr event. The channel would have a trapezoidal cross-section with 2 on 1 side slopes with a vertical height of +/- 5.5 feet and a bottom width of 10-15 feet. The channel would be concrete lined. The existing Willoughby and Gallagher Basins were increased in size to accommodate 100-year flood volumes and a channel was designed between the two basins in order to interconnect them. Eight inlets have been designed to collect surface flood flows and direct them into the basins. The basins would be drained through the existing 24 inch outlet. Approximately 11 acre-feet of storage was allocated for sediment. For discharges greater than the design event, a 400 foot overflow section was located at the south end of Gallagher basin (Plate 4).

Structural Alternative 2 - This alternative would be sited on a 59 acre parcel of land bordered by Farney Lane to the south Boutz Road to the north, South Main to the west, and the Las Cruces lateral to the east. The alternative would consist of a detention basin the would contain flood flows to control the 100-year event. A trapezoidal concrete channel would be constructed along the south side of Boutz Road to collect flood flows and transport them into the detention basin. The alternative would control the 100-year event from sub-drainage areas J and K (see Plate 4-2, Engineering Appendix), a total of 1.8 square miles. For discharges greater than the design capacity, an overflow section was designed to carry the 500-year event. The detention basin would be drained within 96 hours through outlet works designed to carry the flows to the existing Las Cruces lateral (Plate 2-2).

4-07.3 No Action: A high risk to life and property will remain if no action is taken to reduce the potential for flooding with the study area. Average annual damages with the study area, currently estimated at $5,059,300 only increase under the no action scenario. Single occurrence damages from a 100-year event within the study area are currently estimated to be in excess of $56,000,000. This option was used as the base condition against which to measure the effectiveness of other alternatives.

4-08 Screening of Alternatives: An economic analysis and preliminary cost estimate of the alternatives was completed in order to determine if the alternatives were justified from a benefit/cost standpoint. The following paragraphs describe the results of the analysis.

Non-structural Measures As stated in the above paragraphs relating to non-structural measures, once it was determined that there were no non-structural measures that were economically feasibe, all potential non-structural measures were dropped from the screening process. Flood warning systems were also deemed to be infeasible because of the short warning time (less than 1 hour) that would be available during a flood event. While floodplain management is an effective method of preventing damages to future development it does little or nothing to reduce damages to existing structures. The city of

Las Cruces is a participate in the National Food Insurance Program and vigorously enforces flood plain regulations to insure that structures are built either above or out of the 100-year floodplain.

Structural Alternative 1 Costs estimates and economic analysis undertaken for this alternative show that it is economically justified with a benefit cost ratio of 2.8:1. First cost of the alternative was estimated at $8,055,000 with average annual costs (including annual OMRR&R of $16,000) of $461,000. The alternative would accrue benefits of $1,844,000.

Structural Alternative 2 Cost estimates and economic analysis undertaken for this alternative show that it is not justified economically. Because the alternative is located in the southern area of the city, near the terminus of the flowpaths used for hydraulic analysis, it only benefits approximately one-fourth of the properties located within the floodplain. Average annual benefits from the construction of this alternative are estimated at $155,000. The project cost of the alternative is estimated at $3,715,000, with annual costs of $325,000. The resulting benefit/cost ratio for this alternative is 0.5:1. As a result, this alternative was dropped from further consideration.

Comparison of Alternatives Table 4-5 presents a comparison of the structural alternatives that were investigated during the feasibility phase. The only alternative that meets the criteria for economic justification is Alternative 1, the modification of Willoughby and Gallagher detention ponds.

Table 4-5

Comparison of Structural Measures
June 1995 Prices, 7/34 %
($1,000)

	Alternative 1	Alternative 2
First Cost	$8,055	$3,715
Interest During Conts.	415	313
Total First Cost	8,470	4,028
Average Annual Cost	692	322
OMRR&R	16	12
Total Aver. Ann. Cost	708	334
Average Annual Benefits	1,844	150
Benefit/Cost Ratio	2.6:1	0.4:1
Net Benefits	591	-194

4-09 Optimization of the Selected Plan: Once the Alternative 1 was selected as the best alternative, additional analysis was undertaken to determine what size Gallagher and Willoughby ponds should be modified to in order to produce the maximum net benefits within the study area. The size project that produces the maximum net benefits is known as the National Economic Development (NED) Plan.

The NED plan must be selected for construction unless an exception is granted by the Assistant Secretary of the Army (Civil Works). In order to determine the NED plan, modifications and improvements for Gallagher and Willoughby ponds were analyzed that would control flood flows for the 25-, 50-, 100-, and 500-year events. Risk based analysis was performed during the feasibility study in order to determine project optimization.

Table 4-6 presents the benefits attributable to a 10-year, 50-year, 100-year and 500-year level of protection using Alternative 1. Table 4-7 presents a comparison of benefits and costs for 25-year, 50-year, 100-year, and 500-year levels of protection. Once the benefits and costs for several levels of protection werte developed, an optimization curve for the alternative was developed (Figure 4-1). Designing this alternative to control the 100-year event will produce the maximum net benefits for the 100-year event the sub-drainage areas that is controls. Following the completion of the NED analysis, detailed engineering of the project was undertaken and is presented in the Engineering Appendix. Following the detailed engineering of the project, an comprehensive M-CACES cost estimate for the project for the project was developed. Table 4-8 presents a comparison of the cost and risk based benefits for the project using the information developed for the Engineering Appendix.

4-10 FEDERAL INTEREST Because of the unusual nature of the flooding problem that is being addressed by this report, it is necessary to confirm the Federal interest in a project such as this. As stated in Engineering Regulation (ER) 1165-2-21 the following conditions must be met in order for there to be a Federal Interest in a flood control project.

Drainage area must be greater than 1.5 square miles, and benefits must originally be calculated at a point downstream of the project where the 100-year discharge is equal to or greater than 1800 cfs and the 10-year discharge equal to or greater that 800 cfs. This point within the Las Cruces study area is shown on Plate 6 and is designated CP-U. At this point the 100-year discharge is equal to 2570 cfs and the 10-year discharge is equal to 860 cfs. The average annual benefits for the selected project downstream of CP-U are estimated at $1,018,000 (see Economics Appendix, Table 14.3 flow points 4.3-4.6). The total average annual cost of the project is $736,200. The resulting benefit/cost ratio for the project is 1.3:1. ER1165-2-21 also states that if the project is economically justified from the point where the minimum discharges are met, then benefits that accrue to the project upstream of that point may also be used in the benefit/cost analysis. As a result, the entire flood control benefits of $1,859,000 were used to compute the final benefit/cost ratio for the project (includes flood insurance benefits).

TABLE 4-6
AVERAGE ANNUAL DAMAGES AND BENEFITS
INCLUDING RISK ADJUSTED RESULTS
(x $1,000, July 1995 VALUES)

	FLOW PATHS/1				
	1	3	4	5	TOTAL
Average Annual AAD	68.1	701.5	3,461.6	826.5	5,059.3
Benefits-10 YR Protection (RA)	15.9	392.7	1,103.7	.0	1,512.3
Benefits-50 YR Protection (RA)	33.8	437.2	1,191.4	.0	1,662.4
Benefits-100 YR Protection (RA)	43.5	535.1	1,265.2	.0	1,843.8
Benefits-500 YR Protection (RA)	54.9	599.0	1,409.0	.0	2,062.9

1\ Flowpath 2 was omitted from risk analysis since average annual damages are less than $1,000.

TABLE 4-7
BENEFIT/COST ANALYSIS
(x $1,000, 8% INTEREST, 50 YEAR PROJECT LIFE)
June 1995 Price Level

	LEVEL OF PROTECTION			
	25 YR	50 YR	100 YR	500 YR
First Cost	$ 5,780	$7,267	$8,055	$13,040
IDC/1	298	375	415	672
Total First Cost	6,078	7,642	8,470	13,712
Average Annual Cost	497	625	692	1,121
OMRR&R	12	14	16	21
Total Average Annual Cost	509	639	708	1,142
Average Annual Risk Adjusted Benefits	1,576	1,662	1,844	2,063
Benefit/Cost Ratio	3.1:1	2.6:1	2.6:1	1.8:1
Net Benefits	1,067	1,023	1,136	921

1/Interest During Construction (15 months)

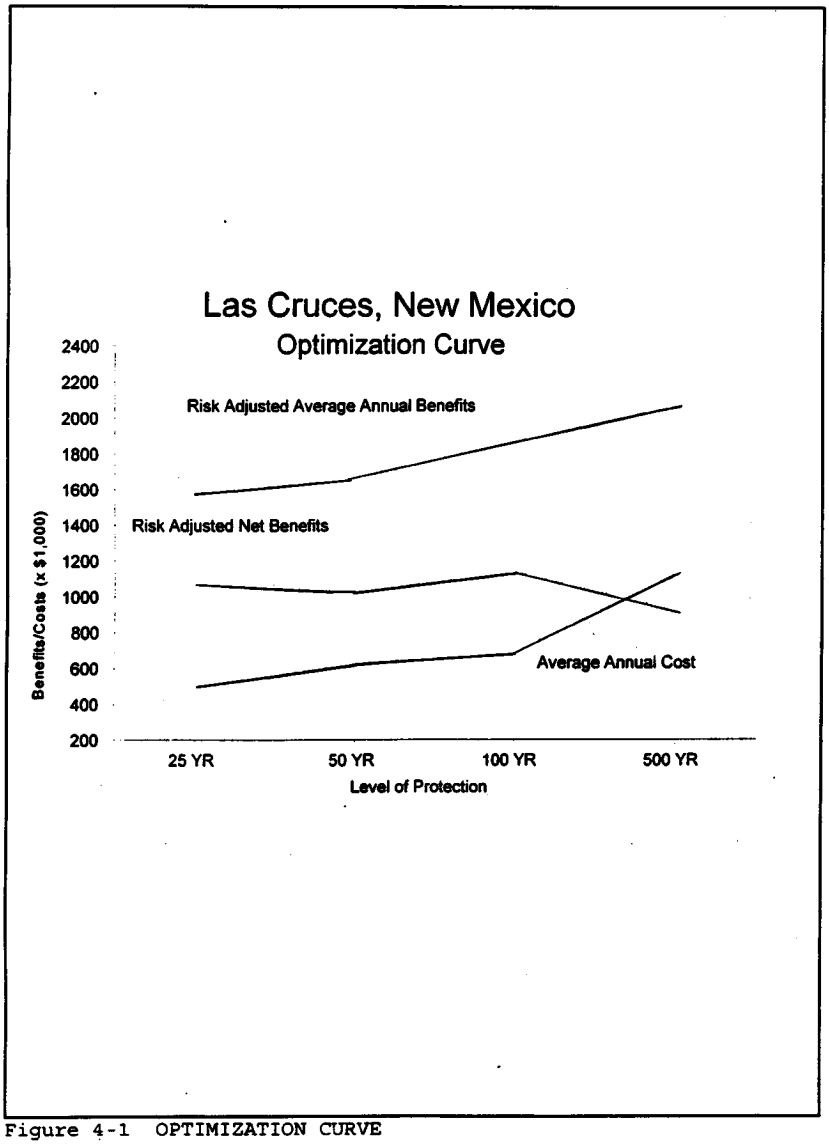


Figure 4-1 OPTIMIZATION CURVE

TABLE 4-8
COMPARISON OF COSTS AND BENEFITS-SELECTED PLAN
June 1995 Price Level, 7 3/4%

First Cost /1	$ 8,092,000
Interest During Construction /2	$ 978,400
Total Investment	$ 9,070,400
Average Annual Cost	$ 720,200
OMRR&R	$ 16,000
Total Average Annual Cost	$ 736,200
Total Average Annual Benefits	$ 1,859,000
Benefit/Cost Ratio	2.5:1
Net Benefits	$ 1,122,800

1/ Excludes relocation assistance costs

2/ Interest during construction is computed based o project completion in the year 2000 and Fiscal Year costs as follows: FY=96 $210,000; FY 97=$$190,000; FY98=$1,231,000; FY99=$4,615,000; and FY2000=$1,846,000. Within each year the monthly expenditures are approximately equal with no benefits accruing until project completion.

4-11 SPECIAL COST SHARING OR WINDFALL BENEFITS: Engineering Regulation 1105-2-21 allows for a proejct to be located upstream of the 10-year/800 cfs point of discharge as long as it is justified based on the benefits accruing downstream of that point. Once justification has been established, all damages prevented by the project can be included in the benefit/cost ratio. There is no guidance in ER 1105-2-21 relative to special cost sharing to account for benefits accruing upstream of the 10-year/800 cfs point (i.e. local sorm drainage benefits). The benefits that accure from the project upstream of the 10-year/800 cfs point are incidental to the project that was formulated for the purpose of flood control. As a result, the incidental benefits that accrue to the proejct require no special cost sharing for the project.

Under existing conditions, approximately 2,100 structures are flooded by the 100-year event (Table 5.5 of Economic Appendix, p. a-18). With the project, about 1,400 properties remain susceptible to flooding by the 100-year event (Tables 12.0-12.2 of Economic Appendix, p. A-32). No structures or entities will are receive any windfall benefits as a result of the construction of the project. Benefits are widespread and not limited to a few entities.

4-12 DESCRIPTION OF THE SELECTED PLAN: The selected plan represents the National Economic Development (NED) Plan and consists of constructing of a concrete lined channel, flood flow inlets at eight locations that will collect flows into the channel, and expanding two existing detention basins. The proposed project will contain the 1 percent chance flood and reduce runoff from a 2.25 square mile urban drainage area. The selected project will accrue benefits from flowpaths 1,3, and 4 only. Depths of flooding from a 100-year event will be reduced between 1 and 3 feet. Features for the proposed plan include the following:

a. Channel: A 1,934 foot long segment of the existing Las Cruces lateral ditch, between Madrid Street and Willoughby basin will be enlarged to convey flood waters to Gallagher and Willoughby detention basins. This ditch currently conveys both irrigation and flood flows. The lateral will be converted into a concrete-lined rectangular channel with vertical slopes, a 20-foot bottom width, and a depth varying between 8 and 9.6 feet. Within the 20-foot bottom width, a 5 by 5 foot channel will be placed along the entire length of the channel to insure the delivery of 75 cubic feet per second (cfs) of irrigation water downstream. The channel capacity and design discharge into Gallagher Basin is 880 cfs. The channel terminus into Gallagher basin will be a concrete rundown with a stilling basin.

b. Inlets: Eight inlets will convey the 1 percent chance flow into the diversion channel. Grated drop structures will be constructed across Madrid Avenue and at Main Street to intercept flood flows and direct them into the channel. A concrete inlet at Mulberry Street will convey flows into the channel. Concrete drop inlets to Gallagher Pond will be located at Palm Street, Villa Mora Street, and Juniper Street. Grated drop inlets will also be constructed at Chestnut Avenue, and Picacho Avenue to intercept flood flows and convey them to Willoughby Basin.

c. Detention Basins: Two existing detention basins, Gallagher and Willoughby, will be enlarged to accept the design volume of flood waters. The lateral will discharge into Gallagher Basin, located north of Chestnut Avenue between the Las Cruces lateral and Main Street. A 379 foot concrete channel will hydraulically connect Gallagher basin to Willoughby basin to allow equalization of the water surface elevation of the two basins during flood events. The two basins currently have a capacity of 110-acre feet. The basins will be expanded to accommodate a volume of 146 acre-feet in Gallagher Basin and 34 acre-feet in Willoughby Basin. Each basin will be 10 feet deep, with 3H:1V sideslopes. The sideslopes will be graveled and the bottom of the basin vegetated with native grasses and forbs. The basins will be fenced with 6 foot chain link fencing to restrict access for safety purposes. Each basin will use existing ungated 24-inch outlet works, with outlets releasing flows into the existing drain system and ultimately the Rio Grande. Drain time for both basins would be about 96 hours. Seasonal ponds about 0.5 acres in area and 6-inches in depth will be constructed near the outlet works in both basins to provide an ephemeral water source for wildlife during rain events. To accomodate discharges exceeding the design capacity, the Gallagher basin will have a 400 foot spillway with a capacity to pass overflows during the 500-year event, while Willoughby Basin's spillway will be 30 feet in length to pass overflows during the 100-year event.

Based on prices prevailing in June 1995, the estimated Federal and non-Federal costs for the proposed improvement are $5,494,000 and $2,784,000, respectively, for a total project cost of $8,278,000. Average annual costs reflecting a 50-year period of economic analysis and a 7.75 percent discount rate, are $736,200. Average annual benefits are estimated at $1,859,000 and the benefit/cost ratio is 2.5:1. Following construction, the City of Las Cruces, acting as the local sponsor, will operate and maintain the project.

While the project does not change the point at which flood waters cause damage within the study area, approximately 705 damageable structures will be removed from the 100-year flood plain and average annual flood damages will be reduced by 37 percent. A general project map is presented on Plate 4. Post-Project floodplains are presented on Plate 5.

4-13 REAL ESTATE REQUIREMENTS: The total cost of real estate required for the selected plan, including land acquisition, permanent and temporary construction easements, relocations is currently estimated at $2,370,100. This includes the relocation of $102,000 for utility relocations, $967,500 for non-federal relocation costs associated with maintaining the irrigation function of the Las Cruces Lateral and $1,300,600 for required real estate actions. This also includes the relocation of nine homes and two businesses that are within the project site. Details of the real estate costs are presented in Section X of the Engineering Appendix. Details of the Utility relocations are presented in Section XI of the Engineering Appendix.

A preliminary Attorney's Opinion of Compesability has been completed. Utility relocations for the project include two sections of sanitary sewer line, one section of an irrigation channel, two sections of water line and three sections of gas line (see Plate 30, Engineering Appendix).

There is no New Mexico statute creating a broad compensable interest in the relocation of utilities. Southern Union Gas Company vs. City of Artesia, 81 N.M. 645, 1970 (Rehearing denied July 8, 1970), is the controlling New Mexico case law in this matter. In that case the plantiff was forced to move its gas lines due to a Federal/State unban renewal project. The New Mexico State Supreme Court held that (1) the common law rule is that in the absense of a valid statute to the contrary, expenses of the removal of utilitites must be accompanied at th expense of the utility owner, and , (2) the common law is only abrogated or repealed by the statute when the statute directly or irreconcilably opposes the common law rule. In New Mexico the legislature has in only two instances directly or irrconcilably creatd a compensable interest in the relocation of utilities (relocations pursuant to construction of interstate highways, 67-8-15 through 67-8-21 NMSA 1978; and relocations pursuant to urban renewal activities, 3-46-33 NMSA, 1978).

The United States Supreme Court has held in Norfork Redevelopment and Housing Authority vs. Chesapeake and Potomac Telephone Company of Virginia, 464 U.S. 30, S.Ct.

304f, 78 L.Ed.2d 29 (1983), that the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 does not require or authorize the treatment of a utility company as a "displaced person" under that Act, where the facilities to be relocated are currently located within a public right-of-way.

Consequently, there is no general compensable interest which exists by either statute or case law. For the final Attorney's Opinion of Compensibility, detailed review of the pertinent real estate documents will be reviewed prior to any credible expenditures being plannned or made. This effort will be completed during the preparation of the Plans and Specifictions for the project.

4-14 MITIGATION REQUIREMENTS: Compliance with the National Environmental Policy Act (NEPA) was accomplished in accordance with ER 200-2-2 and 40 CFR 1500 to 1508, and related laws, regulations, and Executive Orders. Formal coordination with the United States Fish and Wildlife Service was undertaken during the feasibility study. While no formal mitigation is required for the construction of this project, revegetaion of disturbed areas with native grasses and forbes will be undertaken. In addition to this, minor fish and wildlife impacts of the project will be compensated by creating shallow depressions that will pond seasonally in each of the basins near the outlet works. These depressions will be approximately 6 inches deep and one-half acre in size. They will be reseeded and act as habitat for local wildlife. Existing cottonwood and afgan pines along the Las Cruces Lateral will not be affected. Mulberry and locust trees to be removed along Chestnut Avenue during the construction of the project will be replaced and replanted at other locations within the project site.

An intensive cultural resources survey has been conducted for the selected plan. No archeological sites were found within areas to be disturbed by the selected plan. National Historic Preservation Act, Section 106, has been completed and the New Mexico State Historic Preservation Officer have concurred in a determination of on effect on cultural resources as a result of project construction.

The selected plan will no require the placement of dredged or fill material within the waters of the United States. As a result of this a Section 404 permit or a Section 404 (b) 1 determination is not required.

Detailed information regarding the environmental, cultural, and mitigation analysis conducted for the study can be found in the Environmental Assessment and the United States Fish and Wildlife Coordination Act Report

A Phase I Hazardous, Toxic, and Radioactive Waste (HTRW) Environmental Assessment was conducted to evaluate the potential for impacts of HTRW sites on project construction and implementation. Six areas of concern (AOC) were identified during the evaluation. Based on the analysis performed to date, none of the areas were found to contain CERCLA controlled materials or any materials that will require special handling during construction.

4-15 OPERATION, MAINTENANCE, REPAIR, REPLACEMENT AND REHABILITATION:

As with all Corps of Engineers Local Protection Projects, the operation, maintenance, repair, replacement, and rehabilitation of the project are the responsibility of the local sponsor following the construction of the project. Once the construction of the project is completed, the Corps of Engineers will prepare an operations manual for the local sponsor outlining the requirements for (OMRR&R). An analysis of the projected average annual costs for the OMRR& R of the project was conducted, using costs from other similar projects constructed by the Corps of Engineers and the city of Las Cruces. Because of the semi-arid to arid nature of the projects area, several years could pass without the occurrence of a major flood event. The following items have been identified as anticipated to properly care for the facility in the future. In order to determine the annual cost of each item the present cost was projected over the project life and an annual cost was determined from the total present worth of the item. Inspection of the project (4 times a year), at an estimated average annual cost of $2,000. Debris removal from the project is estimated to be required approximately every 3 years. Estimated cost of the required debris removal from the project is $13,000. Over the project life the equivalent average annual cost of debris removal is $4,000. Repair and maintenance of the outlet works is anticipated to be required every five years. The estimated cost of the repair is $23,500, an equivalent average annual cost of $4,000. Maintenance, repair, and rehabilitation of the gravel side slopes of the basins and minor repair of any concrete in the channel is anticipated to be needed every 10 years, at an estimated cost of approximately $80,000; the average annual cost of this is $6,000. This results in an estimated total OMRR&R for the selected project of $16,000. Maintenance of the irrigation section of the diversion channel will remain the responsibility of the Elephant Butte Irrigation District.

4-16 RECREATION: When the feasibility study was initiated, the City of Las Cruces expressed interest in the addition of recreation features to any plan that may be proposed. Initially, some type of playing fields that would be located in the basins were examined for inclusion in the project design. Two problems surfaced as a result of the analysis. First, the City of Las Cruces' Risk Management Department was opposed to any recreation facilities within the basins for safety reasons. Second, the limited space for parking facilities within the project area and the cost to obtain land for parking made the plan for playing fields cost prohibitive. Other than the playing fields within the basins, recreational opportunities within the project area are limited. Trails along the diversion channel and the basins were considered, however, the composition of the maintenance road and it alignment can serve as a walking/jogging trail without making recreation a project purpose.

4-17 COST SHARING REQUIREMENTS: The cost sharing for this project is based of the Water Resources Development Act of 1986. The basic formula for the distribution of Federal and non-Federal funds for flood control works is as follows. The local sponsor will contribute five percent cash of the total project cost attributable to flood control, provide all lands, easements, rights-of-way, relocations, and disposal areas (LERRD) required for the construction and operation of the project, and an additional cash contribution to make the minimum non-federal share at least twenty-five percent. If these cost are greater than twenty-five percent the local sponsor will assume all cost up to fifty percent. After that, the Federal Government will assume additional costs. For this project, the cost of maintaining the irrigation function of the Las Cruces Lateral will be a non-Federal relocation cost not associated with the project purpose of flood control. The cost sharing is based on that premise and presented in Table 4-9.

TABLE 4-9
PROJECT IMPLEMENTATION COSTS
(June 1995 Prices)

ITEM	FEDERAL	NON-FEDERAL
Lands and Damages	$ 0	$1,300,600
Relocations	$ 0	$1,069,500
Dams	$2,110,800	$ 0
Channels and Canals	$1,265,400	$ 0
Flood Control and Div Structures	$1,058,700	$ 0
Mitigation	$ 0	$ 0
PED	$ 751,600	$ 0
Construction Management	$ 721,000	$ 0
Total Project Cost	$5,907,500	$2,370,100
Five Percent Cash	-$ 413,900	$ 413,900
Subtotal	$5,493,600	$2,784,000
Percentage	66%	34%
Additional Cash or Reimbursement	$ 0	$ 0
Adjusted Project Cost	$5,493,600	$2,784,000
Adjusted Percentage	66%	34%
Federal and Non-Federal Project Implementation Costs		$ 8,277,600
Rounded to		$ 8,278,000

4-18 FINANCIAL ANALYSIS: The city of Las Cruces currently has a portion of the city sales tax that is allocated for flood control construction. This fund is estimated by the city to currently have $5,3000,000 and increases by $500,000 per year. The non-Federal financing of the project would come from this source. The city does not anticipate the need for the issuance of bonds in order to finance the project. The District has reviewed the ability of the city to meet the necessary financial requirements of the project and believes that it is well within their financial capacity.

4-19 PROJECT PROCEDURES AND IMPLEMENTATION: Future actions necessary for authorization and construction of the selected plan of improvement are summarized below.

* The Chief of Engineers will seek formal review and comment by the State of New

Mexico and interested Federal Agencies.

* Following the state and agency review, the final report of the Chief of Engineers will be sent to the Assistant Secretary of the Army (Civil Works) for forwarding to the Office of Management and Budget regarding the relationship of the project to the Programs of the Executive Branch. Then the report of the Chief of Engineers will be forwarded to Congress.

* Congressional review of this feasibility report and possible authorization of the project will follow.

* Pending project authorization for construction, the Chief of Engineers may include funds, when appropriate, for continued planning and engineering of the project.

* Following the issuance of the Division Engineers Notice,, plans and specifications for the project will be completed by the Albuquerque District.

* Subsequent to appropriation of construction funds by Congress, but prior to construction, formal assurance of local cooperation will be required form the non-Federal sponsor.

* Following the signing of the Project Cooperation Agreement (PCA), The local sponsor will obtain all of the required lands, easements, rights-of-way, relocations, and disposal areas for construction of the project.

* Bids for construction would be invited and contracts awarded.

4-20 PROJECT ACCOMPLISHMENTS: The selected plan will provide needed flood protection within the study area. The total project cost is currently estimated at $8,278,000 and will control up to the 100-year event for a 2.25 square mile drainage area within the City of Las Cruces. Average annual benefits form the construction of the project are $1,859,000 . The project will also remove 705 homes and businesses from the 100-year floodplain and eliminate their need to pay flood insurance premiums. The selected plan will also reduce the depths of flooding for approximately 1850 structures for any given flood event. The plan will also provide non-quantitative benefits, such as the reduce threat of loss of life, reduced potential for health and sanitary problems associated with flooding, the reduced interruption of business and public services during flood events. Table 4-10 presents a System of Accounts comparing the economic, environmental, and social impacts for taking no action and the implementation of the selected plan.

TABLE 4-10
SYSTEM OF ACCOUNTS
SELECTED PLAN

ITEM	NO ACTION ALTERNATIVE	SELECTED PLAN
Plan Description	No Federal action to reduce flood damages.	Increased flood protection through construction of plan.
CONTRIBUTIONS TO PLANNING OBJECTIVES		
1. Flood Control	No Contribution	Reduction in flood damages for 705 structures in Las Cruces.
2. Preservation of Environmental Values	No Contribution	No mitigation required. But plantings will return area aesthetics to pre-project conditions.
3. Improve Recreational Opportunities	No Contribution	Recreation not a project purpose but maintenance road will serve a jogging path.
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT		
1. Total First Cost	None	$ 8,278,000
2. Annual Cost	None	$ 720,200
3. OMRR&R	None	$ 16,000
4. Total Annual Cost	None	$ 736,200
5. Annual Benefits	None	$ 1,859,000
6. Benefit/Cost Ratio	None	2.5:1
7. Net Benefits	None	$ 1,122,800
ENVIRONMENTAL QUALITY		
1. Riparian and Wetland Vegetation	No Contribution	Small wetlands will be created in both basins
2. Fish	No Contribution	No Contribution

3. Wildlife	No Contribution	Wildlife will be attracted to small seasonal wetlands in basins
4. Rare, Threatened, and Endangered Species	No Impact	No Impact
5. Water Quality	No Contribution	No impact
6. Air Quality	No Contribution	Minor Impacts during construction, no long term impacts
REGIONAL ECONOMIC DEVELOPMENT		
1. Local Government	No Contribution	Reduced emergency costs during flood events.
2. Land Use	No Change	Small change in land use at project area.
3. Flood Insurance	No Change	Remove 705 structures from the 100-year flood plain.
4. Public Facilities		Increased flood protection for several public facilities.
OTHER SOCIAL EFFECTS		
1. Displacement of People	No Change	Eight residences in project area will be required to relocate.
2. Transportation	No Change	Reduced traffic disruptions and associated impacts. Temporary increase in traffic congestion during construction.
3. Employment	No Change	Little effect, except for short-term construction employment
4. Safety	Population in the flood plain would continue to be subject to hazards from flooding	Reduced flood threat and safety hazards.

4-21 PROJECT PERFORMANCE: The spillways for the proposed modified Gallagher and Willoughby detention basins were used as the benchmark for measuring project performance. There is a 53% chance that the Gallagher and Willoughby basins will contain the 1% chance (100-year) flood without spillway flow occurring. The following table provides a probabilistic evaluation of project performance:

Table 4-11
PROJECT PERFORMANCE

10-YEAR FLOOD	50-YEAR FLOOD	100-YEAR FLOOD	500-YEAR FLOOD
>99%	83%	53%	7%

The values in the table were determined by the combined use of the HEC-FFA and HEC-1 programs. The combined use of the FFA and HEC-1 programs was appropriate for this study because this particular application involved the formulation of two detention basins sized to impound the entire 100-year flood volume with minimal outflow. The key parameter is the volume of the flood. Since there is minimal outflow, uncertainty in stage can be excluded.

SECTION 5

5-01 Conclusions: As District Engineer, Albuquerque District, Corps of Engineers, I have reviewed and evaluated, in light of the overall public interest, the data, information, and alternatives for flood control in the study area of Las Cruces, New Mexico. The principal elements of my review include: (a) engineering feasibility, (b) economic factors of local, regional, and national resource development, (c) environmental impacts, and (d) social well-being. The purpose of the project is to meet the demands and requirements for the reduction in flood damages for the citizens of Las Cruces, New Mexico. The community is exposed to a serious and potentially life-threatening flood threat from overland flows within the city. I have considered all the alternatives available for meeting the flood control needs within the area; and have determined that the expansion and modification of the existing Gallagher and Willoughby ponds along with Las Cruces Lateral described in this report, best meets the needs of increased flood control and the desires of the local sponsor. In evaluating the selected plan and alternatives, the following points were considered pertinent.

a. From an engineering standpoint, the selected plan will provide flood reduction measures that will reduce the flood damages within the study area by 37 percent.

b. From an economic standpoint, the selected project is justified based on flood reduction benefits and is the National Economic Development (NED) Plan.

c. From an environmental standpoint, I have determined, in consultation with the U.S. Fish and Wildlife Service, that the selected plan will have no impact on the environment that will require mitigation. However, the selected plan includes features to restore the site of the plan to at least pre-project aesthetic values.

d. From a social standpoint, the selected plan will enhance public welfare by providing a means to reduce flooding within the study area, thereby reducing future disruptions and displacement of people because of flooding and its attendant miseries.

I find that the selected plan is based on thorough analysis and evaluation of various practicable alternatives for achieving the stated objectives; that wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternatives which will achieve the specified purposes and the effects are substantially outweighed by other considerations.

The total first cost of the project, based on June 1995 price levels is estimated at $8,278,000, with annual operation and maintenance costs estimated at $16,000. Benefits derived from the project, all for flood control are currently estimated at $1,859,000. The benefit/cost ratio for the Selected Plan is 2.5:1. Net Benefits for the project are $1,122,800.

The cost of the project, inflated to the currently scheduled mid-point of construction is $9,600,000.

This feasibility study has identified a project that meets the economic and environmental criteria for Federal participation. The report identifies Federal and non-Federal responsibilities based on the flood damage reduction cost sharing policy established by Public Law 99-662. The Administration has proposed changes to that policy which would preclude Federal participation in the identified project. Congress took exception to that proposal and the Administration is reconsidering the policy. Consequently, National flood damage reduction policy is uncertain until agreement is reached between the Administration and Congress. Based on the project's inconsistency with the Administration's proposed policy, at this time I cannot recommend that it be implemented as a Federal project. However, this report will be submitted for Washington level review and a determination of consistency with policy will be made based on the flood damage reduction policies in effect at that time.

If National flood reduction policies remain as outlined in Public Law 99-662 the, Non-Federal interests will be obligated to comply with the following requirements.

a. 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;

b. 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 for the construction, operation, and maintenance of the project;

c. 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;

d. Grant 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;

e. Hold and save the Government free from all damages arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the 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 the 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, 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 in a manner that will not cause liability to arise under CERCLA.

j. Participate in and comply with applicable Federal floodplain management and flood insurance programs in accordance with section 402 of Public Law 99-662;

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

l. Not less than once each year, inform affected interests of the limitations of the protection afforded by the project;

m. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels by the project;

n. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition 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 CAR 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. Comply with all applicable Federal and Commonwealth laws including section 601 of the Civil Rights Act of 1964, Public law 88-352, and Department of Defense Directive 500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Non-Discrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"

These requirements and provisions will be formalized with the signing of the Project Cooperation Agreement (PCA) between the local sponsor and the Department of the Army.

The city of Las Cruces, New Mexico is strongly committed to the construction of the selected project. The understand the cost-sharing requirements of the Water Resources Development Act of 1986 have been active partners in the development of the selected plan.

5-02 Disclaimer: "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." However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Lloyd S. Wagner

LLOYD S. WAGNER
LTC, EN
DISTRICT ENGINEER

City of Las Cruces

D95-467
October 17, 1995

LTC Lloyd S. Wagner
District Engineer
Albuquerque District
P.O. Box 1580
Albuquerque, NM 87103-1580

Dear Colonel Wagner:

The City of Las Cruces, New Mexico has completed our review of the draft Feasibility Report, dated September 1995, for the construction of the Las Cruces Flood Control Project.

The City Council has considered and discussed this project on several occasions. On October 16, 1995, the Council adopted the attached Resolution, which outlines unanimous support by the Council for this project.

This letter serves as notice of the City's decision to strongly support the continuation of planning, engineering, design and construction of project as presented in the report.

We are familiar with the cost-sharing provisions, as outlined in the report and in the Water Resources Development Act of 1986 and are committed to complete the construction of this project.

We look forward to the earliest possible implementation of this project, and are ready to assist in any manner to expedite its completion.

If you have any questions or require further information, please contact Mr. James Ericson, Director of Development Services at (505) 526-0633.

Sincerely,

Ruben A. Smith
Mayor

Attachment
As Stated

RESOLUTION NO. 96-120

A RESOLUTION APPROVING THE CITY'S PARTICIPATION IN THE DESIGN AND CONSTRUCTION OF THE NORTH LAS CRUCES FLOOD CONTROL PROJECT AND AUTHORIZING THE MAYOR TO SUBMIT A LETTER OF INTENT TO THE ARMY CORPS OF ENGINEERS.

The City Council of the City of Las Cruces is informed that:

WHEREAS, the City of Las Cruces and the Army Corps of Engineers have been reviewing on-going flooding problems within the Las Cruces Urban Area; and,

WHEREAS, the Army Corps of Engineers has completed a Reconnaissance Study of the Las Cruces Area and has determined that the North Las Cruces Flood Control Project is a viable solution to reduce flooding hazard to the community; and,

WHEREAS, the City of Las Cruces and the Army Corps of Engineers have previously entered into an agreement to provide cost sharing for the Feasibility Study for the North Las Cruces Flood Control Project; and,

WHEREAS, the Army Corps of Engineers has completed the Feasibility Study, which has indicated that the project can be constructed to meet Army Corps of Engineer's criteria; and,

WHEREAS, the project is subject to the cost sharing provisions as outlined in the Feasibility Study Report and the Water Resources Development Act of 1986; and,

WHEREAS, the total estimated cost of the project is $8,278,000.00; and,

WHEREAS, the City of Las Cruces' share of this project would be approximately $2,566,000.00 (31 % of the estimated project cost); and,

WHEREAS, to obtain continued financial participation by the Army Corps of Engineers, the City must provide a letter of intent to the Army Corps of Engineers indicating the City's willingness to participate in the project under the cost sharing provisions established by the Army Corps of Engineers.

NOW, THEREFORE, the City Council of the City of Las Cruces does hereby determine and resolve as follows:

(I)

THAT the City will participate in the final design and construction of the North Las Cruces Flood Control Project as outlined in the Feasibility Report dated September, 1995.

(II)

THAT the Mayor is authorized to execute a Letter of Intent to the Army Corps of Engineers establishing this commitment.

(III)

THAT staff is directed to take such other actions that may be necessary to implement this Resolution.

DONE AND APPROVED this 16th day of Oct, 1995.

Resolution No. 96-120, cont.
Page 2

MAYOR RUBEN A. SMITH

ATTEST:
CITY CLERK

(SEAL)

VOTE:

Mayor Smith: Aye
Councillor Perrales: Aye
Councillor Kennon: Aye
Councillor Valencia: Aye
Councillor Benavidez: Aye
Councillor Tomlin: Aye
Councillor Haltom: Aye

Moved by: Valencia

Seconded by: Perrales

APPROVED AS TO FORM:
CITY ATTORNEY
10/17/95

LAS CRUCES, NEW MEXICO FEASIBILITY STUDY

PUBLIC COMMENTS

United States Department of Interior

BUREAU OF RECLAMATION
RIO GRANDE PROJECT
700 E. SAN ANTONIO AVE., RM. B-318
EL PASO, TEXAS 79901

IN REPLY
REFER TO:
EP-421
PRJ-23.10

OCT 17 1995

Mr. Fritz Blake
Albuquerque District
U.S. Army Corps of Engineers
P.O. Box 1580
Albuquerque, NM 87103-1580

Subject: Response to the Feasibility Study for Las Cruces, New Mexico Flood Control Project

Dear Mr. Blake:

The Bureau of Reclamation (Reclamation) has reviewed your plans for enlarging Gallagher and Willoughby basins with the use of the Las Cruces Lateral for the conveyance of stormwater. We are in the process of transferring title of the irrigation distribution system in this area to Elephant Butte Irrigation District (EBID), and use of the lateral for stormwater conveyance would require their approval. The address and telephone number for EBID are as follows:

Elephant Butte Irrigation District
P.O. Drawer A
Las Cruces, NM 88004
Attention: Mr. Gary Esslinger
Treasurer-Manager
(505) 526-8391

Reclamation generally did not grant permission for the use of the lateral for stormwater conveyance. If you have any questions or comments, please contact Mr. Woody Irving at (915) 534-6325.

Sincerely,

David O. Allen
Manager, El Paso Field Division

EBID

Elephant Butte Irrigation District
Of New Mexico
P.O. DRAWER A
LAS CRUCES, NEW MEXICO 88004
(OFFICE AT 530 SOUTH MELENDRES)
TELEPHONE
(505) 526-8391
FAX (505) 523-9566

10th ANNIVERSARY
1979-1989

GARY L. ESSLINGER
TREASURER-MANAGER

October 20, 1995

Mr. Fritz Blake
Albuquerque District
U.S. Army Corps of Engineers
P.O. Box 1580
Albuquerque, NM 87103-1580

Ref: 95-288

Dear Mr. Blake,

This is in reply to your letter dated September 22, 1995 concerning the draft feasibility study of the Las Cruces New Mexico Flood Control Project. We see no objections to the proposed co-use of the right-of-way of the Las Cruces Lateral for your project.

When final plans are formulated, please be certain that active turnouts are provided for and also any other structures that may be involved. Please keep us informed of the progress of your project.

Sincerely,

Gary L. Esslinger
Treasurer-Manager

GLE/HM/bis

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services State Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 761-4525 Fax: (505) 761-4542

October 4, 1995

Cons. #2-22-95-I-543

Lt. Colonel Lloyd Wagner
District Engineer
U.S. Army Corps of Engineers
P.O. Box 1580
Albuquerque, New Mexico 87103-1580

Re: Review of the Draft Environmental Assessment for the Las Cruces Flood Protection Project, Las Cruces, New Mexico, September 1995

Dear Lt. Colonel Wagner:

Thank you for the opportunity to review the Draft Environmental Assessment for the Las Cruces Flood Protection Project, Las Cruces, New Mexico. In general, the document is well written and adequately addresses concerns for natural resources. Editorial suggestions have been made directly to the enclosed manuscript.

The U.S. Army Corps of Engineers is to be commended for its efforts to include the construction of 0.5 acre wetlands at outlet works of the basins. These areas should be attractive to waterfowl and shore birds. Please refer any questions to Mr. Craig L. Springer at (505) 761-4525.

Sincerely,

Jennifer Fowler-Propst
State Supervisor

Enclosure

cc: (w/o enc)
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico

NEW MEXICO INTERSTATE STREAM COMMISSION

BATAAN MEMORIAL BUILDING, ROOM 101
STATE CAPITOL
POST OFFICE BOX 25102
SANTA FE, NEW MEXICO 87504-5102
(505) 827-6160
Fax: (505) 827-6188

October 25, 1995

Mr. Fritz Blake
Albuquerque District
U.S. Army Corps of Engineers
Post Office Box 1580
Albuquerque, New Mexico 87103-1580

Dear Mr. Blake:

By letter dated September 22, 1995, the Corps of Engineers transmitted for our review and information copies of the September 1995 Interim Feasibility Report, Main Report, Environmental Assessment and the Engineering Appendix for the Las Cruces, New Mexico Flood Control Project.

This letter is to inform you that we have no comments to submit on the Las Cruces Flood Control Project reports. We appreciate the opportunity to review these documents.

Sincerely,

William J. Miller
Interstate Stream Engineer

WJM:rav

\rav\iscother\blake.fnl

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO

OFFICE OF THE COMMISSIONER
UNITED STATES SECTION

OCT 17 1995

Mr. William R. Pearson, P.E.
Deputy District Engineer for Project Management
Albuquerque District
United States Army Corps of Engineers
P.O. Box 1580
Albuquerque, New Mexico 87103-1580
Attention: Mr. Fritz Blake

Dear Mr. Pearson:

Thank you for your September 22, 1995, letter providing a draft interim feasibility report including environmental assessment and engineering appendix for the Las Cruces, New Mexico, Flood Control Project. The study examined several flood control alternatives to provide flood protection to the central and downtown areas of Las Cruces.

The United States Section, International Boundary and Water Commission, United States and Mexico (USIBWC), reviewed the documents you provided and concur in your determination that the project will have no significant impact upon the human environment. The selected plan for flood control (Structural Alternative 1) will neither interfere with USIBWC projects in the area nor will it have any adverse impact upon the flow of the Rio Grande.

Thank you again for the opportunity to review and comment on the proposed flood control project.

Sincerely,

John M. Bernal
Commissioner

FINAL
ENVIRONMENTAL ASSESSMENT

LAS CRUCES
FLOOD PROTECTION PROJECT
LAS CRUCES, NEW MEXICO

U.S. ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT
ALBUQUERQUE, NEW MEXICO

OCTOBER 1995

FINDING OF NO SIGNIFICANT IMPACT
Las Cruces Flood Control Project
Las Cruces, New Mexico

Studies for the proposed flood protection project are authorized and funded under a United States Senate Resolution on Environment and Public Works dated April 6, 1986. The objective of the proposed flood control project is to provide flood protection to the central portion of Las Cruces. Flooding is caused primarily by run off from intense local thunderstorms that generally occur between July and October.

This Finding of No Significant Impact (FONSI) addresses the proposed expansion of the existing Gallagher and Willoughby detention basins to temporarily hold flood waters, and improvement of a portion of the Las Cruces lateral irrigation ditch to collect and convey flood waters to the detention basins.

Alternatives considered include no action, four structural alternatives including the proposed action, and four nonstructural alternatives.

The proposed project would contain the 1 percent chance flood and reduce damages of runoff from 2.25 square miles of a 14 square mile urban drainage area. The following elements have been analyzed and would not be significantly affected by the planned action: socioeconomic environment, air quality, water quality, floodplains or riparian areas, wetlands, wild and scenic rivers, biological resources, endangered or threatened species or their habitat, wilderness values, prime and unique farmland, and cultural resources. Minor foreseeable effects include loss of vegetation, localized air and noise quality impacts during construction, and minor socioeconomic impacts associated with relocating residences and businesses. Placement of dredged or fill material in the detention basins and irrigation canal does not require a Clean Water Act, Section 404 permit. Compliance with Section 404 of the Clean Water Act has been accomplished.

The proposed action has been fully coordinated with Federal and State agencies with jurisdiction over the biological and cultural resources of the project area. Based upon these factors and others discussed in detail in the Environmental Assessment, the proposed action would not have a significant effect on the human environment. Therefore, an Environmental Impact Statement will not be prepared for the construction of the Las Cruces flood control project.

30 Oct 1995
DATE

Lloyd S. Wagner
LLOYD S. WAGNER
Lieutenant Colonel, EN
District Engineer

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

1.01 BACKGROUND

The proposed flood control project is located in northwest Las Cruces, central Doña Ana County, about 44 miles north of El Paso, Texas and 200 miles south of Albuquerque, in south-central New Mexico (Figure 1). The objective of the proposed project is to control flooding and provide protection to a portion of the city of Las Cruces.

Studies for the proposed flood protection project were authorized and funded under a United States Senate Resolution on Environment and Public Works dated April 6, 1986. The reconnaissance phase study was requested by the city of Las Cruces and the Las Cruces Metropolitan Arroyo Flood Control Authority, with flood control studies initiated in 1990.

1.02 PURPOSE AND NEED

The total drainage area in Las Cruces is approximately 14 square miles. Five major ephemeral arroyos enter the city from the east: Alameda, Las Cruces, Sandhill, Fillmore, and Tortugas. The Las Cruces dam constructed by the Corps of Engineers controls the standard project flood on the Las Cruces and Alameda arroyos. Below (west of) the Las Cruces dam, the arroyos become poorly defined as urbanization has eradicated their natural flow paths. In addition, there are no significant drainage channels to convey flood waters. Consequently, the rather flat central area of the city experiences flooding problems and ponding from localized storm runoff. Manmade features such as irrigation laterals, groundwater drains, and elevated railroads and streets are perpendicular to natural flow, exacerbating flooding problems.

Within the past 50 years, three significant flood events have occurred in Las Cruces. The most recent occurred on August 22 and 23, 1987, when four to five inches of rain fell, causing considerable damage. A survey of the flood prone properties within the project area was conducted in 1990 to assess the potential magnitude of flood damages. Damages start at approximately the 20 percent chance event, with average annual damages calculated at approximately $2.2 million.

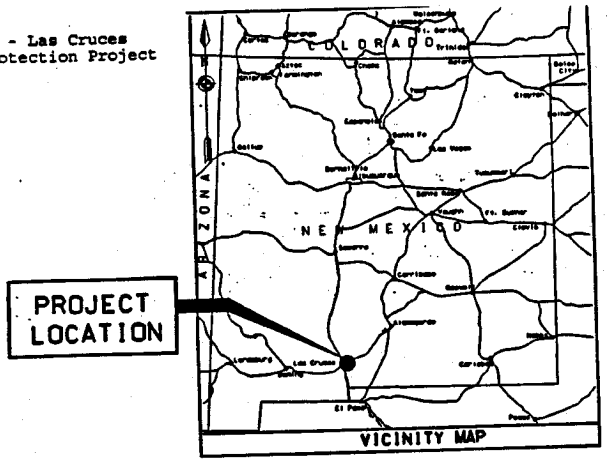
The proposed plan is designed to collect 180 acre-feet of the 410 acre-feet produced by the 1 percent flood (the chance of the 100 year storm occurring in any given year), providing protection to a portion of the affected area. It is economically infeasible to provide protection to the entire flood plain because dense development in the floodplain and drainage area has resulted in high real estate, housing and business relocation, and utility relocation costs.

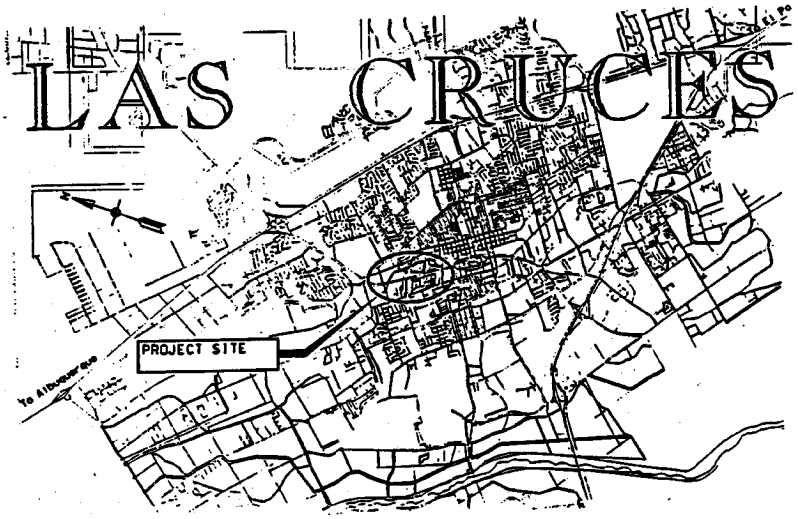
1.03 REGULATORY COMPLIANCE

This Environmental Assessment (EA) was prepared by the U.S. Army Corps of Engineers, Albuquerque District, in compliance with all applicable federal statutes, regulations, and Executive Orders, including the following:

National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*);
Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 *et seq.*);

igure 1: Location - Las Cruces
Flood Protection Project





Clean Air Act, as amended (42 U.S.C. 7609);
Clean Water Act of 1977, as amended (33 U.S.C. 1251 *et seq.*);
Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*); Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq.*);
Floodplain Management (Executive Order 11988);
Protection of Wetlands (Executive Order 11990);
National Historic Preservation Act of 1966, as amended (16 U.S.C. 470a *et seq.*);
Protection of Historic and Cultural Properties (36 CFR 800 *et seq.*); and
Protection and Enhancement of the Cultural Environment (Executive Order 11593).

Compliance with applicable state of New Mexico regulations and standards for water and air quality, as well as regulations conserving endangered plants and animals is also reflected in this EA.

2. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.01 PROPOSED ACTION

The proposed plan consists of construction of a concrete lined channel, street inlets at eight locations that would collect flows into the channel, and expansion of two existing detention basins. The proposed project would contain the 1 percent chance flood and reduce runoff from a 2.25 square mile urban drainage area. Features for the proposed plan include the following:

a. Channel A 1,934-foot-long segment of the existing Las Cruces lateral ditch, between Madrid Street and Willoughby basin would be enlarged to convey flood waters to Gallagher and Willoughby detention basins. This ditch currently conveys both flood and irrigation flows. The lateral would be converted into a concrete-lined rectangular channel with vertical side slopes, a 20-foot bottom width, and a depth varying between 8 and 9.6 feet. Within this 20 foot width, a 5 foot by 5 foot channel would be placed along the entire length of the channel to insure delivery of 75 cubic feet per second (cfs) irrigation flow downstream. The channel capacity and design discharge into Gallagher Basin is 880 cfs. The channel terminus into Gallagher basin would be a concrete rundown with a stilling basin.

b. Inlets Eight inlets would convey the 1% chance flow into the diversion channel. Grated drop inlet structures would be constructed across Madrid Avenue and at Main Street to intercept flood flows and deposit them into the channel. A concrete inlet at Mulberry Street would convey flows into the channel. Concrete drop inlets to Gallagher Pond would be located at Palm Street, Villa Mora Street, and Juniper Street. Grated drop inlets would also be installed on Chestnut Avenue and Picacho Avenue to intercept flood flows and convey them to Willoughby Pond.

c. Detention Basins Two existing detention basins, Gallagher and Willoughby, would be enlarged to accept the design volume of floodwaters. The lateral would discharge into Gallagher Pond, located north of Chestnut Avenue between the Las Cruces lateral and Main Street. Irrigation flow of 75 cfs would continue downstream via the 5 foot by 5 foot irrigation canal, with the flood flows discharging into the basin. A 379-foot long concrete connecting channel would hydraulically connect Gallagher basin to Willoughby basin to allow equalization of the water surface elevation of the two basins during flood events and increase efficiency.

The two basins currently have a combined capacity of 110 acre-feet. They would be expanded to accommodate a volume of 146 acre-feet in the Gallagher basin and 34 acre-feet in the Willoughby basin. The basins would be 10 feet deep, with 3:1 side slopes (3 horizontal feet to 1 vertical foot). Sideslopes would be graveled and the bottom of the basin vegetated with native grasses and forbs. The basins would be fenced with 6 foot chain link fencing to restrict access for safety purposes. Each basin would use existing ungated 24-inch diameter outlet works, with outlets releasing flows into the existing storm drain system and ultimately to the Rio Grande. Drain time for both basins would be about 96 hours. Seasonal ponds about 0.5 acres in size and 6-inches in depth would be constructed near the outlet works in both basins to provide an ephemeral water source for wildlife during rain events. For discharges that exceed the design capacities, the Gallagher basin would have a 400-foot spillway with the capacity to pass overflows during the 500 year event, while the Willoughby basin's spillway would be 30 feet in length to pass overflows during the 100 year event.

d. Access and Maintenance Roads Existing roads would provide access to the project area during construction. A 12-foot access and maintenance road would be constructed along the diversion channel and at the top of the levee around both basins. This maintenance road would serve as a bicycle/walking/jogging trail along the channel and the eastern boundary of the two basins. Trail signs and cross-walks would be provided.

e. Revegetation Revegetation of disturbed areas would be included as a project feature. After construction, disturbed areas would be scarified and revegetated with a mixture of native shrubs, grasses and forbs to retard erosion, restore aesthetic quality, and stabilize the soils.

f. Project costs and benefits The estimated cost of the proposed project is $8,278,000.00. The benefit-to-cost ratio is 2.5:1, with average annual flood reduction economic benefits and streambank erosion control benefits estimated at $1,859,000.00 annually.

2.02 ALTERNATIVES

Various solutions to the flooding problem in the city of Las Cruces have been considered throughout the planning process. Structural alternatives such as flood control channels - including improvement of existing channels, and detention structures - including modifications to existing basins were studied. Structural alternatives are limited due to extensive development within the city of Las Cruces. Nonstructural alternatives explored include floodplain management, flood warning and evacuation, floodproofing, and relocation.

Alternatives to the proposed action that were evaluated in detail are as follows:

a. No action This alternative would consist of taking no federal action to reduce the flooding hazard in Las Cruces. A high risk to life and property would remain if no action is taken. This alternative is not appropriate to meet the needs for flood protection in the city of Las Cruces.

b. Structural alternatives

(1) Diversion Channel and Detention Reservoir For Entire Floodplain This alternative would utilize the existing Las Cruces Lateral irrigation ditch from Madrid Avenue to the Park Drain to collect flood waters and convey them to storage sites, with controlled release of the water to the Rio

Grande. This alternative would provide 100-year protection for the entire 14 square mile floodplain in the city of Las Cruces. A flow division would be incorporated in the main channel to split the flows to the Burn Lake storage facility and a Park Drain storage location. These channel alignments, with various collector and feeder channels, would run through the main business district of Las Cruces requiring utility relocations and construction of a railroad bridge as well as twelve additional bridge crossings. This alternative was eliminated early in the planning process because of very high real estate, relocation, and utility costs.

(2) Diversion Channel and Detention Reservoir in Northeast Las Cruces This alternative differs from the proposed action only in the channel length and the method of release of collected water to Gallagher and Willoughby ponds. This alternative would provide the same protection as described in the proposed action. Under this alternative, the concrete channel would be reshaped and concrete lined for 1,200 linear feet of concrete channel terminating at the existing Gallagher and Willoughby detention ponds; approximately 2,550 feet of embankment from the Las Cruces lateral would be removed to permit flows to fall directly into the detention ponds; with delivery of irrigation flows downstream maintained. The storage capacity of Gallagher and Willoughby would be increased to approximately 175 acre-feet through purchase and excavation of adjacent property. This alternative was eliminated because it lacked economic justification/

(3) Diversion Channel and Detention Reservoir in Southern Las Cruces This alternative in the southern portion of the city would utilize approximately 8,400 feet of the Las Cruces Lateral to convey flood waters from Boutz Road to the existing Park Drain, south of Union Avenue near Interstate-10; would require construction of three new detention ponds (Montana Pond at Montana Avenue and El Paseo, Farney Pond at Farney Lane and South Main, and College Pond South at Union and Stearn Avenues); and/or expansion of an existing pond (Frenger Pond located on the northwest corner of West Park and Lee Whisman Drives). This alternative also lacked economic justification.

c. Nonstructural alternatives

(1) Floodplain management Floodplains play a vital role in the interaction between land and water, particularly with respect to moderation of floods, maintenance of water quality, and recharge of groundwater. They are particularly important in their undisturbed state because of the living resources they support and the environmental values they provide. Development of enforceable floodplain regulations would limit the number of properties and restrict growth in the floodplain. Zoning and watershed management are two ways to accomplish this objective. For the past several years, the city of Las Cruces has vigorously enforced floodplain regulations to ensure that structures are built either out of or above the 100-year floodplain. Floodplain management would be most effective in controlling future development in the floodplain; however, floodplain management by itself cannot alleviate existing flooding conditions.

(2) Flood warning and evacuation Installation of a reliable early-warning system could permit temporary evacuation of the floodplain prior to an impending flood. The National Weather Service provides generalized information on flooding and issues specific flood watches and warnings for many areas of the country. However, in areas where flooding occurs quickly following heavy localized rains, a flood warning system can provide more detailed information to allow for more accurate and reliable predictions of floods. The key components of an effective, reliable flood warning system are gages to monitor rainfall and streamflow; data transmission by radio, telephone, or satellite; procedures for flood forecasting; a preparedness plan; and periodic testing and updating of flood warning equipment

and the preparedness plan. Flood warning and emergency evacuation should be considered by the city as part of an overall flood control plan.

(3) Floodproofing Floodproofing property within the floodplain can include measures such as valving sewer lines; providing watertight coverings for door and window openings; sump pumps; sealing cracks; steel bulkheads on brick walls; raising the structure on walls, piers, and posts; and constructing levees and floodwalls around individual or groups of buildings. Floodproofing is most easily incorporated into new construction since it can be included at little or no additional cost. In new construction, the elevation of the building site can be raised above expected flood levels with earth fill. The high cost to retroactively floodproof existing structures within flood-prone areas of Las Cruces precludes further consideration of this alternative; although it would be appropriate for future or new developments to incorporate floodproofing measures to reduce flood losses.

(4) Relocation The objective of permanent relocation is to move damageable property to a flood-free location. Three general options are available for permanent relocation: relocation of both a structure and its contents; relocation of only the structure's contents and conversion of the structure to a use compatible with the flood hazard; and relocation of contents only and demolition of the structure. The lack of identifiable flood flow paths and the high costs associated with relocation make this alternative cost prohibitive.

2.03 RELATED ACTIONS OF OTHERS

Las Cruces Dam controls two major arroyos, Alameda and Las Cruces, which carry flows from the east from points originating in the Organ Mountains. The dam and reservoir were authorized by the Flood Control Act of 1962 and completed in 1976. The reservoir has a capacity of 12,500 acre-feet, providing standard project flood protection from flows on the Alameda and Las Cruces Arroyos. The outlet controls the release to a maximum of 275 cubic feet per second (cfs), with the reservoir spillway crest elevation at 4,130 feet. Outflows are conveyed westward in the Las Cruces outlet channel for a distance of 17,200 feet to the Rio Grande.

In 1958, the city of Las Cruces constructed the Country Club detention dam on an unnamed arroyo which drains a portion of the area between Alameda and Las Cruces Arroyos. The reservoir has a 225 acre-foot capacity, with maximum outlet capacity of 54 cfs. The city has also constructed several smaller detention basins capable of containing some localized drainage.

The Soil Conservation Service has constructed two floodwater detention structures on Tortugas Arroyo to contain the 1 percent chance event. The combined capacity is 1,326 acre-feet. A 2,929 foot-long channel conveys outlet discharges and runoff collected below the dam to an existing agricultural drain.

New Mexico State University constructed an earthen levee upstream of the University to divert Campus Arroyo flood flows into a small excavated channel located in the southern portion of the campus.

Las Cruces is substantially protected from 1 percent chance event floods on the Rio Grande by a levee-protected floodway constructed by the International Boundary and Water Commission.

3. ENVIRONMENTAL SETTING, FORESEEABLE EFFECTS OF THE PROPOSED ACTION AND ALTERNATIVES

3.01 PHYSIOGRAPHY, CLIMATE AND SOILS

a. Physiography The city of Las Cruces is situated in the Mesilla Valley of the Rio Grande at an elevation of 3,900 feet. The Mesilla Valley is bordered on the east by the San Andres-Organ range, on the north by the Doña Ana Mountains, and to the northwest by the Robledo-Picacho uplifts. The Mesilla valley is a flat plain about five miles wide flanked on the west by a sloping plain which rises about 575 feet to a relatively flat mesa. On the east, an alluvial outwash plain rises gradually from the valley edge (150 feet per mile) for about ten miles, then steeply for about three miles to the crest of the Organ Mountains. Elevations in the Las Cruces vicinity range from 9,012 feet at Organ Needle, the highest point in the Organ Mountains; 4,931 feet at Tortugas Mountain east of the project area; and 3,830 feet on the valley floor along the Rio Grande.

b. Climate Las Cruces has a semiarid climate with hot summers, mild winters, and short temperate spring and fall seasons. The annual mean air temperature is 60 degrees Fahrenheit (°F) with extremes of recorded of 109°F and -10°F. The mean annual precipitation at the lower elevations is 8.0 inches, with sixty percent of the total precipitation accumulating during the summer and fall months - July to October. The remaining 40 percent is received during the winter months from early November to early April. The orographic influence of mountains affects the precipitation distribution. In general, winter storms are low in intensity, last several days and cover large areas, whereas summer storms are high intensity, localized thunderstorms of brief duration. The highest flows in the Las Cruces area have been produced by local summer storms.

c. Soils Most of the soils in the project area belong to the Bluepoint and Belen series. The principal soils in the project vicinity are Bluepoint loamy sand and Belen clay. Bluepoint soils are generally described as gently sloping, deep, somewhat excessively drained soils that formed in alluvium modified by wind. These soils typically occur on fans, terraces, and ridges along the Rio Grande Valley and its tributaries with slopes ranging from 1 to 15 percent. Belen clay is a deep, well-drained, nearly level soil that formed in clayey alluvium on the flood plain of the Rio Grande.

d. Foreseeable Effects of Proposed Action Physiography and climate would not be affected by the proposed action. Some soils would be excavated and reused in the project area, or wasted at a disposal site.

e. Foreseeable Effects of Structural Alternatives Physiography and climate would not be affected by the alternative actions. Some soils would be excavated and reused in the project area, or wasted at a disposal site.

3.02 BIOLOGICAL RESOURCES

a. Vegetation The study area lies within the Chihuahuan Desert biotic community. Types of vegetation vary with altitude, water supply, aspect and grade. The upland species are typical Chihuahuan Desert scrub species, with cultivated crops and ornamental vegetation in the urban areas, and deciduous riparian woodlands at the lowest elevations. Dominant upland plant species include creosote bush, four-wing saltbush, honey mesquite, soaptree yucca, and prickly pear. Grasses include alkali sacaton, sand

dropseed, three-awn, and bush muhly. Urban areas typically contain introduced species including exotic grasses such as bermuda and rye grass; garden fruits and vegetables; exotic ornamental and native ornamental such as chinese elm, fruitless mulberry, New Mexico locust, juniper, prickly pear, agave; and native hybridized species such as Rio Grande cottonwood and hybrids. Riparian areas of the valley have a principle overstory of Rio Grande cottonwood, Russian olive, coyote willow and salt cedar, with understory species including tall goldenrod, Mexican devilweed, spike dropseed, giant dropseed, and salt grass. Croplands surrounding the riparian areas typically produce cotton, alfalfa, beans, chile and pecans.

The existing channel is frequently maintained through mowing. There is little vegetation in the basins other than scattered weeds and grasses. Vegetation along the edges of the channel and the basins is typical upland and ornamental species with a few scattered trees. There are small Afghan pine and cottonwood stands near Gallagher Pond. Typical plant species identified in the project area are listed in Appendix A.

b. Mammals Mammals likely to inhabit the Las Cruces area include the desert pocket gopher, Ord's kangaroo rat, Merriam's kangaroo rat, desert pocket mouse, northern grasshopper mouse, western harvest mouse, cactus mouse, white-footed mouse, deer mouse, white-throated woodrat, spotted ground squirrel, striped skunk, desert cottontail rabbit, and black-tailed jackrabbit. In general, urban development has deterred much wildlife use in the project area.

c. Reptiles and Amphibians Reptiles that are likely to inhabit the Las Cruces upland and floodplain areas include western box turtle, western banded gecko, lesser earless lizard, greater earless lizard, fence lizard, tree lizard, side-blotched lizard, Texas horned lizard, round-tailed horned lizard, Chihuahuan spotted whiptail, western hognose snake, Texas blind snake, ringneck snake, coachwhip, striped whipsnake, western patch-nosed snake, Graham patch-nosed snake, gopher snake, corn snake, desert kingsnake, long-nosed snake, black-necked garter snake, common ground snake, Chihuahuan hook-nosed snake, plains black-headed snake, night snake, western diamond backed rattlesnake, massasauga, black-tailed rattlesnake, and prairie rattlesnake. Amphibians likely to be present are plains spadefoot toad, western spadefoot toad, Couch's spadefoot toad, Woodhouse's toad, great plains toad, green toad, and red-spotted toad.

d. Birds Resident and migrant birds within the Las Cruces upland and riparian areas include black-throated sparrow, verdin, mourning dove, scaled quail, Greater roadrunner, curved-billed thrasher, cactus wren, Scott's oriole, lesser nighthawk, and Chihuahuan raven. Golden eagle, turkey vulture, American kestrel, red-tailed hawk, prairie falcon, sharp-shinned hawk, and Cooper's hawk may use upland and riparian areas in and around Las Cruces for foraging.

e. Fish Fish species are generally absent in the project area due to the intermittent nature of the storm drains and irrigation ditches. Fishes that may find temporary habitat in these ditches and drains include gizzard shad, threadfin shad, grass carp, red shiner, common carp, river carpsucker, yellow bullhead, channel catfish, mosquito fish, sailfin molly, bluegill and largemouth bass.

f. Foreseeable Effects of the Proposed Action Tree removal along the edges of the channel and basins would be avoided to the extent possible during construction of the project. Vegetation, such as grasses and shrubs, would be totally or selectively removed from the embankments along the ditch and the basins. Aquatic species and habitat are generally absent due to the ephemeral nature of the irrigation lateral and drain. Bird and mammal use of the project area is limited by year-round human activity and

traffic. Therefore, although some vegetation including a few trees may be removed, project implementation would not significantly affect fish and wildlife.

g. Foreseeable Effects of Structural Alternatives Same as described above.

h. Proposed Compensation Measures Disturbed areas adjacent to the ditch and maintenance road would be revegetated with native shrubs, forbs and grasses. Shallow depressions about 6 inches in depth and 0.5 acre in size would be created in each basin near the outlet works to provide a seasonally wet area attractive to wildlife, especially birds.

3.03 ENDANGERED AND PROTECTED SPECIES

a. Three agencies have primary responsibility for the conservation of animal and plant species in New Mexico: the U.S. Fish and Wildlife Service (USFWS), under authority of the Endangered Species Act of 1973, as amended and the Migratory Bird Treat Act of 1929; the New Mexico Department of Game and Fish (NMDGF), under the authority of the Wildlife Conservation Act of 1974; and the New Mexico Energy, Minerals and Natural Resources Department, under authority of the New Mexico Endangered Plant Species Act and Rule No. NMFRCD 91-1. Each agency maintains a list of animal or plant species which have been classified or are candidates for classification as Endangered based on present status and potential threat to future survival or recruitment. Coordination with these agencies was conducted by letter requesting lists of endangered and protected species that could occur in the project area.

Four federally endangered taxa were considered by the USFWS as having the potential to occur in the project area: Whooping crane (Grus americana), southwestern willow flycatcher (Empidonax traillii extimus), black-footed ferret (Mustela nigripes), and Sneed's pincushion cactus (Coryphantha sneedii var. sneedii. The Bald eagle (Haliaeetus leucocephalus) has been reclassified from endangered to threatened in the lower 48 states, and a proposal has been made to remove the American peregrine falcon (Falco peregrinus anatum) from the list of endangered and threatened species. There are twenty-four Category 2 Candidate species that occur in Doña Ana County. Plants that are state listed endangered species that have the potential to be in the project area, as described by the New Mexico Energy, Minerals and Natural Resources Department, are Sheer's pincushion cactus (Coryphantha scheeri), Wright's fishhook cactus (Mammillaria wrightii), sand prickly pear cactus (Opuntia arenaria), white visnagita cactus (Neolloydia intertexta), and night-blooming cereus (Cereus greggii).

b. Foreseeable Effects of Proposed Action The project is located in a highly disturbed urbanized area, and there is very little if any potential habitat for any of these species. An intensive pedestrian survey was conducted in May 1993, of the proposed project site and alternative sites for federal or state species of concern. No federally endangered or threatened or state endangered plant or animal species were found within or near the project areas. Investigations of both the proposed site and alternative sites conducted by the USFWS also indicate that threatened, endangered, and candidate species are absent in the project area (Appendix B). Thus, the proposed project would have no effect on any federal or state species of concern.

c. Foreseeable Effects of Structural Alternatives Same as described above.

d. Proposed Compensation Measures None necessary.

3.04 CULTURAL RESOURCES

a. Cultural Resource Survey A cultural resources inventory of the project area, covering approximately 160 acres, was conducted in May 1993. Two archeological sites, one prehistoric and one historic, were located and recorded in agricultural fields associated with the southern flood protection alternative. The historic site (LA 100876), an early 20th century farm house, is considered potentially eligible for inclusion in the National Register of Historic Places. Should the site be affected, subsurface testing would be required to determine its actual eligibility status. During the 1980s, the house and associated outbuildings were razed. The prehistoric site (LA 100875), a possible Formative Period habitation site, is also potentially eligible for inclusion in the National Register of Historic Places.

b. Foreseeable Effects of Proposed Action The alternative in the southern portion of the city was dropped from consideration during the planning process. There were no sites found in the area of the proposed action. Therefore, project construction would have no effect on any known cultural resources. Should previously undiscovered artifacts be unearthed during construction, work would be stopped in the immediate vicinity of the find and a determination of significance would be made.

c. Foreseeable Effects of Structural Alternatives The Corps of Engineers and New Mexico State Historic Preservation Office concur that construction of the southern alternative would have no effect on the known cultural resources of the region, provided that the known sites can be avoided. If avoidance is not possible, one National Register eligible archaeology site and one potentially eligible site could be affected.

d. Proposed Compensation Measures None necessary.

3.05 LAND USE, RECREATIONAL AND SOCIOECONOMIC CONSIDERATIONS

a. Land Use Land in the project area is residential and commercial property which is located in the floodplain. The proposed action would not result in any significant alteration of existing or approved land uses. Implementation of the proposed plan would expand facilities that currently serve flood storage or water conveyance purposes, and convert approximately 5.79 acres of vacant land and 2.41 acres of residential property to flood storage use.

b. Recreation The existing maintenance road along the lateral is used for walking, jogging, bicycling and occasional horseback riding. The basins are fenced to limit access.

c. Socioeconomics Doña Ana County has experienced rapid population growth since 1960. The recent opening of the Santa Teresa border crossing in Doña Ana County ensures continued high migration levels. The University of New Mexico's Bureau of Business and Economic Research projects Doña Ana County to double its 1990 population of 136,500 by the year 2020. Doña Ana County derives most of its employment from the trade and government sectors. The principal employment sectors are federal, state, and local governments; wholesale/retail trade, and service. Other income within the county derives from agriculture, development, and manufacturing.

The flood control improvements would displace eight residences and two businesses. The residences and businesses would be purchased and the dwellings and structures removed to accommodate the project features. Relocation assistance would be undertaken in accordance with Public Law 91-646.

Purchase of the necessary real estate, and relocation costs are estimated at $2,152,000.00. These costs are subject to revision once actual acquisition begins.

d. Foreseeable Effects of the Proposed Action There would be some residential and vacant land converted to flood control use; however, this effect would not be significant. Socioeconomic effects would be temporary and minor with relocations of residences and businesses. The proposed project would provide continued opportunities for recreation along the 12-foot wide maintenance road including bicycling, walking and jogging. Trail signs and cross-walks would be provided. There would be some socioeconomic benefits realized through protection of a portion of the floodplain from the 100 year storm event.

e. Foreseeable Effects of Structural Alternatives Effects would be similar to but greater than those described above.

f. Proposed Compensation Measures Relocation assistance for the affected businesses and residences would be undertaken in accordance with Public Law 91-646.

3.06 HYDROLOGY AND WATER QUALITY

a. Hydrology The total drainage area in Las Cruces is approximately 14 square miles. Five major ephemeral arroyos enter the city from the east: Alameda, Las Cruces, Sandhill, Fillmore, and Tortugas. The Las Cruces dam constructed by the Corps of Engineers controls the standard project flood on the Las Cruces and Alameda arroyos. Below (west of) the Las Cruces dam, the arroyos become poorly defined as urbanization has eradicated their natural flow paths. In addition, there are no significant drainage channels to convey flood waters. Consequently, the rather flat central area of the city experiences flooding problems and ponding from localized storm runoff. Manmade features such as irrigation laterals, groundwater drains, and elevated railroads and streets are perpendicular to natural flow, exacerbating flooding problems.

b. Water Quality Water quality in the project area, when flows are present, is affected by urban runoff and associated contaminants. This water ponds and evaporates or eventually finds its way into the Rio Grande through existing ditches.

There are no perennial tributaries to the Rio Grande within the project region. Sustained flow in the Rio Grande below Caballo Reservoir through Las Cruces is dependent upon releases from Caballo Reservoir during the irrigation season; at other times of the year, there may be little or no flow. Designated uses for this reach of the Rio Grande are irrigation, livestock and wildlife watering, secondary contact recreation, and limited warmwater fishery. Water quality standards for the general region are listed in the 1990 Water Quality Standards for Interstate and Intrastate Streams in New Mexico.

Section 404 of the Clean Water Act of 1977 (CWA), as amended, provides for the protection of waters of the United States through regulation of the discharge of dredged or fill material in aquatic habitats, including wetlands. No construction activities would take place in or near the Rio Grande, nor in any waters of the United States subject to Clean Water Act, Section 404 permitting.

Section 402 of the CWA regulates point source discharges of pollutants into waters of the United States. A Pollution Prevention Plan will be submitted to the Environmental Protection Agency to obtain a stormwater construction permit prior to beginning project construction.

Section 401 of the CWA requires that any applicant for a permit under Sections 402 or 404 also obtain a water quality certification for the proposed action from the state water pollution control agency. In New Mexico this certification is normally issued by the New Mexico Environment Department (NMED). Construction in an ephemeral water course is not regulated under Section 401 of the CWA and any work in irrigation ditches is exempt from regulation. Therefore, water quality certification is not required for the proposed action.

c. Foreseeable Effects of the Proposed Action Although no waters of the United States would be affected and no permits are required, care would be taken at the project site to avoid impacts to water quality during construction. To limit turbidity, construction within the irrigation channel and basins would take place during low flow or no flow periods. Vehicles would be inspected daily to ensure that no leaks or discharges of lubricants, hydraulic fluids or fuels occur in or near the riparian areas. Fuels, lubricants, hydraulic fluids and other petrochemicals would not be stored or discharged in or near the channel or basin and any spills, including contaminated soil, would be removed and properly disposed of at an approved upland site. Poured concrete would be contained in forms and/or behind cofferdams to prevent discharge into the watercourse. The wastewater from concrete batching, vehicle wash-down, and aggregate processing would be contained and treated or removed for off-site disposal. Temporary and permanent fill would be free of toxic materials or materials which may decompose to become a toxic material. Temporary cofferdams would be removed following construction, and the area recontoured to the approximate original configuration. With these precautions, there would be no foreseeable effects on water quality.

d. Foreseeable Effects of Structural Alternatives Same as described above.

e. Proposed Compensation Measures As described above under foreseeable effects.

3.07 AIR QUALITY AND NOISE

The Air Quality Bureau of the New Mexico Environment Department monitors particulate matter, carbon monoxide, and ozone within the city of Las Cruces. The city of Las Cruces is within the state of New Mexico's air quality control Region 6 and is in attainment for all criteria pollutants, as determined by National Ambient Air Quality Standards (NAAQS); no exceedences have been recorded. An area where pollutant levels exceed the NAAQS is designated as a nonattainment area for that pollutant. All of Doña Ana County is considered Class II under the Prevention of Significant Deterioration (PSD) Program. PSD Class II areas allow moderate growth and development and the resulting air quality impacts. Air quality in the project area is good despite some residential development. Background noise levels in the project area are moderate as would be expected in a residential area.

According to the Clean Air Act, if a federal project is taking place in an area that is a nonattainment area for a designated pollutant, a determination of conformity of the federal action to any applicable state or federal implementation plan is required. Since Las Cruces is not a nonattainment area for any pollutants, and there is no implementation plan to improve air quality, a determination of conformity is not required for this project.

a. Foreseeable Effects of the Proposed Action The proposed action would not result in any permanent or significant short-term degradation of air quality. During construction, a slight and temporary increase in local concentrations of suspended particulate matter and carbon monoxide would occur. During construction, noise levels would increase locally in the project area; however, this increase would be minor and temporary, ending when construction is complete.

b. Foreseeable Effects of Structural Alternatives Same as described above.

c. Proposed Compensation Measures Measures to minimize dust, such as surface watering, would be employed during construction and revegetation of disturbed areas would minimize dust generation during the operation and maintenance phase.

3.08 FLOOD PLAINS AND WETLANDS

Executive Order 11988 (Flood Plain Management) provides federal guidance for activities within the flood plains of inland and coastal waters. Preservation of the natural values of floodplains is of critical importance to the nation and the state of New Mexico. agencies are required "to ensure that its planning programs and budget requests reflect consideration of flood hazards and floodplain management."

Executive Order 11990 (Protection of Wetlands) requires the avoidance, to the extent possible, of long- and short-term adverse impacts associated with the destruction, modification, or other disturbance of wetland habitats. The existing Las Cruces lateral ditch and the basins infrequently convey irrigation and storm water. Wetland vegetation may establish in intermittently saturated areas for short periods of time; however, these wetlands are not permanent or quantifiable.

a. Foreseeable Effects of the Proposed Action The proposed action would provide flood protection and prevent flood damages in 2.25 square miles of the existing development in Las Cruces in the event of a 1 percent probability flood (the design flood). However, no additional induced development of the floodplain as a result of the action is foreseen. Local governments should take necessary measures to prevent floodplain development and provide information regarding the hazards of flooding to discourage building in areas susceptible to high water.

Some intermittent wetlands that form in saturated areas within the lateral ditch may be affected by the proposed construction; however, the effect, even though it would be minor, cannot be quantified since they are ephemeral in nature and may or may not exist at the time of construction.

b. Foreseeable Effects of Structural Alternatives Structural alternative No. 1 would provide 100-year flood protection for the entire 14 square mile floodplain, while the other alternatives would provide flood protection to a portion of the floodplain. Wetland effects would be similar to those described above.

c. Proposed Compensation Measures Shallow depressions about 6 inches in depth and 0.5 acre in size would be created in each basin near the outlet works to provide a seasonally wet area attractive to wildlife, especially birds.

4. FORESEEABLE EFFECTS OF NONSTRUCTURAL ALTERNATIVES

The nonstructural alternatives represent components of a long-term strategy for flood damage reduction. Foreseeable effects of the nonstructural alternatives are as follows:

a. Floodplain management The city of Las Cruces currently has in effect floodplain regulations to ensure that structures are built out of or above the 100-year floodplain. Doña Ana County could restrict future growth in the floodplain through enforcement of zoning and watershed management regulations. An effective floodplain management program would reduce the direct and indirect effects of flooding (e.g., property damage; injury and hardship; loss of life; disruption of transportation, communication, and utility service; and reduced expenditure of public funds for emergency action, post-disaster relief, clean-up, and repair, and construction, operation, and maintenance of flood control works). By restricting growth in the floodplain the land would become available for other, more compatible uses such as wildlife habitat, open space, and recreation.

b. Flood warning and evacuation One of the primary uses of a flood warning system is protection of life in areas subject to flash flooding. The extent of damage prevention enabled by a flood warning system is related to the length of warning time it provides. The longer the warning time, the more possibilities there are for preventing damage. Early identification of the severity of floods helps to determine whether flood levels will exceed design capability of the levee. Because of the nature of storms that would produce flooding at Las Cruces, a warning system would not provide sufficient lead time to safely evacuate or prevent flood damages. However, a flood warning system used in conjunction with channels, detention ponds, and other protective measures would help protect public safety and enable timely initiation of emergency actions to reduce damages.

c. Floodproofing Floodproofing measures to augment any protection plan should be incorporated in new construction and where feasible, alterations to existing structures should be made to reduce flood damages. Floodproofing measures incorporated into new construction could include building on earth fill elevated above expected flood elevations, elevating buildings above expected flood elevations, and locating heating equipment above ground level. Flood damages to existing structures can be reduced by altering buildings so as to limit the entrance of flood waters in the structures, or by relocating damageable contents up above the expected flood flow elevations or to a flood-free site. Retroactively floodproofing each individual house within the floodplain is prohibitively expensive, and indiscriminate use of floodproofing measures could induce damage, particularly if the structures were not initially designed to withstand the flood loads or added structural loads.

d. Relocation This measure requires the permanent evacuation of the floodplain via the acquisition of all privately owned lands, dwellings, and related improvements. The dwellings and structures would be removed, residents relocated to flood-free housing, and the land converted to parks, recreation fields, natural areas, or other uses consistent with periodic flooding. The benefits for this alternative would be the reduction in emergency costs, administrative costs of disaster relief, flood insurance subsidy, and potential flood damages to public property (e.g., roads and utilities). The cost to relocate public facilities such as sewer, water, and utility lines out of the floodplain would far exceed the benefits. Options to relocate structures and contents would displace families and disrupt community and neighborhood cohesion. The principal limitation to permanent relocation, aside from physical practicality, is the availability of a suitable alternative site. Alternative flood-free sites which duplicate the desirable aspects of existing sites may be difficult to locate.

5. CONSULTATION AND COORDINATION

The EA was prepared by the U.S. Army Corps of Engineers, Albuquerque District, 517 Gold Avenue SE, Albuquerque, NM 87102.

Agencies consulted in preparation of this EA include:

U.S. Fish and Wildlife Service
New Mexico State Historic Preservation Office
New Mexico Department of Game and Fish
New Mexico Energy, Minerals, and Natural Resources Department
City of Las Cruces - Parks and Recreation Department
U.S. Environmental Protection Agency
New Mexico Environment Department

Consultation with the U.S. Fish and Wildlife Service (USFWS) in support of the Fish and Wildlife Coordination Act and Endangered Species Act was conducted. During the Fish and Wildlife Coordination Act process no significant project impacts were identified (Appendix B).

Coordination with the New Mexico State Historic Preservation Officer (SHPO) regarding cultural resources is documented in Appendix C. The SHPO concurred in a determination of no effect provided that two National Register eligible properties, LA 100875 and LA 100876, can be avoided. Neither site would be affected, since the southern flood protection alternative is not part of the proposed plan. However, any changes in the scope or location of the proposed project would require further consultation and review by the SHPO. In addition, any undeveloped access or off-site borrow or waste areas would require a survey since these activities could potentially affect significant historic properties. Consultation with the New Mexico State Highway Department to identify existing borrow areas in the vicinity, which have already been surveyed is advised.

Public meetings concerning Las Cruces Flood Control Project were conducted by the Corps on November 4, 1991, March 24, 1993 and September 27, 1993. Future public meetings are expected to occur as planning progresses.

6. CONCLUSIONS

Since flooding would be a continuing problem, the "no action" alternative could adversely affect Las Cruces. Due to the brief lead time from warning to arrival of a flood peak, individual property owners can do little to reduce flood damages. Upon review of the minor foreseeable environmental effects of the planned action, the "no action" alternative was considered to be contrary to the National interest and was eliminated from consideration.

The three structural alternatives which were not selected would have effectively controlled the problem of flooding in the entire floodplain or portions thereof. No significant environmental effects would result from implementation of any of the alternatives. However, these alternatives were not economically justified at this time.

The proposed action would provide flood protection up to the design storm (100-year event) for 2.25 square miles of highly developed floodplain in Las Cruces. Minor foreseeable effects include some loss of vegetation, localized and short-term air and noise quality degradation during construction, and minor socioeconomic impacts associated with relocating residences and businesses. No significant impacts resulting from project development are foreseen.

Specific measures to provide environmental protection during construction are written into all Corps of Engineers' contract plans and specifications at the time of detailed design, and are reiterated during the preconstruction conference held prior to the start of construction. These measures are based on the Corps of Engineers Civil Works Construction Guide Specification for Environmental Protection, which provide for the control of noise, air and water pollution, erosion, and aesthetic degradation, as well as protection of vegetation and fish and wildlife resources. After construction, disturbed areas would be scarified and revegetated with a mixture of native shrubs, grasses and forbs to retard erosion, restore aesthetic quality, and stabilize the soils.

7. LITERATURE CITED AND TAXONOMIC REFERENCES

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APPENDIX A

PLANT SPECIES FROM PROJECT AREA

PLANT SPECIES FROM PROJECT AREA

COMMON NAME	SCIENTIFIC NAME
Giant reed	Arundo donax
Fourwing saltbush	Atriplex canescens
Pecan	Carya spp.
Goosefoot	Chenopodium spp.
Bermuda grass	Cynodon dactylon
Mustard	Descurainia pinnata
Horsetail	Equisetum spp.
Kochia	Kochia americana
Yellow clover	Melilotus officinalis
Four-o'clock	Mirabilis spp.
Mulberry	Morus spp.
Cow's tongue prickly pear	Opuntia lindheimeri var. linguiformis
Common reed	Phragmites communis
Mondale (Afghan) pine	Pinus eldarica
Kentucky blue grass	Poa pratensis
Cottonwood	Populus fremontii
Honey mesquite	Prosopis glandulosa
Apricot	Prunus spp.
New Mexico locust	Robinia neomexicana
Curly dock	Rumex crispus
Russian thistle	Salsola kali
Squirreltail bottlebrush	Sitanion hystrix
Nightshade	Solanum elaeagnifolium
Globemallow	Sphaeralcea angustifolia
Dandelion	Teraxacum officinale
Cota	Thelesperma megapotamicum

APPENDIX B

FISH AND WILDLIFE SERVICE COORDINATION ACT REPORT

AND CORPS OF ENGINEERS COMMENTS

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
Suite D, 3530 Pan American Highway, NE
Albuquerque, New Mexico 87107

September 30, 1993

Colonel Gary R. Burroughs
District Engineer
Corps of Engineers, U.S. Army
P.O. Box 1580
Albuquerque, New Mexico 87103-1580

Re: Fish and Wildlife Service Coordination Act Report for the Las Cruces Flood Control Project, Dona Ana County, New Mexico

Dear Colonel Burroughs:

Enclosed is the Fish and Wildlife Coordination Act Report (Report) on the referenced control project proposed by the U.S. Army Corps of Engineers, Albuquerque District. This report has been prepared by the U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667E). This Report has been coordinated with the New Mexico Department of Game and Fish.

We are available to assist you in developing mitigation and monitoring plans for the project, once the full extent of project impacts is known. Please refer any questions or comments you may have concerning this Report to Mr. Clent Bailey at (505) 883-7877.

Sincerely,

Jennifer Fowler-Propst
Field Supervisor

Enclosure

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Regional Director, U.S. Fish and Wildlife Service, Ecological Services, Albuquerque, New Mexico

Final
Las Cruces Flood Control Project
Doña Ana County, New Mexico
U.S. Fish and Wildlife Service Coordination Act Report

August 31, 1993

Submitted to:

Corps of Engineers
Albuquerque District

Prepared by:
Clent Bailey
New Mexico Ecological Services
State Office
U.S. Fish and Wildlife Service
Albuquerque, New Mexico

Table of Contents

Introduction

This document is the final U.S. Fish and Wildlife Service (Service) Coordination Act report for the Corps of Engineers (Corps) Las Cruces Flood Control Feasibility Study. This report was prepared by the Service's New Mexico Ecological Service State Office under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401 as amended: 16 U.S.C. 661-667e). Service investigations and a site analysis were coordinated with representatives from the New Mexico Department of Game and Fish and the City of Las Cruces (City). Additional consultations were conducted between the Service and the Audubon Society, The Nature Conservancy, and New Mexico State University (NMSU). The recommendations in this report have been made by the Service after coordination with the above named agencies and organizations. Copies of this report have been furnished to the New Mexico Department of Game and Fish and the City.

Project Area Description

The City is located in portions of Townships 22 and 23 South, Range 2 East, central Doña Ana County, which is within the Basin and Range Physiographic Region of south central New Mexico. The area is characterized by the rough San Andres Mountain range, broken by alluvial plains, mesas, and arroyos that slope to the extremely level Rio Grande Valley. The City, situated at the mouth of an alluvial fan, lies in the Mesilla Valley, within the Rio Grande riparian corridor at an elevation of approximately 1,170 meters. To the east of the City are the Organ Mountains, with the Rio Grande forming a western boundary. The total land area encompassed within the current corporate limits is approximately 116 square kilometers.

The climate in the City is characteristically semi-arid, with mild temperatures in the winter, hot in the summer, and short, temperate spring and fall seasons. The diurnal range in temperature is great, averaging 20° Celsius (C), and a wide range also exists between temperature extremes, from minus 22° C to 43° C. The average frost free season is from early April through October, and the average temperature is 15.3° C. Mean annual precipitation in the City is about 15 centimeters (Brown 1982) with an average recorded snowfall of 6 centimeters. Approximately 60 percent (%) of the annual precipitation occurs during the period from July through October, with the greatest amounts occurring in July and August when intense, localized thunderstorm activity is most common. Prevailing winds in the City are from the west and average 10.2 kilometers per hour.

The project area lies within the Chihuahuan Desert scrub biotic community, with types of vegetation varying with altitude, water supply, and gradient. Dominant vegetation of this community typically consists of creosote bush, honey mesquite, yucca, four-wing saltbush, and prickly pear. The vegetation within the City is composed of an extraordinarily diverse assortment of introduced species. Exotic grasses, ornamental shrubs, and tree species are extremely common in the City, and comprise a large percentage of the flora found in the study area. The nearby Rio Grande has been heavily impacted by water control and agricultural projects and much of the river bank adjacent to the City has been cleared to a width of approximately 30 meters. A significant amount of the large canopy and dense understory habitat originally proximal to the City has been replaced with cleared areas, agricultural activity, and the exotic woody species such as salt cedar and Russian olive.

The current population of the City is approximately 62,320 and growing. Rapid population growth is a common theme in urban areas in the Southwest, and with NMSU, the City has additional drawing power. Anticipated population growth in the next decade is projected to be between 2.0 and 2.2%, with expansion primarily concentrated in the east portion of the City.

The flooding problems stem from storms centered immediately over the City, and the lack of well defined arroyos or significant drainage channels to convey flood waters. Flow of flood waters does not follow any particular

path but rather resembles a sheet flow centered along the low points of the flow paths. The underlying terrain lacks sufficient gradient to effectively transport water to the river; in some areas of the City the elevation equals that of the river. When this flow reaches the western half of the City where ground slopes are negligible, ponding, and flood damage occurs. Irrigation laterals, groundwater drains, and elevated railroads and streets run perpendicular to the natural flow and thus amplify the problem. The magnitude of the water that must be addressed in this project is approximately 3,300 cubic feet per second (cfs) at the largest analysis point, which corresponds to a storage of 410 acre feet.

Major potential flooding sources in the area include the Rio Grande, which flows southerly approximately 1 mile west of the City, and six major arroyos draining the western slope of the Organ Mountains in a southwesterly direction through Las Cruces toward the Rio Grande. The arroyos include Sand Hill, Alameda, Tortugas, Fillmore, and the North and South forks of the Las Cruces Arroyo.

Previous flood prevention projects include six earth-filled flood water retarding dams in the Las Cruces Arroyo watershed and two in the Alameda Arroyo watershed constructed by the Civilian Conservation Corps. Flows in both forks of the Las Cruces Arroyo, and in the Alameda Arroyo, are controlled by the Las Cruces Dam, a Corps flood retention structure east of the City. Below the Las Cruces Dam natural flow paths of the arroyos have been eradicated due to urbanization. The City constructed an earth-fill dam known as the Country Club Detention Dam, and NMSU completed an earth dike up-gradient from NMSU to divert Campus Arroyo flows into a small excavated channel through the southern portion of NMSU's campus. The City has also constructed a small dike, a floodwall, and a spreader to control and distribute flood flows; however, these projects and the Las Cruces Dam have proven inadequate to completely prevent flood damage. The utilization of retention ponds, with enhanced channel and flood sewer systems to interconnect the ponds, should provide adequate flood protection as well as providing the City the opportunity to enhance it's environmental setting.

Alternatives

Alternative #1 - No-Action Alternative - Without this project the City will continue to experience flooding problems; it is anticipated that such problems will worsen as the City enlarges. Precipitation in the area is magnified by urban-induced temperature fluctuations, and this effect will become more pronounced as the City grows. This fact, combined with the additional urban surface area, will contribute to even greater sheet flows, and further economic loss for the City. Approximately 176 acres of urban area in the flood plain would not be utilized for retention basins, leaving this acreage open to development that would be placed at risk from flooding.

Alternative #2 - Whole City Alternative - The implementation of this alternative would ensure that future flood damage to the City would be minimized, and that approximately 176 acres of urban area in the flood plain would be utilized as retention basins. Also, implementation of the enhancement options outlined below would allow the retention basins to be utilized in a multiple use fashion, providing enhanced recreational and wildlife habitat potential.

Alternative #3 - The Proposed Alternative - Implementation of the proposed alternative should contain and control flooding in the northern half of the City. The Corps proposed Alternative consists of a diversion channel, the expansion of the existing Gallagher and Willoughby Basins, eight inlets and appropriate outlet works. The proposed alternative will be sized for the 1% chance flood and will reduce runoff from a 2.25 square mile drainage area.

Alternative #2 - Project Description

Alternative #2 is divided into the northern and southern portions of the City. The outline for this alternative is more tentative for the south half of the project (Doug Wolf, Corps, personal communication). There have been no plans made for utilization of the Senior Citizens Pond. The feeder channels that will supply runoff to the ponds have also yet to be delineated.

The northern portion of the project would consist of using a segment of the Las Cruces Lateral to convey flood waters to the Gallagher and Willoughby detention areas. In addition, the northern portion would expand the Gallagher Pond while improving the Willoughby Pond. The portion of the Las Cruces lateral to be used runs from Madrid Avenue to a point adjacent to Willoughby Pond and is approximately 3,600 feet long. This portion of the lateral would be improved to sufficiently carry the flood flows. The cross section would consist of a concrete lining with 8-foot vertical walls and a bottom width of 25 feet. The approximate maximum capacity of this channel would be 1,600 cfs. Drop inlets and transverse grates would be constructed at Madrid Avenue and Main Street to intercept flood flows.

The existing Gallagher Pond is located north of Chestnut Avenue, between the Las Cruces Lateral and Main Street. The Gallagher Pond expansion would require the acquisition of an additional 6.14 acres for a total of approximately 16.03 acres. The pond would have an approximate maximum capacity of 119.16 acre feet (af). The pond would be 10 feet deep with an invert elevation of 3,890 and a top of bank elevation of 3,900. Side slopes would be 3 to 1 with a 20-foot wide roadway at the top of the levee. The pond would have a drain time of approximately 96 hours. In addition, two emergency spillways would be reconstructed.

The existing Willoughby Pond is located to the north of Picacho Avenue adjacent to the Las Cruces Lateral. The Willoughby Pond improvement would consist of re-configuring the side slopes to 3 to 1 and installing an emergency spillway and improving another. No additional land is required for construction at this time. The approximate maximum capacity for this pond would be 35.51 af. A 20 foot-wide roadway would be provided around the pond at the top of the levee. The pond would be 14 fest deep with an invert elevation of 3,892 and a top of bank elevation of 3,906. This pond would also have a drain time of 96 hours.

Both Gallagher and Willoughby Ponds would be connected with a pipe to allow each to be used more efficiently. In addition, Willoughby Pond would have pipes to drain a transverse grate that would be installed in Picacho Avenue. The proposed alternative in the southern portion of the City consists of using the Las Cruces Lateral for conveying flood waters from Boutz Road south to a point south of Union Avenue near Interstate 10, and additional construction of three new ponds and the expansion of an existing pond. This portion of the Las Cruces Lateral would consist of a cross section similar to that used in the north portion of the City. A new pond to be analyzed is located on a parcel of land bordered by Montana Avenue to the south, El Paseo Avenue to the east, and lying east of the Las Cruces Lateral. For the purposes of this study, this pond will be referred to as Montana Pond. This parcel of land contains approximately 18.51 acres. The Montana Pond would have an estimated maximum capacity 191.15 af. Side slopes would be 3 to 1 and a 20-foot wide roadway would be located on the crest of the levee. The Montana Pond would be 15 feet deep with an invert elevation of 3,876, and a top of bank elevation of 3,891 feet. According to existing topographic maps, this results in a bank height 4 feet higher than the surrounding existing grade. This pond would have a drain time of 96 hours. Another pond to be analyzed is located on a large parcel of land bordered by Farney Lane to the south, Boutz Avenue to the north, South Main Street to the west and the Las Cruces Lateral to the east. For the purposes of this study this pond will be referred to as Farney Pond. This parcel of land contains approximately 52.84 acres and the maximum impoundment capacity would be 455.29 af. Side slopes would be 3 to 1 and the top of the levee would have a 20-foot wide roadway at the crest. The Farney Pond would be 10 feet deep with an invert elevation of 3,873 and a top of bank elevation of 3,883. According to existing topography maps this results in a bank height 4 feet higher than the surrounding existing grade. This pond would also have a drain time of 96 hours. A trapezoidal concrete lined channel would be constructed from El

Paseo Avenue, west to the Las Cruces Lateral. The channel would be on the south side of Boutz Road, adjacent to the Las Cruces High School, and would be used to collect flood flows from around the intersection of El Paseo Avenue and Boutz Road. In addition, a drain line from Montana Road would discharge into this channel near Jones Road with flows eventually reaching Farney Pond.

Three parcels of land are being considered to increase the capacity of the existing Frenger Pond. For the purpose of this study the two parcels of land will be referred to the Frenger Pond North Expansion and the Frenger Pond South Expansion. Separate detention ponds would be constructed and all would be interconnected. The first parcel in the Frenger Pond North Expansion is located on the northwest corner of West Park Drive and Lee Whisman Drive and contains approximately 6.48 acres. The approximate maximum capacity of this pond would be 33.46 af. This pond would be 8 feet deep with an invert elevation of 3,880 and a top of bank elevation of 3,888. According to existing topography maps this would result in an bank height 4 feet higher than the surrounding existing grade.

The second parcel of the Frenger Park North Expansion is located on the northwest corner of Farney Lane and West Park Drive. This parcel would have to be subdivided, as it is part of a larger parcel. The area is approximately 2.64 acres in size, and the pond would have a maximum capacity of approximately 11.25 af. The pond would be 9 feet deep with an invert elevation of 3,880 and a top of bank elevation of 3,889, which would result in bank height that is 4 feet higher than the existing grade. Side slopes on both ponds would be 3 to 1 and the top of each levee would have a 20-foot wide roadway at the crest. These ponds would also have a drain time of 96 hours.

The parcel of land which consists of Frenger Pond South Expansion is located to the south of Frenger Pond, bordered by Farney Lane to the north, El Paseo Avenue to the west, and Espina Street to the east. This parcel consists of approximately 28.94 acres, with an approximate maximum capacity of 175.78 af. This pond would be 7 feet deep with an invert elevation of 3,880 and a top of bank elevation of 3,887. According to existing topography maps this would result in a bank height that is 4 feet higher that surrounding existing grade. A 20-foot wide roadway would be provided around the pond at its crest, and the side slopes would be 3 to 1 with a drain time of 96 hours. The final pond would be located on a parcel of land located on the southwest corner of Union Avenue and Stearn Avenue, and will be referred to as College Pond South. This parcel contains approximately 11.7 acres and would have an approximate maximum capacity of 139.08 af. This pond would be 16 feet deep with an invert elevation of 3,868 feet and a top of bank elevation of 3,884 feet. According to existing topographic maps this results in a bank height that would be 4 feet higher that the existing grade. Side slopes would be 3 to 1, a 20-foot wide roadway be installed around the crest of the pond, and the drain time would be 96 hours.

It is anticipated that the Las Cruces Lateral used in the southern portion of the City would require excavation to achieve the invert elevations required to effectively convey flood flows from the proposed detention ponds in the City to a final outlet in the Park Drain.

Alternative #3 - Project Description

The proposed flood damage reduction alternative for the City is located in the northwestern area of the city. The project would consist of a diversion channel, the expansion of two existing flood control basins, eight inlets, and appropriate outlet works. The proposed alternative would be sized for the 1 percent chance flood and would reduce runoff from a 2.25 square mile urban drainage area.

The diversion channel would utilize a portion of the existing Las Cruces Lateral. This lateral carries low irrigation flows and would be vacated in the proposed reach. The limits of the vacated reach extend from the branch of the Las Cruces Lateral and the Armijo Lateral near Three Crosses Avenue, to the confluence of these same two laterals near Boutz Road.

The alignment begins at Madrid Avenue and runs 1,950 feet to its terminus at Gallagher Basin. The channel would be concrete and have a trapezoidal section with 2H:1V side slopes. The bottom width would be 10-15 feet. The channel invert would have a 0.0008 ft/ft slope and flow would be sub-critical. The 1% chance depth ranges from 5-6 feet. The design wall height would be set by a final risk assessment. Major inlets to the channel would be at Madrid Avenue, Main Street, and Mulberry Avenue. At the Madrid and Main inlets, high volume transverse grates would be installed in the roadways to collect and deposit flood waters into the channel. The Mulberry inlet would be a side weir concrete structure with wing walls to drain flow into the channel. The design discharge in the channel would be 880 cubic feet per second (cfs). A concrete rundown with an appropriate stilling basin and erosion control apron terminates the channel at the expanded Gallagher Basin.

The existing Gallagher Basin is located north of Chestnut Avenue, between the Las Cruces Lateral and Main Street. The Gallagher Basin expansion would require 2.00 acres of additional land to be acquired for a total of 11.78 acres, more or less. The basin would have an approximate maximum capacity of 142 af. The basin would be 12 feet deep with an invert elevation of 3,890, and a flood control overflow crest elevation of 3,902. Side slopes would be 3 to 1 with a 20-foot wide roadway on the top of the levee. The top of embankment elevation would be at 3904 feet. Maximum embankment height is 6 feet. In addition to the flows from the diversion channel, there are four proposed inlets to the basin. Palm Street, Villa Mora Avenue, and Juniper Street would have weir, rundown inlets at their junction with the proposed basin. High volume transverse grates would be installed on Chestnut Avenue to intercept flood flows and deposit them in the basin through an open channel connecting the basins.

A 400-foot armored overflow section would be constructed on the south side of the basin discharging onto Chestnut Avenue. The section is designed to pass

the 500-year event and will not induce any damages downstream, as the pre-project 500-year flood plain inundates the same area as the overflow discharges will. The basin is primarily incised and therefore catastrophic failure will not occur if the basin embankment fails. There is an existing 24 inch outlet which would be used to drain the basin into the City's existing drainage system and eventually the Rio Grande. A small riser would be constructed on the outlet to the 100-year sediment elevation of 3,891.

The channel connecting the basins would be a concrete rectangular section approximately 315 feet in length. The bottom width is currently set at 15 feet. This value should be maximized pending constructability in this area. The channel invert should be set at 3,901 at its confluence with Willoughby basin and 3,900 at the confluence with Gallagher basin. This corridor serves two functions, to transport flows from Chestnut Avenue into Gallagher basin and as an overflow for either basin.

The existing Willoughby Basin is located to the north of Picacho Avenue adjacent to the Las Cruces Lateral. The Willoughby Basin improvement would consist of expanding to the south and reconfiguring the side slopes to 3H:IV. The basin would be 10 feet deep with an overflow crest elevation of 3,902. Top of embankment would be 3,904. Maximum embankment height is 5 feet. A 30-foot wide armored overflow section would pass flows exceeding the design capacity of the basin. A 20-foot roadway would be provided around the basin perimeter. The capacity of this basin would be 34 af more or less. There is an existing 24-inch outlet which would be used to drain the basin into the City's existing drainage system and eventually the Rio Grande. A small riser would be constructed on the outlet to the 100-year sediment elevation of 3,893.

High volume transverse grates would be constructed at Picacho Avenue to intercept flood flows and direct them into Willoughby Basin by pipes and box culvert. The following paragraphs describe project features in more detail.

Madrid Avenue: Neenah R-4999-L9 (or equivalent) trench grates are proposed for this inlet. A minimum of 200 feet are required for the 1% chance design flow. These trench grates should be placed in series between Main Street and the intersection of the diversion channel along Madrid Avenue Constructability would dictate final arrangement and means of depositing the flow in the diversion channel.

Main Street: Neenah R-4999-L9 (or equivalent) trench grates are proposed for this inlet. The trench and grate should be installed in the roadway from west curb to east curb directly over the proposed diversion channel. A minimum of 50 feet of grate is required.

Mulberry Avenue: A 25-foot side weir inlet to the diversion channel is proposed. Three-foot high training walls should be constructed at 45 degrees from the ends of the weir extending 15 feet to train flow over the weir. A 1-foot sill should be provided as the weir enters the channel.

Diversion Channel: At approximately station 19+00 (diversion channel) the trapezoidal section of the diversion channel should transition to a 25-foot bottom width rectangular section. The end structure should begin at approximately station 19+50, and consists of a concrete rundown with training walls depositing flow into a USBR type III stilling basin at the invert of proposed Gallagher basin. The rundown should be placed on a 2H:1V slope. Wire-wrapped rock should be placed a minimum of 6 feet around the sides of the basin and chute and extend 10 feet beyond the end of the basin. Notches should be cut in the end sill to drain nuisance water.

Palm Street: This low flow inlet would consist of a 10-foot wide Gabion drop structure depositing flows directly into Gallagher Basin.

Villa Mora Avenue: Flows from Villa Mora would enter Gallagher basin through a concrete rundown. Four-foot high training walls set a 45 degree angle extending 20 feet shall be placed at the top of the rundown. The rundown itself shall have training walls and be set on a 2H:1V slope. A USBR type III stilling basin would be utilized for energy dissipation and erosion control. Wire-wrapped rock should be placed a minimum of 6 feet around the sides of the basin and a minimum of 10 feet from the downstream end of the basin. The rock should extend 10 feet up the slope on the sides of the chute. Notches should be cut in the end sill to drain nuisance water. At the design discharge velocities of near 33 feet per second are experienced at the bottom of the chute.

Juniper Street: This low flow inlet would consist of a 25-foot wide gabion drop structure depositing flows directly into Gallagher Basin.

Chestnut Avenue: Neenah R-4999-L9 (or equivalent) trench grates are proposed for this inlet. A minimum of 145 feet are required for the 1% chance design flow. These trench grates should be placed in series along Chestnut Avenue between the proposed basin to basin corridor and Mesquite Street Constructability would dictate final arrangement and means of depositing the flow into Gallagher basin. A 15-foot wide concrete rundown, set on a 2H:1V slope, with a USBR type III stilling basin would be utilized for energy dissipation and erosion control. Wire-wrapped rock should be placed a minimum of 6 feet around the sides of the basin and a minimum of 10 feet from the downstream end of the basin. The rock should extend 10 feet up the slope on the sides of the chute. Notches should be cut in the end sill to drain nuisance water.

Picacho Street: Neenah R-4999-L9 (or equivalent) trench grates are proposed for this inlet. A minimum of 85 feet are required for the 1% chance design flow. The location of these trenches and grates and the corresponding conveyance to Willoughby Basin would depend on constructability. Generally they should be placed on Picacho Street between Mesquite Street and 250 feet east of Main Street. An existing 60-inch inlet to the basin from the Mesquite Street storm drain system shall remain in place. USBR type VI impact type energy dissipators are proposed at the pipe outlets at Willoughby basin.

Gallagher Basin: There is a 24-inch outlet at the invert (3,890) of the existing basin. This outlet drains to the city's existing drainage system. It is proposed to utilize this feature if feasible. Projected sediment deposition in the basin would require a 1.0 foot riser to be constructed around the outlet.

For discharges that exceed the design capacity of the basin, two separate overflow areas are proposed. The first is the basin to basin corridor which would allow low flows (40-50 cfs) to be transferred to Willoughby Basin if space is available. If the discharge is greater, or no space is available, a 400-foot section at the south end of the basin would pass flows onto Chestnut Avenue. The invert of the overflow crest is proposed at elevation 3,902. Head over the crest would not be greater than 2.0 feet. A concrete section or cellular mat should be used for erosion control.

Willoughby Basin: There is a 24-inch outlet at the invert (3,892) of the existing basin. This outlet drains to the city's existing drainage system. It is proposed to utilize this feature if feasible. Projected sediment deposition in the basin would require a 1.0 foot riser to be constructed around the outlet. There is an existing slide gate on the outlet set in the embankment of the basin. There is an existing 27-foot wide overflow section on the basin. Invert is set at elevation 3,902. This section discharges to the west side of the basin directly onto Willoughby Avenue. It is proposed to utilize this structure if it is feasible. The design discharge is 250 cfs which would result in a maximum head of 2.0 feet over the crest. If space is available, low flows would flow into Gallagher basin through the corridor prior to flow over the overflow crest.

Evaluation Methodology

This office has consulted with the Corps on several occasions during formulation of this report. On April 15, 1993, Messrs. Brian Hanson and Clent Bailey of the New Mexico Ecological Services State Office met with Mr. David Church of the Las Cruces City Planning Department and inspected the existing and proposed basins. Mr. Ernie Jaquez of New Mexico Department of Game and Fish was also contacted. During the site visit, vegetation in the existing and proposed retention ponds was inventoried and identified. Fish survey data were obtained from previous samplings, bird sighting data for the area were the result of work done by the Audubon Society, the Service, and the Department of Fisheries and Wildlife Sciences at NMSU.

Fish and Wildlife Resources

Without the Project - Terrestrial floral resources in the City consist primarily of exotic species; among them mulberry, Arizona and green ashes, Mondale and Afghan pines, poplars, sycamores, and Russian olive. Lower level ground cover in most cases is limited to sod placement and grass plantings of hybrid bermuda and rye grasses. There are some shrub plantings along medians and rights-of-way, but this stratum of the floral community is generally lacking in the City park system. Existing basins in the project area are excavated to varying depths with uniformly flat bottoms where the soils are

disturbed and compacted. There is little vegetation other than a scattered herbaceous layer of weed and grass species that have done little to retard the erosion evident on generally steep banks. Appendices 1 through 4 contain the faunal species that typically occur in this region of New Mexico.

Aquatic systems in the study area consist of the drains and channels that are used for irrigation and flood control. Accordingly, in most of the channels, water level fluctuates throughout the year. In the areas where there is relatively permanent flow and vegetation has not been cleared, flora is dense and has signs of wildlife use. In these areas, habitat exists for various invertebrate, amphibian, and reptile species, and associated bird and small mammal species. This habitat consists of hydric soils and emergent vegetation. Cattail (Typha sp.), sedge (Carex sp.), rush (Juncus sp.), and bullrush (Scirpus acutus) were a few of the plant species observed in the channels.

Appendix 5 lists the federally listed and candidate species that may occur in the region. Threatened, endangered, and candidate species are absent in the project area, so failure to implement the project will have no effect on any Federal species of concern.

With the Project - Terrestrial and aquatic resources in the area should not be affected by the proposed project outlined in the Corps feasibility study. Due to the urban location and nature of the project the Service anticipates no species of Federal concern will be adversely affected. The species of Federal concern listed in Appendix 5 could occur in the surrounding area, but stand little chance of being affected with or without the proposed project.

Discussion

Economic considerations compelled the Corps to select Alternative #3; however, for the benefit of the City this discussion will remain as outlined in the draft document; encompassing the entire City. City planners retain the option of proceeding with the original plan for flood control, and the Service recommends that the enhancement features outlined below be considered in future planning.

For this discussion the project will continue to be divided into north and south halves. The project outlined in the feasibility study is totally flood control oriented; however, within this design lies the possibility for multiple use of the retention basins. The Corps's major concern lies in "controlling and minimizing urban flood damage, while protecting the Nation's environment". The Service realizes this is the primary impetus for the project from the City's perspective as well, but we believe the implementation of a project of this magnitude, with such long-term impacts to the City and people of Las Cruces should incorporate strong environmental enhancement objectives as well. A "multiple use" approach would have the benefits of controlling the flood waters that inundate the City, and would also provide excellent recreational and avifauna habitat.

The Service suggests the larger basins and basin complexes be constructed to also serve as natural vegetation parks. These consist of Gallagher with it's expansion in the north half of the project, and Farney and the Frenger complex in the southern half. The Senior Citizens Pond, already excavated and with some vegetation in place, could be an additional part of this natural park matrix, and the other small retention basins could be developed for recreational uses such as softball, volleyball, etc.

The standard practice of floral and habitat replacement is not applicable with this project, due to the scarcity of vegetation and the urban nature of the area. On the north side, the small Afghan pine and cottonwood stands near Gallagher pond will be avoided (Doug Wolf, Corps, personal communication). It is not yet known if the block-long stretch of mulberry and Osage orange to the east of the Frenger complex will be removed, but with the embankment work necessary it is likely that will occur. There has been little discernable effort made towards revegetation within the basins. The trees in the Senior Citizens Pond will be retained, as will the pole plantings in the south of Frenger Park. There are no other trees that will be impacted if the project retains the parameters designated in the feasibility study.

The remainder of this document will refer to the "higher elevations" and "lower elevations" within the parks, and we would like to point out that these entirely arbitrary designations are relative, and maximally separated by approximately 50 feet. Delineation of water table levels is not included in the study. Additional work on water table figures is anticipated in the next few months by the Corps, and these data will be necessary for site specific planning of the proposed parks. By making the depth of the lower elevations water table dependent, the high points approximately 40-50 feet above that, and a mean depth of the ponds slightly lower than that proposed, preservation of the retention capacity lost due to construction of the higher elevations could be achieved. The design possibilities outlined here are rudimentary suggestions that, with refinement, could become the basis of a City-wide matrix of natural areas.

The basins could be constructed in a way that would allow them to be utilized as retention ponds, as well as areas of native flora that would serve as habitat for native wildlife. By contouring the parks into topographically diverse areas, vegetation and wildlife possibilities would increase. The existing and proposed areas that would be utilized for water storage could concurrently be used as a park system.

In the planning objectives outlined in the reconnaissance report, in addition to flood control, emphasis is placed on enhancement of environmental and aquatic resources, and maximization of public recreation facilities. Planning constraints consist of the following: total benefits must equal or exceed total costs for a plan to be approved, and the project must comply "with the spirit" of environmental law. The quantifiable benefits derived from this project are very high in terms of flood control. The estimated yearly flood damages exceed 2 million dollars, and this figure could be underestimated. There is approximately 230 million dollars worth of damageable property within the flood plain, and all the prices are based on 1991 values. The

unquantifible benefits that would be derived from the project, could be broadly grouped under environmental and societal. In the "spirit of enhancement" the Corps could construct retention ponds with multiple use goals in mind that would enhance the "value" of the ponds even above those derived from flood control. The value attached to the recreational experience varies between individuals and cannot be expressed in monetary terms, however it is viewed by some economists as having a "psychic value" (Van Nierop 1966). Urban areas and their spread are problems of national significance to a growing number of people concerned with the preservation of wildlife. Urban expansion and water control projects are a major contributor to the fragmentation of the "natural" landscape, or areas relatively undisturbed by humans, and this fragmentation contributes to the imperilment of wildlife. Extinction rates among birds is substantially higher than normal background rates (Lawton 1991), and habitat fragmentation is a contributing factor to these population declines. With this project the community and City leadership have an opportunity to consolidate some habitat fragmentation by creating patches of natural areas within the City. The location of the basins and their size limits the number and kinds of species that could effectively be influenced by park construction; however, numerous bird species, and the City's populace, could benefit greatly by the creation of natural area parks. Also, the inclusion of open channels in the design would open the possibility of small mammals utilizing them as corridors to access the parks. The channels could also be enhanced with pole and shrub plantings, as well as a mixture of native forbs and grasses.

Underestimating the growth of urban development in the City has contributed to the sheet flow problems that it faces today. Current estimated annual damages in the downtown area are estimated at 2.2 millon dollars per year, and the anticipated losses in the event of the 100 year flood could exceed 32 million dollars (Corps 1991). Use of the "buyout plan" wherever possible should be considered to reduce potential losses from a flood. Removal of all structures in the floodplain is not feasible; however, those that could be removed would enable the City to resolve long-term flood concerns, as well as dramatically enhancing wildlife habitat and the scenic beauty of the City. Acquiring land in the City will become more expensive and potential flood problems more pronounced as the City continues to grow. Also, the eradication of natural water flow patterns, increased sheet flows, and ultimately higher water volumes and velocities at the terminal discharge points, could possibly affect sediment loads downgradient, and this facet of the project should be explored further.

Federal directives mandate that the City flood control plan be consistent with "enhancing the existing environment by the management, conservation, preservation, creation, restoration, or improvement" of extant resources in the City area. These resources could be enhanced considerably by the utilization of the retention ponds as sites for park and possible wetland development. By adopting a multiple use strategy for pond development, the City will see additional long-term benefits over and above flood control. The design of these parks can incorporate both typical park uses while also providing habitat for many bird species. Optimally, for both aesthetics and habitat diversity, the parks will contain a variety of vegetation of different

classes. Design parameters for the parks should include: variations in species and size; large and small trees, and shrubs of different height, with a mixture of coniferous and deciduous vegetation. Also, variation in the horizontal pattern and density of the flora, the frequency and spacing of open areas, and the addition of boulders and areas of xeric plant communities, with varying species of trees and shrubs planted at irregular levels throughout the park, and more hydric species planted at the lower extremes. Resistance to disease and parasitism, and resilience to abiotic factors such as weather extremes are two functional properties that have been shown to increase with species diversity (Frank and McNaughton 1991).

Some species of plants that would do well in the area include: desert willow, Apache plume, little leaf sumac, cottonwood, screwbean mesquite, western soapberry, black locust, Texas silverleaf, Drummond clematis, seep willow, wolfberry, Olney bullrush, saltgrass, and reed grass. This office is available for further suggestions of vegetation possibilities and combinations that would increase the attractiveness of the area and it's utility for birds. Artificial nests could be incorporated into the park design, with the bird houses constructed by City residents. Perennial wetland possibilities exist in the lower elevations of the basins and in the unlined channels, and vegetative opportunities would increase with water availability. The legal ramifications of prolonged water retention should be explored; however, a cursory examination suggests that water retained for these purposes could be exempt from mandatory release downgradient (New Mexico State Engineer's Office 1953). The presence of water would provide areas for invertebrate and amphibian species, and further enhance avifaunal habitat. The feeder channels and basin flow paths could become corridors that would connect the matrix, making it more beneficial and productive for wildlife.

Studies have shown that by increasing the number and size of natural areas, concurrent increases in biological diversity can occur (Western and Pearl 1989). By utilizing as much of the available areas as possible for the park system the City would be adding to the wildlife viability of areas and their biological productiveness. The 20-foot wide roads that are proposed for the levee crests could be reduced to 8-10 feet wide and still accommodate maintenance vehicles. Standard bike and jogging trail width would be optimal for the levee crests and trails within the parks themselves. No mention is made in the feasibility study of the Villa Mora Retention Dam, or of incorporating the Senior Citizens Pond into the proposed plan. Due to Villa Mora's proximity to the Las Cruces Dam, it might be only of marginal use for flood control; however, it could contribute slightly in this respect.

Possibilities for park development and low-cost maintenance strategies are limitless, as are the potential benefits derived from natural parks. Urban residents normally support wildlife enhancement projects within their City. In 1982 an overwhelming majority (94%) of the surveyed residents in Columbia, Maryland, (Leedy and Adams 1984) stated it would be desirable to design and manage storm water retention basins for wildlife as well as for flood and sediment control. Also, 73% of the study's respondents believed that property values were higher in neighborhoods having permanent water basins designed to enhance wildlife use (Leedy and Adams 1984). In Missouri, voters

approved a one-eighth of a cent sales tax for an urban wildlife program called "Design For Conservation", and similar trends have been noted in New York and Colorado, as well as in nationwide studies.

The additional costs associated with construction of the parks and initial planting efforts would be minimized by using Corps assets and equipment that will be on-site for flood control work. Multiple use goals in a project this size should necessitate construction procedures with these goals in mind. Innovative planning and management strategies could mitigate the cost of development and maintenance of the areas. The maintenance costs of natural parks are much less than those of "manicured" parks.

Expenditures would be further reduced by active resident involvement with the areas. The need for flood control will increase with City growth, as will the cost of purchasing land for retention basins and feeder channels. By employing the concept of "buy-out" whenever possible, especially for structures that are placed in the flood plain adjacent to the existing retention areas, or in other blocks of land throughout the City, Las Cruces could create a miniature patchwork ecosystem within their City while providing for future flood concerns. By creating these parks, the City would be investing in a portion of it's environmental future. Local political awareness of the value of these parks would reflect City leadership concerns about pollution, esthetics, wildlife habitat, biological conservation, as well as flood control.

Conclusion

Flood control is only one possible result achieved by completion of the proposed project. This report documents the minimal impacts anticipated from the proposed action, but also attempts to provide a rough outline for other potential uses of the flood control structures. Concurrent development of recreational facilities and the proposed nature areas is a more long-term, utilitarian planning strategy that would maximize use of the areas considered, providing for wildlife enhancement as well as the enhancement of many aspects of life in the City.

Achieving full multiple use from this project in terms of efficiency, cost reduction and speed of completion requires Corps collaboration to achieve the project's full potential. Areas and habitat would be created that would provide true multiple use functions. As the non-Federal sponsor, the City would be the primary input in planning design and maintenance strategies for the parks. This office is willing to assist in the planning of the natural areas, and other State and private conservation organizations have expressed interest as well.

If these natural park areas are developed, and if the City takes an active roll in additional similar projects in the future, subsequent generations in the City would reap the benefits of current leadership's foresight. Long before reaching maturity, or a climax point of biological production, the parks would add to the community additional utilitarian benefits such as noise abatement, pollutant amelioration, wind reduction, temperature modification,

and erosion control. The City would be investing in their biological future, with local political awareness reflecting concerns about pollution control, cultural viability, aesthetics, wildlife habitat, as well as flood control. Unlike manicured parks the areas would be islands of biological diversity within City limits, and would have paid for themselves many times over. The project at hand is an opportunity for Corps and the City to accomplish much more than flood control.

Recommendations

1. The geographic position of the City at the foot of the Organ Mountains blocks natural flow paths down the feeder arroyos, and down the main arroyos that intersect the City. Downgradient of the Las Cruces Dam, normal sediment disbursal mechanisms have been interrupted, and channelized into the focal points of the flood control system. Sediment transport factors have not been considered because the project area is urbanized. Downgradient of the discharge point into the Park Drain the volumes and velocities of water will be substantially altered from the normal flow paths, and the point of discharge into the Rio Grande would possibly carry altered volumes of sediment load. Consideration of these altered loads and potential water quality impacts on the Rio Grande should be explored.

2. Precipitation in the area is magnified by urban induced temperature fluctuations. This effect will become more pronounced as the City enlarges, and combined with the additional urban surface area, will contribute to even greater sheet flows. Demographic and geographic trends, and anticipated growth rates for the City should be examined further, and flood control planning should be based accordingly. Long-term flood plain management strategies should adopt large scale temporal frameworks to alleviate future flood problems in the area. Additional areas adjacent to existing and proposed retention ponds should be acquired whenever possible for incorporation into the City's long-term flood control plan and natural area matrix whenever possible.

3. The retention ponds should serve multiple uses: flood control, recreation, and wildlife enhancement, with all ponds utilized for flood control, the smaller ponds primarily for recreation, and the larger ponds for construction of natural areas.

4. Corps should work closely with the City in the primary contouring and vegetation. With Corps contractors and equipment already in place for flood control work, the cost of natural area modifications would be minimal. The Corps should also coordinate with NMSU and other City land owners in formulating a long range plan that utilizes all available areas for flood control capability and natural parks. Involvement of other environmental agencies such as The Nature Conservancy and the Audubon Society should also be encouraged.

5. The Senior Citizens Pond and the Villa Mora retention dam should be considered in the overall water control plan, and for incorporation into the park matrix. Connect the natural area parks with open channels, and utilize open channels instead of covered storm sewers whenever possible.

6. Project designs that incorporate the other uses proposed here would be different from designs based solely on flood control. Modifications that could allow some water retention should be formulated so that wetland options in the lower elevations in the basins remain open.

7. All retention basins outlined in the feasibility study are proposed to have 20-foot wide roadways on the levee crests. The width of the roads could be reduced to the size of a normal bike and running path, approximately 8-10 feet. The low impact maintenance associated with natural parks should not require vehicle access that could not be done on a narrower width surface.

Construction recommendations:

1. Inspect all equipment daily to ensure leaks or discharges of lubricants, hydraulic fluids, or fuels does not occur. Store and dispense all fuels, lubricants, hydraulic fluids, and other petrochemicals away from any arroyo or its banks. Contain and remove any petrochemical spills, including contaminated soil, and dispose of these materials at an approved upland disposal site, in accordance with Environmental Protection Agency protocol.

2. While working in a watercourse, every effort should be made to perform construction during periods of low flow to minimize turbidity and other water quality impacts. Rubber cofferdams used to divert water should be clean and free of fines and other contaminants.

3. Sediment catchments should be constructed to catch and filter runoff from construction sites. Contain any poured concrete in sealed forms and/or behind cofferdams to prevent discharge into arroyos. Place no surplus concrete within the arroyos or near their banks. Contain and treat, or remove for off-site disposal any wastewater from concrete batching, vehicle wash-down, and aggregate processing.

4. Place only clean, coarse and erosion-resistant fills in water and employ silt curtains, settling basins or other suitable means to control turbidity. Monitor water quality during the construction phase to insure compliance with State water quality standards.

5. Riprap and any other bank stabilizing material, including all temporary and permanent structures placed in a water course, must be free of fines and chemical contaminants.

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Appendix 1 - Fish Species Which May Occur in the Project Area

Common Name	Scientific Name
Sailfin molly	Poecilia latipinna
Gizzard shad	Dorosoma cepedianum
Threadfin shad	D. petenense
Red shiner	Cyprinella lutrensis
Common carp	Cyprinus carpio
Grass carp	Ctenopharyngodon idella
Rio Grande chub	Gila pandora
Fathead minnow	Pimephales promelas
Bullhead minnow	P. vigilax
Llongnose dace	Rhinichthys cataractae
River carpsucker	Carpiodes carpio
White sucker	Catostomus commersoni
Rio Grande sucker	C. plebius
Black bullhead	Ictalurus melas
Yellow bullhead	I. natalis
Channel catfish	I. punctatus
Mosquitofish	Gambusia affinis
Green sunfish	Lepomis cyanellus
Longear sunfish	L. megalotis
Bluegill	L. macrochirus
Smallmouth bass	Micropterus dolomieu
Largemouth bass	M. salmoides
White crappie	Pomoxis annularis
Rainbow trout	Oncorhynchus mykiss
Brown trout	Salmo trutta
American eel	Anguilla rostrata

Appendix 2 - Herpetofaunal Species Which May Occur in the Project Area

Reptiles

Common Name	Scientific Name
Earless lizard	Holbrookia maculata
Prairie lizard	Sceloporus undulatus
Texas horned lizard	Phrynosoma cornutum
Great plains skink	Eumeces obsoletus
New Mexican whiptail	Cnemidophorus inornatus
Chihuahuan whiptail	C. exsanguis
Spiny softshell turtle	Apalone spiniderus
Western Painted turtle	Chrysemys picta belli
Ornate box turtle	Terrapene ornata
Western hognosed snake	Heterdon nasicus
Western patchnosed snake	Salvadora hexalepis
Arizona glossy snake	Arizona elegans
Black-necked garter snake	Thamnophis cyrtopsis
Texas blind snake	Leptotyphlops dulcis
Kingsnake	Lampropeltis getulus
Night snake	Hypsiglena torquata
Coach whipsnake	Masticophis flagellum
Corn snake	Elaphe guttata
Desert striped whipsnake	Masticophis taeniatus
Gopher snake	Pituophis melanoleucus
Longnose snake	Rhinocheilus lecontei
Plains blackhead snake	Tantilla nigriceps
New Mexico common garter snake	Thamnophis sirtalis dorsalis
Prairie rattlesnake	Crotalus viridis
Black tailed rattlesnake	C. molossus
Massasauga	Sistrurus catenatus

Amphibians

Common Name	Scientific Name
Tiger salamander	Ambystoma tigrinum
Plains spadefoot toad	Scaphiopus bombifrons
Woodhouse's toad	Bufo woodhousii
Green toad	B. debilis
Great plains toad	B. cognnatus
Red spotted toad	B. punctatus
Western chorus frog	Pseudacris triseriata
Bullfrog	Rana catesbeiana

Appendix 3 - Birds Which May Occur Within the Project Area

Common Name	Scientific Name
American tree sparrow	Spizella arborea
Chipping sparrow	S. passerina
Brewer sparrow	S. breweri
Lark bunting	Calamospiza melanocorys
Song sparrow	Melospiza melodia
Lincoln sparrow	M. lincolnii
Swamp sparrow	M. georgiana
Ring-necked pheasant	Phasianus colchicus
Gambel quail	Callipepla gambelii
Virginia rail	Rallus limicola
American coot	Fulica americana
Sandhill crane	Grus canadensis
Whooping crane	G. americana
Killdeer	Charadrius vociferus
Bald eagle	Haliaeetus leucocephalus
Northern harrier	Circus cyaneus
Sharp-shinned hawk	Accipiter striatus
Cooper hawk	A. cooperii
Northern goshawk	A. Gentilis
Common black hawk	Buteogallus anthracinus
Swainson hawk	Buteo swainsoni
Red-tailed hawk	B. jamaicensis
Golden eagle	Aquila chrysaetos
American kestrel	Falco sparverius
Merlin	F. columbarius
Peregrine falcon	F. peregrinus
Prairie falcon	F. mexicanus
Spotted sandpiper	Actitis macularia
Great blue heron	Ardea herodias
Snowy egret	Egretta thula
Green-backed heron	Butorides striatus
Black-crowned night heron	Nycticorax
White-faced ibis	Plegadis chihi
Wood duck	Aix sponsa
Mallard	Anas platyrhynchos
Turkey vulture	Cathartes aura
Greater yellowlegs	Tringa melanoleuca
Lesser yellowlegs	T. flavipes
Solitary sandpiper	T. solitaria
Common snipe	Gallinago
Rock dove	Columba livia
Mourning dove	Zenaida macroura
Yellow-billed cuckoo	Coccyzus americanus
Greater roadrunner	Geococcyx californianus
Common barn owl	Tyto alba
Western screech owl	Otus kennecotti
Great horned owl	Bubo virginianus
Burrowing owl	Athene cunicularia
Long-eared owl	Asio otus

Appendix 3 - Birds Which May Occur Within the Project Area cont.

Common Name	Scientific Name
Short-eared owl	A. flammeus
Northern saw-whet owl	Aegolius acadicus
Common nighthawk	Chordeiles minor
White-throated swift	Aeronautes saxatalis
Black-chinned hummingbird	Archilochus alexandri
Calliope hummingbird	Stellula calliope
Broad-tailed hummingbird	Selasphorus platycercus
Rufous hummingbird	S. rufus
Belted kingfisher	Ceryle alcyon
Lewis woodpecker	Melanerpes lewis
Red-headed woodpecker	M. erythrocephalus
Downy woodpecker	Picoides pubescens
Hairy woodpecker	P. villosus
Northern flicker	Colaptes auratus
Olive-sided flycatcher	Contopus borealis
Western wood pewee	C. sordidulus
Willow flycatcher	Empidonax traillii
Dusky flycatcher	E. oberholseri
Gray flycatcher	E. wrightii
Black phoebe	Savornis nigricans
Say phoebe	S. saya
Ash-throated flycatcher	Myiarchus cinerascens
Eastern kingbird	Tyrannus
Cliff swallow	Hirundo pyrrhonota
Barn swallow	H. rustica
Stellar jay	Cyanocitta stelleri
Scrub jay	Aphelocoma coerulescens
Piñon jay	Gymnorhinus cyanocephalus
American crow	Corvus brachyrhynchos
Black-capped chickadee	Parus atricapillus
Bushtit	Psaltriparus minimus
White-breasted nuthatch	Sitta carolinensis
Brown creeper	Certhia american
Bewick wren	Thryomanes bewickii
House wren	Troglodytes aedon
Winter wren	T. troglodytes
Marsh wren	Cistothorus palustris
Golden-crowned kinglet	Regulus satrapa
Ruby-crowned kinglet	R. calendula
Townsend solitaire	Myadestes townsendi
Hermit thrush	Catharus guttatus
American robin	Turdus migratorius
Gray catbird	Dumetella carolinensis
Northern mockingbird	Mimus polyglottos
Brown thrasher	Toxostoma rufum
Water pipit	Anthus spinoletta
Cedar waxwing	Bombycilla cedrorum
European starling	Sturnus vulgaris

Appendix 3 - Birds Which May Occur Within the Project Area cont.

Common Name	Scientific Name
Solitary vireo	solitarius
Warbling vireo	V. gilvus
Orange-crowned warbler	Vermivora celata
Nashville warbler	V. ruficapilla
Virginia warbler	V. virginiae
Lucy warbler	V. luciae
Yellow-rumped warbler	Dendroica coronata
Black-throated gray warbler	D. nigrescens
Townsend warbler	D. townsendi
Black-and-whit warbler	Mniotilta varia
American redstart	Setophaga ruticilla
Northern waterthrush	Seiurus noveboracensis
MacGillivray warbler	Oporornis tolmiei
Common yellowthroat	Geothlypis trichas
Hooded warbler	Wilsonia citrina
Wilson warbler	W. pusilla
Yellow-breasted chat	Icteria virens
Summer tanager	Piranga rubra
Western tanager	P. ludoviciana
Black-headed grosbeak	Pheucticus melanocephalus
Blue grosbeak	Guiraca caerulea
Lazuli bunting	Passerina amoena
Indigo bunting	P. cyanea
Green-tailed towhee	Pipilo chlorurus
Rufous-sided towhee	P. erythrophthalmus
Brown towhee	P. fuscus
White-throated sparrow	Zonotrichia albicollis
White-crowned sparrow	Z. leucophrys
Harris sparrow	Z. querula
Dark-eyed junco	hyemalis
Red-winged blackbird	Agelaius phoeniceus
Common grackle	Quiscalus quiscula
Brown-headed cowbird	Molothrus ater
Northern oriole	Icterus galbula
House finch	Carpodacus mexicanus
Pine siskin	Carduelis pinus
Lesser goldfinch	C. psaltria
American goldfinch	C. tristis
Evening grosbeak	Coccothraustes vespertinus

Appendix 4 - Mammals Which May Occur within the Project Area

Common Name	Scientific Name
Porcupine	Erethizon dorsatum
Coyote	Canis latrans
Beaver	Castor canadensis
Kit fox	Vulpes macrotis
Gray fox	Urocyon cinereoargenteus
Raccoon	Procyon lotor
Long-tailed weasel	Mustela frenata
Mink	M. vison
Badger	Taxidea taxus
Striped skunk	Mephitis
Silver-haired bat	Lasionycterris noctivagans
Big brown bat	Eptesicus fuscus
Hoary bat	Lasiurus cinereus
Spotted bat	Euderma maculatum
Townsend's big-eared bat	Plecotus townsendii
Pallid bat	Antrozous pallidus
Brazilian free-tailed bat	Tadarida brasiliensis
Big free-tailed bat	T. macrotis
Little brown myotis	lucifugus
Long-legged myotis	M. volans
California myotis	M. californicus
Small-footed myotis	M. leibii
Desert cottontail	Sylvilagus auduboni
Black-tailed jackrabbit	Lepus californicus
Spotted ground squirrel	Spermophilus spilosoma
Rock squirrel	S. variegatus
Botta pocket gopher	Thomomys bottae
Silky pocket mouse	Perognathus flavus
Rock pocket mouse	P. intermedius
Plains harvest mouse	Reithrodontomys montanus
Western harvest mouse	R. megalotis
Deer mouse	Peromyscus maniculatus
White-footed mouse	P. leucopus
Northern grasshopper mouse	Onychomys leucogaster
Banner-tailed kangaroo rat	D. spectabilis
Ord's kangaroo rat	Dipodomys ordii
Tawny-bellied cotton rat	Sigmodon fulviventer
Southern plains woodrat	Neotoma micropus
White-throated woodrat	N. albigula
Muskrat	Ondatra zibethicus
Norway rat	Rattus norvegicus
House mouse	Mus musculus
New Mexican jumping mouse	Zapus hudsonius luteus

Appendix 5 - Endangered, Threatened, and Candidate Species which may Occur in Doña Ana County, New Mexico

Endangered Species

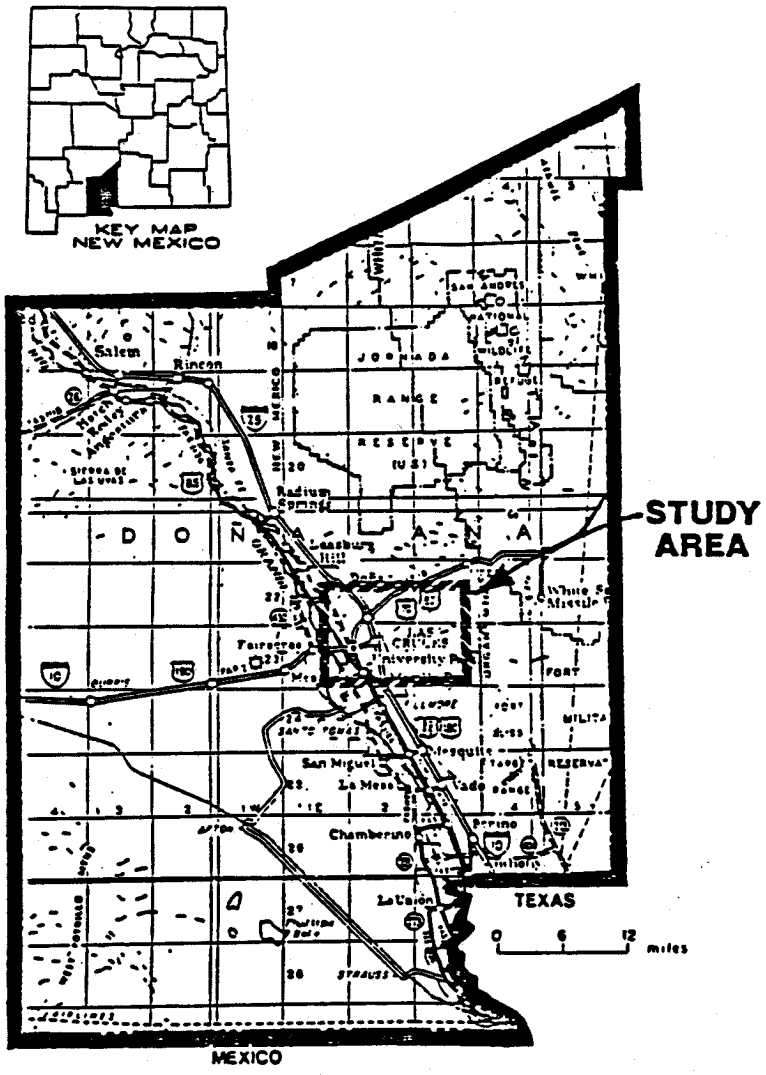
Common Name	Scientific Name
Bald eagle	Haliaeetus leucocephalus
American peregrine falcon	Falco peregrinus anatum
Whooping crane	Grus americana
Black-footed ferret	Mustela nigripes
Sneed's pincushion cactus	Coryphantha sneedii var.sneedii

Species Proposed for Listing

Common Name	Scientific Name
Southwestern willow flycatcher	Empidonax traillii extimus

Category 2 Candidate Species

Common Name	Scientific Name
White-faced ibis	Plegadis chihi
Greater western mastiff bat	Eumops perotis californicus
Occult little brown bat	Myotis lucifugus occultus
Spotted bat	Euderma maculatum
New Mexican jumping mouse	Zapus hudsonius luteus
Arizona black-tailed prarie dog	Cynomys ludovicianus arizonensis
Organ Mountains Colorado chipmunk	Eutamias quadrivittatus australis
White Sands woodrat	Neotoma micropus leucophaea
Ferruginous hawk	Buteo regalis
Western snowy plover	Charadrius alexandrinus nivosis
Big Bend mud turtle	Kinosternon hirtipes murravi
Texas horned lizard	Phrynosoma cornutum
Anthony blister beetle	Lytta mirifica
Los Olmos tiger beetle	Cicindela nevadica olmosa
Alamo beardtongue	Penstemon alamosensis
Grama grass cactus	Pediocactus papyracanthius
Mescalero milkwort	Polygala rimulicola var. pauciflora
Night-blooming cereus	greggii var.greggii
Nodding cliff daisy	Perityle cernua
Organ Mountain figwort	Scrophularia laevis
Organ Mountain evening primrose	Oenothera organensis
Standley whitlowgrass	Draba standleyi
Sand prickly pear	Opuntia arenaria
Five-leaf scurfpea	Pediomelum pentaphyllum



Vicinity Map - Doña Ana County, Las Cruces, New Mexico

FIGURE 1-1

The U.S. Fish and Wildlife Coordination Act Report recommends the following:

1. Consideration of altered sediment loads and potential water quality impacts resulting from project development.

Response: Because, sediment carried in flood flows would be deposited in the detention ponds, sediment loads reaching the Park Drain and Rio Grande would be reduced. Water quality impacts would be avoided through implementing the measures described in responses 8, 9, 10, 11, and 12 below.

2. Flood control planning should be based on demographic and geographic trends, including growth rates for the City. Additional areas adjacent to existing and proposed retention ponds should be acquired whenever possible for incorporation into the City's long-term flood control plan and natural area matrix, whenever possible.

Response: The City is advised to consider this recommendation in its long-term flood control plan.

3. The retention ponds should serve multiple uses: flood control, recreation, and wildlife enhancement.

Response: The City has an interest in multiple use flood control facilities, which would provide flood control, recreational, and wildlife benefits. In the proposed project, a depression approximately 6 inches in depth and 0.5 acre in size would be created in each basin near the outlet works that would provide a seasonally wet area attractive to wildlife, especially birds.

4. The Corps should work closely with Las Cruces in the primary contouring and vegetation to create natural areas attractive to wildlife. Consultation with USFWS, the Nature Conservancy, Audubon Society, New Mexico State University, and landowners is recommended for plant selection and design assistance.

Response: The Corps is working closely with Las Cruces to develop the project and incorporate recreational features into the project design. Disturbed areas will be revegetated with native plant species.

5. The Senior Citizens Pond and Villa Mora retention dam should be considered in the overall water control plan, and for incorporation into the park matrix. The natural park areas should be connected with open channels instead of covered storm sewers.

Response: The above mentioned ponds are not economically justified for inclusion in the proposed project presented to the city by the Corps. However, the city of Las Cruces should consider any existing retention ponds in its overall flood control plan, and their potential for recreational/park development.

6. Modify the design of the flood control features to allow some water retention for wetland creation.

Response: As described above, seasonal ponds about 0.5 acre in size and 6-inches in depth would be constructed near the outlet works in both basins.

7. Reduce the width of levee crest roads from 20 feet to 8-10 feet, sufficient for bike/running path. The reduced width would maintain the character of a natural park, and yet still provide for limited

vehicle access, as needed for maintenance.

Response: The current real estate constraints would limit the embankment crest road to a maximum width of 12 feet. This constraint would allow the project to maintain the character of a natural park, and provide for limited vehicle access for maintenance purposes.

8. Inspect all equipment daily to ensure leaks or discharges of lubricants, hydraulic fluids, or fuels does not occur. Store and dispense all fuels, lubricants, hydraulic fluids, and other petrochemicals away from any arroyo or its banks. Contain and remove any petrochemical spills, including contaminated soil, and dispose of these materials at an approved upland disposal site, in accordance with Environmental Protection Agency protocol.

Response: Vehicles would be inspected daily to ensure that no leaks or discharges of lubricants, hydraulic fluids or fuels occur in or near the riparian areas. Fuels, lubricants, hydraulic fluids and other petrochemicals would not be stored or discharged in or near the channel or basin and any spills, including contaminated soil, would be removed and properly disposed of at an approved upland site.

9. While working in a watercourse, every effort should be made to perform construction during periods of low flow to minimize turbidity and other water quality impacts. Rubber cofferdams used to divert water should be clean and free of fines and other contaminants.

Response: To limit turbidity or avoid altering the circulation patterns, construction would take place during low flow or no flow periods.

10. Sediment catchments should be constructed to catch and filter runoff from construction sites. Contain any poured concrete in sealed forms and/or behind cofferdams to prevent discharge into arroyos. Place no surplus concrete within the arroyos or near their banks. Contain and treat, or remove for off-site disposal any wastewater from concrete batching, vehicle wash-down, and aggregate processing.

Response: Poured concrete would be contained in forms and/or behind cofferdams to prevent discharge into the watercourse. The wastewater from concrete batching, vehicle wash-down, and aggregate processing would be contained and treated or removed for off-site disposal.

11. Place only clean, coarse, and erosion-resistant fills in water and employ silt curtains, settling basins, or other suitable means to control turbidity. Monitor water quality during the construction phase to insure compliance with State water quality standards.

Response: To limit turbidity or avoid altering the circulation patterns, construction would take place during low flow or no flow periods.

12. Riprap and other bank stabilizing material, including all temporary and permanent structures placed in a water course, must be free of fines and chemical contaminants.

Response: Temporary and permanent fill would be free of toxic materials or materials which may decompose to become a toxic material. Temporary cofferdams would be removed following construction, and the basin recontoured to the approximate original configuration.

APPENDIX C

CULTURAL RESOURCES COORDINATION AND INVENTORY

BRUCE KING
GOVERNOR

STATE OF NEW MEXICO
OFFICE OF CULTURAL AFFAIRS
HISTORIC PRESERVATION DIVISION

VILLA RIVERA BUILDING
228 EAST PALACE AVENUE
SANTA FE, NEW MEXICO 87503
(505) 827-6320

HELMUTH J. NAUMER
CULTURAL AFFAIRS OFFICER

THOMAS W. MERLAN
DIRECTOR

August 9, 1993

Mr. Gary L. Gamel, P.E.
Chief, Engineering and Planning Division
Army Corps of Engineers
Albuquerque District
P.O. Box 1580
Albuquerque, NM 87103-1580

Dear Mr. Gamel:

We are writing in response to your request for consultation under 36 CFR 800 on the proposed flood control project in Las Cruces, New Mexico. Eight potential locations for flood control features are being considered in the Las Cruces area.

We concur with your assessment that site LA 100875 is eligible to the National Register of Historic Places under 36 CFR 60.4(d). Site LA 100876, the remnants of a demolished 20th century structure, may have potential to contribute to our understanding of early 20th century residential use of the Las Cruces City area. It is our opinion that site LA 100876 is potentially eligible to the National Register, but that testing is required to determine its actual eligibility status.

We agree that the data potential of the 8 Isolated Occurrence has been exhausted through in-field recordation.

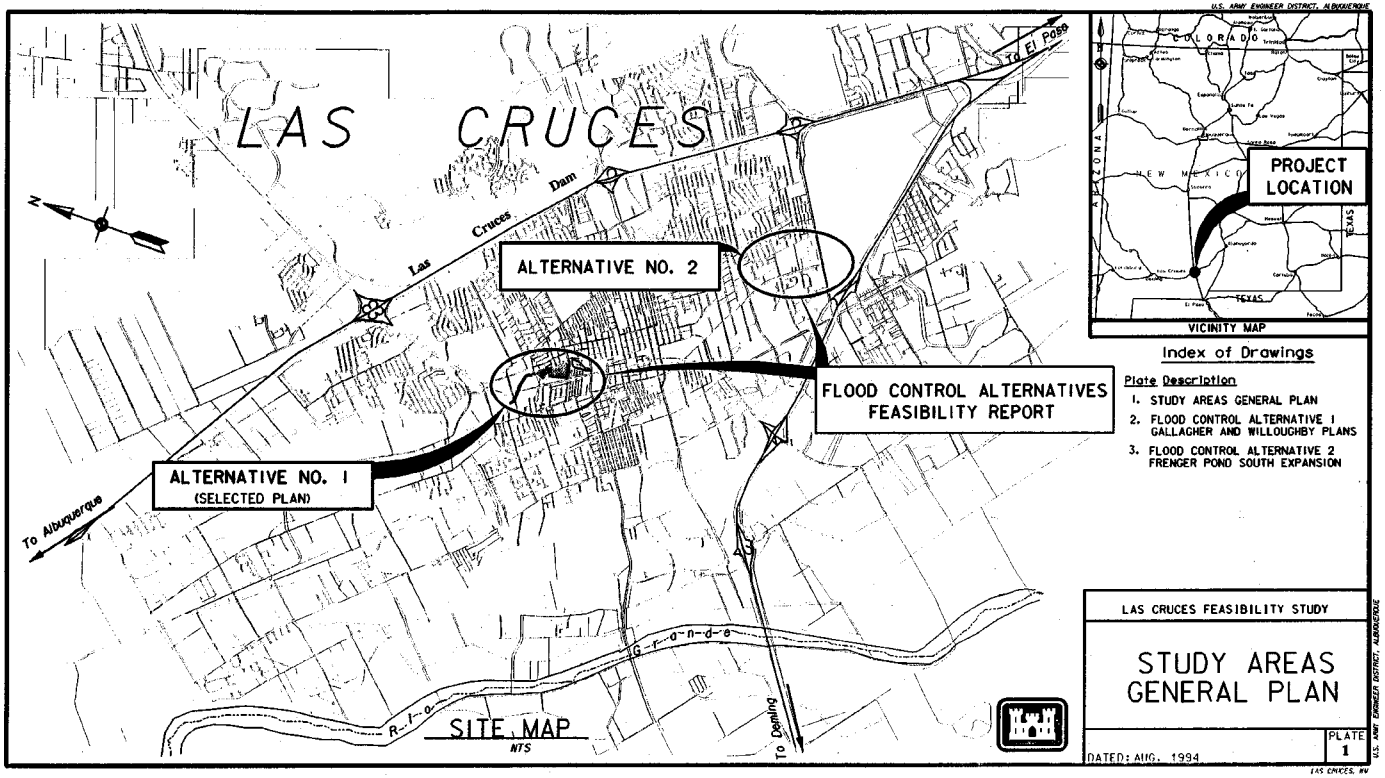
In sum, only the two sites, LA 100875 and LA 100876, merit further consideration. If these sites can be avoided, then the undertaking will have no effect on National Register eligible properties. If avoidance is not possible, however, then site LA 100876 will require testing for eligibility and treatment of effect, if necessary. The Corps will also need to consult with our office on the most appropriate means of mitigating the effect of the undertaking on site LA 100875.

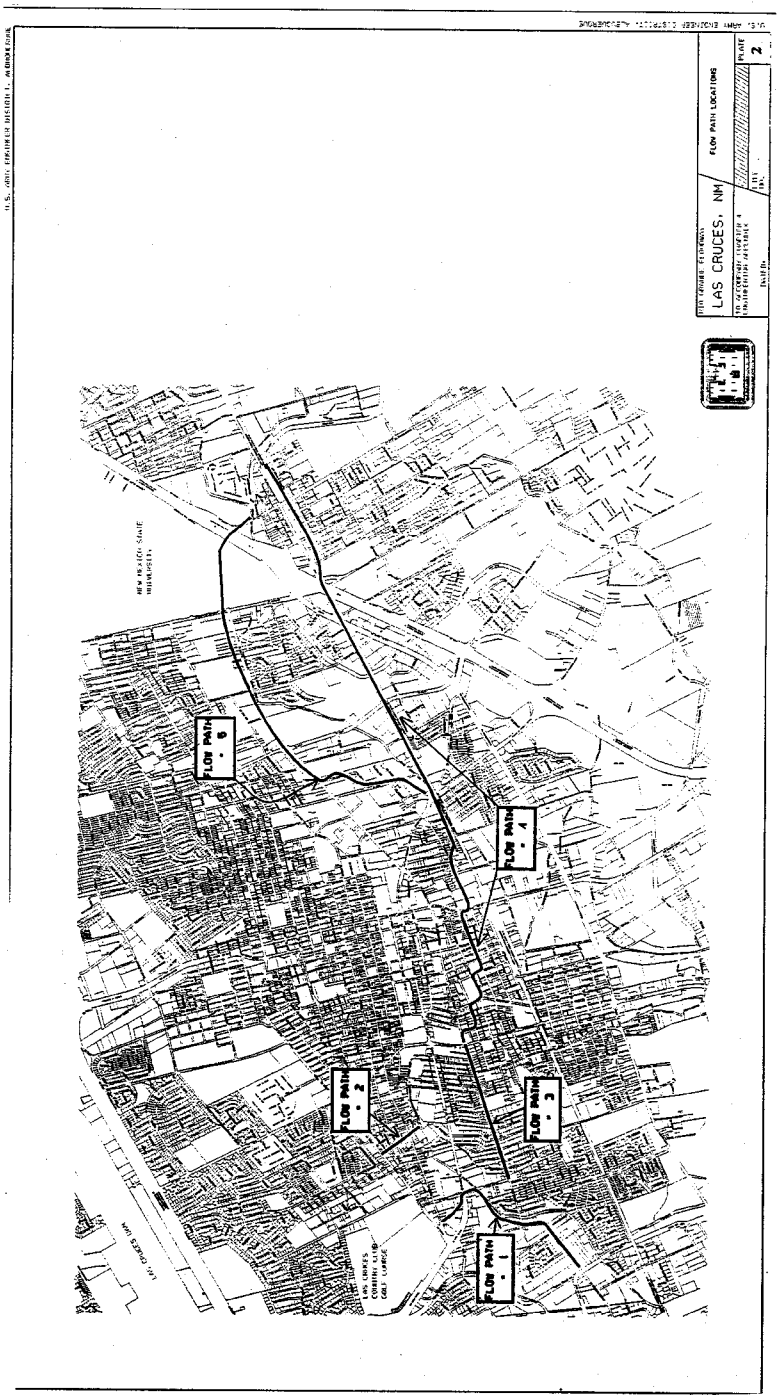
Thank you.

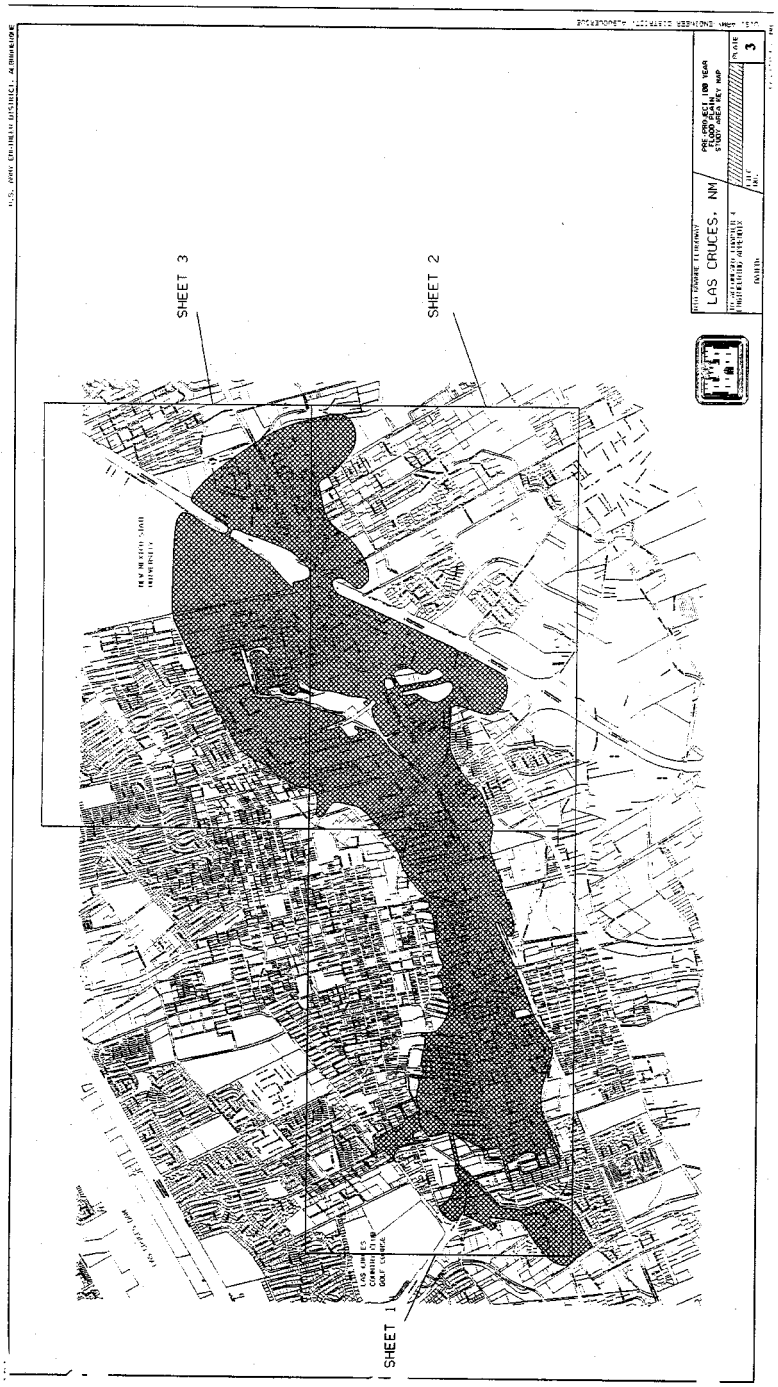
Sincerely,

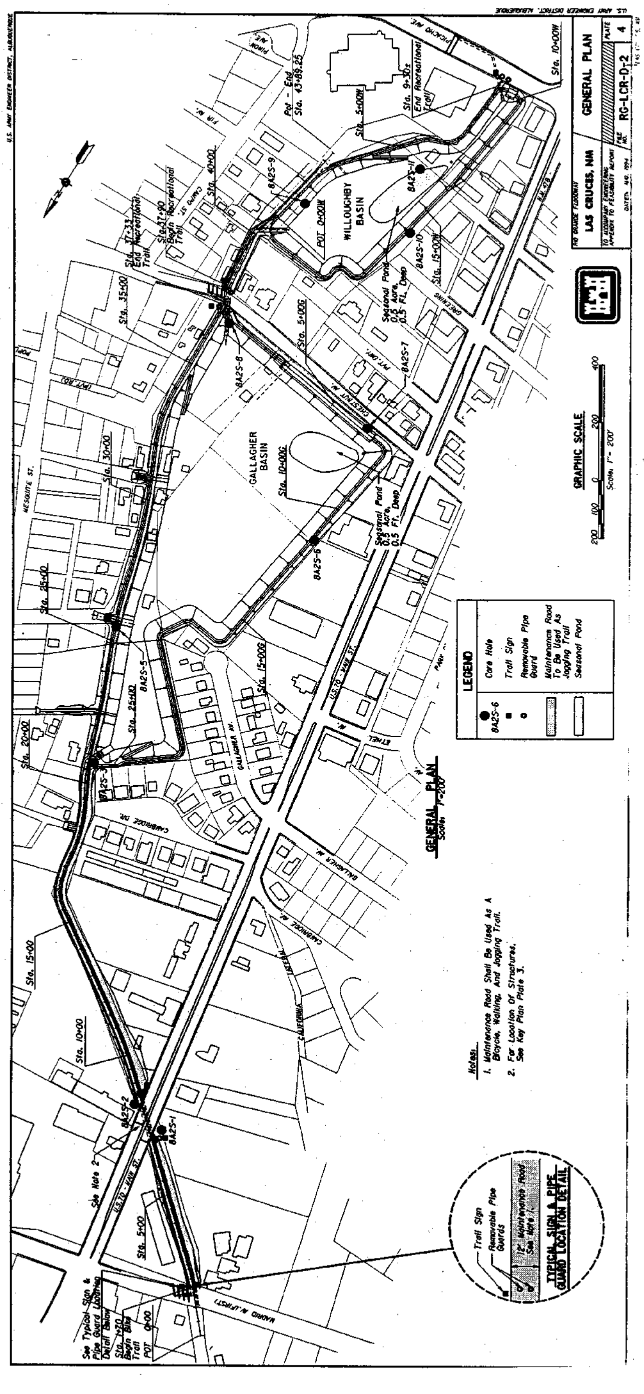
Thomas W. Merlan
State Historic Preservation Officer

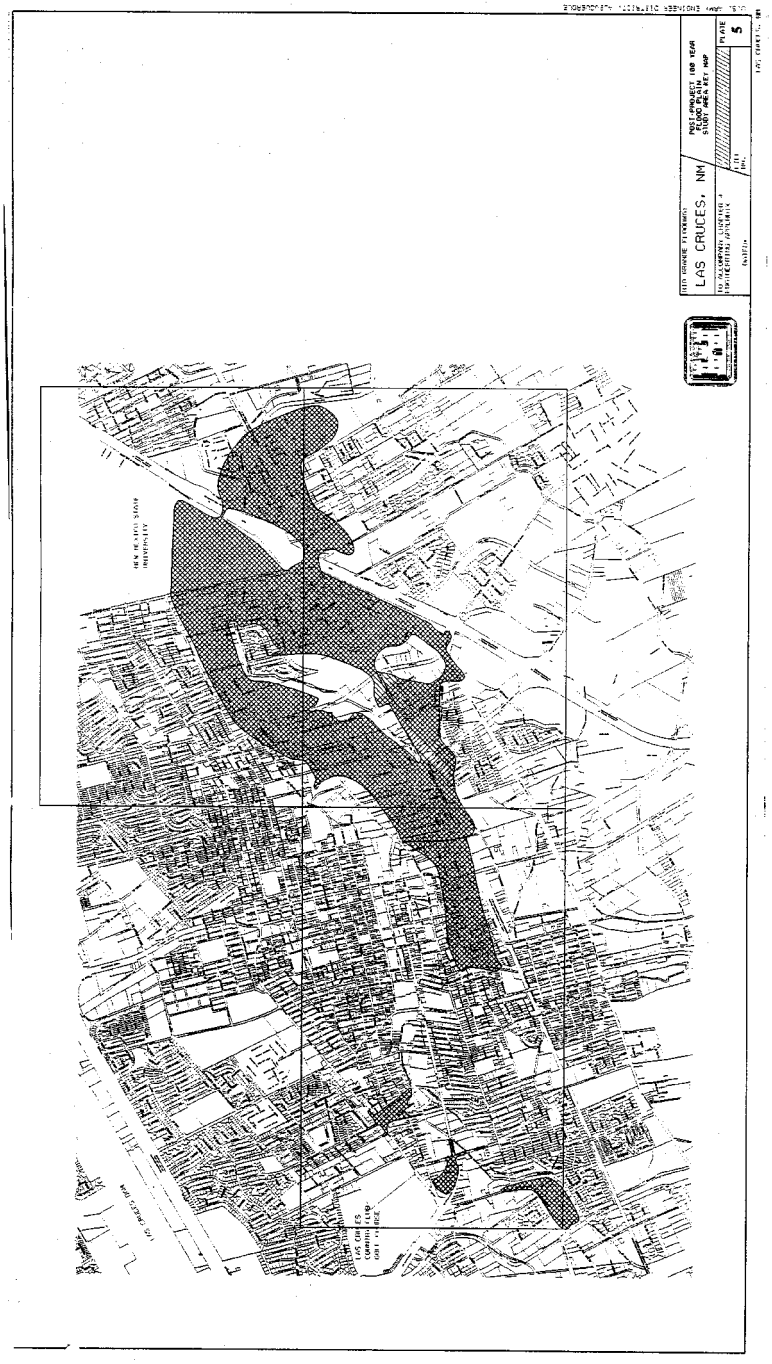
TWM/DWC: 40901

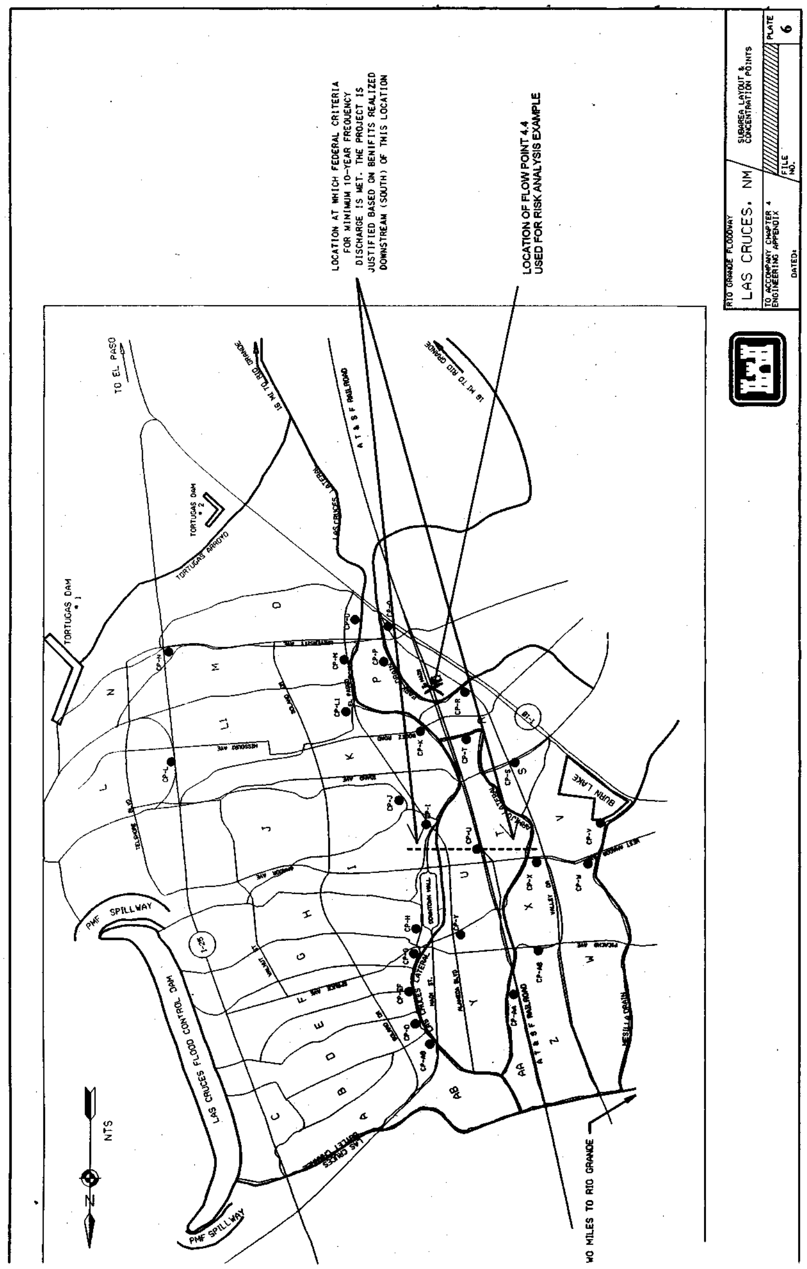

U.S. ARMY ENGINEER DISTRICT, ALBUQUERQUE
LAS CRUCES
To El Paso
Las Cruces Dam
ALTERNATIVE NO. 2
FLOOD CONTROL ALTERNATIVES
FEASIBILITY REPORT
ALTERNATIVE NO. 1
(SELECTED PLAN)
To Albuquerque
Rio Grande
To Deming
SITE MAP
NTS
COLORADO
NEW MEXICO
ARIZONA
TEXAS
PROJECT LOCATION
VICINITY MAP
Index of Drawings
Plate Description
1. STUDY AREAS GENERAL PLAN
2. FLOOD CONTROL ALTERNATIVE 1 GALLAGHER AND WILLOUGHBY PLANS
3. FLOOD CONTROL ALTERNATIVE 2 FRENGER POND SOUTH EXPANSION
LAS CRUCES FEASIBILITY STUDY
STUDY AREAS GENERAL PLAN
DATED: AUG. 1994
PLATE 1
U.S. ARMY ENGINEER DISTRICT, ALBUQUERQUE
LAS CRUCES, NM


LAS CRUCES, NM
FLOW PATH LOCATIONS
PLATE
2
FLOW PATH - 1
FLOW PATH - 2
FLOW PATH - 3
FLOW PATH - 4
FLOW PATH - 5


SHEET 3
SHEET 2
SHEET 1
LAS CRUCES, NM
PRELIMINARY
3


GENERAL PLAN
LAS CRUCES, NM
RG-LCR-D-2
WILLOUGHBY BASIN
GALLAGHER BASIN
LEGEND
Core Hole
Trail Sign
Removable Pipe Guard
Maintenance Road To Be Used As Jogging Trail
Seasonal Pond
GRAPHIC SCALE
GENERAL PLAN
TYPICAL SIGN & PIPE GUARD LOCATION DETAIL
Notes:
1. Maintenance Road Shall Be Used As A Bicycle, Walking, And Jogging Trail.
2. For Location Of Structures, See Key Plan Plate 3.


LAS CRUCES, NM
POST-PROJECT 100 YEAR FLOODPLAIN KEY MAP
STUDY AREA KEY MAP
PLATE
5
NEW MEXICO STATE UNIVERSITY
LAS CRUCES COMMUNITY COLLEGE


LOCATION AT WHICH FEDERAL CRITERIA FOR MINIMUM 10-YEAR FREQUENCY DISCHARGE IS MET. THE PROJECT IS JUSTIFIED BASED ON BENEFITS REALIZED DOWNSTREAM (SOUTH) OF THIS LOCATION
LOCATION OF FLOW POINT 4.4 USED FOR RISK ANALYSIS EXAMPLE
TORTUGAS DAM #1
TORTUGAS DAM #2
TORTUGAS ARROYO
TO EL PASO
A T & S F RAILROAD
BURN LAKE
DOWNTOWN MALL
MESILLA DRAIN
LAS CRUCES FLOOD CONTROL DAM
PMF SPILLWAY
PMF SPILLWAY
I-25
NTS
N
WO MILES TO RIO GRANDE
RIO GRANDE FLOODWAY
LAS CRUCES, NM
TO ACCOMPANY CHAPTER 4 ENGINEERING APPENDIX
DATED:
SUBAREA LAYOUT & CONCENTRATION POINTS
FILE NO.
PLATE
6