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112th Congress, 2d Session – – – – – – – – – – – – House Document 112–134

OLMSTED LOCKS AND DAM: ILLINOIS AND KENTUCKY POST AUTHORIZATION CHANGE REPORT

COMMUNICATION

FROM

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

TRANSMITTING

A PROJECT MODIFICATION RECOMMENDATION FOR THE OLMSTED LOCKS AND DAM



AUGUST 7, 2012.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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U.S. GOVERNMENT PRINTING OFFICE

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

APR 13 2012

Honorable John Boehner
Speaker of the House
of Representatives
Washington, D.C. 20515-0001

Dear Mr. Speaker:

The Secretary of the Army recommends modification of the project authorization to increase the authorized cost of the Locks and Dam 52 and 53 Replacement Project (Olmsted Locks and Dam), Illinois and Kentucky. Increasing the authorized cost of the project is necessary because the estimated project first costs exceed the maximum project cost allowed by Section 902 of the Water Resources Development Act (WRDA) of 1986. The enclosed April 2012 Post - Authorization Change Report (PACR) explains and supports the cost increase. This report also documents that the project remains economically justified and environmentally acceptable.

The project was authorized by Section 3(a)(6) of the WRDA of 1988 (PL 100-676) based on a project first cost of $775,000,000 (October 1987 price level) in the Army Corps of Engineers (Corps) Chief's Report, dated August 20, 1986. Initial construction funding was provided by the Energy and Water Development Appropriations Act of 1991, and $1,358,000,000 has been expended since 1987. The Olmsted Locks and Dam Project provides a structure near Ohio River Mile 964.4 that would replace two existing structures, Lock and Dam 52 at Brockport, Illinois (River Mile 938.9) and Lock and Dam 53 at Grand Chain, Illinois (River Mile 962.6). The structure will consist of twin 110' by 1,200' locks adjacent to the Illinois bank, five tainter gates, a 1,400' navigable pass, and a fixed weir extending to the Kentucky bank. The new locks will lift navigation traffic up to 30 feet and the weir will create a pool that would extend upstream to the Smithland Locks and Dam, a distance of 47 miles.

Section 902 of WRDA of 1986 established a maximum total project cost, and the current estimated project cost exceeds the maximum cost as specified by Section 902. The Section 902 limit for the Olmsted Locks and Dam Project is currently $1,744,680,000 based on the authorized first cost of $775,000,000 (October 1987 price levels) and adjusted for allowable inflation. Based on cost increases described in the PACR, the revised estimated first cost (without inflation) for the Olmsted Locks and Dam Project at October 2011 prices is $2,918,000,000. The fully-funded estimate (inflated through the mid-point of construction) is currently estimated to be $3,098,768,000.

In general, changes in the project costs are a result of design changes, contract modifications, market conditions, site conditions, environmental mitigation (purchase of land and monitoring), river dikes, cultural resources and an extended period of project construction. The substantial cost increase was primarily driven by a variety of difficult and complex site conditions. Rather than using a traditional method of dewatering the construction site, the Corps used an innovative in- the-wet method to construct the dam portion of the project. The reason for selecting this innovative method of construction was with the objective to reduce costs, shorten the construction period, to reduce impacts on navigation, to avoid the risk of the cofferdam being overtopped in high water events, and to reduce potential impacts on endangered mussel beds. In application, the innovation was more difficult than anticipated, primarily due to the tremendous scale of the project, narrow construction tolerances, and dynamic river conditions. The method proved to be sensitive to river velocities, fluctuating water depths, and sediment loads, which reduced productivity and increased costs for river operations. The Corps was unable to attract bidders for the innovative dam construction method using a firm, fixed-price contract due to the perceived risk. As a result, the Corps elected to use a cost-reimbursable contract. Although there is no evidence that this contract vehicle caused cost increases, it did transfer the cost, schedule and technical performance risks to the government.

The project continues to be economically justified based on projected commercial transportation savings and represents a reinvestment in the nation's inland navigation infrastructure. At the October 2011 price level, a 4.0 percent discount rate and a 50-year period of analysis, the Corps estimates the average annual costs to be $146,739,000 and average annual benefits to be $825,200,000. Net benefits are estimated at $678,461,000 and the benefit cost ratio is 5.6 to 1. Authorized project funding is 100 percent Federal with 50 percent from the general funds of the Treasury and 50 percent from the Inland Waterways Trust Fund. The Corps plans to continue to construct the project through the normal budget process.

With respect to environmental compliance, three National Environmental Policy Act (NEPA) documents were prepared for the Olmsted Lock and Dam project between 1986 and 2002 and included the original Environmental Impact Statement (EIS) in 1986, a Supplemental EIS (SFEIS) in May 1993 and a NEPA Environmental Assessment and Finding of No Significant Impact (EA/FONSI) in June 2002. Because the PACR does not contemplate construction changes and because the proposed construction is discussed and addressed in the prior NEPA documentation (1986 EIS, 1993 SFEIS, 2002 EA/FONSI), the NEPA analysis is complete for the current construction project contemplated in the PACR.

The Office of Management and Budget (OMB) advises that there is no objection to the submission of the report to Congress and concludes that the report recommendation is consistent with the policy and programs of the President. A copy of its letter is enclosed. I am providing a copy of this transmittal and the OMB

letter dated April 12, 2012 to the House Committee on Appropriations Subcommittee on Energy and Water Development, and the House Committee on Transportation and Infrastructure Subcommittee on Water Resources and Environment. I am providing an identical letter to the President of the Senate.

Very truly yours,

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

Enclosures

3 Enclosures

1. OMB Clearance Letter, April 12, 2012
2. Director's Report, Dec 13, 2011
3. Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam, Illinois and Kentucky), Post Authorization Change Report, Nov 2011 (CD)

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

April 12, 2012

The Honorable Jo Ellen Darcy
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington DC 20310-0108

Dear Ms. Darcy:

As required by Executive Order 12322, the Office of Management and Budget completed its review of your recommendation to increase the authorized construction cost ceiling of the Locks and Dam 52 and 53 Replacement Project (Olmsted Locks and Dam), Illinois and Kentucky. Based on our review, we concluded that your recommendation is consistent with the policy and programs of the President.

The Office of Management and Budget does not object to you submitting to Congress the Locks & Dams 52 and 53 Replacement Project Post Authorization Change Report.

Sincerely,

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

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, D.C. 20314-1000

CECW-ZB

DEC 13 2011

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

SUBJECT: Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam, Illinois and Kentucky), Post Authorization Change Report (PACR) dated November 2011

1. Purpose: Request your review and approval of the Olmsted Locks and Dam, Illinois and Kentucky Post Authorization Change Report (enclosure 1) which documents the need to increase the authorized project cost to $2,918,000,000.

2. Post Authorization Change: Section 3(a)(6) of the Water Resources Development Act (WRDA) of 1988 (P.L. 100-676; 102 Stat. 4013) authorized the Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam, Illinois and Kentucky) at a total cost of $775,000,000 (October 1987 price level). The authorized cost adjusted for inflation through September 30, 2011 is $1,136,000,000. The currently estimated cost for the Olmsted Locks and Dam project is $2,918,000,000 (October 2011 price level), and includes $1,358,000,000 in sunk costs through September 30, 2011. The updated cost results from design changes, construction modifications, inefficient funding, adverse river conditions, innovative construction methodology, dam procurement and unforeseen first costs. There are no changes in project location, purpose, or scope. The currently estimated project cost inflated to the midpoint of scheduled construction period is $3,099,000,000. The Section 902 (WRDA 1986) limit for the Olmsted Locks and Dam project is currently estimated as $1,745,000,000; therefore, the revised cost exceeds the Section 902 cost limit.

3. Background and Discussion:

a. The Olmsted Locks and Dam Project provides for a single structure near Ohio River Mile 964.4 that will replace both of the existing Locks & Dams 52 and 53 on the Ohio River. The two existing Locks and Dams were completed in 1928 and 1929 with the auxiliary lock chambers being completed in 1969 and 1980. Both Locks and Dam 52 and 53 have one 600'x110' lock and one 1200'x110' lock. The new structure will consist of twin 110' by 1,200' locks adjacent to the Illinois bank, five tainter gates, a 1,400' navigable pass, and a fixed weir extending to the Kentucky bank. During low flow conditions, an upper pool having an elevation 300 feet (Ohio River Datum) at the dam would extend upstream to the Smithland Locks and Dam, a distance of 47 miles. Open river conditions will exist from the Olmsted Locks and Dam site to the mouth of the Ohio River, a distance of approximately 17 miles.

b. Construction of the total project was about 44 percent complete as of September 30, 2011. Construction of the navigation locks is complete. As of 13 October 2011 seven sections of the navigation dam (referred to as "shells") have been successfully set in the Ohio River and five shells are in the precast yard waiting to be set. The dam cost constitutes approximately 60-percent of the current project estimate. The revised cost is largely based on the 2011 re-baseline estimate that used actual productivity rates from fabrication and setting of the first season of shells. Consequently, we place a high level of confidence in the updated project cost estimate. The Cost Engineering DX certified the revised total project cost estimate by memorandum dated November 9, 2011. Battelle Memorial Institute coordinated completion of Independent External Peer Reviews (IEPR) of the PACR and updated cost estimate. IEPR reports are dated November 15, 2010 and November 4, 2011.

c. Authorized project funding is 50-percent from the general fund of the U.S. Treasury and 50-percent from the Inland Waterways Trust Fund (i.e. 100-percent Federal). Construction funds were first appropriated in FY91. In FY 2011 the Congress provided $142,903,000 for this project. $150,000,000 has been proposed in the FY12 President's Budget. The current schedule for project completion assumes that efficient funding will be restricted by the income to the Inland Waterways Trust Fund at approximately $150,000,000 per year.

d. The project, located at the reach of the Ohio River that provides a connection between the Mississippi River, Tennessee River and Cumberland River, is strategically important to the nation. More tonnage passes this point than any other place in America's inland navigation system. In 2010, 89.9 million tons (Locks & Dam 52), traversed this portion of the Ohio River. Twenty-five percent (25%) of all coal shipped on the inland waterways transits Locks & Dam 52 destined for many of the 50 power plants located on the Ohio River System or for many of the 17 power plants located in the eight states on the Upper or Lower Mississippi River. At the October 2011 price level, 4.000-percent discount rate, and a 50-year period of economic evaluation, the total equivalent annual costs are estimated as $146,739,000 and equivalent annual benefits are estimated as $825,200,000. Net navigation benefits for the Olmsted Locks and Dam project are estimated at about $678,461,000 annually. The ratio of benefits to total costs is 5.6-to-1.

4. Conclusions. The Louisville District prepared the PACR in accordance with ER 1105-2-100, Appendix G, dated, June 30, 2004, to document the increases in the project cost and recommend an increase in the authorized project cost. The HQUSACE policy compliance review of the PACR concluded that there are no unresolved policy issues and that the project is technically sound, environmentally acceptable, and economically justified. Documentation of Headquarters review is at enclosure 2.

X

CECW-LRD
SUBJECT: Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam, Illinois and Kentucky), Post Authorization Change Report (PACR) dated November 2011

5. Recommendation: I recommend that the enclosed Post Authorization Change Report be transmitted to Congress as a basis for increasing the authorized project cost of the Olmsted Locks and Dam project to $2,918,000,000 (October 2011 price levels). Documents necessary to coordinate this recommendation with the Office of Management and Budget will be developed in coordination with your staff and provided under separate cover.

FOR THE COMMANDER:

Encls
as

STEVEN L. STOCKTON, P.E.
Director of Civil Works

LOCKS & DAMS 52 AND 53 REPLACEMENT PROJECT

(OLMSTED LOCKS AND DAM)
ILLINOIS and KENTUCKY

POST AUTHORIZATION CHANGE REPORT

-FINAL-

LOUISVILLE DISTRICT

U.S. ARMY CORPS OF ENGINEERS

November 2011
Revised April 2012

EXECUTIVE SUMMARY

The purpose of this report is to recommend that the authorized cost of the Locks & Dams 52 and 53 Replacement Project (Olmsted Locks and Dam) be increased to $2,918,000,000 (October 2011 price level), and to document the reasons for the recommendation. The report is required because the current estimated cost of completing the authorized project exceeds the maximum cost limit, as defined in Section 902 of the Water Resources Development Act of 1986 ("902 cost limit").

The Olmsted Locks and Dam Project ("Olmsted Project" or "Project") was authorized in the Water Resources Development Act of 1988 (PL 100-676). Initial construction funding was provided by the Energy and Water Development Appropriations Act of 1991. The project is economically justified based on estimated future commercial transportation savings derived from reduced processing and congestion time, at a location with a very high level of inland waterways traffic.

The Olmsted Lock and Dam project cost has grown to $2,918,000,000 largely as a result of the low initial estimate associated with the "In-the-Wet" construction technique being utilized, unanticipated project cost associated with unanticipated extended exposure to inflation, and an unanticipated increased rate of inflation since 2004.

Low Initial Estimate: There are several factors that have contributed to the low initial cost estimate for the innovative in-the wet construction technique. The difficulties that were not known when the project was authorized are: the negative productivity impacts of river conditions (elevation & velocities), the complex shell fabrication details necessitated by the seismic condition at the site and the inefficiencies driven by the project's cash flow constraints in some years. After constructing and setting the first set of shells in 2010 the government and contractor realized that the effort associated with fabrication and setting these large pieces of precast concrete and filing them with tremie concrete was not like any work they were previously experienced with or previously had estimated. The construction challenges associated with developing this innovative method of construction have been overcome but require a lot more effort than ever could have been envisioned.

Unanticipated cost increases above inflation: Roughly 77 percent of the increase in the estimated total cost of the project, in real terms, (above inflation), is associated with the increase in the cost of constructing the dam. Many factors contributed to this increase, including a number of earlier decisions over the course of the project's development, which shifted the time frame for constructing the dam to a period that experienced a high rate of inflation.

Unanticipated Exposure to Inflation: The project was authorized in 1988 at a cost of $775,000,000 (Oct 1987 price level), which is equal to $1,590,000,000 at the October 2011 price level. The authorized cost was based on an assumption of a 7-year project construction duration, which derived from an assumption that the project would receive each year the maximum amount of funding that the Corps could efficiently and effectively spend. The project is now anticipated to be complete in 2024, a 24-year increase in duration from the earlier estimate. Due to this increased duration the project was exposed to additional cost in the form of inflation.

The Olmsted Locks and Dam Project provides for a single structure near Ohio River Mile 964.4 that will replace both of the existing Locks & Dams 52 and 53 on the Ohio River. The two existing Locks and Dams were completed in 1928 and 1929 with the auxiliary lock chambers being completed in 1969 and 1980. Both locks and Dam 52 and 53 have one 600'x110' lock and one 1200'x110' lock. The new structure will consist of twin 110' by 1,200' locks adjacent to the Illinois bank, five tainter gates, a 1,400' navigable pass, and a fixed weir extending to the Kentucky bank. During low flow conditions, an upper pool having an elevation 300 feet (ORD) at the dam would extend upstream to the Smithland Locks and Dam, a distance of 47 miles. Open river conditions will exist from the dam site to the mouth of the Ohio River, a distance of approximately 17 miles.

This document was prepared in accordance with the Planning Guidance Notebook, ER-1105-2-100, Appendix G dated June 2004. The Section 902 limit for the Olmsted Locks and Dam Project is currently $1,745,000,000 based on the authorized cost of $775,000,000 as reported in the Report of the Chief of Engineers dated 20 August 1986 and the Water Resources Development Act of 1988. The authorized cost to construct the Project was adjusted for inflation using the method described in ER 1105-2-100, Appendix G. The currently authorized cost, calculated at the October 2011 price level, is estimated at $1,497,000,000. The fully funded authorized cost is estimated at $1,590,000,000. Based on cost increases described in this report, the revised estimated cost for the Olmsted Locks and Dam Project (also fully funded) is currently $3,099,000,000. The current cost estimate without inflation over the future construction period (not fully funded), at the October 2011 price level, is $2,918,000,000. A summary of project costs is provided in Table ES-1.

Table ES- 1. Total Project Costs

Authorized Cost (Oct 1987 price levels)	$775,000,000
Authorized Cost (Oct 2011 price levels)	$1,497,000,000
Authorized Cost (Oct 2011, With Escalation)	$1,590,000,000
Sect 902 Maximum Cost Limit	$1,745,000,000
Current Total Cost (No Escalation)	$2,918,000,000
Current Total Cost (With Escalation / "Fully Funded")	$3,099,000,000
Sunk Costs through FY 2011 (actual expenditures)	$1,358,000,000
Remaining Costs (No Escalation)	$1,560,000,000

The increases in costs are not associated with changes in project purpose, local cooperation requirements, location of project, or as a result of modifications required by law. The changes in costs are a result of design changes, contract modifications, market conditions, site conditions, environmental mitigation (purchase of land & monitoring) rivers dikes, cultural resources and extended period of construction as described in Sections 8 and 9 of this report. Project cost increases are presented by Civil Work Breakdown Structure Feature Code, in October 2011 price levels, in Table ES-2.

Table ES- 2. Project Costs by Feature
($ in thousands)

	Feature	Authorized *1-Oct-87*	Authorized *1-Oct-11*	Current *1-Oct-11*	Difference
01	Lands & Damages	$357	$690	$6,059	$5,369
02	Relocations	$3,172	$6,127	$1,594	-$4,533
03	Reservoirs	$3,361	$6,492	$0	-$6,492
04	Dam	$326,733	$631,122	$1,722,952	$1,091,830
05	Locks	$355,676	$687,028	$486,948	-$200,080
06	Fish & Wildlife Facilities	$0	$0	$12,785	$12,785
08	Roads, Railroads, & Bridges	$700	$1,352	$3,643	$2,291
09	Channels & Canals	$6,166	$11,910	$50,402	$38,492
16	Bank Stabilization	$0	$0	$7,722	$7,722
18	Cultural Resources Preservation	$0	$0	$3,126	$3,126
19	Buildings, Grounds, & Utilities	$1,624	$3,137	$45,610	$42,473
20	Permanent Operating Equipment	$6,803	$13,141	$43,509	$30,368
30	Engineering And Design	$42,245	$81,601	$150,374	$68,773
31	Supervision & Administration	$28,163	$54,400	$128,460	$74,060
50	Operations & Maintenance	$0	$0	$10,616	$10,616
59	Contingencies	$0	$0	$244,200	$244,200
	Project Total	$775,000	$1,497,000	$2,918,000	$1,421,000

The estimate in this report was developed by a diverse and experienced team of cost engineers within the USACE cost engineering community of practice. The team was led by USACE Huntington District and included coordination with Louisville District Olmsted project delivery team for project scope and background information. The team consisted of USACE and AE Contractor technical subject matter experts with significant expertise in cost engineering, scheduling, risk analyses, and construction of technical complex civil works projects. The cost center of expertise reviewed the estimate and certified the cost estimate.

The total project cost estimate is comprised of the sunk cost (spent-to-date), the ongoing cost reimbursable dam construction contract and the out year contracts required to complete the project. The sunk costs thru 30 September 2011 are $1,358,000,000. The cost estimate to complete the dam construction is based on continuing the construction using the in-the-wet construction methodology and the cost reimbursable contract. The remaining cost for the dam is based on the 2011 re-baseline that use the actual productivity rates from fabricating and setting the first season of shells. The out year contracts estimates are based on limited design and that the construction contracts will be firm fixed price.

A Cost and Schedule Risk Analysis (CSRA) was performed to establish the 80-percent confidence level for both cost and schedule. The purpose of a CSRA is to identify potential events that could positively or negatively affect project cost or schedule, analyze their impacts and then be used as a project management tool to plan, track or control these risks. The 80-

percent Confidence Level is the recommended level for USACE cost estimates. The results of the CSRA were to include $244,378,000 for contingency in the cost estimate.

The schedule for completing the dam construction is based on the project receiving $150,000,000 annually with the majority of it being obligated to the dam construction contract. The $150,000,000 was determined due to the limited funds available in the IWTF. Thus, the assumed duration for the completion of the remainder of the project is funding based, rather than driven by the activities on the critical path.

If funding were not a controlling factor, the duration could be shorter and activity-driven. The maximum funding that the Corps could efficiently and effectively spend at this point in the project construction is estimated to be approximately $215,000,000 per year for six years. This funding stream would complete the dam construction approximately three years earlier and reduce the total project cost by nearly $250,000,000.

As part of our continuous improvement process an analysis of the means and methods and the management controls will be performed to assess the most cost effective way to complete the project. The scope of work for this analysis is being developed.

In summary, based on the data presented in this report, the October 2011 fully funded cost estimate for the Olmsted Locks and Dam Project is $3,099,000,000, of which $1,358,000,000 is sunk costs through FY 2011. The $3,099,000,000 figure exceeds the current Section 902 cost limit of $1,745,000,000 and therefore requires explanation and authorization for the higher figure. This report documents the history and background of project costs, and serves as a basis for approval of an increase in the authorized cost. This project has net annual benefits of $741,680,937[1].

[1] Benefits include costs forgone as per Budget EC 11-2-200; Cost excludes sunk costs through 2011; amortized at FY 2012 discount rate of 4.0%

Locks & Dams 52 and 53 Replacement Project

Post Authorization Change Report

TABLE of CONTENTS

EXECUTIVE SUMMARY i
SECTION 1 - Description of Authorized Project 1
1.1 Feature Code 01 Lands and Damages 2
1.2 Feature Code 02 Relocations 2
1.3 Feature Code 04, Dam 3
1.4 Feature Code 05, Locks 4
1.5 Feature Code 06, Fish & Wildlife Facilities 5
1.6 Feature Code 08, Roads, Railroads, & Bridges 9
1.7 Feature Code 09, Channels & Canals 9
1.8 Feature Code 16, Bank Stabilization 9
1.9 Feature Code 18, Cultural Resource Preservation 9
1.10 Feature Code 19, Buildings, Grounds, & Utilities 10
1.11 Feature Code 20, Permanent Operating Equipment 11
1.12 Feature Code 50, Operation & Maintenance 11
SECTION 2 - Authorization 12
SECTION 3 - Funding Since Authorization 12
SECTION 4 - Changes in Scope of Authorized Project 13
SECTION 5 - Changes in Project Purpose 13
SECTION 6 - Changes in Local Cooperation Requirements 13
SECTION 7 - Change in Location of Project 13
SECTION 8 - Design Changes 14
8.1 Design Changes After Feasibility Report Plan (Authorization) 14
8.2 Risk and Uncertainty 22
SECTION 9 - Changes in Total Project First Costs 23
9.1 Feature Code 01, Lands 25
9.2 Feature Code 18, Cultural Resource Preservation 26
9.3 Feature Code 30, Planning, Engineering and Design 27
9.4 Feature Code 31, Construction Management 29
9.5 Feature Code 50, Operation & Maintenance 30
9.6 Changes in First Costs 31
SECTION 10 - Changes in Project Benefits 45
10.1 Analysis History 45
10.2 Analysis Models 46
10.3 Input Assumption Updates 46
10.4 Benefit Update Comparison 52
SECTION 11 - Benefit-Cost Ratio 60
11.1 Construction Cost Interest During Construction 60
11.2 Benefit – Cost Ratio 63

11.3 Total Benefit – Cost Ratio (Benefit to Total Cost Ratio) 64
SECTION 12 - Changes in Cost Allocation 65
SECTION 13 - Changes in Cost Apportionment 66
SECTION 14 - Environmental Considerations in Recommended Changes 66
SECTION 15 - Public Involvement 67
SECTION 16 - History of Project 67
SECTION 17 - Conclusions 72
SECTION 18 - Recommendation 75

LIST of TABLES

Table 1 - History of Project Allocations 13
Table 2 - Comparison of Total Project Costs 24
Table 3 – Project Cost by Feature 24
Table 4 - Net Impact of Construction Modifications 40
Table 6 – Average Transportation Rate-Savings Comparisons 49
Table 7 - Closure Day Assumptions Comparison 52
Table 8 - Benefit Analysis Assumptions 53
Table 9 – Transportation Rate Savings Benefits Comparisons 54
Table 10 - Costs Foregone Benefits Comparisons 57
Table 11– Incremental Fuel Tax Revenue Comparison 59
Table 12 – Last Approved Report Construction Cost IDC and Amortization 61
Table 13 – Construction Cost Interest During Construction and Amortization 62
Table 14 – Average Annual Construction Comparison 63
Table 15 – Calculation of Project Authorization Benefit to Cost Ratio 64
Table 16 – Calculation of OMB Budgetary Benefit to Total Cost Ratio 65
Table 17 – Changes in Cost Allocation 65
Table 18 - Cost Apportionment 66

LIST OF EXHIBITS and FIGURES

Exhibit 1 – Location Map 1
Exhibit 2 – General Plan and Project Features 2

Figure 1 - Water Management Facilities, Ballard Wildlife Management Area 7
Figure 2 – Materials and Components for Construction 41
Figure 3 – Tonnage Demand Forecast Comparisons 47
Figure 4 – L&D 52 Existing Full Operation Capacity Comparison (No Navigable Pass and No Lock Interference) 50
Figure 5 – Transportation Rate Savings Benefits Comparisons – Analysis Year Price Levels ... 55
Figure 6 – Transportation Rate Savings Benefits Comparisons – 1 Oct 2011 Price Level 55
Figure 7 – Costs Foregone Benefits Comparisons 58

LIST of APPENDICES

APPENDIX A – Economics Update

APPENDIX B – Modifications During Construction

APPENDIX C – Section 902 Maximum Project Cost Computations

APPENDIX D – Olmsted L&D FY08 Program Year (PY) PB-3

APPENDIX E – Certification of Independent Technical Review

APPENDIX F – Baseline Cost Estimate for the Post-Authorization Change Report

APPENDIX G – Revised PACR Certification - November 2011

APPENDIX H – Review Plan and Review Plan Approval Memo

APPENDIX I – Independent External Peer Review Documentation

Locks & Dams 52 and 53 Replacement Project
Post Authorization Change Report

SECTION 1 - Description of Authorized Project

The Olmsted Locks and Dam Project is located at Ohio River Mile 964.4 between Ballard County, Kentucky and Pulaski County, Illinois. Reference Exhibit 1 below.

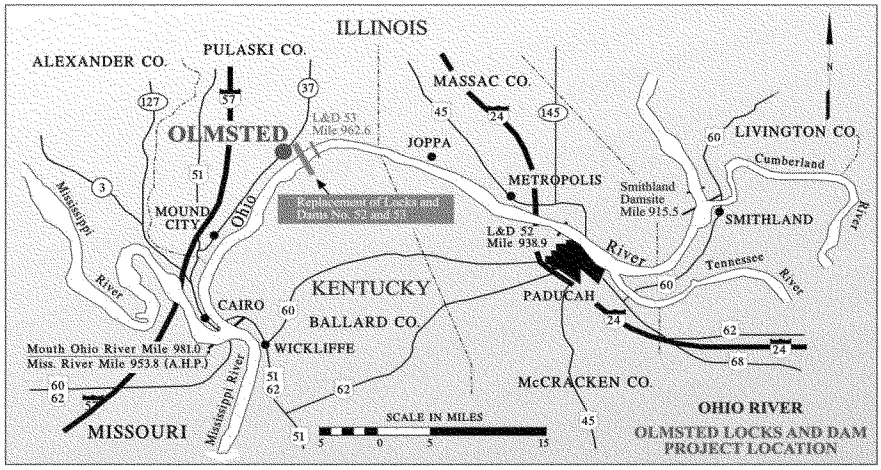


Exhibit 1 – Location Map

The Olmsted Locks and Dam Project features twin 1,200' by 110' locks that have been constructed along the Illinois bank. The dam portion of the Project consists of a tainter gated regulatory dam section composed of five 110' wide tainter gates, a 1,400' wide navigable pass controlled by 140 boat operated wickets and a fixed weir extending to the Kentucky bank. Since the Project is located within a region of high seismic hazard potential, each of the main features which have dissimilar seismic responses will be separated by seismic isolation joints to reduce the risk of damage during an earthquake. Open river conditions will exist from the Project to the mouth of the Ohio River and down to the mouth of the Mississippi River. The upper pool will be maintained by the Olmsted Dam to provide adequate navigable depth throughout the Olmsted pool. Operational objectives are to maintain a pool of 300 at Paducah and 302 at the Smithland Lock lower sill while maintaining a minimum pool of 295.0 at the Olmsted Dam site. The navigable pass will not be available for vessel transit until the tailwater has risen above elevation 295.0. See Exhibit 1 for General Plan and Project Features. Descriptions of project work follow, organized to the extent possible by Civil Work Breakdown Structure (CWBS) Feature Code.

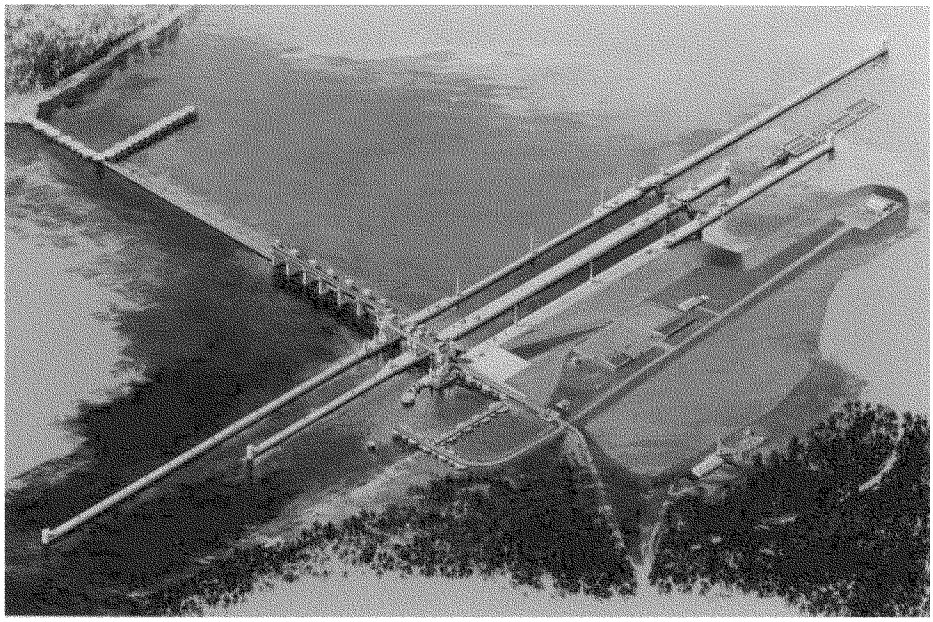


Exhibit 2 – General Plan and Project Features

1.1 Feature Code 01 Lands and Damages

The Feasibility Report identified that 120 acres of land was required on the Illinois side and 5 acres on the Kentucky side for the project construction. The report also identified 22 acres of flowage easement would be required along Ohio River tributaries.

1.2 Feature Code 02 Relocations

1.2.1 Access Road & Resident Engineer's Office

The Access Road and Resident Engineer's Office contract was the first construction contract awarded on the Olmsted Project. The work partially included the construction of 10,917 feet of county road, a 2,000 foot access road into the site, parking lots and support utilities. This required relocation of some utilities. The contract was performed by an 8(a) construction firm.

1.2.2 Relocation of Olmsted Boat Ramp

The old boat ramp was adjacent to the Project site the Feasibility Report planned to move the boat ramp to L&D 53 after the new dam was constructed. Due to safety concerns during construction the boat ramp was required to be relocated early in the construction of the project. Thus it was relocated downstream at Ohio River mile 966. Construction included a 24' wide asphalt access road approximately 710' long, a 4,600 square yard parking lot, a 320' long by 24'

wide ramp, earthwork, riprap, and miscellaneous other items associated with a boat ramp. A deed has been prepared and sent to the Village of Olmsted for signature. This deed swaps the ownership of the old boat ramp for the new boat ramp.

1.3 Feature Code 04, Dam

1.3.1 Dam Prototype

A full scale prototype (five wickets) of the navigable pass gates and their associated machinery was constructed at the fixed weir end of the Smithland Locks & Dam ("L&D"). It is located in a channel which was excavated around the fixed weir. The prototype was constructed with different materials to test various bearings, coatings, etc. In addition, the stilling basin was constructed to aid in the development of dispersing flow. The Prototype was demolished by a contractor constructing a hydropower facility at no cost to the project.

1.3.2 Olmsted Dam Construction

The Dam contract will construct an approximately 2,352' long dam from the lock to the fixed weir constructed in an earlier contract. The dam is comprised of five tainter gates (110' wide by 37' high) operated using hydraulic cylinders, a 1,400' navigable pass consisting of wicket gates that are centered-hinged (horse-type), and 9'-8"-wide flat plate gates at 10-foot centers. Also included in this contract are the two boat abutments, the tainter gate stilling basin, navigable pass paving blocks, and 455,000 tons of riprap. The District studied several alternatives before concluding that this dam configuration was the best one for this application.

In July 1997, the Louisville District decided to design the dam using a heavy lift-in, prefabrication construction method. This decision is further explained in paragraph 8.1.1.2 and 8.1.1.4. The various dam monoliths consist of precast shells, which will be placed using a large crane after the foundation has been completed. The construction will commence at the existing lock structure and proceed to the fixed weir on the Kentucky shore.

In 2002, the District requested proposals for this contract as a firm fixed-price contract, but received no offers. The contract was re-advertised as a cost-reimbursable contract, the District received responsive proposals, and the contract was awarded 28 January 2004. The precast yard and the marine skidway have been constructed and the contractor began placing the scour stone in the summer of 2007. Additionally, the contractor has procured several of the various pieces of specialized equipment required to construct this dam configuration, such as the catamaran barge, a 5,000 ton gantry crane, and an excavator barge. The first two seasons of shells have been fabricated in the precast yard. The first season shells have been set and the second year of shell setting is underway.

1.3.3 Demolition of Locks & Dam 52 and 53

Once the Olmsted Locks and Dam is completed, existing L&D 52 and 53 will be dismantled. The Section 106 consultation will determine the future of the land-based structures.

1.3.4 Site Restoration

The project acquired an abandoned clay pit for up land disposal of river material. It was determined that acquiring this land in fee was the most economical way to handle the material

disposal. At the conclusion of the construction this area will be reclaimed and replanted with native grasses and trees. This activity was not foreseen at the time of the feasibility study.

1.3.5 Excess Government Owned Equipment

The dam construction contract is a cost reimbursable contract thus the equipment purchased by the construction contractor is government property. Once the construction contract is physically complete the government will be responsible to excess any remaining equipment. This activity did not become a requirement until the award of the dam construction contract.

1.4 Feature Code 05, Locks

1.4.1 Lock Cofferdam Construction & Slide Repair

A conventional cellular sheet pile gravity cofferdam was constructed to allow for construction of the new lock in-the-dry. The cofferdam consisted of 50 cells and 49 connecting arcs filed with free draining material and capped with stone. Each of the fifty cells had a diameter of approximately 63 feet. The cells were constructed with 120 sheets of Bethlehem PS27.5 sheet piling and the arcs are built with 50 sheets. The majority of the sheets were 109' in length, for a total of 21,770 tons of sheet piling. The construction of the cofferdam was delayed due to the Mississippi River Flood of 1993. It was necessary to stabilize the Illinois bank prior to dewatering the lock cofferdam. This was accomplished by removing 1,340,000 cubic yards of material from the Illinois hill side. The dewatering system consisted of approximately 250 wells. After the cofferdam was unwatered (approximately 528 million gallons of water over thirty days), approximately 670,000 cubic yards of material was excavated from the bottom of the cofferdam enclosed area.

1.4.2 Locks Construction

A W-Frame dual lock structure was constructed with each lock being 1,200' long and 110' wide. The total width of the structure is 326 feet with an overall length of 1,578 feet. The walls are 54 feet high. The land and river walls are 27' wide at their base and 14' wide at the top. The middle wall is 52' wide. The lock structure consists of 26 monoliths with the outlet bucket downstream of the lower miter gates. The structure is founded on 542,000 linear feet of H-piles. There are approximately 692,000 cubic yards of concrete and 31,100 tons of steel reinforcing in the lock structure. During the construction of the locks, the cofferdam was overtopped, causing a delay and extensive cleanup. Upon completion of the locks construction, the contractor removed the cofferdam.

1.4.3 Lock Approach Walls Construction

Approach walls are provided upstream and downstream of each lock chamber to facilitate alignment of vessels entering and exiting the lock chambers. This contract built the nose piers and floating pontoons associated with the middle and river lock walls. In addition, it constructed the downstream fixed land lock wall. The four nose piers consist of four major drilled shafts that are 10 feet in diameter and casings that are 150 feet long. Three of the shafts are used to support the nose pier superstructure which was built to protect the pylon and floating pontoons. The pylon is constructed upon the fourth shaft. The eleven pontoons were fabricated off-site in a graving yard and floated to the site in 2003. The pontoons were integrated at the site to produce wall lengths as follows: upper river 1,716 feet, upper middle 782 feet, lower river 1,152 feet,

lower middle 167 feet. The lower land wall was constructed with precast concrete segments set on top of nineteen drilled shafts.

1.4.4 **Operating Bulkheads**

The operating bulkheads work consists of fabricating and installing one permanently mounted bulkhead for each lock chamber that can be raised and lowered (similar to a tilt-up garage door) with overhead machinery. The two operating bulkheads are nearly 120' wide by 50' tall and each weighs approximately 340 tons. The contractor was also required to install the guide rails on which the operating bulkheads ride in the existing lock and pier walls. The contractor filed a claim for over-restrictive specifications, the District settled this claim in October 2009 at the Armed Services Board of Contract Appeal.

1.4.5 **Mooring Cells**

Mooring cells will be required upstream and downstream of the Project for tows waiting to process through the locks. Two additional mooring points, one upstream and one downstream, were included to aid the queuing of tows and reduce potential bank erosion. The downstream cells have been constructed. The work consisted constructing four 31'-diameter cells between river miles 966.1 and 965.68 on the Illinois side of the Ohio River. In addition to constructing the cells, nine line hooks per cell were fabricated and installed on the riverside of the faces. The upstream cells will be constructed after L&D 52&53 are out of service.

1.5 **Feature Code 06, Fish & Wildlife Facilities**

1.5.1 **Water Management Facilities, Ballard Wildlife Management Area**

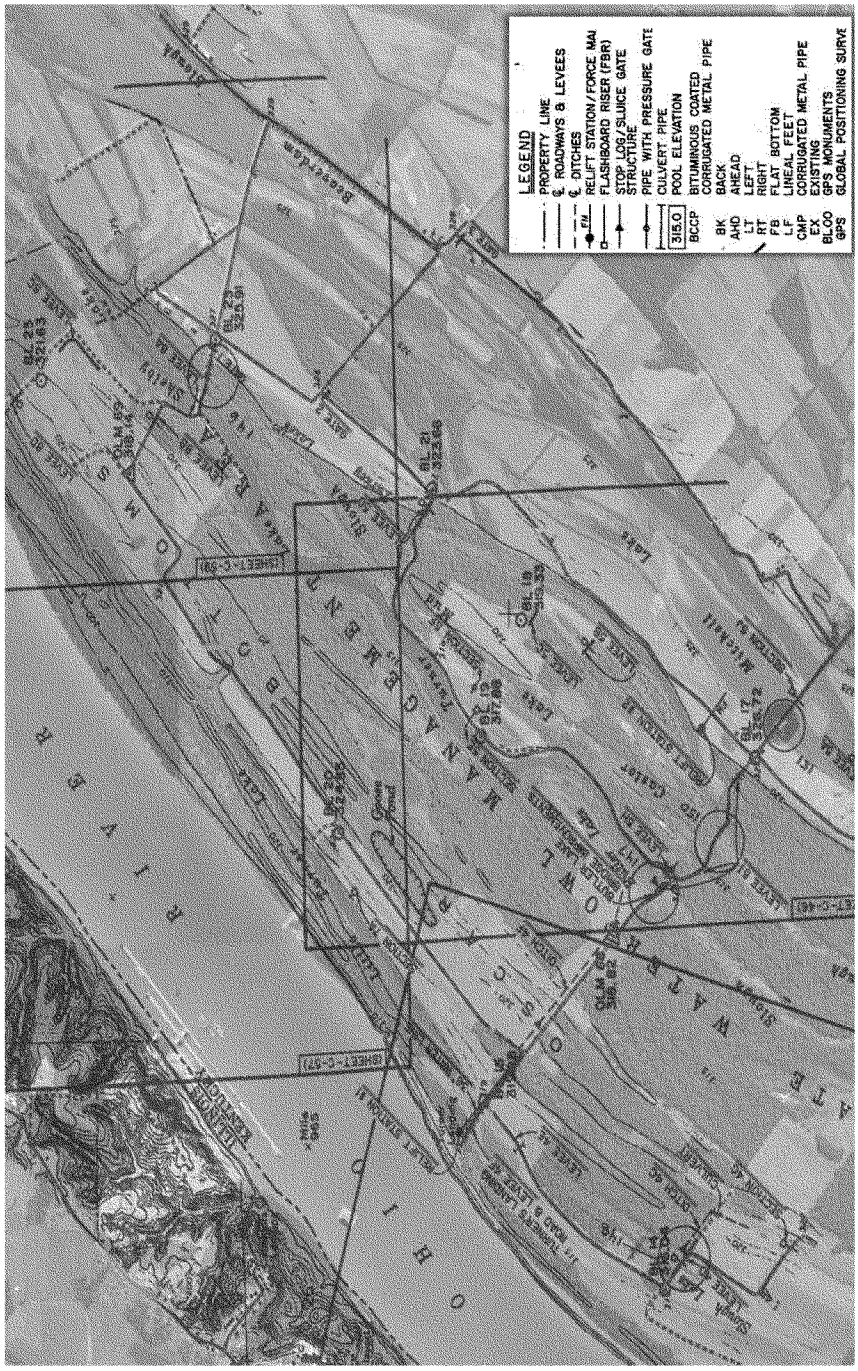
As part of the mitigation for the Project, the Government signed a Cooperative Agreement with the Kentucky Department of Fish and Wildlife Resources. As part of this agreement, the COE was required to construct water management features at the Ballard Wildlife Management Area in Ballard County, Kentucky. The water management features included the construction of pump stations, water distribution pipelines, paved ditches, pipes, stop-log structures, levees, and water control structures. The contract to construct the water management features was awarded in May 1993. The facilities were turned over to Kentucky Department of Fish and Wildlife Resources on 11 February 1998.

After a few years of use, Kentucky Department of Fish and Wildlife Resources discovered that the main pump did not operate when the Ohio River was at extreme low water, resulting in an inability to supply water to the lakes as required. The invert of the primary pump that draws from the Ohio River during the fall (low water period) was designed too high to operate effectively during the low water season. An amendment to the PCA was signed in May 2002 to upgrade Pump #1. Pump #1 was re-designed and a construction contract was awarded. The impeller also failed and was also changed out as part of the follow on contract. The original material used to fabricate the impeller was not specified properly for this application. The work was completed in the fall of 2006.

Figure 1 below shows design drawings for the water management features superimposed on aerial imagery. Features shown are underlined in red, however not all constructed features are

shown in the figure. Additional levees and relief stations have been constructed along Humphrey Creek to the southwest of the area shown.

Figure 1 - Water Management Facilities, Ballard Wildlife Management Area



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1.6 Feature Code 08, Roads, Railroads, & Bridges

1.6.1 Access Road & Resident Engineer's Office

The Access Road and Resident Engineer's Office contract was the first construction contract awarded on the Olmsted Project. The work partially included the construction of 10,917 feet of county road, a 2,000 foot access road into the site, parking lots and support utilities. The contract was performed by an 8(a) construction firm.

Before the county road can be turned back over to Pulaski County, the Government is required to put a final surface course on the road at the end of the Project. In addition, the Government was required to do an interim overlay to maintain the surface in the meantime. This is required due to the fact that the Project has taken much longer than originally anticipated.

1.7 Feature Code 09, Channels & Canals

1.7.1 River Dikes

Model studies conducted during design indicated that dikes were needed to facilitate navigation into and out of the lock chambers on the Illinois side and are needed on the Kentucky side to help control sedimentation around the Locks and Dam. These rock structures were tested in the model facilities and were determined necessary to produce desired conditions. The construction of these dikes will be executed following completion of the dam.

1.8 Feature Code 16, Bank Stabilization

1.8.1 Slide Repair & Lock Cofferdam Construction

A conventional cellular sheet pile gravity cofferdam was constructed to allow for construction of the new lock in-the-dry. The cofferdam consisted of 50 cells and 49 connecting arcs filed with free draining material and capped with stone. Each of the fifty cells had a diameter of approximately 63 feet. The cells were constructed with 120 sheets of Bethlehem PS27.5 sheet piling and the arcs are built with 50 sheets. The majority of the sheets were 109' in length, for a total of 21,770 tons of sheet piling. The construction of the cofferdam was delayed due to the Mississippi River Flood of 1993. It was necessary to stabilize the Illinois bank prior to dewatering the lock cofferdam. This was accomplished by removing 1,340,000 cubic yards of material from the Illinois hill side. The dewatering system consisted of approximately 250 wells. After the cofferdam was unwatered (approximately 528 million gallons of water over thirty days), approximately 670,000 cubic yards of material was excavated from the bottom of the cofferdam enclosed area.

1.9 Feature Code 18, Cultural Resource Preservation

1.9.1 Locks & Dams 52 and 53

Early in the project, cultural resources consultation/studies examined various portions of the Project site and identified both historic structures and archaeological resources. As none of these were deemed to be significant, no further coordination or development of mitigation strategies was required. However, cultural resources requirements changed when, during 1987 - 1988,

L&D 52 and 53 were both identified as historic properties and it was determined that the Olmsted Project would have an adverse effect on them. The identification of these historic resources was not foreseen. Lock and Dams 52 and 53 were not identified as a cultural resources issue by the Feasibility Report (1985) or by the Chief's Report (August 20, 1986). They were not identified until July 1988 as eligible resources that would be adversely affected by the Olmsted Project. They were officially recognized as eligible resources with the signing of Consensus Determination of Eligibility forms on November 17, 1988.

Ways to mitigate the adverse effect of the Project on the historic structures will be addressed in a Memorandum of Agreement (MOA). Seven actions to mitigate the adverse effects are currently being discussed but have not yet been finalized.

The list of the mitigation alternatives that are currently under consideration include:

- Completion of book and pamphlet on the development of navigation at L&D 52 and 53
- Photo and engineering drawing documentation of L&D 52 and 53
- Structure assessment of residences
- Minimal maintenance to stabilize residences at one of the sites
- Public interpretation plan and one set interpretive materials
- Outdoor display of wickets and work boat at one of the sites
- Rehabilitation of one structure (i.e. powerhouse) for interpretation

1.10 Feature Code 19, Buildings, Grounds, & Utilities

1.10.1 Resident Engineer's Office

The Access Road and Resident Engineer's Office contract was the first construction contract awarded on the Olmsted Project. The work partially included the construction of an 8,350 square foot office building to house the COE staff, a visitor's overlook, a public restroom, parking lots and support utilities. The contract was performed by an 8(a) construction firm. At the completion of the Locks and Dams construction, this building will be converted for operations use as a storage/repair for hydraulic cylinders.

1.10.2 Olmsted Miter Gate Storage Yard

Over the years progress was made on the quick change out system for miter gates. The MV. Shreve (gate lifter) was procured by Operations as a regional asset. This concept was not in place at the time the project was authorized. The Olmsted miter gates were designed to be changed out using this new procedure. A spare set of miter gates were fabricated as part of the lock construction contract. In order to properly store these gates and to have them ready to replace an operating gate, the spare gates were assembled and hung on a pier accessible to the river. Due to the fluctuation in river elevation a suitable location (one that would not go under water several times a year and have access to the river) could not be found at the Olmsted site. After considering several options, it was determined that the best location was to construct the pier at the Smithland Locks and Dam.

A contract was awarded in March 2002 for the design and construction of the Olmsted Spare Gate Storage Facility. This was the first design-build civil works contract in the COE. In

addition, the contract was awarded to a HUBZone contractor. The Project consisted of the design and construction of an access road, a bulkhead retaining wall, a concrete slab, a 53' high gate storage pier supported by a deep foundation system, erection of two spare miter gate leaves, and a storage area for the four maintenance bulkheads.

1.10.3 **Service Mound Buildings**

The service mound will consist of approximately three acres of improved area accessible via the access road. There will be three buildings: the Lockmaster/Visitor Center, a maintenance building, and a storage building. Also included in this feature of work are parking lots, fencing, landscaping, sidewalks, and site furniture for the visitor overlook area. The storage building contract was awarded in August 2007 and completed in April 2009. The contract for the remaining work will be awarded late in the project.

At the end of the Project, the current Resident Engineer's Office will be converted to a storage building. The primary items that will be stored in this building are the spare hydraulic cylinders.

1.11 Feature Code 20, Permanent Operating Equipment

1.11.1 **Maintenance Bulkheads**

The maintenance bulkhead work consists of fabricating one 11', one 18', and two 38' portable/stackable steel bulkheads to fit in the maintenance slots. The contract was awarded in September 2001 and completed in July 2005. The contractor filed a claim for over-restrictive specifications, which the District settled in October 2009.

1.11.2 **Permanent Operating Equipment**

Several pieces of equipment will be required to operate this new facility. They include: a washdown barge including pumps and an articulated boom, 700HP towboat, spare parts barge, wicket lifter, 3,000HP tender, flat deck barge, , and miscellaneous shop equipment. Several of these items have already been procured.

1.12 Feature Code 50, Operation & Maintenance

1.12.1 **Maintenance of Completed Work**

Portions of the Project were completed in 2001 such that it became necessary to add maintenance staff to take care of the completed work. Until the project is put in service and opened for navigation traffic the project will pay for the O&M of the completed work. The Olmsted Project is responsible for any operational activities required during the construction period. . This cost was not included in the original estimate. Currently, it is estimated that the O&M account will begin paying these costs when the dam is operational. Once the project is operational the O&M cost will move out of the Construction General account to the Operation and Maintenance account. Also included is the requirement for lock operators during the later stages of the dam construction. The operators will coordinate the passing of river traffic when the navigable pass is obstructed with construction equipment.

SECTION 2 - **Authorization**

The Olmsted Locks and Dam Project was authorized in Section 3(a)(6) of the Water Resources Development Act of 1988 (Public Law 100-676) based on a total cost of $775,000,000 (calculated at October 1987 price levels), as follows:

> *Lower Ohio River, Illinois and Kentucky.—The project for navigation, Lower Ohio River, Locks and Dams 52 and 53, Illinois and Kentucky: Report of the Chief of Engineers, dated August 20, 1986, at a total cost of $775,000,000, with a first Federal cost of $775,000,000, and with the costs of construction of the project to be paid one-half from amounts appropriated from the general fund of the Treasury and one-half from amounts appropriated from the Inland Waterways Trust Fund.*

The Project was authorized substantially in accordance with the plans, and subject to the conditions, recommended in the Report of the Chief of Engineers, dated 20 August 1986. The authorized cost was based on the detailed baseline cost estimate for the recommended plan presented in the Lower Ohio River Navigation Feasibility Report, dated December 1985. The estimated total Project cost in the Report of the Chief of Engineers was $565,719,000 (October 1985 price level). The approximated $209,000,000 increase in cost between the Report of the Chief of Engineers and the Authorization resulted from design changes ($186,000,000) and price level adjustments ($23,000,000) in the intervening years.

SECTION 3 - **Funding Since Authorization**

Table 1 presents the funding history, by fiscal year and appropriations category from FY 1986 through FY 2011.

Table 1 - History of Project Allocations

	General Investigations	Construction General	Construction General (Inland Waterways Trust Fund)	ARRA	Allocation
FY 1986	$239,000				
FY 1987	$2,636,000				
FY 1988	$2,650,000				
FY 1989	$3,730,000				
FY 1990	$3,768,000				
FY 1991			$3,612,000		$3,612,000
FY 1992			$4,657,000		$4,657,000
FY 1993		$9,022,000	$13,778,000		$22,800,000
FY 1994		$41,936,000	$41,936,000		$83,872,000
FY 1995		$3,796,000	$3,796,000		$7,592,000
FY 1996		$18,490,000	$18,490,000		$36,980,000
FY 1997		$34,742,000	$34,742,000		$69,484,000
FY 1998		$38,900,000	$38,900,000		$77,800,000
FY 1999		$24,889,000	$24,889,000		$49,778,000
FY 2000		$43,464,000	$43,464,000		$86,928,000
FY 2001		$28,966,000	$28,966,000		$57,932,000
FY 2002		$28,083,500	$28,083,500		$56,167,000
FY 2003		$14,803,000	$14,803,000		$29,606,000
FY 2004		$16,267,500	$16,267,500		$32,535,000
FY 2005		$29,372,500	$29,372,500		$58,745,000
FY 2006		$44,550,000	$44,550,000		$89,100,000
FY 2007		$55,000,000	$55,000,000		$110,000,000
FY 2008		$51,168,000	$51,168,000		$102,336,000
FY 2009		$54,547,000	$54,547,000	$4,906,000	$114,000,000
FY 2010		$50,760,500	$50,760,500	$24,405,000	$125,926,000
FY2011		$71,451,594	$71,451,594	$205,000	$143,108,188
Total	$13,023,000	$660,209,594	$673,232,594	$29,516,000	$1,375,981,188

SECTION 4 - **Changes in Scope of Authorized Project**

None.

SECTION 5 - **Changes in Project Purpose**

None.

SECTION 6 - **Changes in Local Cooperation Requirements**

None.

SECTION 7 - **Change in Location of Project**

None.

SECTION 8 - **Design Changes**

The following paragraphs describe the major changes and the resulting cost implications, organized to the extent possible by Feature Code. However, it should be noted that cost impacts are shown for conceptual information purposes and are not all calculated at the same price level in this section. Dates identified for cost estimates or cost increases indicate the cost's price level. The summation of the following discussion is that design changes which were necessitated after the Feasibility Report resulted in a cost increase in excess of $200 million through Dam DM #8. The innovative design incorporated in to the project resulting in virtually the same cost reductions. The project design and construction proceeded within budget until the dam construction contract. Concerns with the overall budget began with the initial advertisement of the dam construction contract (no firm fixed price bidders and consequently a cost reimbursable contract). The second advertisement as a cost reimbursable contract also had limited competition and required an extended construction period. The first two years of the contract period provided only limited funding to the contractor. In addition market conditions increased the cost of procurement of the mobilization. Other factors that have led to the increased cost of the dam is the fact that the method of construction is innovative, river conditions and lack of efficient funding. These are a few of the factors that have led the Olmsted Project cost increases beyond the authorized limits.

Additionally, Olmsted L&D has been the subject of many studies and reviews with the goal of providing the most economic solution to the needs of navigation on the Lower Ohio River. The sections below include discussions of the most significant efforts to incorporate innovative design and construction techniques to improve upon the authorized plan which was presented in the Lower Ohio River Feasibility Study, Illinois-Kentucky. These innovative studies included consideration of construction techniques utilized worldwide to design and construct major structures in similar marine environments, value-engineering efforts, and continued refinement of the individual features of the project. The efforts also incorporated sophisticated analysis and design to more accurately define expected loadings and demands on the structure and to assure adequate performance. A special emphasis on refined analysis was required because this region of the country has been subjected to the strongest historically recorded earthquake motions within the continental United States. Lessons learned from these studies have resulted in many new USACE guidance documents which will apply to future designs. A goal of these efforts was not only to improve the project design, but also to improve the way in which the Corps constructs the project so that it is more cost effective.

8.1 **Design Changes After Feasibility Report Plan (Authorization)**

Many changes to the authorized Feasibility Report Plan design have been necessitated as more information has been gathered and problem areas have been better understood. Major elements of these changes are discussed below.

8.1.1 **Feature Code 04, Dam**

8.1.1.1 *Dam*

The design and construction of the Olmsted Dam structure is unique in part because of the need to provide a navigable pass to accommodate the needs of the towing industry, the location of the structure where it is affected by headwater flows of the Ohio River and backwater from the

Mississippi River, the use of a hinged operating pool, and the high seismic demands which the region may place upon the structure.

As authorized in the Feasibility Report, the Olmsted Dam would consist of a gated spillway section with six conventional 110' wide tainter gates with supporting piers and an 1100' wide navigable pass section with 11 drum gates (each 100' wide). The final portion of the dam was an 880' long fixed weir constructed of sheet-pile cells filled with rock.

During the Feasibility and GDM phases, initial emphasis was placed on the navigable pass gate design; various options included drum gates, hydraulic wicket systems operating in a dry or a wet environment, wickets raised or lowered using a gantry-type crane which moved along the dam sill on rails, and wickets raised using a modernized version of the L&D 52 and 53 boat operation. The Olmsted Dam, as presented in the GDM, consisted of six 110' wide tainter gates with piers, 1125 feet of 15' wide articulated strut wickets, and a 650' wide fixed weir. The weir was shortened when hydraulic studies showed that shifting the locks riverward would result in better approach conditions and lessened the length of dam structure as compared to the authorized Feasibility Report Plan.

As the project design continued and more information had been developed on the seismic design requirements for the structure, interest in alternative designs to eliminate the tainter gate piers – which were especially sensitive to earthquake motions – became a priority. This led to investigating an all-wicket dam. This concept was solidified as a reasonable option in July 1989 when the Waterways Experiment Station presented test results of the 1:120 model of an all-wicket dam. Also at that time, preliminary construction cost estimates indicated that pass-type gates were less expensive than comparable tainter gates. These results led to an intensive effort to identify and assess a number of alternative plans with the most promising four plans being studied in greater detail. The plan that was eventually selected consisted of a 2200' wide navigable pass/regulatory section controlled by 220 wickets, and a fixed weir.

Although there was an estimated savings in first costs between this plan and the updated GDM Plan (with 1340 feet of navigable pass as determined with model study results), average annual costs for each plan were estimated to be within 5 percent of each other. Because of the unique nature of this dam, a full-size prototype model was constructed to test gate operations and maintenance procedures and to determine the most durable materials. This model was utilized in conjunction with a 1:5 model constructed at the Waterways Experiment Station. As the design effort progressed for the hydraulic wicket dam, the assembly and controls became increasingly complex. Also, the estimated maintenance effort which would be required for the structure increased significantly. During this time, lessons learned in the seismic design of the locks were applied to the design of the tainter gate structures with the net result being a reduction of pier foundations and reinforcement. Continuing efforts to provide the most suitable and economical facility led to comparing life-cycle costs for a boat-operated wicket navigable pass with a tainter gated section versus the 2200' wide navigable/regulatory pass dam. The life-cycle costs for the tainter-gated /boat-operated facility were only 1 to 2 percent more than the costs for the hydraulic wicket facility. Therefore, the decision was made to revise the design and to build a dam configured of tainter gates and boat-operated wickets. This decision was made to ensure reliability, safety, and cost effectiveness of project operations at Olmsted by utilizing tried and

proven concepts. This decision was a joint decision of COE and Industry representatives.

After this decision, a Tainter Gate Optimization Study recommended utilizing five tainter gates in lieu of the previously planned six, but with a sill elevation five feet lower than the original plan. The study also recommended revisions to the tainter gates and the machinery to raise and lower the gates.

These changes to the Olmsted dam structures (in conjunction with the savings noted in) resulted in cost changes. The October 1987 price level cost for the dam was $326.7 million. The cost was $299.2 million in the GDM (October 1988 price level) and $ 301.8 million in the GDM Supplement (October 1989 price level). The cost was $341.5 million in DM #7, Lock FDM (October 1991 price level). The cost increases and the innovative savings resulted in a main dam cost (including operating equipment) of $286.8 million as shown in DM#8, Dam FDM (October 1998 price level). Limited competition and other significant changes in market conditions resulted in a bid award price of $564 million for the dam construction contract in January 2004. This bid reflected contractor concerns stemming from a lack of financial success on previous related contracts (such as the locks), concern regarding work force efficiency, and perceived risk associated with a new in-the-wet river construction technique.

8.1.1.2 Dam Construction Heavy Lift Equipment and Pre-Cast Yard

Construction of the Dam utilizing the "heavy lift-in" method of construction was determined to be more economical and less environmentally disruptive than construction within a cellular cofferdam. This method requires the procurement of several pieces of equipment which are capable of handling loads as great as 5,000 tons on both land and water. It also requires the construction of a concrete pre-casting yard and a marine launching facility for large pre-cast concrete shells. The cost of these items was not in the Feasibility Report Plan. It is noted that minimal salvage value for these items is included in the Olmsted Dam contract as this equipment is necessary for the contract and disposal may not yield funds back to the Project. However, this Government-owned equipment and the facility could be readily adapted to use for future Corps navigation construction projects such as those on the authorized Upper Mississippi and other Ohio River facilities (such as the authorized J.T. Myers Project). Utilizing this facility would allow the off-site construction of major structural components which could then be set in place rapidly. This type of construction would be highly desirable for existing navigation facilities because it would minimize the loss of benefits associated with interrupting navigation traffic during construction of the new facility. Using this existing Government-owned facility would dramatically reduce the cost to be borne by a new Corps facility.

8.1.1.3 Gate Prototype Facility

Because of the unique nature of the Olmsted navigable pass section of the dam, it was deemed necessary to construct a full size operating model of the wicket gates. At that time, the wicket gates were to be hydraulically raised and lowered and were to be a part of the 2200' long navigable pass/flow regulation dam. This test allowed the function and durability of the operating equipment as well as allowing various materials to be tested. The prototype was completed at a cost of $18,675,499 in December 1995. Additional costs were added to PED to run the testing program and to evaluate results. Demolition of the facility was accomplished by the hydropower contractor constructing a new facility at this location at no cost to the project.

8.1.1.4 Method of Dam Construction Study

The Feasibility Report method of constructing the Olmsted Locks and Dam features was construction inside multiple conventional cellular cofferdams which could be dewatered. This was the method which was utilized to construct the locks, but alternate methods to construct the dam were investigated beginning with the Mobile Cofferdam concept considered in the GDM. These studies culminated in a Method of Construction Study (1997) which was included in the Dam Feature Design Memorandum (DM#8). This Method of Construction Study examined both in-the-dry construction methods using cellular cofferdams and in-the-wet construction using the heavy-lift construction techniques employed on coastal and marine construction projects for more than forty years. The estimated first costs (1997) for the in-the-wet construction method was determined to be $64 million less than the in-the-dry construction method. The shortest reasonable time for construction duration for in-the-wet was estimated to be less than half of that for in-the-dry. The in-the-wet method was also deemed to be more desirable from an environmental viewpoint. The in-the-wet method was therefore selected as the construction method for the Olmsted Dam.

8.1.2 **Feature Code 05, Locks**

The locks feature is comprised of the lock cofferdam, locks, approach walls, operating bulkheads, and mooring cells.

8.1.2.1 Lock Excavation Costs

Lock excavation costs increased $8,894,000 because material excavated for the lock must be spoiled rather than being used as fill as was noted in the Locks DM#7. Also, the Lock Cofferdam costs increased by $8,924,000 due to the addition of pre-dredging to facilitate sheet pile installation, as was recommended by the design consultant (DM#7). In addition, the extended period of construction has resulted in miscellaneous repairs to the locks, dredging, and operation during construction which has added $5.5 million in costs. These values reflect April 1997 cost estimates.

8.1.2.2 Lock Approach Walls

The high seismic forces which became the controlling load case for design of the lock approach walls caused a marked increase in the cost of this portion of the facility. As the design progressed and the difficulty of providing an adequate and stable structure was better understood, the cost increased from approximately $35 million in the Feasibility Report (October 1985) to $64 million in the Lock DM#7 (April 1997). However, the final design which incorporated floating approach walls for the majority of the structure will greatly simplify long-term maintenance and improve the safety of the maintenance operations. The final design does not require manually cleaning the top of the floating approach walls approximately three times per year as would have been required after each inundation event with the Feasibility Report design.

8.1.2.3 Mooring Cells

The number of mooring cells was increased from four to eight with a cost increase of approximately $6.0 million. This change was made to more safely accommodate the arrival of tows at the Olmsted site.

8.1.2.4 Lock Operating Bulkheads

The nature of the lock operating conditions at Olmsted requires that the lock miter gates be opened and closed about three times per year with water temporarily flowing through the lock. This was accomplished at the old L&D 52 and 53 by winching the gates open or closed because the gate-operating equipment is designed to always have an upper or lower gate set closed and to be operated in still water. To safely accomplish opening and closing the much larger Olmsted miter gates, a set of Operating Bulkheads was added which could be set to provide a still water condition. The construction contract was completed in July 2005 at a cost of $10,837,379.

8.1.2.5 W-Frame

The Olmsted Locks structure incorporates a first-of-its-kind W-frame structure. This type of structure allows the middle lock wall to be narrower than it would be for typical separate monolith construction (52 feet versus 64 feet). It also offers advantages for seismic design and for dewatered maintenance conditions. The lock walls were proposed to be concrete gravity structures in the Feasibility Report. GDM investigations showed a W-frame lock design to be more cost effective. Two separate U-frame locks adjacent to each other were considered as well as the Feasibility Report scheme. The W-frame (with a single middle wall culvert) was selected because it showed a savings of $36.4 million (March 1989) as compared to the gravity structures in the Feasibility Report.

Following the GDM, additional studies (GDM Supplement – April 1990) determined that the length of the W-frame could be shortened by revising the location of culvert intakes and the culvert discharge structure. Also, it was determined that two culverts (separate for each chamber) could be provided in the same 52' wide middle wall with taller, narrower culverts. These efforts resulted in a savings of about $21 million and also provided operational improvements compared to the GDM plan.

8.1.2.6 Top of Lock Wall and Backfill

The navigable pass dam structure which was authorized in the Feasibility Report allowed the top of the lock walls to be much lower than other modern Ohio River lock structures. The Feasibility Report presented lock walls with a top elevation of 307 with 3.5' tall concrete parapet walls. Additional studies (GDM) indicated that life-cycle costs, especially those associated with cleaning and maintaining the structure after being overtopped by flood flows, would be improved by changing to a top-of-lock elevation 310 with no parapet walls.

Value-engineering studies and more refined analysis allowed increasing the level of backfill behind the majority of the land wall. By placing the fill to the top of the wall, the need to periodically excavate or dredge sediment deposits from that area was eliminated. That effort affected the slide repair also and resulted in an estimated contract savings of $16 million (GDM – March 1989).

8.1.2.7 Seismic

The potential strong earthquake motions to which the structure could be subjected are greater than those for any other similar Corps structure. This presented unique problems in providing an effective and efficient design that could withstand the demand placed on the structure. The design process was a staged approach where increasingly more refined analysis and criteria

allowed the performance of the structure during an earthquake to be better understood. This generally allowed a lesser amount of concrete reinforcement to be utilized in the W-frame lock structure than would have been required for the less sophisticated analysis. Also, pile quantities were reduced. As an example, more refined dynamic analysis of the typical lock W-frame monolith allowed increasing pile row spacing from 6.5 feet to 7.0 feet (GDM – March 1989 to GDM Supplement – April 1990). Value-engineering efforts which applied revised pile criteria and which improved some foundation materials rather than removed them provided a savings of $9.7 million. These same procedures resulted in new USACE seismic design guidelines for navigation structures.

8.1.2.8 Non-Linear Incremental Structural Analysis

Non-linear Incremental Structural Analysis (NISA) was utilized to analyze thermal effects on the massive concrete W-frame lock monoliths. This was required to understand the stresses which would be produced as the concrete went through the curing process in order to avoid undesirable cracking of the structures. It also afforded an understanding of what effects residual stresses locked into the structure might have during an earthquake event. Results of the NISA studies showed that stringent efforts to reduce the temperature of the concrete prior to placing would not generally be required (as would have been dictated by conventional techniques). The studies also showed that it would be acceptable to place concrete in 10-foot deep lifts (if desired) rather than the normally accepted 5-foot deep lifts. In addition, because rapid development of concrete strength was generally not required (because of the length of time before service loads would be applied), the concrete strengths were specified at 120 days rather than the normal 28-day strength. This allowed more pozzolan which reduced the amount of cement in the concrete mixture, which was more economical and produced less detrimental heat during the curing process.

8.1.2.9 Intake Screens

A modified all-welded screen design (these screens limit drawing large debris into the intake culverts) was adapted for this Project. This screen was based upon a design developed for the Melvin Price L&D. The screens will be more easily maintained and are expected to have a lower life-cycle cost than other typical intake screens which have been utilized on other locks on the Ohio River.

8.1.2.10 Lock Approach Walls

The lock approach walls, which allow tows to more efficiently and safely enter and exit the lock chambers, have gone through several design changes for the Olmsted Project. The approach walls were to be designed as concrete gravity walls supported below water on sheet-pile cellular structures in the Feasibility Report. The upper approach walls presented in the GDM were similar with a concrete wall founded on sand filled circular sheet-pile cells. The lower approach walls were to be concrete-filled sheet-pile cells. As a result of Value Engineering (OVEST – October 1989) studies and Louisville District studies, the design was to be modified in the GDM Supplement (March 1989) to consist of both upper and lower approach walls with a concrete wall on top of circular sheet-pile cells filled with stone. H-piling would be driven inside each cell to help support the loads. The value engineering study indicated potential savings of approximately $6 million as compared to the GDM design. When more comprehensive seismic analysis indicated that these designs would not adequately resist the large earthquake forces, a

change was made to provide floating approach walls for the majority of the project with a drilled caisson design being utilized for the lower land approach wall. These changes dramatically reduced the mass of the structures and subsequently, the force which they must resist during an earthquake. Although it was initially predicted that utilizing this design might be $19 million (or more) less costly than revised alternate designs, the biggest benefit of switching to the floating approach walls may be the elimination of the need to clean them after each flood event (estimated to average three times per year).

8.1.3 **Feature Code 09, Channels & Canals**

8.1.3.1 River Dikes

Model studies which were accomplished throughout the design period indicated that dikes were needed to facilitate navigation into and out of the lock chambers and to help control sedimentation around the Locks and Dam. These rock structures were tested in the model facilities and were determined necessary to produce desired conditions. The construction of these dikes will not be executed until the dam construction is complete. The current estimate for river dikes increased the Channel feature cost estimate by $39,348,000 (October 2011).

8.1.4 **Feature Code 16, Bank Stabilization**

8.1.4.1 Illinois Bank Stabilization

The geologic history of the Olmsted Project site is very complex. The region has been subjected to uplift, subsidence, and tectonic movement. After approval of the Feasibility Report Plan, an intensive geotechnical investigation program was initiated. This included, in part, additional borings to determine the makeup and strengths of the existing materials at the Olmsted site. A program to monitor movement of the relatively steep Illinois bank was also put in place. This monitoring indicated that an active slide existed in both the upper and lower Illinois bank at the site of the locks. Dewatering this area to allow construction of the locks would produce an unacceptable condition. As additional information was gathered, and as input for the design solution was received from numerous outside expert consultants, the recommended solutions progressed from stone columns in the GDM Supplement to a "mass excavation" alternative presented in the Foundation DM#5 Supplement. This solution involved excavating approximately one million cubic yards of material from the upper slope and approximately 600,000 cubic yards of material from the lower slope. It also necessitated acquisition of an abandoned clay mining pit adjacent to the site to allow spoiling unsuitable material. About 1.5 million cubic yards of engineered fill material was then required to construct the service building mound. The service mound serves as a buttress to strengthen the Illinois bank slide repair and will serve as the future location for the Olmsted service facilities. The service mound is greatly increased in size compared to the structure envisioned in the Feasibility Report. Costs associated with these changes were reflected in the Lock DM#7 with a cost estimate of $18,443,000 (October 91) for Bank Stabilization; none was included in the Feasibility Report.

The bank stabilization work was accomplished in the lock cofferdam construction contract. The contract was completed in March 1996 at a cost of $7,722,000.

8.1.4.2 Bank Stabilization Innovative Design

Although the estimated solution discussed above was $18, 443,000 (more than the authorized Feasibility Report) as noted in DM # 7, this amount was a reduction from the $30,401,000

estimated cost in DM #2. The savings was the result of continued effort to better understand the problem with additional investigation and to consider alternate methods and solutions. The use of "mass excavation" was the selected solution to the problem.

As authorized in the Feasibility Report, the Olmsted Dam would consist of a gated spillway section with six conventional 110' wide tainter gates with supporting piers and a 1100' wide navigable pass section with 11 drum gates (each 100' wide). The final portion of the dam was an 880' long fixed weir constructed of sheet-pile cells filled with rock.

Initial emphasis, during the Feasibility and GDM phases, was placed on the navigable pass gate design. The Olmsted Dam, as presented in the GDM, consisted of six 110' wide tainter gates with piers, 1125 feet of 15' wide articulated strut wickets, and a 650-foot wide fixed weir. The weir was shortened when hydraulic studies showed that shifting the locks riverward would result in better approach conditions and lessened the length of dam structure as compared to the authorized Feasibility Report Plan.

As the project design continued, designs to eliminate the tainter gate piers, which were especially sensitive to earthquake motions, became a priority. This led to investigating an all wicket dam. The plan that was eventually selected consisted of a 2200' wide navigable pass/regulatory section controlled by 220 hydraulically operated wickets, and a fixed weir. There was an estimated savings in first costs of $44 million between this plan and the updated GDM Plan.

Continuing efforts to provide the most suitable and economical facility led to comparing life-cycle costs for a boat-operated wicket navigable pass with a tainter-gated section versus the 2200' wide navigable/regulatory pass dam. The life-cycle costs for the tainter-gated /boat-operated facility were only 1-2 percent more than the hydraulic wicket facility. Therefore, the decision was made to revise the design and to build a dam configured of tainter gates and boat-operated wickets. This decision was made to ensure reliability, safety, and cost-effectiveness of project operations at Olmsted.

After this decision, efforts still continued to improve costs associated with the dam. A Tainter Gate Optimization Study recommended revisions to the tainter gates and the machinery to raise and lower the gates. The study also recommended utilizing five 110' wide tainter gates in lieu of the previously planned six, but with a sill elevation five feet lower than the original plan. These changes resulted in an additional estimated savings of almost $9 million. Also, a state-of-the-art seismic design analysis for the dam structures yielded an additional estimated savings of $9.6 million as compared to the Dam Feature DM #8 design (December 1997).

8.1.5 **Feature Code 19, Buildings, Grounds, and Utilities**

The Buildings, Grounds, and Utilities feature is comprised of the Resident Engineer's Office, spare gate storage facility, storage building, maintenance building, Lockmaster office building, and the Visitor Center. The total cost for the Buildings, Grounds, and Utilities feature of work is estimated at $45,610,000. Of this, $32,522,000 is sunk cost.

8.1.5.1 Buildings, Grounds and Utilities

The cost for Buildings, Grounds, and Utilities increased from the Feasibility Study. The Feasibility Report Plan included only an Operations Building and a Service Building. The complexity of the site and the additional facilities which are required to operate and maintain the Locks and Dam were the reasons for the increase. The final plan includes an Administration / Visitor Center which is designed to energy-saving standards, a Visitor Overlook with parking and other facilities, as well as a service/maintenance building and a storage building. The current plan includes a Resident Engineer's Office, which will be converted to a facility to store and repair elements of the dam. There were added costs to provide for an esplanade along the locks and for added grounds facilities to accommodate the extensive floating plant. This equipment is required to raise and lower the dam wicket gates, equipment to safely and efficiently clean the lock wall surfaces after being flooded each year, equipment to remove depositions from underneath the floating approach walls and from the fleet mooring area, and associated maintenance and repair activities. This area also allows access and a wharf-type facility to load and off-load wickets and other elements of the dam that would be needed during semi-routine maintenance of the dam. The mooring area also complicated the slide repair efforts. The cells served to strengthen that area of the hillside.

8.1.5.2 Gate Storage Facility

After authorization of the Olmsted Project, the Louisville District procured a large "Gate Lifter" crane which altered the way that the lock miter gate replacement is performed. This equipment now allows the large gates to be lifted intact from the chamber for repairs, painting, and other maintenance, thus minimizing the negative effect of those actions on the navigation traffic. To fully utilize this procedure, a gate storage facility was needed which would allow setting the gate leaves on a facility located on an area of the river bank that was reachable with the massive load. This required construction of a Gate Storage Facility at a cost of $11.85 million.

8.1.6 Feature Code 20, Permanent Operating Equipment

Equipment which is required to operate the Locks and Dam increased from that in the Feasibility Report Plan for a current total increase in cost estimated at $28,057,000. This increase was necessary to provide the wicket lifter barge and towboat to raise and lower the navigable pass wickets, maintenance bulkheads, washdown barge to safely and efficiently clean the lock walls after being inundated each high water season, and other miscellaneous equipment. The Feasibility Report Plan required only a small tender and barge which is still required and has already been procured.

8.2 Risk and Uncertainty

USACE Principles and Guidelines (P&G) requires a risk-based approach to project analysis. The P&G (ER 1105-2-100, page 1-3) requires that "… planners shall identify areas of risk and uncertainty in their analysis and describe them clearly, so that decisions can be made with knowledge of the degree of reliability of the estimated benefits and costs and of the effectiveness of alternative plans." For navigation projects, including Olmsted, the major areas of analysis risk and uncertainty are in the project costs, project construction duration (and online date), forecasted traffic demands, system congestion effects, reliability of existing and proposed structures, and barge transportation willingness-to-pay (e.g., alternative mode costs). To account for risks and uncertainties in the analyses described in this report, scenario and sensitivity

analyses were performed to capture the potential impacts on project cost, schedule, and benefits of a wide range of likely future scenarios.

Cost risk and uncertainties were addressed by a comprehensive Risk-Based Contingency Development described in detail in Appendix F. "Risk Items", uncertain variables with a potential for significantly impacting cost or schedule, were addressed and the range of impacts quantified. These risks will be monitored throughout the life of the project. Contingency funds were generated to manage risks and ensure contract flexibility to uncertainties using Monte Carlo based analysis of the risk items facilitated computationally by a commercially available risk analysis software package (Crystal Ball). This analysis was certified by the Cost Engineering Directory of Expertise in Walla Walla District. The 80% confidence level of remaining costs yields a contingency amount of $244,378,000 (19%).

The cost estimate and schedule provided in this report are based on an assumption that the project will receive around $150 million per year on average until it is completed. Uncertainty exists as the actual funding levels may vary up or down. Increased funding, sooner in the project schedule would result in reduced escalation over time and potential reduction to contractor's onsite duration and associated extended site overheads. On the other hand, less funding would tend to increase escalation and add contractor's onsite duration and extended site cost. These fixed site cost are approximately $50M per year. An unconstrained funding scenario could cut up to three years from the project schedule resulting in significant cost savings of approximately $150M. Conversely, reduced funding would result in additional schedule impacts and adversely affect overall project costs.

A more detailed discussion of the risk analysis performed and the generation of contingency estimates, as well as the review performed by the Walla Walla Cost Engineering DX, can be found in Appendix F. Risk and uncertainty relating to the economic analysis, included traffic forecasts, is discussed in detail in Appendix A.

SECTION 9 - **Changes in Total Project First Costs**

The authorized costs at both October 1987 and October 2011 price levels, the Section 902 limit, and current estimates of Project costs are listed in Table 2. The Water Resources Development Act of 1988 authorized the Olmsted Locks and Dam project cost of $775,000,000. These authorized costs, when brought to current price levels and inflated per Section 902 guidance, is $1,590,000,000. The current cost estimate without inflation, at the October 2011 price level, is $2,918,000,000. The current cost estimate with inflation applied to the remaining cost to complete, at the October 2011 price level, is $3,099,000,000. Table 3 presents authorized costs and current costs by CWBS Feature Code. A detailed accounting of the changes in Project costs is presented in Appendix C, PACR Cost Tables.

Table 2 - Comparison of Total Project Costs

Authorized Cost (Oct 1987 price levels)	$775,000,000
Authorized Cost (Oct 2011 price levels)	$1,497,000,000
Authorized Cost (Oct 2011, With Escalation)	$1,590,000,000
Sect 902 Maximum Cost Limit	$1,745,000,000
Current Total Cost (No Escalation)	$2,918,000,000
Current Total Cost (With Escalation / "Fully Funded")	$3,099,000,000
Sunk Costs through FY 2011	$1,358,000,000
Remaining Costs (No Escalation)	$1,560,000,000

Table 3 – Project Cost by Feature
($ in thousands)

	Feature	Authorized *1-Oct-87*	Authorized *1-Oct-11*	Current *1-Oct-11*	Difference
01	Lands & Damages	$357	$690	$6,059	$5,369
02	Relocations	$3,172	$6,127	$1,594	-$4,533
03	Reservoirs	$3,361	$6,492	$0	-$6,492
04	Dam	$326,733	$631,122	$1,722,952	$1,091,830
05	Locks	$355,676	$687,028	$486,948	-$200,080
06	Fish & Wildlife Facilities	$0	$0	$12,785	$12,785
08	Roads, Railroads, & Bridges	$700	$1,352	$3,643	$2,291
09	Channels & Canals	$6,166	$11,910	$50,402	$38,492
16	Bank Stabilization	$0	$0	$7,722	$7,722
18	Cultural Resources Preservation	$0	$0	$3,126	$3,126
19	Buildings, Grounds, & Utilities	$1,624	$3,137	$45,610	$42,473
20	Permanent Operating Equipment	$6,803	$13,141	$43,509	$30,368
30	Engineering And Design	$42,245	$81,601	$150,374	$68,773
31	Supervision & Administration	$28,163	$54,400	$128,460	$74,060
50	Operations & Maintenance	$0	$0	$10,616	$10,616
59	Contingencies	$0	$0	$244,200	$244,200
	Project Total	$775,000	$1,497,000	$2,918,000	$1,421,000

The reasons for the $2,143,000,000 increase in total project cost between the authorized project of $775,000,000 (1 Oct 87 price levels) and the current recommended project total cost of $2,918,000,000 is explained in the following sections, which are organized to the extent possible by CWBS Feature Code.

The original authorization, which is included in Section 2, was a somewhat general authorization to provide the navigation project as described in the 1986 Chief's report. Costs of the Chief's report were based on the 1985 Feasibility report which included Lands and Damages; Relocations; Dams; Locks; Removal of Existing Structures; Roads; Channel and Canals; Buildings, Grounds, and Operating Equipment; Engineering and Design; and Supervision and

Administration cost categories. There have been needed project items that have increased the costs that were not foreseen in the original reports. Section 8 explains several increases, the following paragraphs will explain the remaining factors that influenced the cost increase.

9.1 Feature Code 01, Lands

Additional Real Estate Costs

Real estate requirements and estimated land acquisition and administrative costs that were identified in the Olmsted Locks & Dam Design Memorandums are listed below.

Design Memorandum No. 2, Real Estate Interests and Requirements, Segments 1 & 2 (November 1990)

Dam Site & Access	$561,068.00
Boat Ramp	$ 77,500.00

Design Memorandum No. 2A (November 1990)

Spoil Area	$109,475.00

Design Memorandum No. 2B (November 1990)

Flowage Easements	$315,000.00

Design Memorandum No. 2C (November 1990)

Mitigation Lands	$3,764,900.00
	$4,827,943.00

All required land acquisition has been completed. The boat ramp, spoil area, flowage easements, and mitigation lands were not included in the scope at project authorization. Initial plans were to relocate the Village boat ramp to Lock and Dam 53; however, it was determined that a new site had to be acquired. The Cooperative Agreement between Kentucky Department of Fish and Wildlife Resources (KDFWR) and Department of the Army required the acquisition of approximately 2,000 acres for mitigation. The mitigation lands were acquired under the "willing seller" concept. Land payments for the mitigations lands were $2,940,922. All mitigation lands have been outgranted to KDFWR for inclusion in the Ballard County Wildlife Management Area. Acquisition of the flowage easements was based on an Attorney's Opinion prepared February 1995. The closing attorney for the flowage easements prepared a Memorandum of Law in October 2005 concluding that the Federal Government was not required to purchase flowage easements and recommending that all acquisition efforts be discontinued. Direction was received from CELRD-MT-R in March 2007 to discontinue the flowage easement acquisition. Title evidence, survey, legal descriptions, and appraisals were completed for the 24 tracts identified for flowage easement acquisition. Five of the tracts were acquired. The total increase in the land feature of work is approximately $5,369,000.

Upon completion of the Olmsted Locks & Dam Project, the following real estate tasks will have to be accomplished:

1. Disposal of Locks and Dams 52 and 53. Estimated costs to complete the disposals are $60,000.

2. Transfer of the Olmsted-Grand Chain County Road back to Pulaski County. Upon completion of construction of the Project, 2.1 miles of the Olmsted-Grand Chain Road will be transferred back to Pulaski County in accordance with Relocation Contract DACW27-92-C-0085 executed July 1992. Estimated costs to complete the transfer is $10,000.

3. Update of real property records and final real estate audit of The Project. The estimated costs to complete the audit are $5,000.

The total estimated costs for remaining real estate work for the Olmsted Locks & Dam Project is $75,000.

9.2 **Feature Code 18, Cultural Resource Preservation**

No funds for historic structures or archaeological resources encountered at the Olmsted Project were included in the original estimates of cultural resources work. The early Olmsted cultural resources consultation/studies examined various portions of the Project site and identified both historic structures and archaeological resources. As none of these were deemed to be significant, no further coordination or development of mitigation strategies was required. It was noted in the EIS that full compliance with the National Historic Preservation Act would be completed after Project authorization. This was because there were a few cultural resources issues identified by the Illinois and Kentucky State Historic Preservation Officers that still needed to be addressed. None of the identified issues had to do with L&D 52 and 53 or the associated land-based structures.

Cultural resources requirements changed when, during 1987 - 1988, L&D 52 and 53 were both identified as historic properties and it was determined that the Olmsted Project would have an adverse effect on them. The identification of these historic resources was not foreseen. Lock and Dams 52 and 53 were not identified as a cultural resources issue by the Feasibility Report (1985) or by the Chief's Report (August 20, 1986). They were not identified until July 1988 as eligible resources that would be adversely affected by the Olmsted Project. They were officially recognized as eligible resources with the signing of Consensus Determination of Eligibility forms on November 17, 1988 the same day that the Water Resources Development Act of 1988 was approved.

Ways to mitigate the adverse effect of the Project on the historic structures will be addressed in a Memorandum of Agreement (MOA). To date an MOA has not been signed by all interested parties. Seven actions to mitigate the adverse effects are currently being discussed but have not yet been finalized.

Below is a list of the mitigation alternatives that are currently under consideration:

* Completion of book and pamphlet on the development of navigation at L&D 52 and 53
* Photo and engineering drawing documentation of L&D 52 and 53
* Structure assessment of residences
* Minimal maintenance to stabilize residences
* Public interpretation plan and one set interpretive materials
* Outdoor display of wickets and work boat; and

* Rehabilitation of one structure (i.e. powerhouse) for interpretation.

No work has been done on any of the above alternatives.

The total increase in Cultural Resources cost is estimated at $3,126,000 and is included in the current cost estimate.

9.3 Feature Code 30, Planning, Engineering and Design

The Planning, Engineering, and Design costs increased from an authorized $81.6 million to $150.4 million currently. This increase was the result of the unique type of Locks and Dam used in this Project which required many physical model studies, the extreme seismic design demands, the NISA (thermal) studies, the difficult site conditions which involved complex artesian water pressures and a large pre-existing slide area, difficult driving conditions for foundation piles, first-of-its kind construction studies, lost effort resulting from change of direction decisions, and sophisticated analytical studies. In addition, the substantially increased period of time for construction has contributed significantly to the costs for providing engineering support during construction. These issues are discussed in more detail below.

9.3.1 Model Studies

The Olmsted Dam is located near the mouth of the Ohio River where it is influenced by flows coming down the Ohio, by outflow from the tributary Cumberland and Tennessee Rivers, and by backwater from the Mississippi River. That – plus the relatively unique navigable pass dam – led to an intensive and extensive program of scale-model physical models which allowed a better understanding of the complex systems. These models, which were located at the Corps Waterways Experiment Station Labs (ERDC-WES) included a 1:120 navigation model which was modified several times and utilized to study navigation into the locks, navigation over the pass section of the dam, sediment deposition patterns around the locks and the dam, approach wall refinements, and to study currents and scour associated with various construction methods and stages of construction. A 1:25 model was utilized to determine forces on miter gates when they are moved into place under flowing water conditions. This model was modified to study approach walls and the forces on various elements of the dam structure in more detail, but it was limited because the entire width of the river could not be constructed in the model. A 1:60 model was constructed and utilized to study the unique underwater placement of foundation piles and pre-cast concrete shell superstructure. This included gaining information about water velocities around the shells as they would be lowered in the flowing river water and scour associated with the operation. Forces on shells and other pertinent information were also gathered. A 1:5 model was constructed to study the dam navigable pass wicket gate design and various lifting mechanisms. This model cost approximately $2.5 million because the 1:5 model size was determined to be the smallest which could accurately represent both the hydraulic forces from the flowing water and the structural response of the gates. The largest model was located at Smithland Dam because a similar head difference existed at that facility as for the Olmsted Project. The Prototype test facility was constructed at a 1:1 size to allow modeling full size wickets. This was deemed necessary in part because of the unique hydraulic wickets which were proposed for the full-width navigable pass/flow regulating dam. When the decision was made to utilize tainter gates to control river flow and boat operated wickets for the navigable pass, lessons learned from the 1:1 model regarding material selection were incorporated into that design. The

1:5 model was modified to determine lifting forces and overall performance of the new boat-operated wickets.

9.3.2 Seismic and Thermal Design

The Olmsted Project is located near the New Madrid fault system which was the source of the largest historically recorded earthquakes (1811/1812) in the continental United States. This resulted in the seismic design being a controlling load case for many of the Olmsted Locks and Dam structures. Since these seismic demands were greater than for any other Corps navigation project of a similar nature, the effort that was required was much greater than normal. Expertise was needed to properly determine the ground motions to which the facility could be subjected. The analytical tools strained the state-of-the-art and included use of the WES Super Computer. The ability to analytically model the large structure was a major challenge and required expertise from within the Corps as well as from outside experts. The lessons learned by applying increasingly sophisticated analysis (pseudo-static to response spectrum to time history) to the design of the elements of the Locks and Dam resulted in the establishment of new Corps design guidance documents.

The thermal design requirements were initiated as a result of relatively new Corps design guidance contained in ETL-1110-2-324. This analysis was again the first to be required to the extent that the Olmsted Project required. Again, the use of the ERDC-WES Super Computer was required to accommodate the very large analytical files and the complex analysis. The problems still required 2-dimensional simplified models with only specific high problem areas modeled as 3-dimensional models because even the supercomputer was unable to accommodate the full representation of the structures. The results of the analyses were extremely valuable in limiting actual cracking problems for the structures and in not requiring costly cooling of the concrete where conventional wisdom would have required it. The cost for this analysis was over $1 million for the locks structures alone.

9.3.3 Difficult Site Conditions

The Project is located in an area which complicated the design and construction efforts. One of these complications was the presence of artesian water pressures which had to be understood and then accounted for in design and construction. The artesian pressures were different depending on the natural layers of foundation material. These pressures made designing for dewatering a lock or dam element more difficult and required more foundation piles for that load condition. It was necessary to understand the natural site conditions more precisely and how they varied from one location to another.

The foundation design was complicated even more than has been noted above by difficult driving conditions. Earlier construction at Locks and Dam 53, just upstream of the Olmsted Project, had revealed the difficulty in driving foundation piles to the depth required to safely resist applied loads. At Feasibility Report stages of design, the foundation piles were to be auger cast to help address this known difficulty. However, the extreme seismic loads and the need to provide as much flexibility in the foundation system as possible led to the need to switch to steel H-piles in lieu of the auger cast piles. The problems required more intensive pile test programs, gathering more data while driving the test piles, and more sophisticated analysis of the test data. This knowledge was then applied to the design of the foundations for all of the Locks and Dam

structures. The site condition difficulties were exacerbated when an active slide was observed during monitoring of the Illinois bank at the site of the locks. Defining the extent of the slide problem and determining the best solution required much additional effort. These problems have also added to the effort required to design and build the boat mooring area and the pre-cast yard and marine launching facility to move the very large shells from the pre-cast yard to the river.

9.3.4 First-of-Its Kind Construction Studies

The Olmsted Project has included studies which were not envisioned or which were not of the required scope at the time of the Feasibility Report. The unique navigable pass led to a study of various types of gates. A corrosion study was needed to address accelerated corrosion of steel and galvanized steel elements which was noted at nearby L&D 53. This effort required gathering atmospheric and river water quality data and a testing program for various materials. The design and construction of the locks required highly precise measurements of potential concrete mixes to determine variables such as strength and heat produced as the concrete aged. The potential for constructing the dam in-the-wet, in-the-dry, or inside a Mobile Cofferdam resulted in the need to advance all types of construction methods far enough to produce good construction estimates. The floating approach walls and the pre-cast panel approach wall all required significantly greater design effort than was originally anticipated in the Feasibility Report.

9.3.5 Change of Direction Decisions

As has been discussed above, several decisions which were made for various reasons have resulted in lost effort and a longer design schedule. The decision to revert back to a navigable pass dam section with a tainter-gated spillway section to control the flow of the river was the most consequential of these decisions, as it resulted in a five to seven year increase in design effort. The type of navigable pass gate was changed numerous times to more adequately address the operational needs of the dam facility as a whole. The decision to utilize a boat-operated wicket type of navigable pass resulted in a loss of much of the value gained from the 1:1 prototype and 1:5 models which were noted previously. Significant effort was also involved in designing emergency gates into the locks as was required by then existing Corps design guidance. This guidance was then changed to delete the emergency gates. The decision was later made to include operating bulkheads to facilitate opening and closing the locks after each high water event which would overtop the lock walls.

9.3.6 Sophisticated Analytical Studies

The detailed and state-of-the-art seismic studies, the NISA studies, the hydraulic studies, the foundation and Illinois bank stability issues, and the unique method of construction studies have all been discussed above. Each of these efforts required extensive engineering support, which far exceeded that envisioned in the Feasibility Report.

9.4 Feature Code 31, Construction Management

As the construction schedule has been extended, the costs for construction management have increased as well. The scheduled completion date has extended the construction management efforts to 26 years. The effort required to manage a cost reimbursable contract is much more cost- and time-intensive than with a firm fixed-price contract. Added activities include award fee evaluation boards, voucher review, DCAA reviews, DCMA reviews, and procurement

oversight. As a result, the construction management feature of work is estimated to increase $74,060,000.

9.5 Feature Code 50, Operation & Maintenance

9.5.1 Maintenance of Completed Work

Portions of the Project were completed in 2001 such that it became necessary to add maintenance staff to take care of the completed work. Until the Olmsted L&D project becomes operational and is opened for navigation traffic and operated and maintained by Operations Division and vessels no longer have to use the locks on Dams 52 and 53, the costs associated with maintenance of the completed work is treated as a construction cost of the Olmsted project. The O&M cost during construction was not included in the original estimate.

During construction of the dam the construction equipment will restrict the river at times and prevent navigation traffic from navigating through the navigable pass portion of the project site. In order to enable traffic to bypass this area during the construction of the navigable pass it will be necessary at times to pass traffic through the Olmsted lock chambers. This will require lock operators. The operations cost associated with these operators are treated as a construction cost of the Olmsted project. This operations cost was also not included in the original cost estimate.

The two sources of additional O&M costs discussed in this section have increased the project cost by approximately $10,616,000.

9.5.2 Wicket Dam Operation & Maintenance

Estimates of O&M for both hydraulic wickets and boat operated wickets at Olmsted were made in a 1995 study conducted by Black & Veatch. This study made estimates of annual O&M including costs for labor, additional towboat fuel, and major repair and replacements. Price levels and assumptions of these estimates were revisited in order to estimate separable O&M costs for the boat operated wicket dam with the current configuration of 140 wickets.

The Black & Veatch report (April 1995) assumed Olmsted Dam will have a maintenance/repair crew made up of an Equipment Mechanic Supervisor, Equipment Mechanic Leader, and eight Equipment Mechanics/ Repairers. Because the report did not present the wage grades assumed for these, the current grades for these positions at LDs 52 & 53 were applied. Labor rates including overhead were used in this estimate. It was further assumed such a crew would spend 25% of its time on wicket gates O&M, resulting in an annual labor cost of $311,235. Additional annual O&M costs include fuel for the towboat. The Black & Veatch study estimated additional annual fuel usage of the towboat to be 7,608 gallons. At $3.50 per gallon, annual fuel costs are $26,628.

Major wicket gate repairs were estimated to occur every 20 years in the Black & Veatch study. Major repair costs were assumed to be $2,500 per day for a 50 ton crane, $2,500 per day for a towboat, $1,500 per day for auxiliary plant and equipment, and $2,000 per day for a five person dive team. It was estimated that two wickets could be repaired per day and that wicket part costs would be $4,000 per wicket. However, actual towboat costs were included in the life cycle estimate, described below, so the daily towboat cost used in the study was not included. This

resulted in a per wicket repair cost of $7,000 in October 1994 price levels. These were brought to October 2011 price levels using annual factors for dams from the 2011 Civil Works Construction Cost Index System (CWCCIS), which is published in EM 1110-2-1304. Major wicket gate repairs occurring at 20 years in the life cycle are estimated to be $1,690,000 in October 2011 price levels.

The Black & Veatch study assumed that the wicket gates would be replaced at 40 years. The same daily costs for the crane, auxiliary plant, and dive team were used to estimate the $3,000 per wicket cost for these. New wicket gates were estimated to be $115,000. The resulting cost of $118,000 per gate for the 140 wicket gates yields $16,520,000 in October 1994 price levels. Applying the CWCCIS described above yields $28,430,000 in October 2011 price levels for wicket gate replacement occurring at 40 years.

The towboat and wicket lifter crane are being obtained to operate the wicket dam. Other floating plant used to operate and maintain the wicket dam, such as the deck cargo barge, washdown barge, and 700HP tender are necessary for O&M of the locks and are therefore not additional. Actual costs for the towboat were $8.6 million, expended in FY08. The wicket lifter crane is estimated to cost $19.6 million.

The towboat and wicket lifter costs were included in the appropriate years in a life cycle analysis, along with the annual labor and fuel costs described above, to calculate annual equivalent costs. The total annual equivalent costs to operate and maintain the wicket dam, calculated at 4.875% for a 50-year period of analysis, is $2.48 million. It should be noted that this estimate represents a mixture of expenditures to procure plant made during construction along with future O&M costs after construction.

9.6 Changes in First Costs

There have been several other causes for unanticipated changes in the Project first costs. Cost increases due to these are further explained in the following paragraphs.

9.6.1 Increases Due to Inflation

The Section 902 limit for inflation through construction is $722,036,500 (see Appendix C). The Section 902 inflation factors, which were applied to the authorized cost of $775,000,000, were derived from the Corps of Engineers' Civil Works Construction Cost Index System (CWCCIS) index. Real estate costs were updated for historical inflation based on the Consumer Price Index data for Not Seasonally Adjusted, US city average, rent of primary residence, published by the U.S. Department of Labor, Bureau of Labor Statistics. For a detailed explanation of the application of these factors to the authorized project cost, see Appendix C, Tables C-1, C-2 and C-3.

9.6.2 Net Impact of Design Changes and Construction Modifications

The changes on the awarded contracts to date can be classified as $138,910,961 for design changes, $29,372,146 for differing site conditions, a savings of $644,285 through the Value Engineering Contractor Proposals, and $50,350,440 paid in contractor claims.

Detailed information on the construction modifications is provided in the following paragraphs.

9.6.2.1 Access Road & Resident Engineer's Office Contract (Feature Codes 02, 08, & 19)
There was a total of $298,072 in modifications to this construction contract. This figure includes $9,743 associated with unforeseen site conditions and $288,329 in other contract modifications. See Table B-1, Appendix B, for a list of modifications from the award in November 1992 through contract completion in June 1994. The most significant change was the substitution of cement for the specified lime to stabilize the subgrade.

9.6.2.2 Construction Modifications – Relocation of Olmsted Boat Ramp (Feature Code 02)
There was a total of $14,628 in modifications to this construction contract. This figure includes $12,380 associated with unforeseen site conditions and $2,248 in other contract modifications. See Table B-7, Appendix B, for a complete list of the modifications from the award on 4 June 2001 through contract completion on 7 November 2002.

9.6.2.3 Construction Modifications – Dam Prototype (Feature Code 04)
There was a total of $3,890,782 in modifications to this construction contract. This figure includes $126,000 associated with the settlement of the request for equitable adjustment; $14,700 in savings from value engineering contractor proposals; and $3,779,482 in other contract modifications. See Table B-5, Appendix B, for a complete list of the modifications from the award on 17 May 1994 through contract completion on 4 December 1995.

The most significant changes were:

a. Tremie Concrete Modification – This was necessary due to the failure of the dewatering system to lower the water table inside the cofferdam to below EL 280. This resulted in the use of tremie concrete as opposed to placing concrete in the dry and eliminated the installation of the bottom row of cofferdam soil anchors as well as a significant quantity of H-pile.

b. Additional Rock Excavation - Riprap/shot rock must be excavated in order to allow driving of sheet piling and later excavation for the prototype structure. Differing site conditions caused additional contractor effort to complete the required excavation work as shown on the plans and specifications. Portions of the site were covered with a substantial layer of riprap and shot rock. The extent of this condition was not addressed on the plans or in the specifications. Other portions of the site contained old haul roads with substantial rock bases as well as buried concrete rubble, steel, trees, and rubbish. The plans and the specifications did not indicate the existence of these items.

c. Modification of Props – Miscellaneous mechanical revisions were detailed on a total of nineteen new and/or revised contract drawings and affected the following items: bearing frames, anchor pins, hydraulic cylinder details and piping, jib hoist details, ventilation system, and gallery sleeve assembly. Also included were significant design changes to the props and associated support forks and blades. These revisions resulted from the findings of model tests performed by WES and were necessary to allow for the proper operation of the mechanical components.

Without these revisions, various components would not have mated up and the props could have possibly failed during operation.

9.6.2.4 Construction Modifications – Dam (Feature Code 04)

There has been a total of $336,359,783 in modifications to this construction contract through 30 September 2011. These figures include $23,377,681 associated with unforeseen site conditions; $211,374,335 associated with funding delays/time extensions and over target budgets (contract modification P00065 and A00017) and $101,607,767 in other contract modifications. See Table B-11, Appendix B, for a complete list of the modifications from the award on 28 January 2004 through October 2011. The current contract completion date is 1 December 2014. At the end of the 2011 low water season (the first season of shells had been fabricated and five shells had been placed in the river) a rebaseline estimate was prepared and reviewed. The estimate to complete the dam construction was significantly increased based on the productivity achieved with the first season of shells. The cost team reviewed the reviewed the rebaseline estimate (the review is explained in detail in appendix F) and the Cost DX certified the estimated.

The completion date will be extended between four and five years. The estimate includes a future modification amount of $219,285,000 to cover the time extension from December 2014 to 2019. The 2011 rebaseline estimate will increase the estimate to complete by approximately $551,100,000 bringing the total cost of the dam construction contract to $1.67B.

What caused the contract that was awarded for $564,148,484 to increase such that the estimate at completion is $1.67B? There are several factors that have contributed to the cost increase such as: a low initial estimate by the government and the contractor, difficulties associated with innovative construction, river conditions (elevation & velocities), market conditions, and funding to name a few.

After constructing and setting the first set of shells the government and contractor realized that the effort associated with fabrication and setting these large pieces of precast concrete and filing them with tremie concrete wasn't like anything they had ever done or estimated. The construction challenges associated with developing this innovative method of construction have been overcome but require a lot more effort than envisioned by the estimators. The re-estimate of the project reflects the estimated cost based on the actual cost of the first six shells.

The most significant contract changes to date have been:

a. Funding Impacts – the RFP included a funding stream for the bidders to base their proposals. The Government did not meet that funding stream in FY04 or FY05. Not providing the funding stream as originally anticipated required extending the contract completion date to December 2013, thereby increasing the estimated cost by $53,436,155. This change was added to the dam contract by modification A00017 on 24 June 2005 (see Table B-11 page Appendix B-18).

b. Rebaseline 2006 – The contractor's proposal was prepared in 2003 and included costs for normal escalation through the proposed contract completion date. Since the award of this contract, there has been much higher than anticipated inflation that has caused significant cost increases beyond normal escalation. Factors such

as hurricanes, war, fuel prices, and growth in China have created extenuating circumstances that affected market conditions. Factoring these market conditions into a major construction contract like this yielded an estimated cost increase of $81,648,669 (modification P00041).

c. Differing Site Conditions – After award of the construction contract, it was determined that the soil conditions at the site for the precast yard and the marine skidway were inadequate to support the foundation loads. An extensive amount of piling was required to support the marine skidway and the slabs in the precast yard. Also contributing to this increase was the tainter gate portion of the dam foundation piles length increased and additional excavation was required due to sand waves. These unforeseen site conditions resulted in an increase of $23,377,681.

d. Rebaseline 2011 – After the dam contractor completed fabrication and setting of the first low water season shells the contractor was requested to rebaseline the remainder of the project. This milestone was selected because the contractor now had historical data for fabricating and setting shells. This productivity information was factored into the estimate for the remaining shells creating a significant increase in the estimate to complete the dam construction. The contractor's rebaseline estimate has been reviewed by the cost team (see Appendix F for details of the review), resulting in an increase of approximately $551,100,000.

e. The cost increases described above require an increase in the annual funding requirements if the project were to meet the current contract completion date of 1 December 2014. The Inland Waterways Trust Fund cannot support the annual funding requirement. The basis for this contract is that the government would obligate $140M annually to the contract until completion. This would delay the completion date by approximately five years until December 2019. This time extension will likely increase the cost to complete to approximately $219,284,700 (as shown in Table B-11).

9.6.2.5 Slide Repair & Cofferdam Contract (Feature Codes 05 & 16)

There was a total of $16,402,254 in modifications to this construction contract. This figure includes $155,000 associated with unforeseen site conditions; $12,000,000 associated with the settlement of a claim; $43,650 in savings from value engineering contractor proposals; and $4,290,904 in other contract modifications. See Table B-2, Appendix B, for a complete list of the modifications from the award on 1 June 1993 through contract completion on 1 March 1996.

The most significant changes were:

a. Final Request for Equitable Adjustment Claim – Near the end of the project, the contractor filed a claim that was eventually settled by the Department of Justice in the amount of approximately $12 million. This claim included all the above issues plus several more that were unresolved near the end of the contract to

include mussel monitoring problems; sheet pile manufacturing tolerances; hard driving and out-of-interlock sheets; cell settlement; work re-sequencing issues; sheet pile gauging; VECP wick drains; cell 10 movements; river elevations and velocities associated with floods like the great Mississippi Flood of 1993; defective soil borings; US deflector arm sheet pile failure; and acceleration issues.

b. Pre-Excavation for Cofferdam Cells – This change was initiated at the request of the contractor to facilitate installation of remaining cofferdam cells because of the difficulties being encountered trying to install 109' long sheet piles through the 20 feet of river bottom material. After reviewing the contractor delays and difficulties experienced in the first few cell installations (which caused this contract to be behind schedule) and an evaluation of the overall Olmsted Project (including the future locks and dam project), it was determined to be in the Government's best interest to "over-excavate," affording the opportunity for an improved cell construction rate and more timely completion of this contract.

c. Cell 10 - This change was required due to the substantial amount of scour that occurred between Cells 10 and 11 around Cell 10 during a January and February 1994 high water event. The severity of this scour ultimately led to the failure of the partially constructed Cell 11 and its salvage operation. This scour eventually led to the placement of rock around the base of Cell 10 to prevent further scour before adjacent cells could be built. Ultimately, this scour resulted in numerous changes to the area around Cell 10 to ensure the cofferdam was sound. These changes included lengthening the sheets of Cells 9, 9.5, 10.5, and 11; increasing the size and shape of the beam in this area, installing riprap upstream of the completed cells and installing various alarms.

d. Dewatering Revisions – This change was due to the unpredictable nature of the soil being dewatered. The designed pumping system once installed was not working in all locations because dewatering wells were installed into porous cracks or lenses in the subsurface soil formations which required significantly greater pumping capacity than was included in the design.

9.6.2.6 Construction Modifications – Lock Contract (Feature Code 05)

There was a total of $50,655,795 in modifications to this construction contract. This figure includes $234,600 associated with unforeseen site conditions, $32,537,870 associated with the settlement of the request for equitable adjustment, $575,274 in savings from value engineering contractor proposals and $18,458,599 in other contract modifications. See Table B-3, Appendix B, for a complete list of the modifications from the award on 6 December 1995 through contract completion on 7 November 2001.

The most significant changes were:

a. Request for Equitable Adjustment (Global Settlement) – The Contractor experienced a number of performance difficulties, changes, and consequential effects with resulting additional costs for which the Government had significant,

but not total, responsibility. The additional costs resulted from: direct costs, impacts, inefficiencies, delays, additional work efforts, multiplicity of changes, rescheduling, extended overhead, etc., arising from the Locks construction.

b. March 1997 Flood – This modification was issued to cover all costs associated with the Flood Event of March 1997 to include any and all damages from the flood, cleanup, and recovery and all consequential damages other than those covered under Bid Items of the Contract. (The cofferdam was filled in a controlled manner prior to overtopping by the rising river water.) Due to the Flood Event, numerous bid items had be extended which included the O&M of Ground & Surface Water Control System, Field Engineer, Instrumentation Engineer, Maintenance of the Resident Office and Misc. Facilities, O&M Vacuum System, and the O&M Generator 3A/Additional Electric Floor Pump. Other concurrent and varied issues as well as numerous other outstanding issues were included in this agreement.

c. Furnish Spare Miter Gates - Operations Division requested that a spare miter gate be provided under this contract for the purpose of procuring it in a timely and cost-effective manner.

d. Utility Trench Revisions – Operability and maintenance concerns raised by Operations Division representatives included the following: The original trench layout prevented the replacement of electrical power and control cables in a timely and economic manner since access to the direct buried cables was relegated to a few lock wall manholes. Likewise, the original design location of the hydraulic manifolds placed them well below the ordinary high water elevation which made them susceptible to damage from water inundation and debris. The revisions to the utility trench minimized potential future maintenance problems associated with the hydraulic manifolds/valves being submerged for long periods and accommodated replacement of electrical trench feeders/branch circuits.

e. Revise the Lifting System for the Miter Gates – Operations Division requested this change so that the miter gates could be picked-up utilizing a gate lifting beam which was being designed to lift any miter gate along the Ohio River under the control of the Louisville District.

9.6.2.7 Construction Modifications – Approach Walls (Feature Code 05)

There was a total of $13,595,334 in modifications to this construction contract. This figure includes $4,924,722 associated with unforeseen site conditions, $9,817 in savings from value engineering contractor proposals, and $8,680,429 in other contract modifications. See Table B-4, Appendix B, for a complete list of the modifications from the award on 26 August 1999 through contract completion on 31 March 2004.

The most significant changes were:

a. Lower Land Wall Drilled Shaft Changes – The drilled shaft casing for Nose Pier

and Pylon 4 could not be advanced to the design tip elevation. Based on the experience at Nose Pier 4, a change to the remaining shafts was required. This change was required to reduce the risk of significant delay to the project if any of the remaining casings could not be advanced to the required tip elevation.

b. Suction Dredge River Excavation - This allowed the contractor to utilize hydraulic dredging in lieu of clam bucket dredging for the approaches to the lock chambers. In addition, as a result of more recent underwater surveys, it was determined that the dredge quantity would increase, thereby overrunning the original quantity from an estimated 465,000 CY's to 638,863 CY's. This is an increase in excavated quantity of 173,863 CY's, or about 37%. Utilizing the hydraulic dredge method reduced the unit cost of excavation. The contract originally restricted suction dredging in the river for the purposes of excavation. Due to the anticipated overrun, suction dredging would be more economical and would reduce the amount of time required to excavate the existing quantity.

c. Additional Form System - By the end of the first year of the contract (October 2000), the contractor was significantly behind schedule. At the Senior Partnering Meeting held on November 3, 2000, the lack of progress was discussed and the contractor was asked to propose measures to regain the schedule. The contractor admitted that a portion of the delay was his fault. However, he also stated that significant delay was caused by the Government as a result of "daily design/detail/approval problems" stemming from "incomplete design drawings and tolerance issues." In order to overcome all of these delays, the contractor proposed purchasing a second set of formwork which would enable him to work concurrently on multiple pontoons. It was eventually determined that the second set of formwork benefited both the Government and the contractor equally and therefore the associated costs should be equally shared between the contracting parties. Utilizing the additional set of formwork allowed the contractor to regain the schedule delays that were caused by both himself and by the Government.

9.6.2.8 Construction Modifications – Maintenance & Operating Bulkheads (Feature Codes 05 & 20)

There was a total of $4,195,785 in modifications to this construction contract. This figure includes $34,126 associated with unforeseen site conditions, $3,300,000 claim for fabrication tolerances and $861,659 in other contract modifications. See Table B-8, Appendix B, for a complete list of the modifications from the award on 27 September 2001 through contract completion on 7 July 2005.

The most significant changes were:

a. Machinery Roof – New roof hatches are necessary to replace the existing ones that fail to prevent water infiltration into the machinery rooms. The uninsulated aluminum hatches also allow water condensation which falls (rains) in the machinery rooms.

b. Drill Holes in Operating Bulkheads – The need for drainage holes was overlooked at the time of design. The additional weight of silt and water captured between the flanges of the girders during the lifting of the bulkhead would be excessive should the holes not be drilled. The lifting system was not designed with this additional weight in mind.

c. Revised Bearing of the 11' and 18' Bulkheads – As designed the lower bulkheads would not seat properly and additional support or feet were added to the bulkheads. This modification settled several miscellaneous issues settling everything except for the tolerance issue.

d. Claim – The subcontractor for the fabrication of the bulkheads filed a claim regarding the fabrication tolerances. This claim was resolved at the Armed Services Board of Contract Appeals during the period of 20-22 October 2009 using the Alternative Disputes Resolution process.

9.6.2.9 Construction Modifications – Downstream Mooring Cells (Feature Code 05)
There was a total of $500,703 in modifications to this construction contract. This figure includes $341,800 associated with unforeseen site conditions and $158,903 in other contract modifications. See Table B-10, Appendix B, for a complete list of the modifications from the award on 4 June 2002 through contract completion on 11 December 2003.

9.6.2.10 Construction Modifications – Water Management Facilities, Ballard Wildlife Management Area (Feature Code 06)
The total amount of this contract was reduced $25,537 due to modifications to this construction contract. This figure includes a reduction of $17,905 associated with unforeseen site conditions, a reduction of $844 from a value engineer contractor proposal and a reduction of $6,788 in other contract modifications. See Table B-6, Appendix B, for a complete list of the modifications from the award on 17 May 1996 through contract completion on 30 November 1997.

A second contract was awarded on 30 April 2003 to improve the operating conditions of Pump #1. There has been a total of $322,881 in modifications to this construction contract to date. The one modification of note on this contract was a request for equitable adjustment that dealt with the feasibility to construct the new sump as shown on the contract documents, this issue was settled for $239,627. See Table B-6, Appendix B, for a complete list of the modifications.

9.6.2.11 Construction Modifications – Miter Gate Storage Yard (Feature Code 19)
There was a total of $3,153,117 in modifications to this construction contract. This figure includes $300,000 associated with unforeseen site conditions; $466,547 in other contract modifications; and $2,386,570 associated with the settlement of the request for equitable adjustment. See Table B-9, Appendix B, for a complete list of the modifications from the award on 8 March 2002 through contract completion on 15 May 2006.

The most significant changes were:

a. Request for Equitable Adjustment (Global Settlement) – Contractor (ATI)

requested a change from drilled shaft (the preferred, more economical method for providing the required deep foundation), to H-pile. The contractor pushed for approval of H-pile and eventually offered a $240K credit to promote Government acceptance. Eventually, after the credit offer was made, since H-pile had been recognized in the Report as acceptable, the Government issued an undefinitized change order (Modification No. A00001) for H-pile in lieu of drilled shaft. The contractor then experienced a great deal of difficulty installing the H-pile. Even after ATI improved its practices, driving problems persisted. It then became apparent that the karstic subsurface conditions were more severe than expected, resulting in greater impact on the pile driving. ATI submitted a claim with the principle issue being the change to H-pile and the large cost overrun that resulted. Many meetings and discussions were held over this H-pile claim. While some documentation supported the Government's position, other documentation weakened the Government's position. The Government had significant risk in pursuing this case where substantial concerns existed regarding degrees of merit. When the opportunity was presented for global settlement, it was considered in the best interest of the Government to reach a favorable settlement. Therefore, it was necessary to issue the appropriate contract modification to incorporate the global settlement and provide the proper adjustments to the contract price and time.

b. River Excavation – During the excavation of the material riverward of the mooring wall, the contractor encountered large boulders and riprap sized stone that was not anticipated to be in that area.

c. Miter Gate Paint – The Government-furnished miter gates were partially painted by the original supplier. The gate leaves should have a double spray coat of zinc-rich primer, and two double spray coats of vinyl totaling an average of 5.5 mils. Currently, the paint system thickness is approximately 4.5 mils on the average. Other difficult-to-access areas, such as inside the diaphragm chambers, have as little as 2.9 mils. In addition, some underneath sides of the fender supports either had no paint or only a primer. ATI was responsible for applying one additional double spray coat of vinyl to achieve an average coating thickness of 7.0 mils. This change was necessary in order to provide a complete paint system and to insure proper corrosion protection of the miter gates.

9.6.2.12 Future Construction Contract Modifications

The Corps will be issuing several additional construction contracts to complete the Olmsted L&D Project. They are as follows: , Upstream Mooring Cells, Final County Road Paving, Service Mound Buildings, Wicket Lifter, Demolition of L&D 52 and 53, and River Dikes (two contracts Illinois & Kentucky dikes). Any modifications to these contracts will be funded out of contingency funds (Paragraph 8.2 above discusses such contingency funding.) Table 4 summarizes the net impact of construction modifications as of 30 September 2011.

Table 4 - Net Impact of Construction Modifications

Contract	*Amount*
Access Road & Resident Engineer Office	$ 298,072
Slide repair & Cofferdam	$ 16,402,254
Locks	$ 50,655,795
Approach Walls	$ 13,595,334
Prototype	$ 3,890,782
Ballard Wildlife Management Area	$ 297,344
Boat Ramp	$ 14,628
Bulkheads	$ 4,195,785
Miter Gate Storage Yard	$ 3,153,117
Down Stream Mooring Cells	$ 500,703
Dam	$336,359,783
Total Construction Modifications	$429,363,598

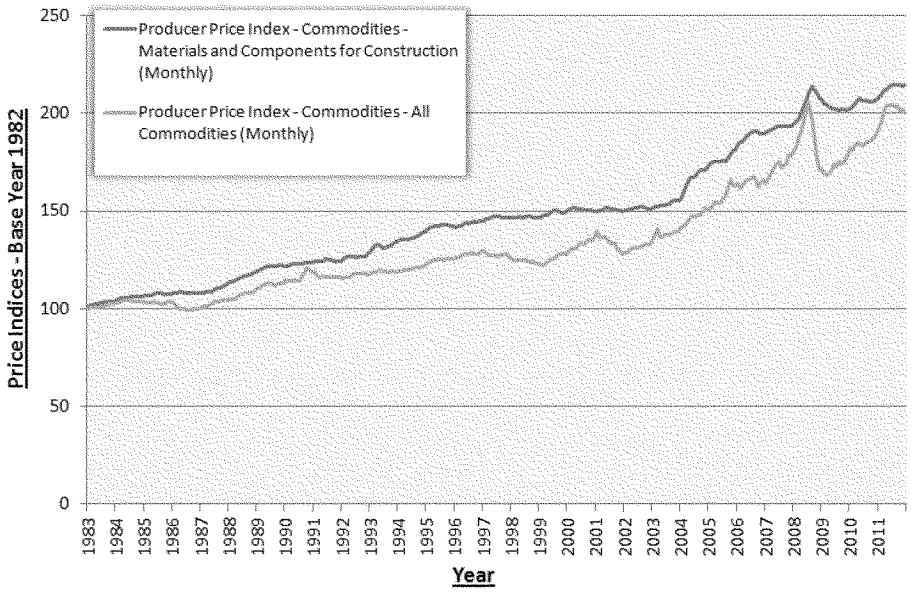
9.6.3 **Impact of Market Conditions on Bid Estimates**

Although all of the aforementioned solicitations experienced negative cost impacts attributable in part to market conditions associated with the remote region in which the Project is located, the most significantly impacted, by several orders of magnitude, is the Dam solicitation. The award to the selected responsive proposer for the Dam contract was approximately $141 million above the Independent Government Estimate (IGE). The Government awarded to this contractor after a detailed cost analysis of the IGE and cost proposals were performed and subsequent determination that the proposed pricing was reasonable. The contract solicitation utilized a request for proposal. The best value proposal was also the lowest cost.

A significant difference between the Government Estimate and the selected proposal amount is a premium associated with market conditions. This cost-reimbursable solicitation received only two proposals, both from joint ventures. It is noted that a previous fixed-price solicitation for the same scope of work received no responsive proposals. The heavy demand in the civil construction market may have been a factor in the number of available contractors within the region in addition to the relatively new construction methods required for the specified in-the-wet construction approach. The already limited number of companies capable of heavy civil and marine construction formed joint ventures, resulting in fewer bidders and less competition and leading to significant additional costs. It is also noted that the Olmsted site is located more than 100 miles from a population center of 50,000 or more (the nearest is St. Louis, MO at 162 miles). This remoteness significantly compromised competitive and free market forces within the contracting community and was not adequately reflected in the Government Estimate. It is estimated that a premium of approximately $47.5 million is attributable to market conditions and skittish bid climate during the period in which the Project was solicited.

Figure 2 below from the US Department of Labor, Bureau of Labor Statistics shows a steady increase in construction materials until 2004. After 2004 construction materials increased significantly more than in the previous years of the project. This significant increase is likely attributed to thing like war, hurricanes, & the growth in China which resulted in higher fuel prices, steel, cement, etc. Figure 2 displays the Producer Price Index for construction materials and components, as well as for all commodities (inputs to production) for comparison.

Figure 2 – Materials and Components for Construction



(The above figure was extracted from Bureau of Labor Statistics Data on March 23, 2012)

The dam construction contract was awarded on 28 January 2004 right at the beginning of this sharp increase in construction materials. Thus the contractors proposal did not include this sharp increase in material cost.

9.6.4 **Profit**

As directed by ER 1110-2-1302, profit was not included in the original Government estimates and constitutes 5 to 10 percent of the identified contract award amounts. The Dam Contract represents the single largest instance of imbalance attributable specifically to profit. The profit, or fee, was established by contract requirement and the contractor's submitted proposal resulting in "base + award fee" of 3 percent base fee + 5 percent maximum award fee which calculates to approximately $41.8 million. No single bid item accounts for the remainder of the difference between the Government Estimate and the selected proposal.

9.6.5 **Inland Waterways Trust Fund**

In allocating funds within the civil works program, the Corps gives priority to the work that offers the greatest return to the Nation in achieving economic, environmental, and public safety objectives. For example, this includes providing priority funding for the maintenance of existing high-performing inland waterways. However, current revenues to the Inland Waterways Trust Fund require the Corps to limit spending for inland waterways capital investments.

According to the Treasury Department, the receipts to the Trust Fund from the fuel tax in FY08 was $83,950,643, FY09 was $76,396,853, in FY10 it was $74,077,047, and in FY11 it was $83,950,643. During this four year period, the Olmsted Locks and Dam project received/expended approximately 72 percent ($228 million) of the total amount collected from the fuel tax.

9.6.6 **Historic Funding Stream**

For various reasons, the project has taken much longer to complete than estimated in the original feasibility report. Early in the construction phase of the project, the timeframe and funding levels for the access road, Resident Engineer's office, the lock cofferdam, and the lock construction contracts were comparable to the original estimates. This changed with the approach wall contract. This contract could have been awarded two years earlier had more funding been available to the project, saving approximately $3.3 million in inflation costs.

Had the approach wall contract been awarded as originally planned, the Corps then could have awarded the Dam Contract two years earlier, saving $49.5 million in inflation costs. Initially, the Corps did not constrain the bidders by funding considerations in their proposals. The successful bidder proposed to build the dam in six years. The COE then determined it was not reasonable to assume that the Congress would provide the level of funding required to construct the dam in that quickly and told the bidders two develop revised estimates based on the assumption that the first year $17.5 million would be available, with $80 million available per year thereafter. This increased proposal costs by $18.2 million and added one year to the completion date. Award was made on 28 January 2004, but the project had less funding than assumed during the RFP during the first two years. By not providing the proposed funding in the RFP the estimate to complete work on the dam increased by $53.4 million and extended the completion date.

The cumulative effects of these delays pushed the contractor into a timeframe that witnessed significant increases in market conditions (war, fuel prices, hurricanes, steel, cement, etc.). The contractor was trying to mobilize the necessary equipment to construct the dam during a time when it was difficult to find barges and cranes. Thus, these items cost significantly more than originally anticipated. Mobilization costs and market conditions of future activities increased $69.8 million as a result. With all these impacts – along with the technical changes – four to five years were added to the construction phase. The estimate includes $219.4 million to cover this impact.

In addition to the direct contract cost noted above, COE staff will be involved during all of these additional years and thus for the life of the project the COE staff increase will be approximately $74 million. Table 5 presents original Olmsted authorized costs, expenditures through FY 2011,

and estimated remaining project costs through completion of construction by year and CWBS Feature Code.

Table 5 – Olmsted Project Cost Estimate through Completion

Feature Account	Expended			Remaining Cost to Complete			Final Project Costs (No Escalation)
	Authorized Oct-87	Expenditures thru FY 11	Planned Expenditures for FY 12	Planned Allocations thru FY 12	Balance to Complete	Pending Modifications	Adjusted Balance to Complete	
01 Land & Damages	357	6,032	0	6,032	27	0	27	6,059
02 Relocations	3,172	1,594	0	1,594	0	0	0	1,594
03 Reservoirs	3,361	0	0	0	0	0	0	0
04 Dam	335,733	671,947	142,344	814,291	908,661	0	908,661	1,722,952
05 Locks	354,475	427,832	852	428,484	58,464	0	58,464	486,948
06 Fish & Wildlife	0	8,393	606	8,999	3,786	0	3,786	12,785
08 Roads, Railroads, & Bridges	700	2,795	0	2,795	848	0	848	3,643
09 Channels & Canals	6,186	0	0	0	50,402	0	50,402	50,402
16 Bank Stabilization	1,201	7,722	0	7,722	0	0	0	7,722
18 Cultural Resource Preservation	0	116	10	120	3,006	0	3,006	3,126
19 Buildings, Grounds, & Utilities	1,624	32,522	600	33,122	12,488	0	12,488	45,610
20 Permanent Operating Equipment	6,803	22,864	0	22,864	20,645	0	20,645	43,509
30 Planning, Engineering, Division	42,245	108,702	3,349	112,051	38,323	0	38,323	150,374
31 Construction Management	28,163	63,893	5,533	69,426	59,034	0	59,034	128,460
50 Construction Facilities	0	3,896	498	4,396	6,220	0	6,220	10,616
59 Contingencies	0	0	0	0	244,200	0	244,200	244,200
Total	775,000	1,358,104	153,792	1,511,896	1,406,104	0	1,406,104	2,918,000

Feature Account	Adjusted Balance to Complete (No Escalation)	Remaining Cost to Complete												Adjusted Balance to Complete (w/escalation)	Project Cost with Escalation
		FY 13 Const Accts 1.03 Labor Accts 1.03	FY 14 1.044 1.057	FY 15 1.061 1.101	FY 16 1.079 1.151	FY 17 1.096 1.203	FY 18 1.118 1.298	FY 19 1.138 1.316	FY 20 1.158 1.377	FY 21 1.179 1.442	FY 22 1.200 1.509	FY 23 1.222 1.580	FY 24 1.244 1.656		
01 Land & Damages	27													34	6,066
02 Relocations	0													0	1,594
03 Reservoirs	0													0	0
04 Dam	908,661	139,426	139,331	137,202	124,059	134,141	135,849	135,337	2,900	1,777	30,652	3,657		984,331	1,796,622
05 Locks	58,464				13,383				5,700		43,809	5,660		68,552	497,036
06 Fish & Wildlife	3,786	476	485	493	502	511	520	529	161		167	191	100	4,157	13,156
08 Roads, Railroads, & Bridges	848											1,036		1,036	3,831
09 Channels & Canals	50,402										33,886	27,084		60,970	60,970
16 Bank Stabilization	0													0	7,722
18 Cultural Resource Preservation	3,006											3,673		3,673	3,795
19 Buildings, Grounds, & Utilities	12,488								12,913			1,634		14,547	47,669
20 Permanent Operating Equipment	20,645									1,232	23,520			24,752	47,616
30 Planning, Engineering, Division	38,323	2,254	2,271	3,931	3,089	2,764	3,719	4,090	925	9,657	8,921	6,924	2,845	51,379	163,430
31 Construction Management	59,034	7,430	7,489	7,558	7,368	8,518	8,244	8,308	1,385	921	3,364	8,056	4,269	72,880	142,306
50 Construction Facilities	6,220	412	424	816	1,150	1,203	1,258	1,316	935					7,514	11,910
59 Contingencies	244,200				450	2,863	410	430	125,111	118,213	3,861	26,886	15,056	293,279	293,279
Total	1,406,104	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	131,800	148,200	84,800	22,304	1,587,104	3,099,000

- ❶ Authorized (Oct 87) - Authorized Project Cost as authorized by WRDA 1988
- ❷ Expenditures thru FY 11 - All project expenses incurred through September 2011 (CEFMS).
- ❸ Expenditures Planned for FY 12 - Scheduled expenditures for Fiscal Year 2012
- ❹ Allocated Funds Thru FY 12 - Total of all funds that have been allocated through Fiscal Year 2012
- ❺ Balance to Complete - The estimated cost for FY 12 through completion in FY 24
- ❻ Pending Modifications - None
- ❼ Adjusted Balance to Complete - This is the cost to complete the project (sum of Balance to Complete and Pending Modifications). Price escalation is not included.
- ❽ Final Project Cost (no escalation) - The revised total project cost, including Allocated Funds through FY 11 and the Adjusted Balance to Complete. This estimate will be used for reauthorization.
- ❾ Distribution of Remaing Funds - This section illustrates the yearly distribution of the Adjusted Balance to Complete.
- ❿ Cost to Complete (w/escalation) - Adjusted Balance to Complete with escalation applied according to the Distribution Schedule.
- ⓫ Final Project Cost (w/escalation) - The revised fully funded project cost, including Allocated funds thru FY 11 and Adjusted Balance to Complete (w/escalation) required to complete the project.

SECTION 10 - **Changes in Project Benefits**

10.1 **Analysis History**

The original authorizing benefits were estimated in the Lower Ohio River Navigation Study, Locks and Dams No. 52 and 53 Feasibility Study, dated (revised) November 1985. The first update to these benefits was done in the Olmsted Locks and Dam (Replacement of Locks and Dams 52 and 52) Benefit Update, dated October 1990. The second update to these benefits was done for this Post Authorization Change (PAC) Report and is documented in Appendix A – Economics Update. The Economic Update includes revisions made in response to a 2010 Independent External Peer Review (IEPR), and has been updated to 1 Oct 2011 price levels and the FY 2012 discount rate (4.0%).

The without-project condition assumptions used in the 1990 Benefit Update were essentially the same as those outlined in the 1985 Feasibility Study, except for authorized changes that had occurred to the waterway system in the intervening years. The without-project structural components in the 1990 Benefit Update consisted of LDs 52 and 53, including the locks, dam components, navigable portion of the dam and all related equipment and facilities at these sites. Relative to the operation and maintenance of these projects it was assumed that: 1) The existing Locks and Dams 52 and 53 would be repaired, rehabilitated and maintained as required to continue their function over the 2006-2055 economic planning period, with 2006 being the first year that a new Olmsted facility would be complete; 2) Helper boats would be available to process tows through the smaller 600' auxiliary chamber at LD 52 to assist double-cut tows beginning in 1995; and 3) All four lock chambers would be rehabilitated in the 2010 – 2018 timeframe as indicated by the probability of failure analysis conducted in the 1985 Feasibility Study.

The without-project condition assumptions used in the 2011 revision of the Economics Update (Appendix A) are, for the most part, the same as those used in the 1990 Benefit Update, with the exception of the assumption that major rehabilitation of all four lock chambers would address the increasing probability of structural failure over the analysis period. No major rehabilitation is in the planning stages that would allow for accomplishment of major rehabilitations in the 2010 – 2018 timeframe as assumed in the 1990 Benefit Update.

Planning guidance specifies that in defining the without-project condition that Corps analysts should identify the condition most likely to prevail in the absence of a new project, which in the past included advanced maintenance, rehabilitations, and even lock replacements-in-kind (RIK). Rehabilitation costs below a specified threshold (currently $14 million, EC 11-2-199) are 100% Federally funded and paid from the O&M account, while rehabilitation costs above this threshold are 50/50 cost shared with the IWTF. The expectation now is that major lock rehabilitations and / or advanced maintenance practices will continue to be difficult to implement, regardless of any underlying economic justification, and that major component replacement will only occur after failure conditions exist. Similarly, RIK (referred to as the Chamber Replacement alternative) was judged to be an unlikely without-project alternative. This is not to say that advanced maintenance, rehabilitations, and RIK are no longer considered, but that they now will be considered as a with-project condition where additional funds must be allocated. All navigation projects are formulated against a similar fix as fails (FAF) / reactive maintenance base assuming

normal operations and maintenance practices. Advanced maintenance, rehabilitation, and RIK are considered and analyzed as with-project conditions.

10.2 Analysis Models

All benefit estimations in the 1985 Feasibility Study, the 1990 Benefit Update and the 2011 revision of the Economics Update are made within a system's context. In analyses for both reports, the relevant system modeled in detail was the Ohio River System (ORS), which comprises the mainstem Ohio River and its navigable tributary waterways. System economic analysis relies upon movement level traffic demand forecasts, lock chamber specific performance simulations, transportation rates for existing and alternate modes, and structural performance of the lock projects is also required.

The two latest benefit estimates, the 1990 Benefit Update and the Economics Update, were conducted using system economic modeling to project future system performance under normal operating conditions (that is, no major closures of system lock components), which was then adjusted in a spreadsheet environment to account for degraded structural conditions. The lock performance and each of the major components of this system analysis are discussed in the Economics Update.

System benefit estimations presented in the 1985 Feasibility Study and in the 1990 Benefit Update were made with the Tow Cost/Equilibrium Model (TC/EQ). Since those analyses were completed, the TC/EQ has evolved into the Ohio River Navigation Investment Model (ORNIM), which was used in the 2011 revision of the Economics Update used for this PAC Report. Though ORNIM has the capability to analyze reliability within the model, this feature was not exercised in the Olmsted Economics Update owing to the lack of engineering reliability analysis that provides hazard functions and consequences as required by ORNIM. Rather, project reliability was handled in the Economics Update in a fashion similar to that done in the 1990 Benefit Update; that is, using information from condition surveys and assessments and informed judgment, Louisville District engineers developed a schedule of lock closures for repair in Cost-Closure Matrices corresponding to alternative project scenarios.

10.3 Input Assumption Updates

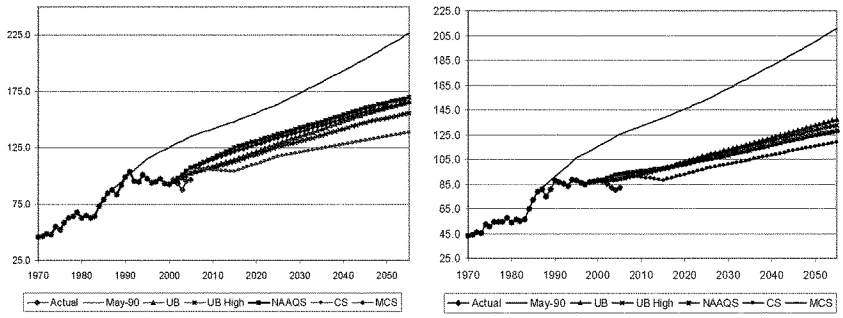
Forecasts of future traffic demand on the Ohio River System (ORS) and at the new Olmsted project are an important element in the project benefit evaluation. Estimates of the benefits from waterway investments require an analysis of the likely level of demand for waterway transportation over the 50-year economic life of the navigation project.

10.3.1 Waterway Traffic Demand Forecasts

The benefit estimates presented in the 1990 Benefit Update relied on the most up-to-date ORS traffic demand forecasts at the time. These forecasts were developed in 1989-90 by the Great Lakes and Ohio River Division Navigation Planning Center (CELRH-NC). More current forecasts were used in the Economics Update. In April 2003, CELRH-NC completed an update of the ORS forecasts and an analysis of the industries that ship and / or receive on the ORS. New forecasts were prepared for all commodity groups, but because of the dominance of utility steam coal on the system and the uncertainties surrounding the regulatory future, five alternative scenarios were developed only for utility coal and sorbent materials (lime and limestone) used

for coal desulfurization. Based upon the recent performance of these five forecasts, the Clear Skies Scenario was selected for use in displays of project benefits. As shown in Figure 3, recent traffic levels and the most current ORS traffic demand forecasts, are much lower than the traffic forecast levels used in the 1990 Benefit Update.

Figure 3 – Tonnage Demand Forecast Comparisons



After the completion of the original version of the Economic Update in 2007, a 2010 Independent External Peer Review (IEPR) requested inclusion of a comparison of the traffic forecast assumptions against newer traffic data and traffic forecasts. As stated above, the Clear Skies Scenario was used as the basis for analysis. The Clear Skies Scenario, at the time the forecasts were developed, was the most restrictive of the alternative forecasts in terms of waterborne coal traffic generally and traffic through Locks 52 and 53 specifically, though it did not include carbon dioxide emission restrictions.

A more recent update of the ORS forecasts included three alternative forecasts of steam coal traffic. These were designated High Case, Base Case, and Low Case. The High Case includes high level economic growth forecasts, continuation of sulfur dioxide and nitrogen oxide emission restrictions, implementation of CO2 emission restrictions, and relatively low growth in nuclear power. The Base Case differs from the High Case in that it assumes mid-level economic growth and nuclear power development. The Low Case assumes low-level economic growth, stricter emission restrictions on SO2 and NO, strict, nation-wide CO2 emissions restrictions, and high-level development of nuclear power.

When compared to these three scenarios, the Clear Skies Scenario for both L&D 52 and 53 is similar to but somewhat higher in terms of tonnage than the Low Case for most of the forecast horizon (lower in the beginning and end). A flat forecast, which is equal to the Clear Sky Scenario until 2010, at which point it remains flat until the end of the forecast horizon, was included as a sensitivity test. Both the Low Case and the Clear Sky Scenario are higher than this flat forecast. In the flat forecast scenario the project remains justified, indicating that no further sensitivity tests are necessary.

10.3.2 **Waterway Demand Elasticity**

The conventional method of defining and handling shipper response, or waterway demand elasticity in waterway system economic models is to use each origin-destination-commodity movement's least-costly all-overland rate to represent that move's willingness-to-pay for barge transportation. As delays due to service outage mount, the waterway cost increases. Once the waterway cost exceeds this willingness-to-pay (e.g., the all-overland rate), the movement is diverted off the waterway. This land rate is assumed fixed through the analysis period (i.e., no future land congestions effects). In the system equilibrium process, marginal movements, and parts of marginal movements, are diverted.

This technique, used in the Economic Update (2008), has been succeeded by techniques to define each origin to destination commodity movement with a movement level downward sloping demand curve rather than one willingness-to-pay diversion price (the least-cost all-overland rate) of the movement. As such, as the transportation price of the waterway increases, fractions of tonnage from all movements on the waterway system are diverted.

Deriving a movement demand curve is more analytically involved than deriving the movement's alternative rate, requiring very detailed shipper surveys and sophisticated econometric analyses whether using stated or revealed preference models. The work to develop movement-level demand shaping functions was only just underway at the time of the Olmsted economic update. While a movement-level demand curve would be important when movements are highly aggregated, this was not the case in the Olmsted analysis. Additionally, movements in the Ohio River system prove to be relatively insensitive to waterway price changes and more influenced by commodity requirements and available sources that are not geographically ubiquitous. Nevertheless, this newer technique would result in traffic being much more sensitive to waterway price change resulting in greater tonnage diversion under a without-project condition and thus greater tonnage attraction under a with-project condition. It is uncertain whether incorporation of the more detailed movement response data would increase, decrease, or make no difference to the results from the conventional shipper response method used.

10.3.3 **Transportation Rates**

The 1990 Benefit Update used 1987 transportation rates to develop the navigation benefits for the recommended plan. The rates were based on an update of a comprehensive rate study of ORS traffic by the Tennessee Valley Authority (TVA) done in 1984.

The economic update in this Olmsted Economics Update uses FY2003 transportation rates; the most current rate data available at the time ORNIM was run for this analysis. In the FY2003 rate analysis 1,589 ORS movements were rated, indices for truck, rail and barge modes by commodity group were developed, and the un-sampled movements rated. The rate data and the model results, however, were subsequently indexed to October 2010 (FY 2011) based on a comprehensive rate study of ORS traffic by the University of Tennessee, Center for Transportation Research done in March 2011 under contract with the Marshall University Appalachian Transportation Institute. In the FY 2011 rate analysis 1,552 year 2004 ORS movements were rated, indices for truck, rail and barge modes by commodity group were developed, and the un-sampled movements rated.

Table 6 summarizes the average transportation rate-savings by commodity group for the FY1987 (used in the 1990 Benefit Update), FY2003, and FY2011 ORS rate studies.

Table 6 – Average Transportation Rate-Savings Comparisons

Commodity Group	Rate Study 1987	2003	2011
Coal	$ 6.13	$ 5.92	$ 8.79
Petrol	$ 16.25	$ 9.45	$ 27.54
Stone	$ 12.68	$ 7.51	$ 12.33
Grain	$ 14.98	$ 10.41	$ 17.38
Chemical	$ 15.77	$ 22.20	$ 49.47
Ore	$ 16.26	$ 23.13	$ 20.91
Steel	$ 17.29	$ 16.43	$ 20.91
Other	$ 22.82	$ 11.38	$ 23.31
Total	$ 9.67	$ 7.44	$ 13.46
L/Ds 52 & 53	$ 13.69	$ 14.21	$ 27.46

10.3.4 Capacity Analysis

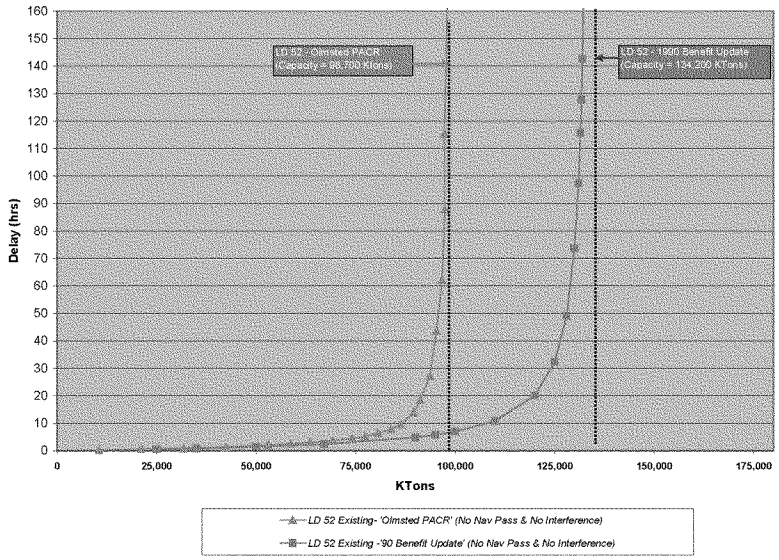
In the 1990 Benefit Update a deterministic (algebraic) queuing model called LOCALC was used, while for the 2011 Economics Update the Waterways Analysis Model (WAM), a discrete event simulation model, was used[2]. Direct comparison of the capacity results from the 1990 Benefit Update and the Economic Update is difficult owing to the difference in the techniques and applications employed. For example, LOCALC could not estimate capacity of a project with intermittent periods of navigable/open pass (tow passage not requiring a lockage) such as occurs at both LD 52 and LD 53. To accommodate this limitation, LOCALC runs were made to separately estimate capacities for the project with tows using the locks and with navigable/open pass. These capacities were then weighted by percent time of year in one of these two conditions to estimate a project capacity. The WAM, however, is able to accommodate navigable/open pass and tow lockages within the same annual simulation of project performance. A detailed description of the lock capacity analysis completed for this report is available in Appendix A - Economics Update.

For direct comparison, full chamber operation of LD 52 (1200' main and 600' auxiliary chamber working together) without navigable/open pass was the only project condition where comparison of capacity estimates could be made. Tonnage-transit curves and capacity estimates used in the 1990 Benefit Update and in the Economics Update for this full chamber operation at LD 52 are shown in Figure 4. The Economic Update capacity estimate (98.7 million tons) for LD 52 is 26% lower than the estimate made in the 1990 Benefit Update (134.2 million tons).

[2] The Waterways Analysis Model was certified for use by the HQUSACE Model Certification Panel. The certification memo, dated 15 August 2011, is included as an attachment to Appendix A.

The decrease in these capacity estimates between these LOCALC model and WAM is driven by two primary changes. First and foremost is an increase in main chamber average processing times from 60.8 minutes (1990 LPMS) to 75.4 minutes (2000-2005 LPMS); higher processing times mean lower capacity. The higher processing times reflect the continuing physical deterioration of the main chamber. The fill/spill of the chamber was also filling/spilling the coffer wall cells which were constructed to temporarily extend the main chamber to 1200' until Olmsted was completed. The chamber butterfly valves had also deteriorated to an extent to complicate navigation to the point of slowing tow entry into the chamber. While repairs have been made (summer 2007) to the cells and valves, the 2000-2005 processing times serve as a better estimate of long-term performance over the analysis period.

Figure 4 – L&D 52 Existing Full Operation Capacity Comparison (No Navigable Pass and No Lock Interference)



Second, the LOCALC analysis assumed unrealistically high auxiliary chamber utilization. Given a better analysis technique (discrete event simulation) and newer understanding of chamber interference effects, the auxiliary chamber is not expected to boost project capacity as much as previously estimated. Limiting the auxiliary chamber to single-cut tows is the best operating policy to maximize project throughput. As a result, at high traffic levels WAM simulations drive the main 1200' chamber to a utilization rate of 100%, with the main chamber processing almost 90 percent of project tonnage. This high level of main chamber utilization coupled with the higher main chamber processing times results in the significantly lower capacity estimates used in the Economic Update.

10.3.5 **Cost-Closure Matrices**

Louisville District engineering developed Cost-Closure Matrices in order to represent the structural reliability of the exiting lower Ohio projects by indicating the consequences of failure through days each chamber is out of service and the repair costs needed to place the project(s) back into service. The 1990 Benefit Update utilized probability of failure work completed for the 1985 Feasibility Study in developing near term closure for repair requirements, while the 2011 Economics Update closure estimates were based upon current engineering judgment informed by condition surveys and assessments. The cost and closure matrices prepared for the original Economics Update in 2007 were revised in 2011, in part to account for the shift in the online year for Olmsted.

Categories and information used in the cost and closure matrices were based upon an extensive database search of historical records over roughly the last 20 years. Sources included the Corps of Engineers' Lock Performance Monitoring System (LPMS) data, Operations repair reports and field notes and historical notices to navigation. In general, the Operations repair reports coupled with historical navigation notices generally provided the most reliable set of historical data to draw from when developing the cost and closure information. The LPMS data was also useful but variability among how project personnel input the data required a more careful screening of the information. Each of these historical repairs was logged on a site-specific spreadsheet by lock chamber and then cross-referenced with the other databases.

A comparison of the closure days assumed in the 2011 revision of the Economics Update with the 1990 Benefit Update over the project period-of-analysis (50-year project life) is shown in Table 7. The matrices also include maintenance closures for the recommended plan (Olmsted) for inspections and miscellaneous unscheduled closures. Generally, the number of closure days are significantly higher in the newer analysis under the without-project condition and slightly higher in the with-project condition. Most notable are the complete navigation closures in the new analysis. Additional discussion of the Louisville District engineering Cost-Closure Matrices can be found in Attachment 1 to Appendix A - Economics Update.

Table 7 - Closure Day Assumptions Comparison

Group	Without-Project Condition *				Difference	
	Oct. 1990 Benefit Update		Dec. 2007, rev Nov 2011 Economics Update			
	L&D 52	L&D 53	L&D 52	L&D 53	L&D 52	L&D 53
No Navigation - dam closed & chambers unavail.	0.0	0.0	711.8	511.0	711.8	511.0
No Navigation - both chambers closed & no nav pass	0.0	0.0	390.1	169.9	390.1	169.9
Main Chamber Closed & Aux Open (no nav/open pass)	441.1	113.2	1,791.8	447.8	1,350.7	334.6
Auxiliary Chamber Closed & Main Open (no nav/open pass)	436.4	113.4	776.9	293.6	340.4	180.2
Total Days a Closure Event was Experienced	877.6	226.6	3,670.5	1,422.3	2,793.0	1,195.7
Average % of Year with No Navigation	0.0%	0.0%	6.0%	3.7%	6.0%	3.7%
Average % of Year with Main Chamber Closure	2.4%	0.6%	9.8%	2.5%	7.4%	1.8%
Average % of Year with Aux Chamber Closure	2.4%	0.6%	4.3%	1.6%	1.9%	1.0%

Group	With Project Condition *		Difference
	Oct. 1990 Benefit Update	Dec. 2007, rev Nov 2011 Economics Update	
	Olmsted	Olmsted	Olmsted
No Navigation - dam closed & chambers unavail.	0.0	0.0	0.0
No Navigation - both chambers closed & no nav pass	0.0	0.0	0.0
Main Chamber Closed & Aux Open (no nav/open pass)	144.0	291.0	147.0
Auxiliary Chamber Closed & Main Open (no nav/open pass)	144.0	294.0	150.0
Total Days a Closure Event was Experienced	288.0	585.0	297.0
Average % of Year with No Navigation	0.0%	0.0%	0.0%
Average % of Year with Main Chamber Closure	0.8%	1.6%	0.8%
Average % of Year with Aux Chamber Closure	0.8%	1.6%	0.8%

** 1990 Benefit Update period of analysis 2006-2055 and Economics Update period of analysis 2016-2065. Note that the newer data also contains without and with-project differences pre-online (construction period). In the Nov 2011 revisions the period of analysis was shifted to 2020-2069.*

10.4 **Benefit Update Comparison**

The benefit streams last reported to Congress are from the Olmsted Locks and Dam (Replacement of Locks and Dams 52 and 52) Benefit Update, dated October 1990. The October 1990 Update benefits and costs were at a 1 October 1990 price level and assumed a 16-year construction and a 2006 - 2055 project analysis period amortized at a Federal Discount Rate of 8.875%. The updated benefits for this PAC Report is at a 1 October 2011 price level and assumes a 34-year construction and a 2020 - 2069 project analysis period. This re-analysis is also amortized at the FY 2012 Federal Discount Rate of 4.0%. A comparison of the analysis assumptions between the benefit estimates are summarized in Table 8. In addition, the updated benefits in this analysis were amortized at an OMB analysis rate of 7.0% and at the last approved report rate of 8.875% (for comparison).

Table 8 - Benefit Analysis Assumptions

	Benefit Update Oct. 1990	Economics Update Dec. 2007, rev Nov 2011
Study Period (GI $)	1986 - 1990	1986 - 1990
Construction Period (CG $)	1991 - 2006	1991 - 2024
Construction Duration	16-years	34-years
Project Analysis Period	2006 - 2055	2020 - 2069
Price Level	1 Oct. 1990	1 Oct. 2011
Federal Discount Rate	8.875%	4.0%

The primary benefits from a replacement project comes from waterway transportation savings, however, additional savings occur from without-project condition costs foregone. Both benefit categories were estimated in the last approved report and in this reanalysis. Comparisons are discussed in the following sections.

10.4.1 Transportation Rate Saving Benefits

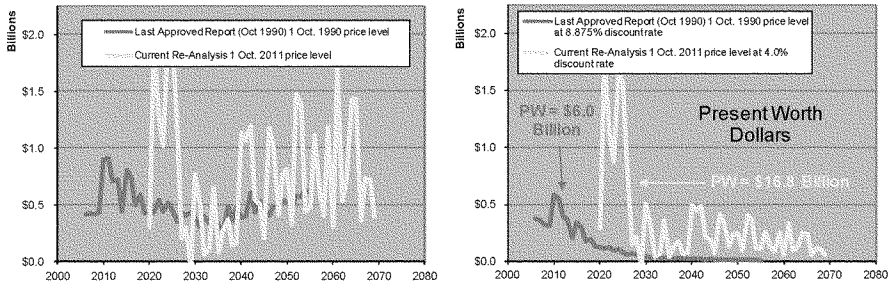
Waterway transportation savings are specifically calculated as the rate-savings for the accommodated waterway traffic. Rate-savings are measured as the difference between a movement's equilibrium waterway rate and the movement's least-costly all-overland mode rate. While the equilibrium waterway rate tends to increase through time as congestion increases on the waterway system (assuming here that the forecasted waterway demands increase through time) while the least-costly all-overland mode rates are assumed constant. Assuming the least-costly all-overland mode rates as constant is a conservative simplifying assumption assumed in estimating the water transportation savings in the original authorizing document, the last approved report and in the current re-analysis update. A comparison of the transportation rate-savings benefit streams between the last approved report and the current re-analysis update are shown in Table 11 and Figure 4. A comparison of both benefit streams at the OMB 7% rate can be found in Appendix A – Economics Update.

In addition to the slippage of the project analysis period, there are also significant differences in the transportation saving levels and patterns as shown in Figure 5. Looking at the base normal operations with-project condition incremental rate-savings, the re-analysis estimates are higher with the price level difference (current estimates are at a 1 October 2011 price level while the 1990 Benefit Update are at a 1 October 1990 price level), however when these differences in price level are accounted for, incremental rate savings in real terms have in fact decreased. The primary driver of this lower normal operation transportation savings estimate is lower traffic demand forecasts, which more than off-sets the lower without-project condition capacity estimates assumed in the current analysis which would tend to increase incremental with-project benefits. Additional information and comparisons of the traffic demands can be found in Appendix A - Economics Update.

Table 9 – Transportation Rate Savings Benefits Comparisons

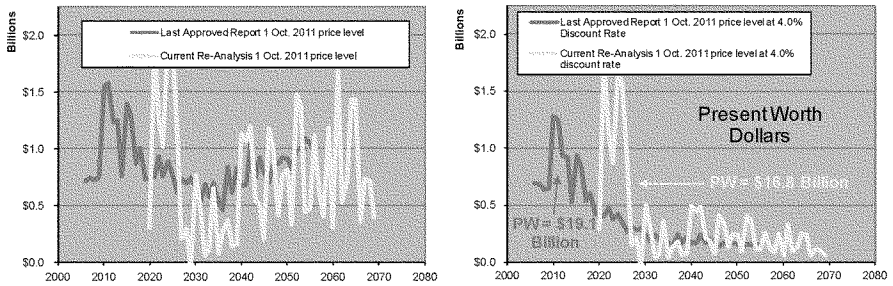
	Transportation Benefits (Incremental Transportation Rate Savings)		Present Worth Factors		Present Worth	
	Benefit Update Oct. 1990	Economics Update Dec. 2007, rev Nov 2011	Benefit Update	Economics Update	Benefit Update	Economics Update
Year	(1 Oct. 1990 price level)	(1 Oct. 2011 price level)	8.875%	4.000%	8.875%	4.000%
2006	$412,167,036		0.9185		$ 378,569,034	
2007	$426,333,535		0.8436		$ 359,660,844	
2008	$413,951,792		0.7748		$ 320,748,965	
2009	$434,030,294		0.7117		$ 308,892,506	
2010	$894,497,284		0.6537		$ 584,706,856	
2011	$907,994,499		0.6004		$ 545,147,732	
2012	$707,767,211		0.5514		$ 390,295,247	
2013	$720,706,691		0.5065		$ 365,033,909	
2014	$436,930,523		0.4652		$ 203,263,253	
2015	$801,801,531		0.4273		$ 342,598,298	
2016	$740,673,646		0.3925		$ 290,681,267	
2017	$497,946,861		0.3605		$ 179,491,953	
2018	$581,049,551		0.3311		$ 192,374,270	
2019	$423,321,760		0.3041		$ 128,728,954	
2020	$426,445,082	$308,323,785	0.2793	0.9615	$ 119,107,906	$ 296,465,176
2021	$429,791,500	$1,935,031,716	0.2565	0.9246	$ 110,257,244	$ 1,789,045,595
2022	$535,761,374	$1,266,202,949	0.2356	0.8890	$ 126,238,709	$ 1,125,649,811
2023	$436,930,523	$1,020,631,781	0.2164	0.8548	$ 94,559,542	$ 872,440,324
2024	$508,432,301	$2,033,019,663	0.1988	0.8219	$ 101,064,339	$ 1,670,993,969
2025	$445,185,018	$1,973,693,466	0.1826	0.7903	$ 81,278,781	$ 1,559,838,616
2026	$351,485,340	$1,127,476,806	0.1677	0.7599	$ 58,940,754	$ 856,789,709
2027	$419,417,607	$199,647,609	0.1540	0.7307	$ 64,599,173	$ 145,880,552
2028	$402,573,974	$298,722,279	0.1415	0.7026	$ 56,950,538	$ 209,878,311
2029	$428,229,838	($62,054,691)	0.1299	0.6756	$ 55,641,764	$ (41,921,926)
2030	$373,794,787	$766,740,604	0.1193	0.6496	$ 44,609,673	$ 498,060,076
2031	$290,915,191	$503,257,660	0.1096	0.6246	$ 31,888,496	$ 314,333,250
2032	$397,554,348	$62,883,984	0.1007	0.6006	$ 40,025,427	$ 37,766,491
2033	$333,526,235	$116,489,436	0.0925	0.5775	$ 30,841,912	$ 67,269,747
2034	$401,235,407	$646,150,106	0.0849	0.5553	$ 34,078,650	$ 358,784,217
2035	$310,882,146	$78,221,768	0.0780	0.5339	$ 24,252,178	$ 41,763,241
2036	$265,817,063	$263,877,994	0.0717	0.5134	$ 19,046,257	$ 135,467,902
2037	$483,891,909	$365,193,239	0.0658	0.4936	$ 31,845,420	$ 180,269,652
2038	$354,274,021	$142,535,568	0.0604	0.4746	$ 21,414,590	$ 67,653,428
2039	$479,206,925	$162,917,548	0.0555	0.4564	$ 26,605,129	$ 74,353,442
2040	$383,164,755	$1,126,688,864	0.0510	0.4388	$ 19,538,880	$ 494,428,933
2041	$397,554,348	$1,070,693,709	0.0468	0.4220	$ 18,620,119	$ 451,784,978
2042	$599,231,751	$1,194,192,053	0.0430	0.4057	$ 25,778,201	$ 484,515,163
2043	$426,556,630	$552,152,493	0.0395	0.3901	$ 16,854,129	$ 215,406,545
2044	$532,972,693	$504,246,080	0.0363	0.3751	$ 19,342,224	$ 189,151,177
2045	$455,447,364	$204,040,991	0.0333	0.3607	$ 15,181,388	$ 73,595,389
2046	$407,035,863	$1,176,682,386	0.0306	0.3468	$ 12,461,714	$ 408,092,949
2047	$489,803,912	$1,018,107,028	0.0281	0.3335	$ 13,773,338	$ 339,515,757
2048	$498,839,238	$408,622,620	0.0258	0.3207	$ 12,883,960	$ 131,025,421
2049	$532,861,145	$769,540,550	0.0237	0.3083	$ 12,640,803	$ 237,263,717
2050	$527,729,973	$815,749,098	0.0218	0.2965	$ 11,498,580	$ 241,837,188
2051	$472,514,091	$328,637,249	0.0200	0.2851	$ 9,456,252	$ 93,680,657
2052	$578,595,512	$1,477,877,327	0.0184	0.2741	$ 10,635,335	$ 405,077,564
2053	$571,121,847	$1,377,429,372	0.0169	0.2636	$ 9,642,213	$ 363,024,389
2054	$630,688,071	$440,395,252	0.0155	0.2534	$ 9,779,899	$ 111,602,970
2055	$600,012,581	$475,037,821	0.0142	0.2437	$ 8,545,785	$ 115,751,859
2056		$1,114,906,116		0.2343		$ 261,218,989
2057		$601,641,328		0.2253		$ 135,541,026
2058		$405,745,803		0.2166		$ 87,892,902
2059		$1,180,596,757		0.2083		$ 245,905,371
2060		$304,981,202		0.2003		$ 61,081,003
2061		$1,700,390,234		0.1926		$ 327,452,531
2062		$527,131,283		0.1852		$ 97,607,952
2063		$724,888,687		0.1780		$ 129,083,784
2064		$1,426,025,358		0.1712		$ 244,133,277
2065		$1,431,240,722		0.1646		$ 235,602,056
2066		$362,924,129		0.1583		$ 57,444,559
2067		$734,420,061		0.1522		$ 111,774,888
2068		$716,733,654		0.1463		$ 104,887,606
2069		$398,292,088		0.1407		$ 56,044,721
			TOTAL PRESENT WORTH:		$ 5,990,072,390	$ 16,772,186,906
			AVERAGE ANNUAL EQUIVALENT:		$ 539,300,000	$ 780,748,662

Figure 5 – Transportation Rate Savings Benefits Comparisons – Analysis Year Price Levels



The next observable pattern in the benefit estimates is that closures are much more severe. This affect occurs because of significant increases, and lumpiness, of the closures in the Louisville District engineering Cost-Closure Matrices. A significant component of the increase in severity and lumpiness of closures, is the inclusion of complete river closure situations in the Cost-Closure Matrices, as summarized in Table 7, which were not included in the 1990 Benefit Update. This increase in closure severity can be seen by comparison of the benefit streams in Table 9 and in left-hand panel of Figure 5. Figure 5 shows the benefit stream from the last approved report, and that estimated for this revision of the Economic Update. In the figure, these two benefit streams are displayed at their original analysis year price levels (Oct 2009 and Oct 2011, respectively). The right-hand panel illustrates the effect of discounting on the benefits streams, with the 1990 Benefit Update benefits discounted at 8.875% discount rate, and the Economic Update benefits discounted at the FY 2012 4.0% discount rate. The average annual transportation rate-savings benefit for the current re-analysis update, at a 4.0% discount rate is 44.8% higher, at the original respective price levels, than the last approved report at its 8.875% discount rate. When both are discounted at the FY 2012 discount rate of 4.0%, re-analysis benefits are 52.1% higher than in the last approved report.

Figure 6 – Transportation Rate Savings Benefits Comparisons – 1 Oct 2011 Price Level



However the difference in price levels over the 21-year period between 1990 and 2011 is fairly substantial; roughly a 73% increase using the Consumer Price Index. When this price level

difference is accounted for, as displayed in Figure 6 above, annual benefits in real dollars have decreased from the 1990 Benefit Update by 12.3% using the 4.0% discount rate.

10.4.2 **Costs Foregone Benefits**

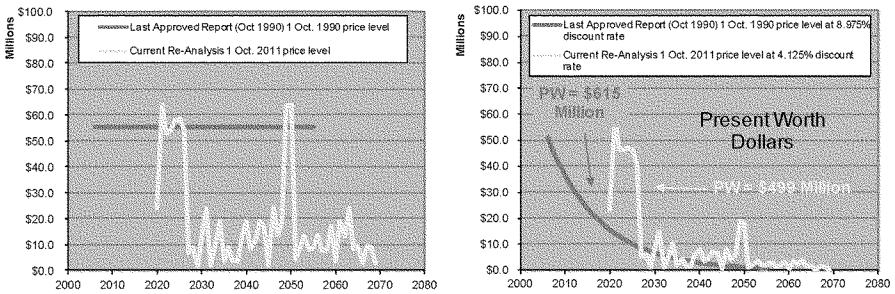
The Louisville District engineering Cost-Closure Matrices not only represents the structural reliability of the exiting lower Ohio projects by indicating the consequences of failure through days a chamber is out of service (which factor into the waterway transportation rate-savings calculation), the Cost-Closure Matrices also estimate the repair costs needed to place the project(s) back into service. Generally, for both the 1990 Benefit Update and the 2011 revision of the Economics Update, the repair costs are greater under the without-project condition where L/Ds 52 and 53 are maintained, than under the recommended plan with a newly constructed Olmsted project. As a result, both analyses show a cost foregone benefit as displayed in Table 10 and Figure 6. A comparison of both cost streams at the OMB 7% rate can be found in Appendix A – Economics Update. As previously noted, the 1990 Benefit Update assumed LD 52 and LD 53 rehabilitations in 2010-2018, while the current analysis assumes a cost-closure matrix.

From Table 10 the Economic Update costs foregone are 57.5% lower than those assumed in the 1990 Benefit Update ($23.6 million versus $55.4 million average annual). If both cost streams are discounted and amortized at 4.0% the reduction remains at 57.5% since the 1990 Benefit Update costs foregone are flat (and result in the same average annual regardless of the discount rate used). The 1990 Benefit Update costs foregone are flat through time because the year-to-year estimates used in that analysis were not available and only an average annual estimate was available for comparison. If both cost streams are discounted and amortized at 8.875% the reduction reduces to a 46.7% difference.

Table 10 - Costs Foregone Benefits Comparisons

	Costs Foregone Benefits *		Present Worth Factors		Present Worth	
	Benefit Update Oct. 1990 **	Economics Update Dec. 2007, rev Nov 2011	Benefit Update	Economics Update	Benefit Update	Economics Update
Year	(1 Oct. 1990 price level)	(1 Oct. 2011 price level)	8.875%	4.000%	8.875%	4.000%
2006	$55,400,000		0.9185		$ 50,884,041	
2007	$55,400,000		0.8436		$ 46,736,203	
2008	$55,400,000		0.7748		$ 42,926,478	
2009	$55,400,000		0.7117		$ 39,427,305	
2010	$55,400,000		0.6537		$ 36,213,369	
2011	$55,400,000		0.6004		$ 33,261,418	
2012	$55,400,000		0.5514		$ 30,550,097	
2013	$55,400,000		0.5065		$ 28,059,790	
2014	$55,400,000		0.4652		$ 25,772,482	
2015	$55,400,000		0.4273		$ 23,671,626	
2016	$55,400,000		0.3925		$ 21,742,021	
2017	$55,400,000		0.3605		$ 19,969,710	
2018	$55,400,000		0.3311		$ 18,341,869	
2019	$55,400,000		0.3041		$ 16,846,722	
2020	$55,400,000	$24,082,274	0.2793	0.9615	$ 15,473,453	$ 23,156,032
2021	$55,400,000	$63,907,274	0.2565	0.9246	$ 14,212,127	$ 59,085,867
2022	$55,400,000	$52,707,274	0.2356	0.8890	$ 13,053,618	$ 46,856,574
2023	$55,400,000	$54,182,274	0.2164	0.8548	$ 11,989,546	$ 46,315,235
2024	$55,400,000	$57,757,274	0.1988	0.8219	$ 11,012,212	$ 47,472,269
2025	$55,400,000	$58,707,274	0.1826	0.7903	$ 10,114,546	$ 46,397,211
2026	$55,400,000	$53,982,274	0.1677	0.7599	$ 9,290,054	$ 41,022,091
2027	$55,400,000	$6,982,274	0.1540	0.7307	$ 8,532,771	$ 5,101,879
2028	$55,400,000	$8,707,274	0.1415	0.7026	$ 7,837,218	$ 6,117,615
2029	$55,400,000	$1,507,274	0.1299	0.6756	$ 7,198,363	$ 1,018,260
2030	$55,400,000	$13,882,274	0.1193	0.6496	$ 6,611,585	$ 9,017,660
2031	$55,400,000	$23,782,274	0.1096	0.6246	$ 6,072,638	$ 14,854,338
2032	$55,400,000	$2,132,274	0.1007	0.6006	$ 5,577,624	$ 1,280,588
2033	$55,400,000	$8,757,274	0.0925	0.5775	$ 5,122,961	$ 5,057,107
2034	$55,400,000	$18,832,274	0.0849	0.5553	$ 4,705,360	$ 10,456,893
2035	$55,400,000	$3,482,274	0.0780	0.5339	$ 4,321,801	$ 1,859,214
2036	$55,400,000	$8,832,274	0.0717	0.5134	$ 3,969,507	$ 4,534,253
2037	$55,400,000	$3,407,274	0.0658	0.4936	$ 3,645,931	$ 1,681,926
2038	$55,400,000	$3,707,274	0.0604	0.4746	$ 3,348,731	$ 1,759,629
2039	$55,400,000	$13,082,274	0.0555	0.4564	$ 3,075,757	$ 5,970,579
2040	$55,400,000	$18,732,274	0.0510	0.4388	$ 2,825,035	$ 8,220,351
2041	$55,400,000	$8,582,274	0.0468	0.4220	$ 2,594,751	$ 3,621,337
2042	$55,400,000	$11,732,274	0.0430	0.4057	$ 2,383,239	$ 4,760,092
2043	$55,400,000	$18,907,274	0.0395	0.3901	$ 2,188,968	$ 7,376,134
2044	$55,400,000	$16,982,274	0.0363	0.3751	$ 2,010,533	$ 6,370,336
2045	$55,400,000	$1,832,274	0.0333	0.3607	$ 1,846,643	$ 660,881
2046	$55,400,000	$24,132,274	0.0306	0.3468	$ 1,696,113	$ 8,369,472
2047	$55,400,000	$13,682,274	0.0281	0.3335	$ 1,557,854	$ 4,562,730
2048	$55,400,000	$18,707,274	0.0258	0.3207	$ 1,430,865	$ 5,998,514
2049	$55,400,000	$63,207,274	0.0237	0.3083	$ 1,314,227	$ 19,487,982
2050	$55,400,000	$63,732,274	0.0218	0.2965	$ 1,207,097	$ 18,894,086
2051	$55,400,000	$4,257,274	0.0200	0.2851	$ 1,108,700	$ 1,213,570
2052	$55,400,000	$8,282,274	0.0184	0.2741	$ 1,018,324	$ 2,270,123
2053	$55,400,000	$13,457,274	0.0169	0.2636	$ 935,315	$ 3,546,693
2054	$55,400,000	$7,882,274	0.0155	0.2534	$ 859,072	$ 1,997,490
2055	$55,400,000	$8,657,274	0.0142	0.2437	$ 789,044	$ 2,109,507
2056		$13,832,274		0.2343		$ 3,240,858
2057		$7,507,274		0.2253		$ 1,691,279
2058		$7,957,274		0.2166		$ 1,723,709
2059		$16,732,274		0.2083		$ 3,485,149
2060		$3,557,274		0.2003		$ 712,443
2061		$18,832,274		0.1926		$ 3,626,624
2062		$13,382,274		0.1852		$ 2,477,972
2063		$23,907,274		0.1780		$ 4,256,603
2064		$8,307,274		0.1712		$ 1,422,192
2065		$9,082,274		0.1646		$ 1,495,068
2066		$2,782,274		0.1583		$ 440,385
2067		$9,282,274		0.1522		$ 1,412,713
2068		$8,782,274		0.1463		$ 1,285,208
2069		$2,782,274		0.1407		$ 391,501
			TOTAL PRESENT WORTH:		$ 615,334,713	$ 506,136,228
			AVERAGE ANNUAL EQUIVALENT:		$ 55,400,000	$ 23,560,743

Figure 7 – Costs Foregone Benefits Comparisons



1990 Benefit Update costs foregone are a constant $55.4M per year because the year-to-year estimates could not be found, only the average annual values exist.

10.4.3 **Fuel Tax Revenues**

Waterway fuel consumption and fuel taxes are calculated in both the TC/EQ (used for benefit estimation in the 1985 Feasibility Study and in the 1990 Benefit Update) and in the ORNIM (used in the revised Economics Update) models. Fuel costs are factored into the model's waterway rate calculation and as fuel costs increase, water rates increase and waterway rate-savings decrease. The tax revenues collected, however, are not lost and are just a transfer payment. As such, the revenues should be added back into the system NED benefits. Neither the 1985 Feasibility Study nor the 1990 Benefit Update itemized these fuel tax revenues to add them back into the recommended plan NED benefit, however, the revised Economics Update does as itemized in Table 11. Over the analysis period there is a $0.20 per gallon waterway fuel tax (the Leaking Underground Storage Tank, or LUST tax, ended in 2004 and the Deficit Reduction Tax ended in 2006). Interestingly, while the fuel tax revenues are positive under both the without and with-project conditions, the with-project condition incremental fuel tax revenue is sometimes positive and sometimes negative. While queuing fuel consumption (and thus tax revenues) are less under the recommended plan as closures are reduced, closures in the without-project condition can choke off waterborne traffic (and thus tax revenues). As a result the incremental fuel tax revenues flip from negative to positive depending upon the extent of the closures assumed in the without-project condition. Overall, there is an incremental tax revenue benefit of $16.7 million average annual as shown in Table 11.

Table 11– Incremental Fuel Tax Revenue Comparison

Year	Ohio River System Movement Waterway Fuel Tax Revenues Without Project	Ohio River System Movement Waterway Fuel Tax Revenues With Project	Incremental Waterway Fuel Tax Revenues	Present Worth Factors Benefit Update 8.875%	Present Worth Factors OMB 7.000%	Present Worth Factors Econ Update 4.000%	Present Worth Incremental Waterway Fuel Tax Revenues Benefit Update 8.875%	Present Worth Incremental Waterway Fuel Tax Revenues OMB 7.000%	Present Worth Incremental Waterway Fuel Tax Revenues Econ Update 4.000%
2013	na	na	na	na	na	na	na	na	na
2014	na	na	na	na	na	na	na	na	na
2015	na	na	na	na	na	na	na	na	na
2016	na	na	na	na	na	na	na	na	na
2017	na	na	na	na	na	na	na	na	na
2018	na	na	na	na	na	na	na	na	na
2019	na	na	na	na	na	na	na	na	na
2020	$130,590,422	$138,861,982	$8,271,561	0.9185	0.934579439	0.9615	$ 7,597,300	$ 7,730,430	$ 7,953,424
2021	$74,654,899	$139,661,767	$65,006,868	0.8436	0.873438728	0.9246	$ 54,840,689	$ 56,779,516	$ 60,102,503
2022	$97,918,788	$139,285,677	$41,366,889	0.7748	0.816297877	0.8890	$ 32,052,976	$ 33,767,704	$ 36,775,014
2023	$109,708,061	$141,649,492	$31,941,430	0.7117	0.762895212	0.8548	$ 22,732,211	$ 24,367,964	$ 27,303,669
2024	$73,500,874	$140,758,478	$67,257,605	0.6537	0.712986179	0.8219	$ 43,964,340	$ 47,953,743	$ 55,280,848
2025	$78,596,763	$143,354,329	$64,757,566	0.6004	0.666342224	0.7903	$ 38,879,575	$ 43,150,701	$ 51,178,845
2026	$110,556,013	$145,423,233	$34,867,221	0.5514	0.622749742	0.7599	$ 19,227,382	$ 21,713,553	$ 26,496,222
2027	$141,217,439	$142,780,495	$1,563,055	0.5065	0.582009105	0.7307	$ 791,679	$ 909,712	$ 1,142,109
2028	$140,874,146	$145,422,575	$4,548,429	0.4652	0.543933743	0.7026	$ 2,115,962	$ 2,474,044	$ 3,195,666
2029	$151,219,205	$142,599,935	($8,619,270)	0.4273	0.508349292	0.6756	$ (3,682,890)	$ (4,381,600)	$ (5,822,870)
2030	$127,789,127	$148,316,550	$20,527,423	0.3925	0.475092796	0.6496	$ 8,056,095	$ 9,752,431	$ 13,334,222
2031	$137,952,283	$148,672,456	$10,720,173	0.3605	0.444011959	0.6246	$ 3,864,237	$ 4,759,885	$ 6,695,789
2032	$155,024,440	$149,208,663	($5,815,776)	0.3311	0.414964448	0.6006	$ (1,925,491)	$ (2,413,340)	$ (3,492,804)
2033	$154,959,747	$150,524,424	($4,435,323)	0.3041	0.387817241	0.5775	$ (1,348,748)	$ (1,720,095)	$ (2,561,288)
2034	$137,177,910	$151,643,346	$14,465,437	0.2793	0.36244602	0.5553	$ 4,040,257	$ 5,242,940	$ 8,032,144
2035	$158,179,794	$151,207,665	($6,972,129)	0.2565	0.338734598	0.5339	$ (1,788,606)	$ (2,361,701)	$ (3,722,477)
2036	$156,459,712	$155,476,077	($983,636)	0.2356	0.31657439	0.5134	$ (231,769)	$ (311,394)	$ (504,972)
2037	$151,974,702	$154,188,418	$2,213,716	0.2164	0.295863916	0.4936	$ 479,088	$ 654,959	$ 1,092,752
2038	$162,239,164	$155,357,351	($6,881,814)	0.1988	0.276508333	0.4746	$ (1,367,942)	$ (1,902,879)	$ (3,266,401)
2039	$162,367,314	$156,001,951	($6,365,363)	0.1826	0.258419003	0.4564	$ (1,162,144)	$ (1,644,931)	$ (2,905,069)
2040	$129,256,501	$158,295,579	$29,039,078	0.1677	0.241513087	0.4388	$ 4,869,578	$ 7,013,317	$ 12,743,323
2041	$131,997,854	$158,492,135	$26,494,281	0.1540	0.225713165	0.4220	$ 4,080,679	$ 5,980,108	$ 11,179,404
2042	$126,240,174	$157,486,583	$31,246,409	0.1415	0.210946883	0.4057	$ 4,420,305	$ 6,591,333	$ 12,677,491
2043	$154,586,183	$160,381,763	$5,795,580	0.1299	0.19714662	0.3901	$ 753,045	$ 1,142,579	$ 2,260,980
2044	$154,349,778	$158,133,182	$3,783,404	0.1193	0.184249178	0.3751	$ 451,522	$ 697,089	$ 1,419,218
2045	$173,337,079	$164,480,319	($8,856,760)	0.1096	0.172195493	0.3607	$ (970,828)	$ (1,525,094)	$ (3,194,538)
2046	$137,157,571	$165,307,213	$28,149,642	0.1007	0.160930367	0.3468	$ 2,834,082	$ 4,530,132	$ 9,762,762
2047	$143,493,037	$165,167,971	$21,674,934	0.0925	0.150402212	0.3335	$ 2,004,329	$ 3,259,958	$ 7,228,102
2048	$169,387,154	$166,387,266	($2,999,888)	0.0849	0.140562815	0.3207	$ (254,793)	$ (421,673)	$ (961,918)
2049	$156,151,988	$166,699,858	$10,547,870	0.0780	0.131367117	0.3083	$ 822,848	$ 1,385,643	$ 3,252,105
2050	$157,412,358	$168,888,355	$11,475,996	0.0717	0.122773007	0.2965	$ 822,275	$ 1,408,943	$ 3,402,177
2051	$179,106,484	$170,505,074	($8,601,410)	0.0658	0.114741128	0.2851	$ (566,068)	$ (986,935)	$ (2,451,900)
2052	$133,385,120	$170,117,296	$36,732,176	0.0604	0.107234699	0.2741	$ 2,220,328	$ 3,938,964	$ 10,068,075
2053	$137,780,442	$169,544,177	$31,763,735	0.0555	0.100219345	0.2636	$ 1,763,493	$ 3,183,341	$ 8,371,399
2054	$177,742,871	$171,124,096	($6,618,775)	0.0510	0.093662939	0.2534	$ (337,514)	$ (619,934)	$ (1,677,300)
2055	$176,986,667	$171,958,438	($5,028,229)	0.0468	0.087535457	0.2437	$ (235,505)	$ (440,148)	$ (1,225,222)
2056	$156,813,059	$176,475,930	$19,662,871	0.0430	0.081808838	0.2343	$ 845,872	$ 1,608,597	$ 4,606,949
2057	$174,209,666	$172,926,871	($1,282,795)	0.0395	0.076456858	0.2253	$ (50,686)	$ (98,078)	$ (288,995)
2058	$187,168,290	$176,395,481	($10,772,809)	0.0363	0.071455008	0.2166	$ (390,958)	$ (769,771)	$ (2,333,612)
2059	$153,235,783	$174,149,719	$20,913,936	0.0333	0.066780381	0.2083	$ 697,122	$ 1,396,641	$ 4,356,144
2060	$194,775,752	$178,176,837	($16,598,915)	0.0306	0.062411571	0.2003	$ (508,188)	$ (1,035,964)	$ (3,324,396)
2061	$141,736,546	$183,277,759	$41,541,213	0.0281	0.058328571	0.1926	$ 1,168,143	$ 2,423,040	$ 7,999,796
2062	$190,662,963	$180,881,467	($9,781,496)	0.0258	0.054512683	0.1852	$ (252,635)	$ (533,216)	$ (1,811,222)
2063	$184,163,002	$181,797,304	($2,365,697)	0.0237	0.050946433	0.1780	$ (56,120)	$ (120,524)	$ (421,204)
2064	$157,019,304	$184,377,611	$27,358,307	0.0218	0.047613489	0.1712	$ 596,103	$ 1,302,624	$ 4,683,699
2065	$160,416,066	$186,412,394	$25,996,328	0.0200	0.044498588	0.1646	$ 520,255	$ 1,156,800	$ 4,279,356
2066	$205,881,448	$185,459,031	($20,422,417)	0.0184	0.041587465	0.1583	$ (375,390)	$ (849,317)	$ (3,232,512)
2067	$195,638,178	$189,273,772	($6,364,406)	0.0169	0.03886679	0.1522	$ (107,450)	$ (247,364)	$ (968,629)
2068	$196,658,374	$188,204,678	($8,453,696)	0.0155	0.036324103	0.1463	$ (131,089)	$ (307,073)	$ (1,237,123)
2069	$211,060,088	$189,470,557	($21,589,532)	0.0142	0.033947759	0.1407	$ (307,493)	$ (732,916)	$ (3,037,919)
						TOTAL PRESENT WORTH:	$ 251,459,462	$ 282,852,742	$ 358,431,815
						AVERAGE ANNUAL EQUIVALENT:	$ 22,639,474	$ 20,495,467	$ 16,685,073

SECTION 11 - **Benefit-Cost Ratio**

Project formulation and selection of a recommended plan is done by calculation and comparison of the alternative's net benefit (costs minus benefits); or more specifically the alternative's incremental net benefit over the base or without-project condition. Despite this, a benefit-to-cost ratio (BCR) is an often referenced performance metric of a cost benefit analysis. For this metric, the analysis period benefit and cost cash flows are discounted, amortized, and divided; the BCR is defined as the average annual equivalent benefits divided by average annual equivalent costs.

The BCR has traditionally only been used as a summary statistic demonstrating the economic viability of the alternative (i.e. BCR > 1.0). Traditionally in the Ohio River Division (ORD), and now in the Great Lakes and Ohio River Division which replaced ORD, this BCR has been calculated as an incremental benefit to incremental cost ratio. This means that the without project condition costs foregone are subtracted from the recommended plan construction cost to reflect an actual incremental cost of the investment over the base condition. This ratio is dependent upon the discount and amortization rate, and upon which specific cash flows are considered benefits and which specific cash flows are considered costs. Depending upon the specific cash flows, an incremental benefit to incremental cost ratio will typically be higher than a straight benefit to cost ratio where costs foregone are counted as a benefit (rather than a negative cost). In this section the BCR will be displayed with costs foregone counted as a benefit. The incremental benefit to incremental cost ratio, as well as other methods of computing the BCR, are included in Appendix A – Economics Update.

11.1 **Construction Cost Interest During Construction**

A primary factor in the BCR is the construction cost. Previous sections in this PAC Report discuss cost changes by CWBS Feature Code. This section will itemize the financial implications of the Federal Discount Rate and interest during construction. The 1990 Benefit Update construction cost amortization is shown in Table 12. The 2011 Economics Update construction cost amortization is shown in Table 13. Note that Table 13 includes calculation at the last approved report, OMB and current discount rates. This table also itemizes the total and remaining cost calculations.

Table 12 – Last Approved Report Construction Cost IDC and Amortization

Fiscal Year	Construction Cost Benefit Update Oct. 1990 (1 Oct. 1990 price level)	IDC Factor 8.875%	Interest During Construction
1990 *	$ 13,023,000	3.73583	$ 35,628,658
1991	$ 3,532,000	3.43130	$ 8,587,345
1992	$ 12,292,700	3.15159	$ 26,448,900
1993	$ 106,569,600	2.89469	$ 201,916,383
1994	$ 62,081,900	2.65873	$ 102,976,995
1995	$ 109,850,000	2.44200	$ 158,403,765
1996	$ 117,460,600	2.24294	$ 145,996,442
1997	$ 51,111,100	2.06011	$ 54,183,150
1998	$ 80,314,800	1.89217	$ 71,654,843
1999	$ 38,251,100	1.73793	$ 28,226,759
2000	$ 16,460,000	1.59626	$ 9,814,518
2001	$ 72,927,300	1.46614	$ 33,994,655
2002	$ 29,208,900	1.34663	$ 10,124,708
2003	$ 17,932,800	1.23686	$ 4,247,557
2004	$ 60,873,200	1.13604	$ 8,280,972
2005	$ 31,820,700	1.04343	$ 1,382,031
2006	$ 8,290,300	0.95838	$ (345,076)
	$ 832,000,000		$ 901,522,603
		TOTAL INVESTMENT COST	$ 1,733,522,603
		Av.Ann. IDC	$81,166,154.30
		Av.Ann. Construction Costs	$74,906,874.35
		TOTAL Av.Ann. Costs (including IDC)	$ 156,073,029

** 1986 through 1989 GI expenditures were lumped into the 1990 expenditures.*

Table 13 – Construction Cost Interest During Construction and Amortization

Fiscal Year	Current Construction Cost*	Recommended PAC Report Construction Costs	IDC Factors ** LAR 8.875%	IDC Factors ** OMB 7.000%	IDC Factors ** Current 4.000%	Interest During Construction: Current Construction Cost LAR 8.875%	Current Construction Cost OMB 7.000%	Current Construction Cost Current 4.000%	PAC Report Recommended Construction Cost LAR 8.875%	PAC Report Recommended Construction Cost OMB 7.000%	PAC Report Recommended Construction Cost Current 4.000%
1986	$	$ 206,000									
1987	$ 2,422,000	$ 2,422,000									
1988	$ 2,822,000	$ 2,822,000									
1989	$ 3,658,000	$ 3,658,000									
1990	$ 3,498,000	$ 3,498,000									
1991	$ 3,296,000	$ 3,296,000									
1992	$ 4,626,000	$ 4,626,000									
1993	$ 16,632,000	$ 16,632,000									
1994	$ 38,942,000	$ 38,942,000									
1995	$ 45,524,000	$ 45,524,000									
1996	$ 49,678,000	$ 49,678,000									
1997	$ 70,080,000	$ 70,080,000									
1998	$ 76,174,000	$ 76,174,000									
1999	$ 51,060,000	$ 51,060,000									
2000	$ 87,163,000	$ 87,163,000									
2001	$ 57,775,000	$ 57,775,000									
2002	$ 56,308,000	$ 56,308,000									
2003	$ 29,858,000	$ 29,858,000									
2004	$ 32,513,000	$ 32,513,000									
2005	$ 58,767,000	$ 58,767,000									
2006	$ 88,250,000	$ 88,250,000									
2007	$ 88,189,900	$ 88,189,900									
2008	$ 107,934,000	$ 107,934,000									
2009	$ 103,730,000	$ 103,730,000									
2010	$ 140,500,000	$ 140,500,000									
2011	$ 138,966,000	$ 138,966,000									
2012	$ 34,106,939	$ 153,792,000	1.81541	1.66078	1.31693	$ 30,998,134	$ 23,085,507	$ 12,039,730	$ 125,096,702	$ 93,164,345	$ 48,587,780
2013	$ 36,042,293	$ 146,016,000	1.66559	1.50873	1.25632	$ 24,082,698	$ 15,117,572	$ 9,598,649	$ 97,196,627	$ 73,115,645	$ 38,741,392
2014	$ 25,572,721	$ 143,556,000	1.52882	1.40855	1.21985	$ 18,847,203	$ 14,319,869	$ 7,706,833	$ 76,060,155	$ 57,799,521	$ 31,102,257
2015	$ 34,927,715	$ 140,955,000	1.40512	1.31080	1.19886	$ 14,149,832	$ 10,955,394	$ 5,932,771	$ 57,103,351	$ 43,606,252	$ 23,944,413
2016	$ 34,274,532	$ 138,319,000	1.29698	1.22804	1.17986	$ 9,959,450	$ 7,713,243	$ 4,279,655	$ 40,192,580	$ 31,127,723	$ 17,271,064
2017	$ 39,965,613	$ 135,619,500	1.19538	1.14469	1.09160	$ 6,229,693	$ 4,869,453	$ 2,742,216	$ 25,140,677	$ 19,651,266	$ 11,066,551
2018	$ 32,909,886	$ 132,611,000	1.09875	1.07000	1.04000	$ 2,920,735	$ 2,303,678	$ 1,318,387	$ 11,786,978	$ 9,296,770	$ 5,312,440
2019	$ 32,245,352	$ 130,130,000	1.00000	1.00000	1.00000	$ -	$ -	$ -	$ -	$ -	$ -
2020	$ 31,645,320	$ 127,709,500	0.91848	0.93458	0.96154	$ (2,579,584)	$ (2,070,265)	$ (1,217,128)	$ (10,410,222)	$ (8,354,762)	$ (4,911,865)
2021	$ 28,903,298	$ 109,571,500	0.84361	0.87344	0.92456	$ (4,207,395)	$ (3,494,916)	$ (2,029,667)	$ (16,979,067)	$ (13,740,947)	$ (8,191,045)
2022	$ 29,947,316	$ 120,956,000	0.77485	0.81630	0.88800	$ (8,742,753)	$ (5,501,386)	$ (3,324,261)	$ (27,211,190)	$ (22,201,504)	$ (13,415,456)
2023	$ 16,437,250	$ 66,334,500	0.71188	0.76290	0.85480	$ (4,738,119)	$ (3,897,351)	$ (2,366,620)	$ (19,125,284)	$ (15,726,228)	$ (9,631,491)
2024	$ 3,816,396	$ 15,401,000	0.65367	0.71299	0.82193	$ (1,321,894)	$ (1,095,321)	$ (679,575)	$ (5,333,614)	$ (4,420,300)	$ (2,742,501)
				TOTAL IDC PRESENT WORTH :		$ 87,597,299	$ 85,295,462	$ 33,980,277	$ 353,509,450	$ 283,507,781	$ 137,131,500
				TOTAL INVESTMENT COST :		$ 1,832,277,199	$ 1,809,975,362	$ 1,778,660,177	$ 3,271,687,350	$ 3,181,685,681	$ 3,055,309,400
				TOTAL REMAINING INVESTMENT COST :		$ 474,173,299	$ 451,871,462	$ 420,556,277	$ 1,913,583,450	$ 1,823,581,781	$ 1,697,205,500
TOTALS Sunk :	$ 1,358,103,900			Av.Ann. Sunk IDC		$ -	$ -	$ -	$ -	$ -	$ -
Remaining :	$ 386,576,000	$ 1,560,074,000		Av.Ann. Remaining IDC		$ 7,886,586	$ 4,731,301	$ 1,581,789	$ 31,827,269	$ 19,093,734	$ 6,383,499
	$ 1,744,679,900	$ 2,918,177,900		TOTAL Av.Ann. IDC		$ 7,886,586	$ 4,731,301	$ 1,581,789	$ 31,827,269	$ 19,093,734	$ 6,383,499
				Av.Ann. Sunk Construction Cost		$ 122,273,219	$ 98,408,004	$ 63,220,009	$ 122,273,219	$ 98,408,004	$ 63,220,009
				Av.Ann. Remaining Construction Cost		$ 34,804,327	$ 28,011,239	$ 17,995,190	$ 140,457,052	$ 113,042,727	$ 72,621,757
				TOTAL Av.Ann. Construction Cost		$ 157,077,546	$ 126,419,243	$ 81,215,199	$ 262,730,271	$ 211,450,732	$ 135,841,766
				Av.Ann. Sunk Costs (no IDC)		$ 122,273,219	$ 98,408,004	$ 63,220,009	$ 122,273,219	$ 98,408,004	$ 63,220,009
				Av.Ann. Remaining Costs (including IDC)		$ 42,690,913	$ 32,742,540	$ 19,576,979	$ 172,284,321	$ 132,136,461	$ 79,005,265
				TOTAL Av.Ann. Costs (including IDC)		$ 164,964,132	$ 131,150,544	$ 82,796,988	$ 294,557,540	$ 230,544,466	$ 142,225,265

Directed by HQ to exclude sunk IDC in this analysis.

* *Section 902 limit is $1744.7 million*

** *On-line stepped from year 2006 to 2020. End-of-year discounting used, resulting in no IDC for 2019 costs. Post-2020 costs are after on-line, resulting in negative IDC (present worth adjustment).*

Table 14 – Average Annual Construction Comparison

	Benefit Update Oct. 1990 (1 Oct. 1990 price level, 8.875% Fedeeral Discount Rate)	Economics Update Dec. 2007, rev Nov 2011 PAC Report Cost (1 Oct. 2011 price level, 4.0% Fedeeral Discount Rate) *
Construction Cost	$ 832,000,000	$ 1,560,074,000
Interest During Construction	$ 901,522,603	$ 137,131,500
Total Investment Cost	$ 1,733,522,603	$ 1,697,205,500
Average Annual Equivalent PROJECT COST	$ 156,073,029	$ 79,005,256
Average Annual Equivalent COSTS FOREGONE	$ 55,400,000	$ 23,560,743
Average Annual Equivalent INCREMENTAL COST	$ 100,673,029	$ 55,444,513

** These are the remaining construction costs. $1,358,103,900 has been spent (sunk) through FY 2011.*

11.2 Benefit – Cost Ratio

At the time of the 1990 Benefit Update, Olmsted construction had just begun with 16 years remaining. In 2011 for this economic update, the Olmsted project has been under construction for 20 years, with 13 years remaining. Sunk costs through FY2011 total $1,358,000,000, with remaining construction costs of $1,560,000,000. This 2011 economic update focuses on remaining work and construction costs, FY2012 through FY2024. Project benefits will not begin to accrue until the lock is operational in 2020. As such, the benefit-cost ratio (BCR) can also be described as the benefit- remaining cost ratio.

11.2.1 Benefit – Cost Ratio (Benefit to Remaining Cost Ratio)

A benefit – cost ratio is shown for both the 1990 Benefit Update (last approved report), which was computed using costs and benefits at an 8.875% discount rate and a 1 Oct 2009 price level, and for the 2011 Economic Update, computed at a 1 Oct 2011 price level and the FY 2012 discount rate of 4.0%. The Olmsted Project remains well justified with a BCR of 9.9 to 1 at the FY2012 discount rate.

Table 15 – Calculation of Project Authorization Benefit to Cost Ratio

	Authorized Project Last Approved Report / 1990 Benefit Update (1 Oct 1990 price level)	Recommended Project PAC Report / 2007 Economics Update, Revised Nov 2011 (1 Oct 2011 price level)
	LAR 8.875%	Current 4.000%
Annualized Benefits		
Transportation Benefits	$ 539,300,000	$ 780,748,662
Fuel Tax Revenues	$ -	$ 16,376,787
Less WOPC Normal O&M	$ 5,000,000	$ 7,664,547
Less LD 52 Repairs	$ 28,350,000 *	$ 10,462,184
Less LD 53 Repairs	$ 27,050,000 *	$ 9,947,814
Incremental Annual Benefits	$ 599,700,000	$ 825,199,996
Annualized Costs		
Construction	$ 74,906,874	$ 72,621,757
Interest During Construction	$ 81,166,154	$ 6,383,499
Normal O&M	$ 2,500,000	$ 3,832,274
Main Chamber Maintenance	$ -	$ 295,393
Aux Chamber Maintenance	$ -	$ 314,515
Dam Maintenance	$ -	$ 71,621
Incremental Annual Costs	$ 158,573,029	$ 83,519,059
Net Annual Project Benefits	$ 441,126,971	$ 741,680,937
BENEFIT - COST RATIO	**3.8 ****	**9.9**

** The 1990 Benefit Update contained an average annual $36.5 million for without-project condition O&M and replacements. Here it is assumed $2.5M normal O&M for 52 and 53 (since Olmsted was specified as $2.5M). Post report, BERH directed additional analysis which resulted in an additional $12.6M and $11.3M being added to 52 and 53 for unscheduled repairs. The average annual values do not vary by interest rate because only av.ann. values at the*

*** Page 53 of the Benefit Update (1990) shows a BCR of 4.3, however, this does not include the BERH adjustment as discussed in the footnote above and costs foregone are subtracted from costs.*

11.3 Total Benefit – Cost Ratio (Benefit to Total Cost Ratio)

For budgeting purposes, the BCR is relied on as a metric for prioritizing construction funds. In FY2013 the annual budget EC prescribed a specific method for calculating this metric. While the last approved decision document appropriately excludes sunk costs in a reevaluation, all costs must be accounted for in the budget metric. Additionally the budget method directs the exclusion of sunk interest during construction and a discount rate of 7%. The revised BCR at Olmsted for budgeting purposes is 3.7 to 1.

Table 16 – Calculation of OMB Budgetary Benefit to Total Cost Ratio

	Authorized Project Last Approved Report / 1990 Benefit Update (1 Oct 1990 price level)		Recommended Project PAC Report / 2007 Economics Update, Revised Nov 2011 (1 Oct 2011 price level)	
	OMB 7.000%		OMB 7.000%	
Annualized Benefits				
Transportation Benefits	$	530,845,211	$	823,272,341
Fuel Tax Revenues	$	-	$	19,976,006
Less WOPC Normal O&M	$	5,000,000	$	7,664,547
Less LD 52 Repairs	$	28,350,000 *	$	12,291,092
Less LD 53 Repairs	$	27,050,000 *	$	11,860,808
Incremental Annual Benefits	$	591,245,211	$	875,064,795
Annualized Costs				
Construction	$	60,286,595	$	211,450,732
Interest During Construction	$	46,991,789	$	19,093,734
Normal O&M	$	2,500,000	$	3,832,274
Main Chamber Maintenance	$	-	$	277,669
Aux Chamber Maintenance	$	-	$	314,605
Dam Maintenance	$	-	$	60,200
Incremental Annual Costs	$	109,778,384	$	235,029,214
Net Annual Project Benefits	$	481,466,826	$	640,035,580
BENEFIT - COST RATIO	**5.4 ****		**3.7**	

** The 1990 Benefit Update contained an average annual $36.5 million for without-project condition O&M and replacements. Here it is assumed $2.5M normal O&M for 52 and 53 (since Olmsted was specified as $2.5M). Post report, BERH directed additional analysis which resulted in an additional $12.6M and $11.3M being added to 52 and 53 for unscheduled repairs. The average annual values do not vary by interest rate because only av.ann. values at the report interest rates were available.*

*** Since costs foregone in the Benefit Update (1990) were only presented as average annuals, they could not be re-amortized at the new interest rates.*

SECTION 12 - **Changes in Cost Allocation**

There is no change in the cost allocation among project purposes. The Project's sole purpose is to provide improvements to navigation. Table 17 shows the cost allocation of the authorized project purpose at various price levels.

Table 17 – Changes in Cost Allocation

Project Purpose	Authorized Project Oct-87	Authorized Project Fully Funded	Recommended Project Fully Funded
Navigation	$ 775,000,000	$1,590,000,000	$3,098,768,052

SECTION 13 - **Changes in Cost Apportionment**

There is no change in the cost apportionment. It was authorized as a federal project with 50% of the funding coming from the general fund and 50% of the funding coming from the Inland Waterways Trust Fund. Table 18 shows cost apportionment for the authorized, Section 902 Limited and Recommended Project.

Table 18 - Cost Apportionment

	Total	Federal General (50%)	Inland Waterways Trust Fund (50%)
Authorized Project	$775,000,000	$387,500,000	$387,500,000
Section 902 Limit	$1,745,000,000	$872,500,000	$872,500,000
Recommended Project	$3,099,000,000	$1,549,500,000	$1,549,500,000

SECTION 14 - **Environmental Considerations in Recommended Changes**

The changes described in this report are economic and developed entirely to address cost realities and technical issues encountered during project development. None of the design changes described in Section 8 of this report have been determined individually or cumulatively to have a significant environmental impact requiring preparation of a supplemental EIS. An Environmental Assessment/Finding of No Significant Impact was prepared to address the in-the-wet construction methodology not covered in the EIS. This document was completed and circulated to the public in June 2002.

In the course of complying with the National Environmental Policy Act and all other laws and regulations governing impacts of the Locks and Dam Project, a mitigation plan was developed and approved by state and federal agencies. A Cooperative Agreement between the Corps of Engineers and the Kentucky Department of Fish and Wildlife Resources was signed in September 1992. This agreement led to the purchase of 2,063 acres of mitigation lands, construction of facilities on Ballard Wildlife Management Area providing water management capabilities on an additional 1,400 acres (and reducing the required purchase of lands), and provision to fund annually the Department's cost for monitoring construction related impacts to the bald eagle and migratory waterfowl. Compliance with Section 7 of the Endangered Species Act resulted in the design and installation of a sediment scour and deposition system in the Ohio River. As a result of continued operation and maintenance problems with the system, a review of observed data both from the system, diver monitoring surveys, hydrographic mapping of river bottom conditions by St. Louis District, computer modeling of impacts by the U.S. Geological Survey, and changes in construction techniques, the U.S. Fish and Wildlife Service and the Louisville District agreed to revise compliance with Section 7 such that the scour and sediment monitoring system was removed from the downstream area. (It is still used to monitor the same conditions around the actual construction site and other such construction sites in streams.) The Corps now provides funding to support research, propagation, and monitoring of freshwater mussels, including threatened and endangered species, especially those that would be impacted

by the Project. Annuadiver and hydrographic monitoring surveys also continue. These requirements and/or activities were not originally anticipated, as neither the bald eagle nor any endangered mussels were known to occur at the Project site prior to the late 1980's. The total increase in the Fish & Wildlife feature of work, fully funded, is estimated at $11,727,000.

SECTION 15 - **Public Involvement**

Private individuals, elected officials, agencies, and all levels of government have been publically involved in the development of the project. The primary vehicle for public involvement has been the process of complying with the National Environmental Policy Act and its provisions for public involvement. The 1985 and 1993 Environmental Impact Statements each had a 45-day comment period for the draft documents followed by a 30-day comment period for the final documents. The 2002 Environmental Assessment had a 30-day comment period.

Public involvement is also part of the permitting process whether for Section 401 water quality certification under the Clean Water Act or for some other law or regulation. For example, changes involving Historic/Cultural Mitigation issues resulted from coordination with consulting parties undertaken in accordance with the National Historic Preservation Act (NHPA). Changes involving cultural resources/archaeology sites resulted from coordination with the Illinois and Kentucky State Historic Preservation Officer and Native American tribes in accordance with NHPA and the Native American Graves Protection and Repatriation Act.

Public involvement and coordination was maintained with residents of local communities such as Paducah, KY and Olmsted, IL on Project features such as the disposition of L&D 52 and 53, construction of a new boat ramp at Olmsted, construction and operation of a contractor facility in Paducah, and purchase of mitigation lands in Ballard County, Kentucky.

SECTION 16 - **History of Project**

The following is a history of the Project since authorization, including other studies accomplished, directions from Appropriations or Authorization Committees, relationship of Project to basin plans, and other pertinent information not found elsewhere in the Report.

- Chief of Engineer's Report to ASA(CW) – August 1986
- General Design Memorandum – September 1989
- General Design Memorandum Supplement – August 1990
- Concrete Materials Design Memorandum – December 1990
- Real Estate Interest and Requirements Design Memorandum – May 1991
- Foundation Design Memorandum – December 1991
- Construction Documents Access Road & Resident Engineer's Office - May 1992
- Construction Documents Slide Repair & Cofferdam – June 1992
- Award Construction Contract Access Road & Resident Engineer's Office – Nov 1992
- Supplement Environmental Impact Statement – May 1993
- Award Construction Contract Lock Cofferdam – May 1993
- Construction Documents Dam Prototype – June 1993
- Lock Feature Design Memorandum – June 1994

- Structural Properties and Special Design Consideration Memorandum – July 1994
- Construction Documents Locks – December 1994
- Construction Documents BWMA Waterfowl Improvements – January 1995
- Award Construction Contract Locks – December 1995
- Construction Documents Locks Approach Walls – March 1999
- Construction Documents Boat Ramp – March 2000
- Environmental Assessment for Alternative Construction Techniques – June 2002
- Construction Documents Dam – July 2002
- Award Construction Contract Dam – January 2004
- Construction Complete Approach Walls – May 2005
- Construction Complete Bulkheads – July 2005
- Construction Complete Gate Storage Facility – May 2006
- Construction Complete BWMA Pump #1 Improvements – September 2006
- Estimated Dam Construction Complete – FY 2021

Appropriation/Authorization Act and Bill History

Congress provided Construction General funding for the Olmsted Locks and Dam Project in Energy and Water Development Appropriations Acts in 1991-2007. Below are the pertinent excerpts from the appropriations Bills.

2011

Senate Report 111-228, Energy and Water Development Appropriations Bill, 2011

Olmsted Locks and Dam, Ohio River, Illinois and Kentucky.—The Committee recommends $136,000,000 to continue construction of this project. None of the funds provided for the Olmsted Locks and Dam Project or any other construction funds are to be used to reimburse the Claims and Judgment Fund.

2010

Senate Report 111-45, Energy and Water Development Appropriations Bill, 2010

Olmsted Locks and Dam, Ohio River, Illinois and Kentucky.—The Committee recommends $105,000,000 to continue construction of this project. None of the funds provided for the Olmsted Locks and Dam Project or any other construction funds are to be used to reimburse the Claims and Judgment Fund.

House Report 111-203, Energy and Water Development Appropriations Bill, 2010

House recommendation for *Olmsted Locks and Dam, Ohio River, IL & KY* - $109,790,000

2009

Senate Report 110-416, Energy and Water Development Appropriations Bill, 2009

Olmsted Locks and Dam, Ohio River, Illinois and Kentucky.—The Committee recommends $114,000,000 to continue construction of this project. None of the funds provided for the Olmsted Locks and Dam Project or any other construction funds are to be used to reimburse the Claims and Judgment Fund.

House Report 110-921, Energy and Water Development Appropriations Bill, 2009
House recommendation for *Olmsted Locks and Dam, Ohio River, IL & KY* - $114,000,000

2008

Senate Report 110-127, Energy and Water Development Appropriations Bill, 2008
Olmsted Locks and Dam, Ohio River, Illinois and Kentucky.—The Committee provides $94,000,000 to continue construction of this project. The reduction made to this project should not be viewed as any diminution of support for this project, rather an attempt to balance out the Corps of Engineers nationwide program among the various missions of the Corps. None of the funds provided for the Olmsted Locks and Dam Project are to be used to reimburse the Claims and Judgment Fund.

House Report 110-185, Energy and Water Development Appropriations Bill, 2008
The budget request for *Olmsted Locks and Dam, Ohio River, IL & KY* - $104,000,000
The Committee provides no recommendation at this time for specific projects contained in either the Administration's budget or proposed by Members of Congress.

2007

Senate Report 109-274, Energy and Water Appropriations Bill, 2007
Olmsted Locks and Dam, Ohio River, Illinois and Kentucky- The Committee provides $90,000,000 to continue construction of this project. The reduction made to this project should not be viewed as any diminution of support for this project, rather an attempt to balance out the Corps of Engineers nationwide program among the various missions of the Corps. None of the funds provided for the Olmsted Locks and Dam Project are to be used to reimburse the Claims and Judgment Fund.

2006

House Conference Report 109-275, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2006, and for Other Purposes
Conference allowance for *Olmsted Locks and Dam, Ohio River, IL & KY* – $ 90,000,000

House Report 109-086, Energy and Water Development Appropriations Bill, 2006
Committee recommendation for *Olmsted Locks and Dam, Ohio River, IL & KY* – $ 90,000,000

Senate Report 109-084, Energy and Water Appropriations Bill, 2006
Olmsted Locks and Dam, Ohio River, IL and KY- The Committee has provided $85,000,000 to continue construction of this project. The reduction made to this project should not be viewed as any diminution of support for this project, rather an attempt to balance out the Corps of Engineers nationwide program among the various missions of the Corps. None of the funds provided for the Olmsted Locks and Dam Project are to be used to reimburse the Claims and Judgment Fund.

2005

House Conference Report 108-792, Consolidated Appropriations Act – Division C, Energy and Water Development Appropriations Act, 2005

Olmsted Locks and Dam, Ohio River, Illinois & Kentucky. – None of the funds provided for the Olmsted Locks and Dam Project are to be used to reimburse the Claims and Judgment Fund.

Conference allowance for *Olmsted Locks and Dam, Ohio River, IL & KY* – $ 69,000,000

House Report 108-554, Energy and Water Development Appropriations Bill, 2005

House recommendation for *Olmsted Locks and Dam, Ohio River, IL & KY* – $75,000,000

2004

House Conference Report 108-357, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2004, and for Other Purposes

The conferees direct that none of the funds provided for the Olmsted Locks and Dam, Ohio project be used to reimburse the Claims and Judgment Fund.

Conference allowance for *Olmsted Locks and Dam, Ohio River, IL & KY* – $63,000,000

Senate Report 108-105, Energy and Water Development Appropriation Bill, 2004

Olmsted Locks and Dam, Ohio River, IL & KY- The Committee recommendation includes $53,000,000 for the Olmsted Locks and Dam project. This reduced funding level should in no way be considered any diminution of interest or support for the project, but instead reflects the very limited resources of the Committee. None of the funds provided for the Olmsted Locks and Dam Project are to be used to reimburse the Claims and Judgment Fund.

2003

House Report 107-681, Energy and Water Development Appropriations Bill, 2003

Committee allowance for *Olmsted Locks and Dam, Ohio River, IL & KY* – $65,000,000

Senate Report 107-220, Energy and Water Development Appropriation Bill, 2003

Olmsted Locks and Dam, Ohio River, IL & KY- The Committee recommendation includes $68,000,000 to continue construction of the replacement navigation structure. This is a $9,000,000 reduction from the budget request, but should in no way be considered any diminution of interest in this critically important portion of the Nation's inland waterway system by the Committee. Rather it reflects the extraordinarily unbalanced nature of the budget request and the Committee's attempt to restore some balance to this account. None of the funds provided for the Olmsted Locks and Dam Project are to be used to reimburse the Claims and Judgment Fund.

2002

House Conference Report 107-258, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2002, and for Other Purposes

The conference agreement includes $40,000,000 for the Olmsted Locks and Dam project. The conferees agree that none of the funds are to be used to reimburse the Claims and Judgment Fund.

House Report 107-112, Energy and Water Development Appropriations Bill, 2002

Olmsted Locks and Dam, Illinois – The Committee has provided $40,000,000 for the Corps of Engineers to continue construction of the Olmsted Locks and Dam project. Within the amount provided, the Committee urges the Corps to work with the Ohio River Valley Water Sanitation Commission to develop tools to describe and monitor the biological processes of the Ohio River for the purpose of maintaining and improving water quality.

Senate Report 107-039, Energy and Water Development Appropriation Bill, 2002

Olmsted Locks and Dam, IL & KY- An appropriation of $41,000,000 is provided. While this is a significant increase over the budget request of $34,000,000, it is still far below the amount needed to fund the project at an optimum level. No funds are included for reimbursement of the Claims and Judgment Fund.

2001

Senate Report 106-395, Energy and Water Development Appropriation Bill, 2001

Olmsted Locks and Dam, Ohio River, IL and KY- An appropriation of $53,142,000 is provided for the Olmsted Lock and Dam, Illinois project. The administration's budget request for fiscal year 2001 significantly underfunded the construction needs and the Committee has, therefore, recommended an additional $15,000,000 in an effort to mitigate delays on this important facility on the Nation's inland waterway system. No funds are included for reimbursement of the Claims and Judgment Fund.

2000

Senate Report 106-058, Energy and Water Development Appropriation Bill, 2000

Committee recommendation for *Olmsted Locks and Dam, IL and KY* – $38,634,000

1999

House Conference Report 105-479, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1999, and for Other Purposes

Conference allowance for ***Olmsted Locks and Dam, IL and KY*** – $54,500,000

1998

House Conference Report 105-271, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1998, and for Other Purposes

Conference allowance for ***Olmsted Locks and Dam, IL and KY*** – $98,440,000

House Report 105-190, Energy and Water Development Appropriations Bill, 1998

House allowance for *Olmsted Locks and Dam, IL and KY* – $98,440,000

Senate Report 105-044, Energy and Water Development Appropriation Bill, 1998

Committee recommendation for *Olmsted Locks and Dam, IL and KY* – $98,440,000

1997

House Conference Report 104-782, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1997, and for Other Purposes

Conference allowance for ***Olmsted Locks and Dam, IL and KY*** – $70,352,000

House Report 104-679, Energy and Water Development Appropriations Bill, 1997

House allowance for *Olmsted Locks and Dam, IL and KY* – $70,352,000

Senate Report 104-320, Energy and Water Development Appropriation Bill, 1997

Committee recommendation for *Olmsted Locks and Dam, IL and KY* – $70,352,000

1996

House Conference Report 104-293, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1996, and for Other Purposes
Conference allowance for ***Olmsted Locks and Dam, IL and KY*** – $32,100,000

House Report 104-149, Energy and Water Development Appropriations Bill, 1996
House allowance for *Olmsted Locks and Dam, IL and KY* – $32,100,000

Senate Report 104-120, Energy and Water Development Appropriation Bill, 1996
Committee recommendation for *Olmsted Locks and Dam, IL and KY* – $32,100,000

1995
House Conference Report 103-672, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1995, and for Other Purposes
Conference allowance for ***Olmsted Locks and Dam, IL and KY*** – $26,000,000

House Report 103-533, Energy and Water Development Appropriations Bill, 1995
House allowance for *Olmsted Locks and Dam, IL and KY* – $26,000,000

1993
House Conference Report 102-866, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1993, and for Other Purposes
Conference allowance for ***Olmsted Locks and Dam, IL and KY*** – $60,000,000

1991
House Conference Report 101-889, Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 1991, and for Other Purposes
Conference allowance for ***Olmsted Locks and Dam, IL and KY*** – $4,000,000

SECTION 17 - **Conclusions**

The Olmsted Locks and Dam Replacement project was authorized in the Water Resources Development Act of 1988 at a cost of $775,000,000. There will be over seventeen construction contracts awarded to complete the Project. The Section 902 limit for the Project is currently $1,745,000,000, based on the authorized cost of $775,000,000. The revised cost estimate for the Olmsted Locks and Dam Project, based on October 2011 price levels, is $2,918,000,000 and fully inflated through the construction period, $3,099,000,000.

The changes in costs are a result of project design changes, construction modifications, inefficient funding, river conditions, innovative construction methodology, dam procurement and unforeseen first costs, accounting for $1,781, 956,000 of the cost increase. The majority of costs documented in this Report are associated with the dam construction effort and the dragging out of the Project construction period, as described in Sections 8 and 9. The remainder of the cost increase of $542,044,000 is attributable to inflation.

Project benefits were last reported to Congress in the *Olmsted Locks and Dam (Replacement of Locks and Dams 52 and 53) Benefit Update*, dated October 1990. The benefits

were calculated at an October 1990 price level, and amortized at 8.875%, resulting in an average annual incremental transportation benefit of $539.3 million.

Project benefits for this Post Authorization Change Report have been re-evaluated and are presented in the *Olmsted Locks and Dam (Replacement of Locks and Dams 52 and 53) Economics Update*, included as Appendix A of this report. These were rediscounted and amortized at the interest rate used in the last approved report (LAR) of 8.875%, Budget EC OMB rate of 7.0% and the FY 2012 "current rate" (EGM 08-01 dated 19 October 2007) of 4.0%, with end-of-year discounting. PACR regulations (ER 1105-2-100 Appendix G, Amendment #1 30 June 2004) only require analysis at the current interest rate. However, current Budget EC guidance requires analysis at the OMB 7% rate and the LAR interest rate was prepared for comparison.

As stated in the report, Project funding began in FY 1986, and the Project entered Construction General funding in FY 1991 and, as a result, significant expenditures have been made (sunk) to date. Approximately 44% of fully funded Project expenditures are complete. There are 26 years of sunk construction and 13 years of expenditures remaining. Therefore, the Remaining Benefit-to-Remaining Cost Ratio is a more meaningful statistic than the total Benefit-to-Cost Ratio. Since navigation projects typically realize no benefits prior to completion of the project, in effect the RBRCR is essentially a Benefit-to-Remaining Cost Ratio. Funds expended through FY 2012 are considered sunk in this analysis. The interest during construction (IDC) for the remaining Project costs are calculated with end-of-year discounting and the remaining Project costs are annualized at the desired interest rates. Based on the analysis, despite the Project costs increases, the RBRCR remains significantly high at 6.4-to-1 (at an OMB 7% rate calculated per Budget EC guidance).

There were no changes to the authorized Project purpose – navigation – and no change to the cost apportionment. The Project cost is shared 50% Federal and 50% non-Federal (Inland Waterways Trust Fund).

Olmsted Locks and Dam began construction prior to the publication of the Corps Environmental Operating Principles. Even so, the Corps recognized that environmental sustainability, the interdependence of life and the physical environment, and the other factors articulated in the Principles. The Corps and state and federal resource agencies together evaluated alternatives and impacts, developed mitigation and monitoring, and implemented all mutually agreed plans to protect and sustain our nation's resources. Monitoring activities continue today. The essence of the Environmental Operating Principles were employed by the Corps when it (1) protected the habitat of nine species protected under federal law; six freshwater mussels, one bat and two migratory birds, (2) contributed significantly to the advancement of knowledge in life histories and propagation of mussels through monitoring and support of others research efforts, (3) supported reintroduction of juveniles of endangered mussel species, (4) avoided nearly all physical impacts to Illinois and Kentucky preserves and wildlife management areas, (5) benefited migratory waterfowl through purchase of mitigation lands, reforestation, and provision of water management features on state and federal lands, (6) disposed of all excess materials in an abandoned mine which will be reclaimed as wildlife habitat, and aggressively managed and monitored all sources of noise, air and water pollution during construction. The District has committed to continue monitoring for up to ten years following completion of construction and the beginning of operations.

Although Olmsted Locks and Dam construction began prior to the development and release of the 12 Actions for Change, its three overarching themes of a comprehensive systems approach, communication, and reliable public service professionalism are evident in this Post Authorization Change Report as well as its original Feasibility Report. Appendix E of the Feasibility Report was a Navigation System Analysis. Subsequent to that the Ohio River Mainstem Study (ORMSS) and System Investment Plan (SIP) report included Olmsted and the Economic Update, upon which benefits of this Post Authorization Change Report are based, is system-based. The Economic Update employs risk-based analysis, with uncertainties accounted for in key inputs. Risk analyses were included in project design, construction techniques, and cost contingencies. Current policies, guidance, and engineering and construction standards were adhered to. These studies underwent thorough Independent Technical Review. Chapter 8 describes the innovative and adaptive engineering design of the project. Environmental sustainability continues to be a focus of the project. Appendix C of the Feasibility Report describes communication at public meetings that included potential impacts of the project. There has been ongoing communication and coordination with navigation industry representatives. Section 15 of this report further describes Public Involvement and agency coordination. The Olmsted project has prompted considerable research due to its innovative engineering design, such as in Non-linear Incremental Structural Analysis, described in Section 8.1.2. The project Operation and Maintenance Manual will provide procedures for annual inspections and ER1110-2-100, Period Inspection and Continuing Evaluation of Completed Civil Works Structures, provides the procedures under which decennial detailed inspections will be performed.

SECTION 18 - **Recommendation**

The recommendation contained herein reflects the information available at this time, and current Departmental policies. Based on the analysis of the cost increases for the Olmsted Locks and Dam Project, and the resulting impact on project economics, it has been determined that authorization of an increase in the project cost to $2,918,000,000 from $775,000,000 is in the Federal Government's interest. Therefore, it is recommended that the Olmsted Locks and Dam Project be authorized at a cost of $2,918,000,000, and that the remaining portion of the Project be completed.

4 Nov 11

Date

LUKE T. LEONARD

Colonel, Corps of Engineers

Commander and District Engineer

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX A

Economics Update

OLMSTED LOCKS AND DAM

(Replacement of Locks and Dams 52 and 53)

ECONOMICS UPDATE

February 2008
Revised November 2010 (per IEPR)
Revised February 2012

Prepared by:

USACE Planning Center of Expertise for Inland Navigation,
Huntington District and the Institute for Water Resources

Prepared for:

Louisville District

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 OLMSTED ECONOMICS UPDATE HISTORY 2

3.0 THE WITHOUT-PROJECT CONDITION 2

3.1 1990 Benefit Update 2
3.2 2011 Olmsted Economics Update 3
3.2.1 Waterway System Assumptions 3
3.2.2 Without-Project Definition 3

4.0 ANALYSIS METHODOLOGY 4

4.1 Calculation of Transportation Consumer Surplus 5
4.2 System Analysis - 1990 Benefit Update 5
4.3 System Analysis – 2011 Olmsted Economics Update 6
4.4 Risk and Uncertainty 6

5.0 WATERWAY TRAFFIC DEMAND FORECASTS 8

5.1 1990 Benefit Update Report Forecasts. 8
5.2 2011 Olmsted Economics Update Forecasts 11
5.3 Forecasts Selected for the Economic Update 15
5.4 Newest Traffic Trends and Forecasts 15
5.5 Shipper Response 17

6.0 TRANSPORTATION RATES 19

6.1 General 20
6.1.1 Coal (group 1) 23
6.1.2 Aggregates (group 3) 23
6.1.3 Grain (group 4) 24
6.2 Methods and Procedures 24
6.2.1 Barge Rates 24
6.2.2 Railroad Rates 26
6.2.3 Motor Carrier Rates 26
6.2.4 Handling Charges 27
6.2.5 Loading and Unloading Costs 27
6.2.6 Methodological Standards 27
6.3 Transportation Rate-savings 27

7.0 LOCK CAPACITY ANALYSIS 28

7.1 WAM Simulation Results 28
7.1.1 LD52 Tonnage-Transit Time Curves 28
7.1.2 LD53 Tonnage-Transit Time Curve 31
7.1.3 Olmsted Tonnage-Transit Time Curve 32
7.1.4 Comparison of LD52, LD53, & Olmsted Simulation Results 34
7.2 Comparison of 1990 Benefit Update .vs. 2011 Olmsted Economics Update 34
7.2.1 Traffic Transit-Time Results 34
7.2.2 LD52 Full Operations, Existing Condition Without Navigable Pass Operations and Without Interference. 38

8.0 COST AND CLOSURE MATRICES 39

8.1 Modifications 40

9.0 RESULTS OF ECONOMIC ANALYSIS 42

9.1 General Information Section 42
9.2 Analysis Years and Discount Factor Section 43
9.3 Transportation Rate-savings Section 44
9.4 Cost-Closures Section 44
9.5 Total Costs 45
9.6 Adjusted Rate-savings 46

10.0 FINANCIAL ANALYSIS 49

10.1 Transportation Rate-savings Benefits 50
10.2 Costs Foregone Benefits 54
10.3 Fuel Tax Revenues 58

11.0 BENEFIT-COST RATIO 60

11.1 Construction Cost and Interest During Construction 60
11.2 Benefit – Cost Ratio (Benefit to Remaining Cost Ratio) 65
11.2.1 Benefit to Remaining Cost Ratio 65
11.2.2 Incremental Benefit to Incremental Remaining Cost Ratio 66
11.2.3 Sensitivity – No Growth in Traffic 67
11.3 Benefit to Total Cost Ratio 67
11.3.1 Total Benefit to Total Cost Ratio 68
11.3.2 Total Incremental Benefit to Total Incremental Remaining Cost Ratio 69

LIST OF ATTACHMENTS

ATTACHMENT 1 – Engineering Cost and Closure Matrices

ATTACHMENT 2 – Commodity-Level Waterway Traffic Demand Forecasts for Locks 52 and 53

ATTACHMENT 3 – Waterway Analysis Model (WAM) Model Certification Memo

LIST OF TABLES

Table 1. Actual and Projected Traffic for LD52, LD53 & the ORS 10
Table 2. Actual and Projected Traffic for LD52, 1986-2005 10
Table 3. Actual and Projected Traffic for LD53, 1986-2005 11
Table 4. Actual and Projected Traffic for LD52 14
Table 5. Actual and Projected Traffic for LD53 15
Table 6. Average ORS Transportation Rate-savings 20
Table 7. LD 52 Existing Condition Tonnage-Transit Points 30
Table 8. LD 53 Existing Condition Tonnage-Transit Points 32
Table 9. Olmsted Tonnage-Transit Points 33
Table 10. Olmsted Economics Update 35
Table 11. 1990 Olmsted Benefit Update Lock Capacity and Delay Parameters 37
Table 12. LD52 Processing Times for Selected Years 39
Table 13. Analysis of Alternative Lockage Policies at LD52 39
Table 14. Comparison of Closure Days between the 42
Table 15. Analysis Year and 4.0% Discount Factor 43
Table 16. Transportation Rate-savings 44
Table 17. Cost-Closure Section for LD52, Fix-as-Fails Alternative 45
Table 18. Cost-Closure Section for LD53, Fix-as-Fails Alternative 45
Table 19. Total Repair Construction Cost 46
Table 20. System Savings Adjustment Calculations for year 2021 47
Table 21. Example Rate-savings with Failures 47
Table 22. Benefit Analysis Assumptions 49
Table 23. Transportation Rate-savings Benefits Comparisons 52
Table 24. Transportation Rate-savings Benefits Comparisons 53
Table 25. Costs Foregone Benefits Comparisons 56
Table 26. Costs Foregone Benefits Comparisons 57
Table 27. Incremental Fuel Tax Revenue Comparison 59
Table 28. Average Annual Construction Comparison 61
Table 29. Last Approved Report Construction Cost IDC and Amortization 61
Table 30. Construction Cost Interest During Construction and Amortization 63
Table 31. Benefit to Remaining Cost Ratio Calculation 65
Table 32. Incremental Benefit to Incremental Remaining Cost Ratio Calculation 66
Table 33. Construction First Cost Comparison 67
Table 34. No Growth Sensitivity Test 67
Table 35. Total Benefit to Cost Ratio Calculation 68
Table 36. Total Incremental Benefit to Incremental Cost Ratio Calculation 69

LIST OF FIGURES

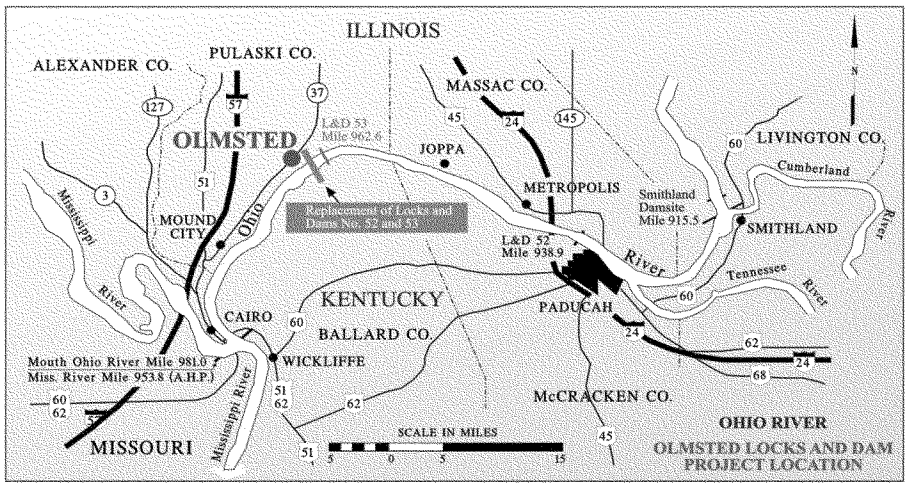
Figure 1 – Project Location 1
Figure 2. LD52 Tonnage Forecasts 13
Figure 3. LD53 Tonnage Forecasts 14
Figure 4. LD52 Tonnage Forecasts 16
Figure 5. LD53 Tonnage Forecasts 17
Figure 6. Sample Rate Sheet 21
Figure 7. LD52 Existing Condition Tonnage-Transit Curve 29
Figure 8. LD52 Existing Condition - Interference vs. No Interference 31
Figure 9. LD52 Existing – Interference Sensitivity 31
Figure 10. LD53 Existing Condition Tonnage-Transit Curve 32
Figure 11. Olmsted Tonnage Transit Curve 33
Figure 12. Comparison of LD52, LD53, & Olmsted Tonnage-Transit Curves 34
Figure 13. LD52 Existing – 1990 Update vs Olmsted PACR 38
Figure 14. Closure Cost Matrices Modification 41
Figure 15. Adjusted System Savings Compare 48
Figure 16. Adjusted System Tonnage 49
Figure 17. Transportation Rate-savings Benefits Comparisons – Analysis Year Price Levels 54
Figure 18. Transportation Rate-savings Benefits Comparisons – 1 Oct 2011 Price Level 54
Figure 19. Costs Foregone Benefits Comparisons 58

ECONOMIC UPDATE – OLMSTED LOCKS AND DAM
(Replacement of Locks and Dams 52 and 53)

1.0 INTRODUCTION

The Olmsted Locks and Dam Project is located at Ohio River Mile 964.4 between Ballard County, Kentucky and Pulaski County, Illinois. The project location is shown in Figure 1 below.

Figure 1 – Project Location



Olmsted Locks and Dam will replace two projects (LDs 52 and 53) built in the 1920s that were modified to increase main chamber capacity using temporary structures in the 1970s. LDs 52 and 53 process the greatest volumes of traffic of any locks in the U.S. They also control the greatest flow of water on the Ohio River System with manually operated wicket dams. The Olmsted project will improve transit times for tows through the lower river by replacing two locks with one and offering a configuration with two 1200' chambers rather than one 1200' and one 600' chamber, will improve reliability by replacing increasingly unreliable structures (both locks and dams) and improve operating conditions for both users and operators of the locks and dam.

The benefit estimates necessarily reflect the improved performance and reliability of the Olmsted structure relative to the existing structures and compare these to the cost of gaining these improvements in a benefit-cost analysis. A brief description of the assumptions, models and databases used in this process, as well as any revisions to the assumptions, models or

databases that occurred between the 1990 Benefit Update and this 2011 Olmsted Economics Update are provided in the following sections of this appendix.

2.0 OLMSTED ECONOMICS UPDATE HISTORY

The original version of the Olmsted Economics Update was completed in 2007. In November 2010, the 2007 Economics Update was revised in response to comments resulting from an Independent External Peer Review. The changes in that revision included expanded documentation of lock closure estimation and discussion of cost closure matrices (Section 9.4), an updated discussion of traffic projections (Section 5.4), an expansion of the rate analysis methodology discussion (Section 6.0), and a discussion of uncertainty.

Further revisions were then made in November 2011 where: 1) the construction completion was slipped further to a 2020 online year; 2) new without and with-project cyclical maintenance assumptions were incorporated; 3) the benefit estimates were updated to a 1 Oct 2011 price level (for comparison against the newer construction cost estimates); and 4) the FY 2012 federal discount rate was used for discounting and amortization. Throughout the remainder of this appendix, the Economics Update will be referred to as the 2011 Economics Update to reflect the fact that the analysis uses price levels and discounting current as of November 2011, though analyses were performed in 2007, 2010, and in 2011.

3.0 THE WITHOUT-PROJECT CONDITION

Planning guidance specifies that in defining the without-project condition that Corps analysts should identify the condition most likely to prevail in the absence of a new project.

3.1 1990 Benefit Update

The without-project condition used in the 1990 Benefit Update was essentially the same as that outlined in the November 1985 feasibility report, except for authorized changes that had occurred to the waterway system in the intervening years[1]. The without-project structural components in the 1990 Benefit Update consisted of LDs 52 and 53, including the locks, dam components, navigable portion of the dam and all related equipment and facilities at these sites. Relative to the operation and maintenance of these projects it was assumed that:

- The existing LDs 52 and 53 would be repaired, rehabilitated and maintained as required to continue their function over the 2006-2055 economic planning period, with 2006 being the first year that a new Olmsted facility would be complete.
- Helper boats would be available to process tows through the smaller 600' auxiliary chamber at LD52 to assist double cut tows beginning in 1995.
- All four lock chambers would be rehabilitated in the 2010-2018 timeframe as indicated by the probability of failure analysis conducted in the feasibility report in 1985.

[1] New locks within the Ohio River Basin authorized as of the 1990 analysis were assumed to be in service by year 2006. Namely Byrd Locks and Dam (expanding Gallipolis Locks and Dam), Winfield Locks and Dam, Grays Landing (replacing Monongahela Locks and Dam 7), and Point Marian (expanding Monongahela Locks and Dams 8).

3.2 2011 Olmsted Economics Update

For the 2011 Olmsted Economics Update, the without-project assumptions are for the most part the same as those used in the Benefit Update, except for: 1) authorized changes that had occurred to the waterway system in the intervening years; and 2) the assumption that the increasing probability of structural failure will be addressed through major rehabilitation of all four lock chambers at LD52 and LD53.

3.2.1 Waterway System Assumptions

The modeling and analysis process considers the interaction and interconnectivity of the movements in the system with the locks in the system. As such, the performance characteristics of system, and locks, outside the immediate LD 52 and LD 53 study area can be important. As a part of an economic update, newly constructed or authorized projects are updated as necessary. Since the 1990 analysis, several new locks within the Ohio River Basin have been authorized for improvement. As of this 2008 analysis, these investments were assumed to be in service by year 2020, namely Kentucky Locks and Dam, Marmet Locks and Dam, and the Lower Monongahela.

3.2.2 Without-Project Definition

As noted, the 1990 Benefit Update assumed rehabilitation of LD 52 and LD 53 in the 2010-2018 timeframe (which was then avoided with Olmsted Lock replacement). Planning guidance specifies that in defining the without-project condition that Corps analysts should identify the condition most likely to prevail in the absence of a new project, which in the past included advanced maintenance, rehabilitations, and even lock replacements-in-kind (RIK). Rehabilitation costs below a specified threshold (currently $14 million, EC 11-2-199) are 100% Federally funded and paid from the O&M account, while rehabilitation costs above this threshold are 50/50 cost shared with the IWTF. The expectation now is that major lock rehabilitations and / or advanced maintenance practices will continue to be difficult to implement, regardless of any underlying economic justification, and that major component replacement will only occur after failure conditions exist. Similarly, RIK (referred to as the Chamber Replacement alternative) was judged to be an unlikely without-project alternative. This is not to say that advanced maintenance, rehabilitations, and RIK are no longer considered, but that they now will be considered as a with-project condition where additional funds must be allocated. All navigation projects are formulated against a similar fix as fails (FAF) / reactive maintenance base assuming normal operations and maintenance practices. Advanced maintenance, rehabilitation, and RIK are considered and analyzed as with-project conditions.

It should also be noted that this 2011 Economics Update was an economic update and not a general reevaluation report. As such, the recommended plan is not reformulated, but simply updated given new information and guidance on the without-project and the recommended plan.

The without-project condition assumption for the lower Ohio River projects at LD 52 and LD 53 was FAF / reactive maintenance. In short, the without-project condition is not necessarily a least-cost without-project future, however, it does reflect a realistic without-project future from which to incrementally analyze advanced maintenance and other investment

opportunities. Similarly, for the recommended plan (the with-project condition) normal operations and maintenance is assumed over the analysis period.

4.0 ANALYSIS METHODOLOGY

All benefit estimations presented in the 1990 Benefit Update and the 2011 Olmsted Economics Update are made within a system's context. In analyses for both reports, the relevant system modeled in detail was the Ohio River System (ORS), which comprises the mainstem Ohio River and its navigable tributary waterways. System economic analysis relies upon movement level traffic demand forecasts, lock chamber specific performance simulations, transportation rates for existing and alternate modes, and structural performance of the lock projects is also required.

In both reports the system analysis was conducted using system economic modeling to project future system performance under normal operating conditions (that is, no major closures of system lock components), which was adjusted in a spreadsheet environment to account for degraded structural conditions and therefore lock performance (each of the major components of this system analysis are discussed in sections 5.0 through 9.0 of this update).

System benefit estimations presented in the 1985 feasibility study and in the 1990 Benefit Update were made with the Tow Cost/Equilibrium Model (TC/EQ). The WSDM Module of the Ohio River Navigation Investment Model (ORNIM) was used in this Economics Update. Though ORNIM has the capability to analyze reliability within the model, this feature was not exercised owing to the lack of engineering reliability analysis that provides hazard functions and consequences as required by ORNIM. Rather, project reliability was handled in a fashion similar to that done in the Benefit Update. That is, using information from condition surveys and assessments and informed judgment, Louisville District engineers developed a schedule of lock closures for repair in Cost-Closure Matrices corresponding to alternative project scenarios.

Both system models have two major uses: (a) fleet sizing and costing; and (b) determination of equilibrium traffic flows. This is accomplished by determining the cost-effective fleet of towboats needed to transport a pre-determined set of annual port-to-port commodity movements on a waterway network of existing or assumed towing and operating characteristics and computes towing costs associated with these fleet requirements and traffic flows. Once this is accomplished, the system model determines the equilibrium traffic flows, where every movement fully assigned to the waterway has a lower cost-per-ton by water routing than by land, resulting in a positive rate-savings, while every movement fully assigned to the land routing has a lower cost-per-ton by land than by water.

Some marginal movements may have their annual tonnage split between the land and water modes. In these cases, the tonnage assigned to the waterway at equilibrium is such that the transportation rate or cost-per-ton by water is the same as the transportation rate or cost-per-ton by land. Determining the equilibrium traffic flows requires an iterative approach because the cost of shipping a movement by water depends on the aggregate traffic level at each lock on the movement's route. If all movements with negative rate-savings were taken off the

waterway, excessive diversion would most likely be the result, because some of the diverted movements would have a positive rate-savings under the lower system traffic level and, therefore, could be shifted back to the waterway. Shifting some of them back, however, could cause the rate-savings of other movements to change from positive to negative. The goal of the equilibration process is to eventually converge to a solution.

The iterative process continues until one of the following occurs: (a) two successive iterations yield virtually the same results; (b) the program detects a cycle of equilibrium solutions; or (c) the program runs out of movements to load into the system.

4.1 Calculation of Transportation Consumer Surplus

The primary guidance for this methodology framework is described in USACE Principles and Guidelines (P&G) and "... *relies on the marginal analysis of benefits and costs for the formulation, evaluation, and selection of alternative plans that provide incremental changes in the net value of desired goods and services.*"[2] The conceptual basis for the "... *basic economic benefit of a navigation project is the reduction in the value of resources required to transport commodities.*"[3] This benefit can also be described as a consumer surplus gain, where the surplus represents the difference between the price shippers paid and the price they would be willing-to-pay to transport commodities. Specifically, this surplus can be termed transportation consumer surplus. Then to measure the gain (i.e. the incremental benefit or reduction in transportation costs) both the TCM/EQ and the WSDM module of ORNIM compares the transportation consumer surplus between a base (the without-project condition) and the alternative (a with-project condition, or in this case the recommended plan). In short, the without-project and with-project transportation consumer surplus estimates are used to estimate reductions in transportation costs.

To measure the transportation consumer surplus for a movement the barge transportation willingness-to-pay must be known for that movement. As a proxy for barge transportation willingness-to-pay the least-cost all-overland rate, or land rate, is used (rate data is discussed in Section 6.0). The difference between a movement's land rate and its water rate (which often also includes land transportation legs) is the movement's barge transportation consumer surplus and is typically referred to as the movement's transportation rate-savings. Summing the transportation rate-savings for all movements in the system develops the system's transportation rate-savings. The without-project and with-project system transportation rate-savings are then used to estimate the reductions in system transportation costs by subtracting the with-project system transportation rate-savings from the without-project system transportation rate-savings.

4.2 System Analysis - 1990 Benefit Update

The TC/EQ was run for the without-project condition and for the recommended plan for the years 2005, 2025, 2035, and 2055. Without-project condition runs were made for the following conditions:

- Normal operating conditions

[2] National Economic Development Procedures Manual Overview, IWR Report 09-R-2, U.S. Army Corps of Engineers, June 2009, page 9.
[3] "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies", U.S. Water Resources Council, March 10, 1983, page 49.

- LD52 1200' chamber closed
- LD52 600' chamber closed
- LD53 1200' chamber closed
- LD53 600' chamber closed

With-project runs were made for these conditions:

- Normal operating conditions
- Olmsted LD with one 1200' chamber closed

Individual tables were developed for the without-project condition and for the recommended plan that integrated system benefits under normal conditions and lock closures. For any given year, system savings for the without-project condition were computed as the weighted average savings output from each of the five without-project conditions specified above and for the recommended plan as the weighted average savings output from the relevant two conditions specified above.

For any given future year, the annual percentage weighting for each of the above conditions was based upon future preventative maintenance schedules and an analysis of the probability of failure for key components as described in the 1985 feasibility report.

4.3 System Analysis – 2011 Olmsted Economics Update

For this report the WSDM system model was run for all years between 2005 and 2070 for both the without-project condition and the recommended plan under normal operation conditions. Due to schedule and budgetary constraints during the original analysis, no conditions representing closures of any one of the four chambers in the without or the two chambers of the recommended plan were run in the system modeling. The discrete event simulation model (the Waterways Analysis Model, or WAM) used to model lock performance could not be used to accurately reflect individual lock performance during main or auxiliary chamber closures due to the lack of reliable tow arrival information during closures from which to build shipment lists.

A weighting technique was used instead to adjust system benefits for the without-project condition and recommended plan by the percent of use and the days of closure by chamber. Estimated days of closure for both the without and with-project conditions were developed in the cost and closure matrices, discussed in greater detail in Section 8.0 and in Attachment 1. First the percents by chamber of total capacity were determined. These percents and days of closure were used to find to the reduced savings at each individual project. Once the project benefit adjustment was established the amounts were reduced from the overall system benefits. This approach was thought adequate to capture cyclical maintenance closures in lieu of more in-depth modeling. This approach is discussed in greater detail in Sections 9.4 and 9.6.

4.4 Risk and Uncertainty

USACE Principles and Guidelines (P&G) requires a risk-based approach to project analysis. The P&G requires that "... *planners shall identify areas of risk and uncertainty in their analysis and describe them clearly, so that decisions can be made with knowledge of the*

degree of reliability of the estimated benefits and costs and of the effectiveness of alternative plans."[4] For navigation projects, including Olmsted, the major areas of analysis risk and uncertainty are in the project costs, project construction duration (and online date), forecasted traffic demands, system congestion effects, reliability of existing and proposed structures, and barge transportation willingness-to-pay (e.g., alternative mode costs). Some risk and uncertainty can be incorporated probabilistically into and analysis, while some can only be handled though sensitivity analysis.

For this economic update the construction costs and construction duration was given (see section 11.1), however, it should be noted that the construction cost contingencies were determined using a risk-based approach. It goes without saying, that: 1) higher costs and / or longer construction will decrease the economic viability of the project; and 2) lower costs and / or shorter construction will increase the economic viability of the project.

Traffic demand forecasts (see section 5.0) is an area of risk and uncertainty that is often best described though sensitivity or scenario analysis. Since there is great uncertainty in future forecasts, and since waterway system congestion is driven by the amount of traffic on the system, five forecast scenarios and a no traffic growth scenario were considered in the analysis. Two forecasts were actually utilized in the analysis, although only the results for the most-likely forecast is displayed in this documentation. In addition, a no growth forecast scenario was analyzed and displayed, which represents the most pessimistic traffic demand assumption.

The traffic congestions effects, while incorporated into the economic model as expected point estimates (i.e., annual tonnage to average tow transit time), are generated through a vessel level simulation (see section 7.0) which contains vessel arrival and processing time variability.

Reliability of the existing and proposed structures is incorporated into the analysis through a "*cost and closure matrix*" (see section 8.0). Variability in the with- and without-project maintenance costs and service disruptions were not analyzed in the economic model, however, the repair costs were itemized separately so that decision makers can see the contribution of these costs (sensitivity) to the overall analysis.

Barge transportation willingness-to-pay is estimated through the estimation of a least-cost all-overland transportation rate (see section 6.0). Adding variability into the modeling process for movement level willingness-to-pay would require extensive effort and add little to the analysis.

An additional variable that impacts the sensitivity of future risk and uncertainty is the discount / amortization rate. A higher discount rate will discount future variability. The analysis was discounted and amortized at a 8.875% Federal Discount Rate (which was used in the 1990 Benefit Update), a 4.0% FY 2012 Federal Discount Rate (used in this revision of the Economics Update), and a 7.0% discount rate (preferred by OMB). As the discount rate is increased, the weighting of future costs and benefits is decreased.

[4] ER 1105-2-100 page 1-3.

5.0 WATERWAY TRAFFIC DEMAND FORECASTS

Forecasts of future traffic demands on the Ohio River System (ORS) and at the new Olmsted project are an important element in the project benefit evaluation. Estimates of the benefits from waterway investments require an analysis of the likely level of demand for waterway transportation over the 50-year economic life of the navigation project.

5.1 1990 Benefit Update Report Forecasts.

The benefit estimates presented in the October 1990 Olmsted Locks and Dam Benefit Update relied on the most up-to-date ORS traffic demand forecasts. These forecasts were developed in 1989-90 by the Great Lakes and Ohio River Division Navigation Planning Center (CELRH-NC). The forecasting effort entailed two separate, but related tasks: (1) an industry analysis geared toward activities that generate waterway commodity traffic on the Ohio River System, and (2) the generation of the waterway traffic demand forecast itself. A description of the study procedures and results is contained in the following paragraphs. Detailed documentation of the study effort is contained in the report entitled *Forecast of Future Ohio River Basin Waterway Traffic, 1986-2050 (May 1990).*

Commodity traffic on the inland waterways comprises the inputs to and outputs from specific industrial processes. The industry analysis was undertaken to update and expand available information on the Ohio River Basin industries that rely on waterway transportation and to obtain information concerning future economic growth in the markets served by those industries. The analysis examines historic industry development, current operations and expected future trends that could affect industry requirements for waterway transportation.

Future traffic demands on the Ohio River System were projected as a function of future economic growth in the markets served by waterway-using industries. These included local markets, broader regional markets, national markets and international markets. In this context the traffic demand projections were developed by reference to industry-produced supply/demand forecasts; the 1985 OBERS BEA Regional Projections prepared by the Bureau of Economic Analysis, U.S. Department of Commerce; and other government forecasts.

Traffic levels and patterns in 1986 were used as a base with modifications based on extensive industry surveys. Industry contacts provided information regarding changes in traffic patterns and tonnages that were then incorporated into the traffic demand forecasts. The forecast period extended from 1986 until year 2050 and encompassed two distinct time horizons: a short term (1986-2000) and a long term (2000-2050). The short term generally corresponds to the planning horizon of most of the available industry forecasts.

Generally speaking, two methods were used to project traffic demand, one for utility-related commodities (utility steam coal, and lime and limestone used in coal desulfurization), and a second for all other commodities. Coal movements to waterside utility plants were forecast over the short term by sharing out industry-produced electricity demand forecasts to specific plants or units, and relating coal utilization to electric generation. The long-term forecast was developed in a similar fashion except that electricity demand was first extended using

appropriate OBERS variables for utility market areas. Projected lime and limestone movements were based on coal utilization.

For most of the non-utility commodities, the short-term (1986-2000) traffic projection procedure involved computing growth induces using industry-produced forecasts and applying these indices to the base year traffic flows on the Ohio River System. For the lone-term (2000-2050), indices were computed from appropriate OBERS variables and applied to commodity flows in year 2000.

The most important salient forecasting issues at the time of the 1990 Olmsted Benefit Update (and subsequently) were associated with the future of environmental regulations dealing with pollutant emissions, especially of sulfur dioxide. At the time the forecasts were generated, the electric utility industry was operating under the requirements of the Revised New Source Performance Standards, which, among other things, effectively required that all new or modified units at power plants be equipped with scrubbers. The utility steam coal forecasts, as a result of extensive utility surveys, reflected the outlook of the utilities themselves concerning the impact of these and expected future regulations on coal burn and coal sourcing at waterside coal-fired electric generating facilities.

The overall traffic demand forecasts (1986-2050) from the Benefit Update for LDs 52 and 53 as well as the ORS are presented in Table 1. The overall forecasts in Table 1 show total traffic for LDs 52 and 53 growing at annual rates of 1.4 and 1.5 percent respectively over the 64-year timeframe, or about the same as the ORS. Traffic growth is driven largely by growth in coal traffic. Short-term forecasts (1986-2005) from the Benefit Update compared to actual traffic for that time period are shown in Table 2 and Table 3. The data in these tables show how the forecasts for LDs 52 and 53 tracked with actual traffic over the 19-year period from 1986 to 2005. Recent years have seen a growing disparity between the Benefit Update forecasts and actual traffic at the two facilities, with most of this disparity residing in the coal traffic. Coal traffic at the LDs 52 and 53 actually diminished by 12 and 16 million tons respectively over the 19-year period. The reduced traffic levels are explained largely by reductions in utility steam coal and export coal traffic through the lower Ohio River. The forecasts failed to anticipate the impacts of ever-tightening environmental restrictions post-1986, which included a loss of non-ORB markets for ORS coal to western coal and to conversions to natural gas. The forecasts also failed to anticipate a loss of export markets for ORS coal as ORB producers were unable to compete in export markets with other coal-producing countries.

Table 1. Actual and Projected Traffic for LD52, LD53 & the ORS
(Million of Tons)

	L/D 52			L/D 53			ORS		
Year	Coal	Other	Total	Coal	Other	Total	Coal	Other	Total
Actual:									
1970	13.3	32.6	45.9	11.3	32.0	43.3	89.7	74.2	163.9
1980	24.9	38.1	63.0	16.3	37.3	53.6	119.6	59.7	179.3
1986	41.0	45.6	86.6	33.4	45.5	78.9	135.2	88.7	223.9
Projected:									
1990	46.7	52.7	99.4	38.5	52.4	90.9	153.0	100.3	253.3
2000	59.8	68.1	127.9	50.6	67.5	118.1	191.9	127.1	319.0
2010	65.3	76.8	142.1	56.1	76.1	132.2	210.0	144.3	354.3
2020	68.8	85.3	154.1	59.6	84.6	144.2	219.4	165.4	384.8
2030	78.4	95.0	173.4	68.2	94.2	162.4	257.6	184.6	442.2
2040	87.6	105.4	193.0	75.8	104.4	180.2	289.2	205.7	494.9
2050	97.8	116.8	214.6	84.0	116.0	200.0	325.4	228.5	553.9
Growth Rates (%):									
1970-86	7.3	2.1	4.0	7.0	2.2	3.8	2.6	1.1	2.0
1986-50	1.4	1.5	1.4	1.5	1.5	1.5	1.4	1.5	1.4

SOURCE: Waterborne Commerce Statistics and the LRD Navigation Planning Center

Table 2. Actual and Projected Traffic for LD52, 1986-2005
(Million of Tons)

	L/D 52						Actual as
	Actual			Projected			% of
Year	Coal	Other	Total	Coal	Other	Total	Projected
1986	41.0	45.6	86.6	41.0	45.6	86.6	100.0
1990	51.7	52.7	101.4	46.7	52.7	99.4	102.0
1995	39.3	58.9	98.2	53.8	61.6	115.4	85.1
2000	24.2	67.5	91.7	50.6	67.5	118.1	77.6
2001	29.4	65.4	94.8	53.0	68.5	121.5	78.0
2002	28.2	64.7	92.9	55.4	69.5	124.9	74.4
2003	23.6	62.9	86.5	57.7	70.5	128.2	67.5
2004	26.5	67.7	94.2	60.1	71.5	131.6	71.6
2005	29.4	67.2	96.6	62.5	72.5	135.0	71.6
Growth Rates (%):							
1986-2005	-1.7	2.1	0.6	2.2	2.5	2.4	

SOURCE: Waterborne Commerce Statistics and LRD Navigation Planning Center

Table 3. Actual and Projected Traffic for LD53, 1986-2005
(Million of Tons)

	L/D 53						Actual as
	Actual			Projected			% of
Year	Coal	Other	Total	Coal	Other	Total	Projected
1986	33.4	45.5	78.9	33.4	45.5	78.9	100.0
1990	37.7	52.7	87.8	38.5	52.4	90.9	96.5
1995	28.7	59.2	87.9	44.9	61.1	106.0	82.9
2000	18.4	66.9	85.3	50.6	67.5	118.1	72.2
2001	18.8	63.5	82.3	51.1	68.4	119.5	68.9
2002	17.0	63.1	80.1	51.7	69.3	120.9	66.2
2003	12.7	61.1	73.8	52.2	70.1	122.4	60.3
2004	14.9	65.4	80.3	52.8	71.0	123.8	64.9
2005	17.4	64.5	81.9	53.3	71.9	125.2	65.4
Growth Rates (%):							
1986-2005	-3.4	1.9	0.2	2.5	2.4	2.5	

SOURCE: Waterborne Commerce Statistics and LRD Navigation Planning Center

5.2 2011 Olmsted Economics Update Forecasts.

More current forecasts were used in the benefit estimation for the Economics Update. In April 2003, the LRD Navigation Planning Center completed an update of the ORS forecasts and an analysis of the industries that ship and/or receive on the ORS. The ORS traffic demand forecasts presented here represent a comprehensive update. New forecasts were prepared for all commodity groups, but because of the dominance of utility steam coal on the system and the uncertainties surrounding the regulatory future, alternative scenarios were developed only for utility coal and sorbent materials (lime and limestone) used for coal desulfurization.

The current round of adjustments to the utility coal forecasts was necessitated by existing and likely future regulatory changes affecting the electric utility industry. Environmental issues are acknowledged by industry experts to be the dominant issues expected to affect future coal utilization and sourcing on the part of the electric utilities. In light of this, five alternative forecast scenarios were developed, three of which directly reflect alternative legislative approaches to emissions reductions.

The basic forecasting framework for developing waterway traffic demand forecasts is similar in most instances, the major exceptions being three of the alternative utility coal forecasts, which are based on a linear programming approach. The procedure starts with a set of base-year waterway traffic commodity flows and information about the economic prospects of the industries and individual companies consuming these waterborne commodities. The first steps in projecting waterway traffic demands are to identify the industry and market that each dock serves and to adjust commodity flows to these docks to represent base-level expectations for each facility. Adjustments are based on examination of historical flows and the results of

extensive shipper surveys. Industry and market prospects are analyzed by examination of relevant industry and economic/demographic forecasts and the company-specific information obtained by means of shipper surveys. Finally, future traffic demands are generated based both on the information obtained in the shipper surveys and the application of appropriate growth forecasts.

Since utility coal dominates the traffic picture on the ORS, the most detailed analyses surrounded the utility-related commodities, i.e., utility coal and lime and limestone used in coal desulfurization. Two distinct approaches were taken to forecasting ORS utility coal traffic. One approach involved surveying the utilities themselves, soliciting information from them regarding their future coal sourcing plans in light of the environmental regulations, and using this information in the ORS utility coal model to generate future coal burn, sources and flows. The second approach involved using the output of Hill and Associates' linear programming techniques, based on the use of their National Power Model and other related models. The linear programming approach determines a least cost combination of inputs in a market context, including coal by type and source, to meet electricity demands through time.

These two basic approaches were used to generate the five alternative forecasts of ORS utility coal traffic demands. The first two of these, dubbed the Utility-Based and Utility-Based High scenarios, make use of utility survey information and the ORS utility coal model to generate a forecast that, among other things, reflects the utilities' view of the environmental regulatory future. The Utility-Based High scenario assumes high economic growth, while the Utility-Based scenario reflects base case or mid-level growth. The Hill and Associates scenarios reflect the impact of three alternative futures on ORS coal flows. The first of these is a continued application of existing law which, at the time of forecast development, was the National Ambient Air Quality Standards. This scenario is referred to as the NAAQS scenario. The second Hill scenario reflects implementation of the administration's multi-emissions proposal, the Clear Skies Initiative, as an amendment to the Clean Air Act. This proposal, referred to as the Clear Skies scenario could be expected to have a fairly profound impact on the use of coal by electric utilities, largely because of the proposal's implied mercury emissions restrictions. The final Hill scenario would be implementation of the Clear Skies initiative without the severe mercury restrictions that are included under Clear Skies. This scenario is referred to as the Modified Clear Skies Scenario.

Figure 2 and Figure 3 show the alternative scenario forecast results for LDs 52 and 53 relative to the forecasts used in the Olmsted Benefit Update. As a result of the issues mentioned previously, i.e. the impacts of evolving environmental regulations and the loss of ORS export coal markets, all of the alternative forecast scenarios are substantially below the forecasts used in the 1990 Olmsted Benefit Update.

Figure 2. LD52 Tonnage Forecasts

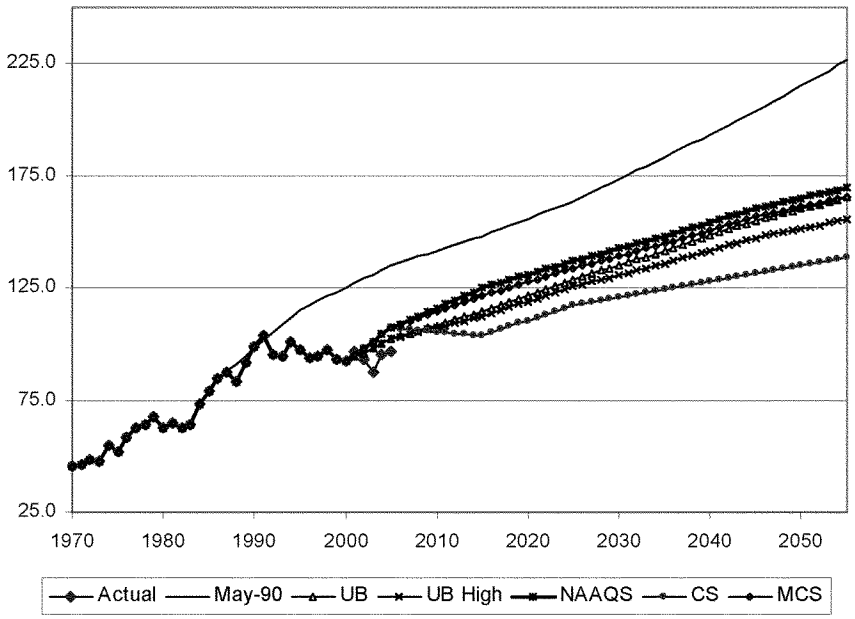


Table 4 shows the high forecast among the Olmsted Economics Update forecasts at LD52 to be NAAQS and the low forecast Clear Skies. Between 2000 (the base year for forecasting purposes) and 2030, NAAQS shows total traffic increasing at an annual rate of 1.5 percent. Between 2000 and 2050, the growth rate slows slightly to about 1.2 percent. The Clear Skies scenario shows total traffic at LD 52 to be increasing at an annual rate of 0.9 percent between 2000 and 2030. Over the longer term, 2000-2050, the growth rate under Clear Skies also diminishes slightly, to about 0.8 percent per year.

Unlike LD 52, the forecasts for LD 53, as seen in Table 5, range between Utility-Based High on the high side and Clear Skies on the low side. This difference occurs because a major coal loading facility, which is an important entry point into the ORS for western coal, affects overall traffic patterns on the lower Ohio. Between 2000 and 2030, Utility-Based High shows total traffic at LD 53 increasing at an annual rate of 0.9 percent. Over the longer term, 2000-2050, the annual growth rate remains the same. Clear Skies shows annual traffic growth running at 0.6 percent for the 2000-2030 period, and similarly at 0.6 percent from 2000-2050. The Benefit Update column in both Table 4 and Table 5 shows the overall traffic demand forecasts that were used in the 1990 Benefit Update (referred to in Figure 3 as the May-90 forecasts) for the period between 2010 and 2050, illustrating how forecasts have changed between that report and this 2011 Economics Update.

Figure 3. LD53 Tonnage Forecasts

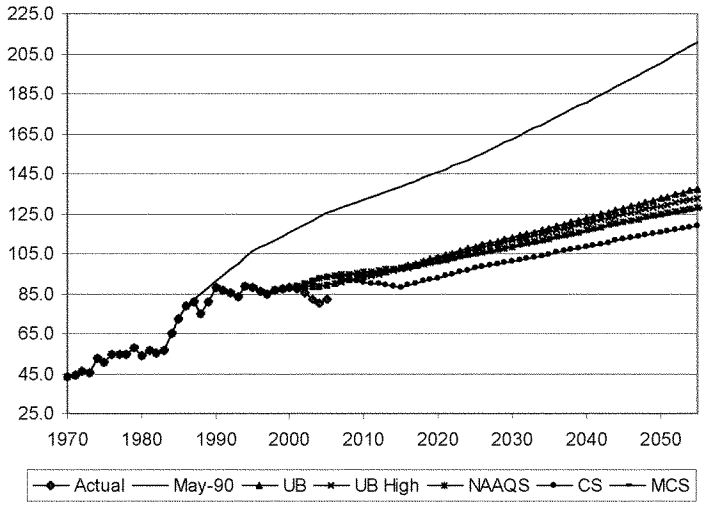


Table 4. Actual and Projected Traffic for LD52
(Million of Tons)

	L/D 52					
	PACR - Alternative Forecasts					
Year	Benefit Update	Utility-Based High	Utility-Based	NAAQS	Clear Skies	Modified Clear Skies
Actual:						
1970	45.9	45.9	45.9	45.9	45.9	45.9
1980	63.0	63.0	63.0	63.0	63.0	63.0
1990	101.4	101.4	101.4	101.4	101.4	101.4
2000	91.7	91.7	91.7	91.7	91.7	91.7
2005	96.6	96.6	96.6	96.6	96.6	96.6
2006	93.7	93.7	93.7	93.7	93.7	93.7
2007	89.0	89.0	89.0	89.0	89.0	89.0
2008	89.7	89.7	89.7	89.7	89.7	89.7
2009	79.8	79.8	79.8	79.8	79.8	79.8
Projected:						
2010	142.1	107.5	107.5	114.1	98.5	116.2
2020	154.1	121.2	118.7	130.0	113.1	127.2
2030	173.4	134.7	130.3	141.9	120.6	138.7
2040	193.0	148.9	142.1	154.7	128.5	151.2
2050	214.6	158.4	150.2	163.7	135.1	159.9
Annual Growth (%):						
2000-30	2.1	1.3	1.2	1.5	0.9	1.4
2000-50	1.7	1.1	1.0	1.2	0.8	1.1

SOURCE: Waterborne Commerce Statistics, Lock Performance Monitoring System and the Navigation Planning Center

Table 5. Actual and Projected Traffic for LD53
(Millions of Tons)

	L/D 53					
		PACR - Alternative Forecasts				
Year	Benefit Update	Utility-Based High	Utility-Based	NAAQS	Clear Skies	Modified Clear Skies
Actual:						
1970	43.3	43.3	43.3	43.3	43.3	43.3
1980	53.6	53.6	53.6	53.6	53.6	53.6
1990	87.8	87.8	87.8	87.8	87.8	87.8
2000	85.3	85.3	85.3	85.3	85.3	85.3
2005	81.9	81.9	81.9	81.9	81.9	81.9
2006	81.0	81.0	81.0	81.0	81.0	81.0
2007	78.3	78.3	78.3	78.3	78.3	78.3
2008	77.8	77.8	77.8	77.8	77.8	77.8
2009	68.0	68.0	68.0	68.0	68.0	68.0
Projected:						
2010	132.2	93.2	93.2	91.9	85.8	93.4
2020	144.2	103.0	102.1	102.8	93.5	103.5
2030	162.4	112.5	111.1	108.0	100.9	107.5
2040	180.2	123.0	120.5	117.1	108.8	116.6
2050	200.0	132.0	128.5	124.0	115.3	123.5
Annual Growth (%):						
2000-30	2.2	0.9	0.9	0.8	0.6	0.8
2000-50	1.7	0.9	0.8	0.8	0.6	0.7

SOURCE: Waterborne Commerce Statistics, Lock Performance Monitoring System and the Navigation Planning Center

It should be noted that the traffic forecasts, by the nature of their development process, have certain limitations on their usefulness. Because of the time required to develop the forecasts, they tend to be overtaken by events. For example, the current forecasts do not reflect, specifically, the implementation of the Clean Air Interstate Rule (CAIR) and Mercury Rule. They also do not reflect the renewed interest in such issues as containerized traffic on the ORS in the face of mounting congestion at coastal ports for this type of traffic. As discussed in Section 5.4 below however, sensitivity tests using forecasts lower than those including both CAIR and mercury emission controls (the flat, or no growth scenario) demonstrate that the project remains economically justified.

5.3 Forecasts Selected for the Economic Update

Based upon the recent performance of the five forecasts, the Clear Skies Scenario was selected for use in displays of project benefits in the main report. The NAAQS Scenario is used to indicate the benefit impacts of an upper bound traffic scenario.

5.4 Newest Traffic Trends and Forecasts

After the completion of the 2007 version of the Economic Update, a 2010 Independent External Peer Review (IEPR) requested inclusion of a comparison of the traffic forecast assumptions against newer traffic data and traffic forecasts.

Because of recent traffic experience on the lower Ohio, analyses in the Olmsted PACR are based largely on the Clear Skies Scenario, which, at the time the forecasts were developed,

was the most restrictive of the alternative forecasts in terms of waterborne coal traffic generally and traffic through Locks 52 and 53 specifically. Under this scenario, nationwide sulfur dioxide emissions are restricted to 4.5 million tons by 2010 and 3.0 million tons by 2018, compared to actual emissions of 12.0 million tons in 1999. Nitrogen oxide emissions are reduced from an actual level of 7.1 million tons in 1999 to levels of 2.1 million tons in 2008 and 1.7 million tons in 2018. Mercury emissions, which is a key driver in this scenario, are restricted to 26 tons in 2010 and 15 tons in 2018, versus actual emissions of 48.6 tons in 1999. Clear Skies, in contrast to other multi-emissions proposals, contained no restrictions on carbon dioxide emissions. The Clear Skies Initiative was never enacted into law, however, an EPA regulation entitled the Clean Air Interstate Rule (CAIR), described as the Clear Skies Initiative by regulation, was implemented by EPA in 2003.

The more recent update of the ORS forecasts included three alternative forecasts of steam coal traffic designated High Case, Base Case, and Low Case. The High Case forecast assumes a high level economic growth; a continuation of the sulfur dioxide and nitrogen oxide emissions restrictions contained in CAIR; implementation of the so-called Regional Greenhouse Gas Initiative (RGGI) for CO2 emissions; and relatively low growth in nuclear power additions. The Base Case forecast assumes mid-level economic growth; a continuation of CAIR requirements for sulfur dioxide and nitrogen oxide emissions; implementation of RGGI for CO2 emissions; and mid-level nuclear plant development. The Low Case forecast assumes a relatively low level of economic growth; sulfur dioxide and nitrogen oxide emissions restrictions somewhat stricter than CAIR; implementation of the Waxman-Markey bill (HR 2454) imposing strict nationwide limitations on CO2 emissions; and relatively high levels of nuclear plant development. All of the forecast alternatives assume usage of the Maximum Available Control Technology (MACT) for control of mercury emissions.

Figure 4. LD52 Tonnage Forecasts

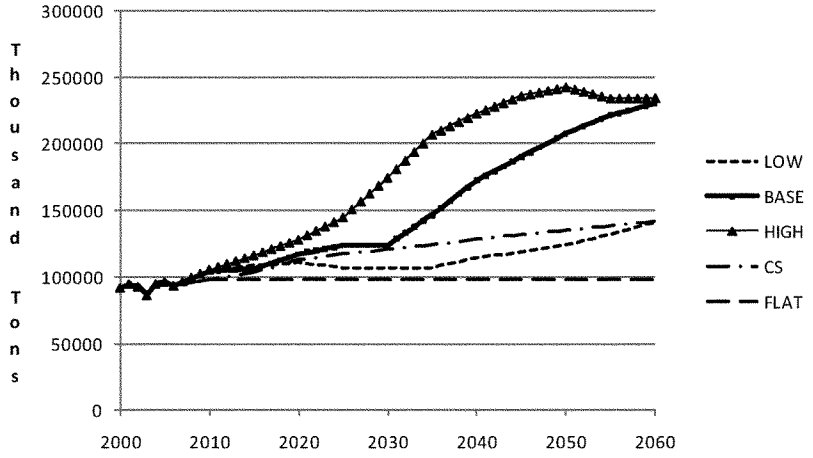
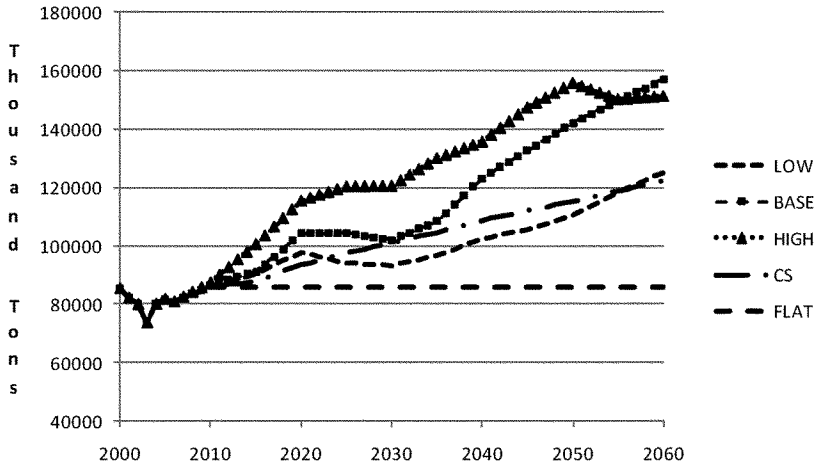


Figure 4 and Figure 5 show the traffic forecasts for Locks 52 and 53. The Clear Skies scenario is shown along with the Low Case, Base Case and High Case scenarios from the updated ORS traffic forecasts. Also shown is a flat forecast that was used for a sensitivity test in the Olmsted PACR. Except for the early years, the updated Low Case scenario is actually somewhat lower than the Clear Skies scenario over most of the forecast horizon at both projects. This is attributable, in large part, to the effects of strict, national-level restrictions on CO2 emissions contained in the Low Case scenario. However, the flat forecast, which is actually Clear Skies flattened after 2010, is lower than both Clear Skies and the Low Case scenario. The sensitivity test using the flat forecast indicates that the Olmsted project remains justified (see Section 11.2.3), at a benefit to cost ratio of 7.4 at the FY 2012 discount rate of 4.0%. This would appear to indicate that additional sensitivity tests are unnecessary. Tonnage forecasts associated with the Clear Skies scenario were retained for the November 2011 revisions.

Figure 5. LD53 Tonnage Forecasts



5.5 Shipper Response

Demands presented in the previous section represent what shippers are likely to move through the lower Ohio River at existing waterway transportation costs. Arriving at equilibrium waterway traffic levels and estimating the benefits of alleviating delays on the system requires an understanding of how shippers respond to the increased waterway costs caused by these delays whether the result of chronic or seasonal traffic congestion (generally not experienced along the lower Ohio River) or due to service outages, both scheduled and unexpected, necessitated by lock repairs or construction activity.

Shippers may wait in queues, divert to other modes, or seek alternative sources or markets; however, these choices are framed by the relative cost of pursuing each alternative. The

largest single waterway movement on the lower Ohio River is Powder River Basin coal being moved by rail from the western United States to large transloading facilities for ultimate delivery by water to power plants in the Ohio River System. Evolving environmental regulations and the cost of compliance generally drive coal sourcing rather than the cost of transportation. It is unlikely that a switch to another coal source would occur; a switch to direct rail is the more likely response. In that event the time horizon becomes important – in the near term, additional railcars and locomotives could very well be difficult to obtain. Two massive limestone quarries on the lower Tennessee and lower Cumberland rivers dominate the aggregate trade with stone poor lower Mississippi/Gulf Coast markets. Stone could be sourced off of the Upper Mississippi River, but it is uncertain that the quantities needed would be available from quarries there. Petroleum products now coming from Gulf Coast refineries might be sourced more from small to medium-sized Ohio River Basin refineries, but it is unlikely that these could meet the demand. Iron ores can and do come from domestic and Canadian sources in the Great Lakes basin; iron ores could also be railed from the east coast. Salt would still come from the Gulf Coast. Ohio River Basin export grains and oilseeds might be diverted to the agricultural products processing market (oils, feeds and sugars) and to the poultry market; however, it is unknown whether Ohio River Basin production of grains and oilseeds and consumption would balance.

The conventional method of defining and handling shipper response (a.k.a. waterway demand elasticity) in waterway system economic models is to use each origin-destination-commodity movement's least-costly all-overland rate to represent that move's willingness-to-pay for barge transportation. As delays due to service outage mount, the waterway cost increases. Once the waterway cost exceeds this willingness-to-pay (e.g., the all-overland rate), the movement is diverted off the waterway. This land rate is assumed fixed through the analysis period (i.e., no future land congestions effects). In the system equilibrium process, marginal movements, and parts of marginal movements, are diverted.

This technique, used in the Economic Update (2008), has been succeeded by techniques to define each origin to destination commodity movement with a movement level downward sloping demand curve rather than one willingness-to-pay diversion price (the least-cost all-overland rate) of the movement. As such, as the transportation price of the waterway increases, fractions of tonnage from all movements on the waterway system are diverted. While the technique results in traffic being much more sensitive to waterway price change resulting in greater tonnage diversion and generally lower waterway surplus (benefits) for a waterway system, the incremental benefit between two alternatives are not necessarily lower (e.g., without and recommended plan).

Deriving a movement demand curve is more analytically involved than deriving the movement's alternative rate, requiring very detailed shipper surveys and sophisticated econometric analyses whether using stated or revealed preference models. The work to develop movement-level demand shaping functions was only just underway at the time of the Olmsted economic update. While a movement-level demand curve would be important when movements are highly aggregated, this was not the case in the Olmsted analysis. Additionally, as suggested in the discussion above, movements in the Ohio River system prove to be relatively insensitive to waterway price changes and more influenced by

commodity requirements and available sources that are not geographically ubiquitous. Nevertheless, this newer technique would result in traffic being much more sensitive to waterway price change resulting in greater tonnage diversion under a without-project condition and thus greater tonnage attraction under a with-project condition. It is uncertain whether incorporation of the more detailed movement response data would increase, decrease, or make no difference to the results from the conventional shipper response method used.

6.0 TRANSPORTATION RATES

The October 1990 Benefit Update for the Olmsted Locks and Dam used FY 1987 transportation rates to develop the navigation benefits for the recommended plan. The rates were based on an update of a comprehensive rate study of ORS traffic by the Tennessee Valley Authority (TVA) done in 1984. Over 1,000 year 1986 ORS movements were rated, indices for truck, rail and barge modes by commodity group were developed, and the un-sampled movements rated.

Every few years the USACE Planning Center of Expertise for Inland Navigation has the ORS rates updated. The economic update in this Olmsted Economics Update uses FY 2003 transportation rates; the most current rate data available at the time ORNIM was run for this analysis. In the FY 2003 rate analysis 1,589 ORS movements were rated, indices for truck, rail and barge modes by commodity group were developed, and the un-sampled movements rated.

The rate data and the model results, however, were subsequently indexed to October 2010 based on a comprehensive rate study of ORS traffic by the University of Tennessee, Center for Transportation Research done in March 2011 under contract with the Marshall University Appalachian Transportation Institute. In this FY 2011 rate analysis 1,552 year 2004 ORS movements were rated, indices for truck, rail and barge modes by commodity group were developed, and the un-sampled movements rated.

For this 2011 Economic Update, the October 2010 rates are assumed equivalent to a 1 Oct 2011 price level (for comparison against the engineering costs). While the rate data, and specifically the waterway rate-savings, is used to determine future system equilibrium traffic levels and traffic mix, the driver of the incremental benefits between the without and with-project condition remains the transportation cost differentials. In short, the Oct 2010 to 1 October 2011 price level difference is an insignificant conservative assumption.

Table 6 summarizes the average transportation rate-savings by commodity group for the FY 1987 (used in the 1990 Benefit Update), FY 2003, and FY 2011 ORS rate studies. From 1987 to 2003 the apparent decline in nominal rate-savings is largely attributable to efficiency gains in rail transportation resulting from railroad de-regulation since the Staggers Act of 1987. A total average rate-savings of $13.46 per ton results from a tonnage weighted average of all the sample movements. Coal has the greatest impact on total average savings because it is the dominant commodity on the ORS accounting for over 55 percent of system tonnage. In general, rate-savings for traffic on the lower Ohio River is greater than the system as a whole.

Table 6. Average ORS Transportation Rate-savings

Commodity Group	Rate Study 1987	2003	2011
Coal	$ 6.13	$ 5.92	$ 8.79
Petrol	$ 16.25	$ 9.45	$ 27.54
Stone	$ 12.68	$ 7.51	$ 12.33
Grain	$ 14.98	$ 10.41	$ 17.38
Chemical	$ 15.77	$ 22.20	$ 49.47
Ore	$ 16.26	$ 23.13	$ 20.91
Steel	$ 17.29	$ 16.43	$ 20.91
Other	$ 22.82	$ 11.38	$ 23.31
Total	$ 9.67	$ 7.44	$ 13.46
L/Ds 52 & 53	$ 13.69	$ 14.21	$ 27.46

6.1 General

Transportation rate specialists at the Tennessee Valley Authority (TVA) have been providing the Corps (USACE) transportation rates for use in navigation feasibility studies for over 30 years, however, transportation rate expertise has been transferred to Regional Transportation Centers (RUCs). The Marshall University Appalachian Transportation Institute serves as the primary contractor. The most current ORS rate database was developed by the University of Tennessee, Center for Transportation Research (March 2011).

The rate analysis is compliant with USACE Principles and Guidelines (P&G) to facilitate the calculation of National Economic Development (NED) benefits attributable to Ohio River navigation. Toward this objective, the analysis provides a full range of transportation rates and supplemental costs for a sampling of waterborne commodity movements which, in total or in part, were routed on the Ohio River Navigation System.

Freight rates for each sample movement are calculated based on the actual water-inclusive routing, as well as for a competing all-land alternative. Results are documented on a movement-by-movement basis, including a separate worksheet for each observation (see Sample Rate Sheet in Figure 6). These dis-aggregated data are also integrated into individual spreadsheets for each of the eight commodity groupings. A full description of the methods of rate research and construction, and supporting assumptions follows.

Figure 6. Sample Rate Sheet

TRANSPORTATION RATE ANALYSIS

Commodity			
WCSC		Tonnage	
River Origin		River Dest	
Origin Port Code		Dest Port Code	
Origin WW Mile		Dest WW Mile	
Off-River Orig		Off-River Dest	

Water Route	Mode	Miles	Time	Cost
(1) Loading at Origin				$0.00
(2) Charge to Transfer Point				$0.00
(3) Transfer Charge				$0.00
(4) Charge to River				$0.00
(5) Handling at River Origin				$0.00
(6) Line Haul Charge				$0.00
(7) Handling at River Destination				$0.00
(8) Charge to Exit River				$0.00
(9) Unloading at Destination				$0.00
(10) Other				$0.00
(11) Total				$0.00

Land Route	Mode	Miles	Time	Cost
(1) Loading at Origin				$0.00
(2) Charge to Transfer Point				$0.00
(3) Transfer Charge				$0.00
(4) Line Haul Charge				$0.00
(5) Transfer Charge				$0.00
(6) Final Leg to Destination				$0.00
(7) Unloading at Destination				$0.00
(8) Other				$0.00
(9) Total				$0.00

SUMMARY	Cost
(1) Water Route	$0.00
(2) Land Route	$0.00

Because many of the sample movements have off-river origins and/or destinations, a full accounting of all transportation costs for waterborne movements also requires the calculation of railroad and/or motor carrier rates for movement to or from the nearest appropriate port facility. Additionally, all calculations reflect the loading and unloading costs at origin and destination, all transfer costs to or from barge, and any probable storage costs.

With the exception of over-dimension shipments and intra-pool sand dredging, rail or truck rates are calculated for all movements. For over dimension truck and intra-pool dredged materials, the land rate was estimated as compared to a specific modeled rate using identifiable data inputs. Additionally, pipeline or conveyor alternatives are calculated for applicable commodities when both the origin and destination are pipeline or conveyor served. As in the case of the barge-inclusive routings, many all-land routes require the use of more

than one transport mode. Therefore, when appropriate, calculations include all requisite transfer charges.

To accurately reflect NED benefits, it is necessary to develop rates which portray the normal market conditions which are anticipated over the project life. For this reason, every attempt was made to purge the data of anomalous or transitory influences. As a part of all shipper surveys and interviews, respondents were directed to ignore temporary market disruptions and provide information reflective of "*normal*" operating conditions. As a result of the commodity mix represented within the ORS sample, there was no need to adjust for seasonal fluctuations. Annual contract barge rates with a fuel escalation feature and five year average spot market grain rates provide an annual average barge rate that is comparable to the multi-year contract rail rates that remove seasonality. The result is consistent rate treatment for each mode.

In a Ohio River 2007 Rate Study, three notable situations emerged with respect to long-term cost efficiencies for the rail mode of transportation. First, prior rail mergers in 1996 through 2005 time periods have been completed. The result of these mergers is a decrease in the variable cost of the surviving carrier and a decrease in absolute rates to reflect the surviving carriers' historic rate levels. Second, the Class 1 rail carries continue to deploy larger capacity rail cars and to install heavier gauge rail track capacity. Lading weights in excess of 120 tons for coal and grains frequently occur, reducing unit costs by fifteen to twenty percent compared to the traditional 100 ton capacity rail cars. Third, the decline in volume in the export coal market has forced rail carriers to reduce coal pricing to selected export locations to maintain the viability of railroad owned transfer docks and terminals.

Based on information collected from shippers, receivers, carriers, river terminal operators, stevedores, federal agencies, and private trade associations, probable origins and destinations for the majority of those movements that originated or terminated at off-river locations are identified. In the absence of specific shipper/receiver information, it is assumed that the river origin and destination are the respective originating and terminating points for both river and alternative modes of transportation. In every case, an attempt is made to gather information from all shipping ports. However, in some instances, logistical data were not available from these ports. In other cases, port representatives declined to provide the requested information.

For movements that originate or terminate at a river port location, it was assumed that rail service could also be utilized by the shipper or receiver if that port is rail served. Exceptions to this assumption are noted on individual worksheets. When the shipper or receiver is served by truck only, a railroad team track or transfer facility at the station nearest the off-river shipper or receiver is used for the land alternative. Only those shippers who ship more than 150,000 tons annually and who are adjacent to rail tracks would be assumed to undertake the significant capital expenditures necessary to acquire direct rail service. Mileage allowances made by carriers to shippers for the use of private equipment are also ignored as are rebates to shippers.

For the long run, in all cases, it is assumed that the alternative modes of transportation would have the physical capacity to accommodate the additional tonnage represented by each

commodity movement (This is provided for in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G)). Commodity specific judgments and assumptions include:

6.1.1 **Coal (group 1)**

A number of assumptions are made for land haul rates on the movements of coal to utility destinations that are not rail served. Volumes to these utility destinations are, in many cases, substantial, so that long-haul truck transportation cannot be considered a viable option. In the absence of water transportation, receiving utilities would have to carefully evaluate those available options which might insure their ability to continue to receive large volumes of coal. These considerations might include the replacement cost of transfer and handling facilities, the construction cost of switch or main line rail track, the cost of new or improved highway access, the economies of buying or leasing rail equipment, and the possibility of shifting origins to assure adequate coal supply. For their part, we may assume that rail carriers would be willing to construct additional track capacity if volumes are sufficient. However, these construction costs would most likely be passed on to the shipper via higher rates.

To accommodate those instances in which sample barge movements are to non-rail served utilities, we have incorporated the following judgments and assumptions.

- If the receiving utility is not rail served, rates are applied to the nearest railhead, and trucking costs from the railhead to the destination are applied. If the shipping point is not rail served, a motor carrier charge is applied from the mine origin to the nearest railhead. It is assumed that transfer facilities would be available at both origin and destination for transfer between rail and truck.
- If the receiving utility is rail served for supplies only, but not coal, the rail car unloading cost of the utility is inflated to accommodate a rail track expansion to the coal stockpile.
- In some instances, movements involve a truck haul from multiple origins to a concentration or preparation point for loading to rail. In these instances, where shipments originate at several mines within the same general area, a representative rail origin is selected as the transfer location.

6.1.2 **Aggregates (group 3)**

Land haul rates on limestone and sand and gravel reflect the modes necessary to transport the shipments from actual origins to actual destinations. If origins or destinations are not rail served, a trucking charge is applied from the nearest rail station. For those movements where both rail and truck transportation are an option, truck hauls are limited to a distance of 100 miles. This, on occasion results in slightly higher rates. However it was deemed impractical, in the absence of water transportation, to transport large volumes of these commodities for long distances by truck. Limiting factors of truck transport include lower cargo carrying capacity, the inability to round-trip more than three times per day, and the absence of loaded back-haul opportunities.

With regard to waterway improvement materials, we assume that land movements would require a truck haul at the destination for delivery to river bank work locations. These truck

movements would likely average five miles each. It should be noted that a significant amount of channel improvement and bank stabilization work is conducted off shore or at locations without highway access, making land transportation impractical.

6.1.3 **Grain (group 4)**

The computation of rates for grain is based upon the survey responses of the shippers and receivers. Specifically, if a country elevator gathers grain then ships it to the river terminal, we assume a 20 mile truck haul from the farmer's field to the country elevator. If the grain moves for export, a unit train movement is assumed, and land rates are computed from a unit train capacity elevator to a Gulf port location. For domestic shipments, the computation of rail rates is based on the track capacity of the country elevator or domestic receiver. We assume that the grain shipper would maximize the use of his facilities and utilize gathering rates to reach the track capacity of the receiver.

The rail rating of feed ingredients follows assumptions similar to those used for the rating of grain - namely rates constrained by track capacity. Rail and barge transit programs for meals (soybean, cottonseed, oilseed and fish) were not considered.

6.2 **Methods and Procedures**

As a result of pricing flexibility and differential rates allowed by surface transportation deregulation, it is sometimes difficult to determine the exact rate charged by a carrier on shipments moving under contract. Barge rates are a matter of negotiation between shipper and barge line operator, and these rates are not published in tariff form. Each carrier's rates are based on individual costs and specific market conditions, so that these rates will vary considerably between regions, across time, and from one barge line to another.

Contract rates are also common in pipeline, rail and motor carrier transportation and, like barge rates, may be maintained in complete confidentiality. In other cases (particularly grain), tariff rates are still applied. However, there is rarely any dependable means for determining whether a contract rate or a tariff rate should be used to price a particular movement. A further complication is the use of rebates and allowances as an incentive by carriers to shippers to induce higher traffic volumes.

6.2.1 **Barge Rates**

With the exception of grain and feed ingredients and average trade publication spot market rate quotes, unobservable barge rates are calculated through the application of a computerized Barge Costing Model (BCM) developed by the Tennessee Valley Authority and now maintained by the PCX and run by each RUC. Additionally, data from the Waterborne Commerce Statistical Center trip reports and data from the Lock Performance Monitoring System are incorporated into BCM costing parameters.

The BCM contains three costing modules: a one-way general towing service module, a round-trip dedicated towing service module, and a round-trip general towing service module. The one-way module calculates rates by simulating the use of general towing conditions between origin and destination, including the potential for a loaded return. The dedicated towing service module calculates costs based on a loaded outbound movement and the return movement of empty barges to the origin dock. The round-trip general towing service module

is similar to the one-way, except that it provides for the return of empty barges to the point of origin. This module does not calculate costs for towboat standby time during the terminal process but does include barge ownership costs (maintenance, replacement cost, supplies, insurance, and administration) for both the terminal and fleeting functions. It does not require that the empty barges be returned with the use of the same towboat. Depending on the module in use inputs may include towboat class, barge type shipment tonnage, the interchange of barges between two or more carriers, switching or fleeting costs at interchange points or river junctions, and barge ownership costs accruing at origin and destination terminals, fuel taxes, barge investment costs, time contingency factors, return on investment, and applicable interest rates.

Barge rates on dry commodities are calculated with the use of the general towing service round-trip costing module. Inputs, based on information from carriers and the Corps' Lock Performance Monitoring System (LPMS) database were programmed into the module to simulate average towboat size (horsepower) and corresponding tow size (barges) for each segment of the Inland Waterway System. Other inputs include barge types, waterway speeds, horsepower ratios and empty return ratios.

An example of a typical shipment cost in this analysis would be a dry bulk commodity (iron ore intermediates or cement clinker) originating on the Mobile River at Mobile, Alabama and terminating on the Ohio River at Cincinnati, Ohio. Based on the modeling process, this shipment would be assumed to move in an four barge tow from Mobile to the Mississippi River at New Orleans, a twenty four barge tow from New Orleans to Cairo, and a fifteen barge tow from Cairo to Cincinnati. At each interchange point, appropriate fleeting charges would be calculated. Empty return (back haul) factors would also be included for each segment of the movement.

With the exception of movements involving Northbound and tributary rivers, barge rates for grain and feed ingredients are estimated on the basis of a percentage of base rates formerly published in Waterway Freight Bureau Tariff 7.[5] For movements with origins in the Ohio River Basin, the five year average percent of base for the Lower Ohio, Mid Ohio, Upper Mississippi, Illinois, and Missouri Rivers is used. For movements on the Tennessee, Gulf Inter Coastal Waterway, an arbitrary charge is added to the New Orleans base rate. Rates for those movements that traversed the Tennessee -Tombigbee Waterway are calculated through the use of the BCM general towing service round-trip costing module.[6]

Barge rates for asphalt, heavy fuel oils, and light petroleum products are calculated through the use of the dedicated service round-trip costing module. Twenty hours standby time is allocated at origin and destination for towboat terminal functions. Finally, rates for sodium hydroxide, vegetable oils, lubricating oils, liquid chemicals, and molasses are calculated through the use of the general service round-trip costing module. As a result of comparable barge sizes, these commodities normally move in the same tow with dry commodities.

[5] The expression of barge rates for agricultural commodities as a percentage of waterway Freight Bureau Tariff 7 is consistent with industry standards.
[6] There is no basis for rates via the Tenn-Tom in the Waterway Freight Bureau Tariff.

Barge rates calculated by the use of the BCM reflect charges that would be assessed in an average annual period of typical demand for waterway service. It should be noted that the model does not explicitly consider market factors such as intra or inter modal competitive influences, favorable back haul conditions created by the traffic patterns of specific shippers, or the supply and demand factors which affect the availability of barge equipment. These and other factors can influence rate levels negotiated by waterway users. The model does, however, calculate rates based on the overall industry's fully allocated fixed and variable cost factors, including a reasonable rate of return on assets. It is assumed that the rates estimated are representative of the industry and provide a reasonable basis for the calculation of NED benefits.

The spot market hopper barge rates were derived from the River Transport News published by the Criton Corporation of Silver Springs, Maryland.

6.2.2 **Railroad Rates**

In 2007, rail shippers received rate relief from the Surface Transportation Board (STB) in the calculation of fuel surcharges. The result of the STB decision was a new calculation method for surcharges based upon mileage with the Class 1 rail carriers adopted the ALK mileage software program to estimate mileage. A further complication in rail rate calculation was the failure of Global Insight, Inc. to correct and update the Reebie Rail Costing Model that they purchased in 2004 when Global Insight acquired Reebie & Associates.

To resolve the above analytical issues, TVA developed a rail rate estimating technique using the attributes of rail shipping exhibited in the STB Waybill Sample. This technique was first employed in the Upper Mississippi and Illinois Rivers 2006 Transportation Rates Project for USACE.

The TVA/RUC rail rate estimating method has six steps. First, field or telephone interviews of the dock operator to establish the off river origin and/or destination, the mode and carrier of transport to or from the dock, rail track capacity at the dock, and river dock handling capability. Second, a rail route is constructed from either the off river origin or the dock origin. Third, the STB Waybill Sample is sorted by seven digit STCC number (or five digit if insufficient observations) by carrier, by state (or all states if insufficient observations), by single car-multi car-small unit train-large unit train, and by distance (less than 500 miles or greater than 500 miles). Fourth, the average revenue per mile was calculated along with the standard deviation. Fifth, a revenue un-masking factor is applied, price level is adjusted (non fuel 3.5%) if necessary, and a fuel surcharge ($0.28 per mile) are applied. Last, carrier mileage was multiplied by the adjusted revenue per mile, and the result was divided by the average weight per car to produce an estimate of the rail rate per short ton for the land move.

6.2.3 **Motor Carrier Rates**

Truck rates for off-river movements were obtained from the shipper and dock surveys as part of the RUC contract with USACE. In addition, each RUC maintains transportation trade publications that report various regional trucking rates and costs. The truck rate methods consist of a rate per loaded mile for moves over 100 miles or a shuttle truck rate per hour for

moves under 100 miles. The truckload weight is provided by the individual state highway axel load and bridge formula for truckload and permitted load limits.

6.2.4 Handling Charges

Handling charges between modes of transportation are estimated on the basis of information obtained from shippers, receivers, stevedores, and terminal operators. Handling charges for the transfer of commodities from or to ocean-going vessels are on the basis of information obtained from ocean ports or stevedoring companies. For import or export movements that involved mid-stream transfer operations, handling costs to or from land modes at a competing port with rail access are applied.

Except as noted within individual worksheets, it is assumed that movements of bulk products (for example, grain or fertilizer) would be handled through elevators or storage facilities. It was also assumed that liquid commodities transferred between modes would require tank storage. Additional costs are incurred at both river and inland locations if shipments remain in storage past the free-time period allocated by the facilities involved. Storage charges are usually assessed on a monthly basis.

6.2.5 Loading and Unloading Costs

Because loading and unloading costs are not usually documented by shippers and receivers, they are particularly difficult to obtain.[7] Moreover, these costs can vary considerably across firms. In an attempt to provide the best possible estimates of these costs, we use available shipper and receiver information in combination with data from Corps studies performed by other researchers, as well as previous RUC and TVA studies. These data are revised to reflect current conditions then averaged as required. In those cases where varying sources produced disparate estimates, we relied on shipper and receiver estimates.

6.2.6 Methodological Standards

The methodological standards described above reflect essentially the same processes TVA and the RUCs have applied in developing transportation rates for other recent (or ongoing) Corps studies. Specifically, the outlined methodology was used in the 1996, 2000, 2003, 2007, and 2010 Ohio River Studies and the 1996 and 2006 Upper Mississippi Navigation Feasibility Study and was applied in the Missouri River Master Manual Review process, the Soo Locks Study and Port Allen Cutoff assessment. Thus, inter-project comparison is facilitated by this uniform approach. More importantly, recent methodological improvements enable TVA/RUCs to produce transportation rate/cost materials which are, simultaneously, more complete and more reliable than the transportation data TVA has produced for similar studies in the past. Each rate study for each District of the USACE is integrated into a series of databases for quick accessibility and data manipulation.

6.3 Transportation Rate-savings

The economic update in this study uses FY 2003 transportation rates (the most current rate data available at the time ORNIM was run for this analysis) with the rate data and the model results indexed to October 2010 (FY 2011) based on more current rate study of ORS traffic by the University of Tennessee, Center for Transportation Research (March 2011).

[7] Loading and unloading costs are often considered a part of through-put or production costs.

Of the 1,589 ORS commodity movements rated in the FY 2003 transportation rate analysis, 635 transited L/Ds 52 and 53 (55.4 million tons) with a tonnage weighted average savings per ton of $14.21. Of the 1,552 ORS commodity movements rated in the FY 2011 transportation rate analysis, 694 transited L/Ds 52 and 53 (57.6 million tons) with a tonnage weighted average savings per ton of $27.46. A FY 2003 to 1 October 2011 transportation rate savings index of 1.9324 was then constructed to update the economic model's estimated FY 2003 transportation surplus (a.k.a. rate-savings) to an 1 October 2011 price level.

7.0 LOCK CAPACITY ANALYSIS

The tools used to describe lock performance and develop tonnage transit relationships used in the economic system models have undergone dramatic change. The 1990 Benefit Update used an analytical (algebraic) model called LOCALC, while the Olmsted Economics Update used the Waterways Analysis Model (WAM), a discrete event simulation model[8]. A detailed description of the lock capacity analysis completed for this report is available in the Capacity Attachment to this update.

7.1 WAM Simulation Results

The Waterway Analysis Model is a vessel-level simulation that processes traffic upon its arrival according to a timing distribution describing process characteristics. Navigable pass, periods in which the wicket dams are lowered and traffic can pass through the project without locking, was treated for both existing projects in the without-project condition and for Olmsted in the with-project condition as a separate process time category, with seasonal navigable pass data specified in the simulation based on historical record.

Fully described tonnage-transit time curves were not required for the analysis; WAM simulation runs were made based on the projects' relevant range of traffic during the period of analysis. Tonnage-transit time curves for each of the lock projects were created by determining the maximum delay at the upper end of the relevant range.

7.1.1 LD52 Tonnage-Transit Time Curves

For LD 52, the traffic escalator was increased to 208 to reach the desired tonnage level (175.3 Mtons), and 5 WAM simulation runs were made, resulting in an average delay of 109 hours. The traffic escalator was increased by 10% to determine the maximum delay at the project. Using an escalation factor of 229, 5 WAM runs were made, resulting in a maximum delay of 129 hours. A full curve, or 1,350 WAM simulation runs, was made with a traffic escalation factor of 116 and max delay of 129 hours to create a tonnage-transit time curve that lies within the relevant range of traffic.

Figure 7 shows the WAM results for LD52 tonnage-transit time curve for the full operation existing condition ("*temporary*" 1200'x110' main chamber and a 600' x 110' auxiliary chamber, working together) with a 62% navigable pass operation. At LD52, there are very high delays at the upper end of the relevant range of traffic and delays are even significant at

[8] The Waterways Analysis Model was certified for use by the HQUSACE Model Certification Panel. The certification memo, dated 15 August 2011, is included as an attachment to this appendix.

the low end of the relevant range. The average delay is 10.9 hours even at the minimum expected demand of 98.5 Mtons in year 2010 and continues to increase at higher tonnages. With its deteriorating condition, LD 52 remains the critical constraint on the Lower Ohio River, even though LD52 is used on average about 40 percent of the year (when navigable pass is not available). Much of this is traced to the poor condition of the main chamber, resulting in significantly higher processing times for the main chamber than at other 1200' chambers in the ORS and the fact that the auxiliary is used only to process the smaller, single cut tows in order to minimize interference with use of the main chamber. The actual points used by ORNIM to represent LD52 full operations tonnage-transit time curve is also shown in Table 7.

Figure 7. LD52 Existing Condition Tonnage-Transit Curve
Full Operations (62% Navigable Pass & Interference)

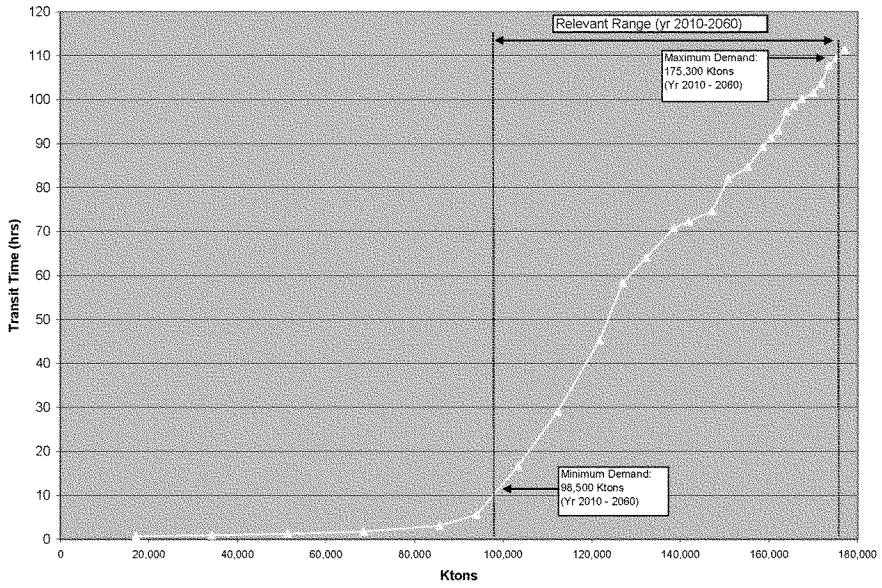


Table 7. LD 52 Existing Condition Tonnage-Transit Points
Full Operations (62% Navigable Pass & Interference)

Point Number	Transit Time	Tonnage
1	0.73	17,065,980
2	0.93	34,195,660
3	1.24	51,315,260
4	1.77	68,478,000
5	3.07	85,653,060
6	5.58	93,981,510
7	16.66	103,375,245
8	29.02	112,259,306
9	45.26	121,740,592
10	58.37	127,002,469
11	64.08	132,316,542
12	70.77	138,552,408
13	72.31	141,974,360
14	74.65	147,157,347
15	82.05	150,807,490
16	84.77	155,247,787
17	89.23	158,603,020
18	91.32	160,449,520
19	93.01	162,122,521
20	97.41	163,961,245
21	98.73	165,614,674
22	100.19	167,444,260
23	101.57	170,026,688
24	103.54	171,748,979
25	107.75	173,513,020
26	109.46	175,215,796
27	111.36	177,107,122

Additional WAM runs were made for LD52 existing condition full operations with navigable pass locking conditions, but without gate interference. The 1990 Benefit Update did not incorporate interference parameters in the capacity estimates.

As shown in Figure 8, the tonnage-transit time curve, excluding interference, has a slightly higher capacity than the curve that incorporated lock interference. That is, for a given tonnage level, tow delays tend to be slightly higher when interference is part of the locks' operating conditions. This occurs as the tonnage levels fall within the relevant range of traffic.

Further analysis was done to determine the impacts of experiencing very low water at LD52. When water levels fall below the required minimum flow for the use of navigable pass, the Corps raises the wickets at LD52 and stops navigable pass operations forcing all traffic through the locks. As shown in Figure 9, if LD52 is in the 100 percent locking mode and there are no interference parameters, as shown in the 1990 Benefit Update, the relevant range lies at or above the projects capacity. Even the lowest expected demand, 98.5 Mtons, has already just about reached the project's full capacity, 98.7 Mtons.

Figure 8. LD52 Existing Condition - Interference vs. No Interference
Full Operations (62% Navigable Pass)

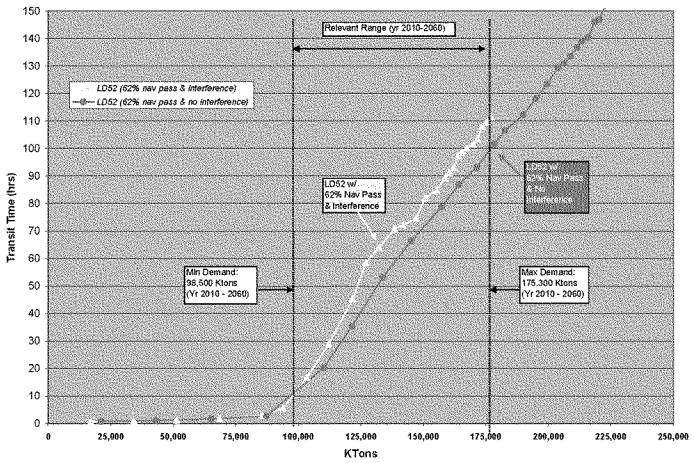
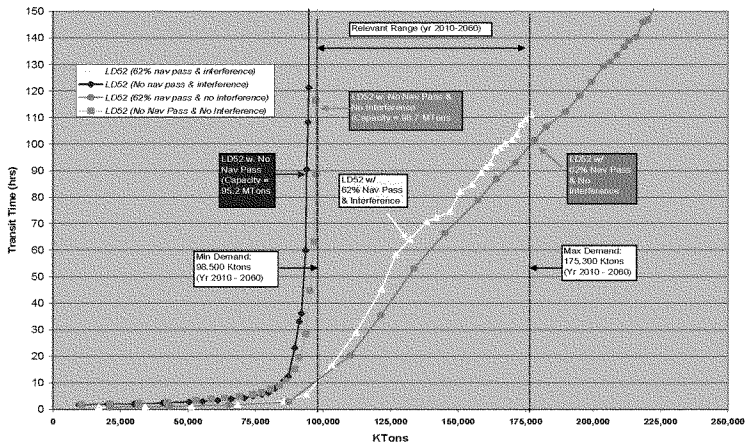


Figure 9. LD52 Existing – Interference Sensitivity
With & without interference vs. No Navigation Pass, Full Operations (62% Navigable Pass)



7.1.2 LD53 Tonnage-Transit Time Curve

Figure 10 shows the tonnage-transit time curve for LD53 under existing conditions. This represents full operations (no major closures) and the use of navigable pass 88% of the time. The actual points used by ORNIM to represent LD53 full operations tonnage-transit time curve is also shown in Table 8.

Figure 10. LD53 Existing Condition Tonnage-Transit Curve
Full Operations (88% Navigable Pass)

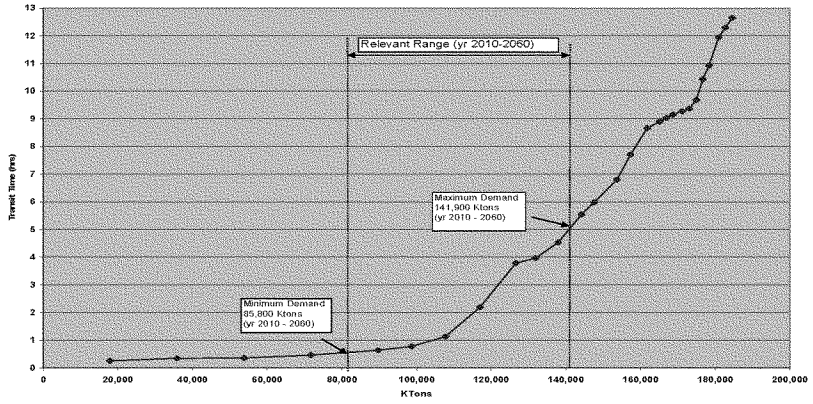


Table 8. LD 53 Existing Condition Tonnage-Transit Points
Full Operations (88% Navigable Pass)

Point Number	Transit Time	Tonnage
1	0.25	17,885,600
2	0.35	35,822,840
3	0.35	53,769,580
4	0.46	71,709,180
5	0.64	89,683,041
6	0.78	98,673,438
7	1.13	107,743,694
8	2.19	117,028,870
9	3.79	126,609,500
10	3.96	131,864,224
11	4.54	137,932,833
12	5.54	144,183,306
13	5.98	147,584,000
14	6.81	153,693,245
15	7.71	157,284,224
16	8.66	161,783,673
17	8.90	165,138,521
18	9.03	166,959,440
19	9.15	168,668,510
20	9.27	171,145,592
21	9.37	173,066,760
22	9.68	174,943,755
23	10.43	176,647,745
24	10.93	178,341,020
25	11.95	180,938,776
26	12.30	182,746,694
27	12.65	184,569,306

7.1.3 Olmsted Tonnage-Transit Time Curve

Figure 11 shows the tonnage-transit time curve for Olmsted LD under existing conditions. This represents full operations (no major closures) and also the use of navigable pass 62% of

the time. The actual points used by ORNIM to represent Olmsted full operations tonnage-transit time curve is also shown in Table 9.

Figure 11. Olmsted Tonnage Transit Curve
Full Operations (62% Navigable Pass)

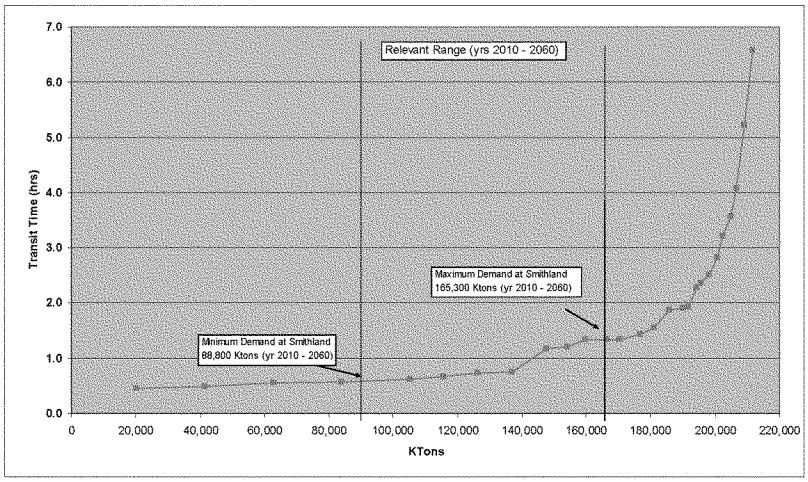


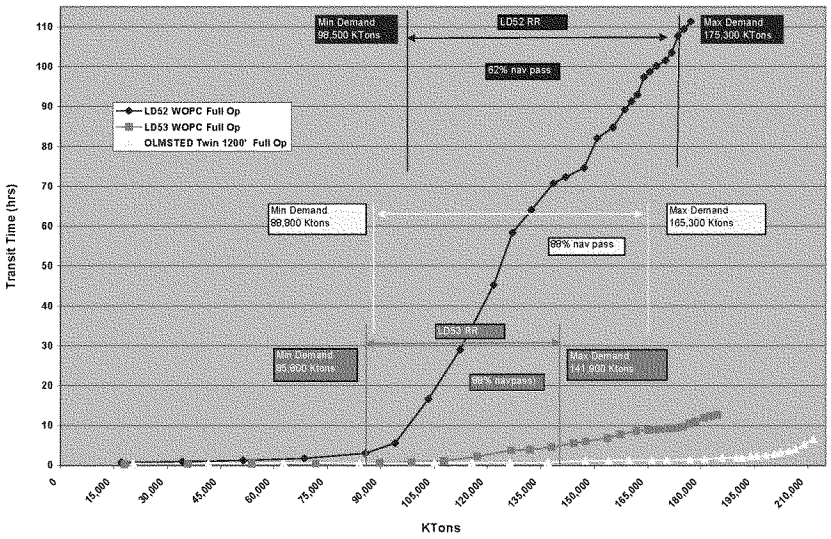
Table 9. Olmsted Tonnage-Transit Points
Full Operations (62% Navigable Pass)

Point Number	Transit Time	Tonnage
1	0.45	20,338
2	0.49	41,527
3	0.55	62,738
4	0.57	83,927
5	0.62	105,109
6	0.67	115,699
7	0.74	126,291
8	0.74	136,930
9	1.18	147,529
10	1.21	154,045
11	1.33	159,745
12	1.33	166,276
13	1.34	170,362
14	1.44	176,897
15	1.55	180,971
16	1.88	185,867
17	1.91	189,945
18	1.92	191,596
19	2.29	194,064
20	2.36	195,709
21	2.52	198,145
22	2.82	200,665
23	3.22	202,303
24	3.58	204,767
25	4.08	206,520
26	5.23	209,003
27	6.57	211,597

7.1.4 Comparison of LD52, LD53, & Olmsted Simulation Results

As shown in Figure 12, LD52 full operations existing condition continues to experience extremely high tow delays, even under normal lock operating conditions, compared to LD 53 full operations existing condition and Olmsted full operations WPC (Twin 1200'x110' locks). Olmsted is to replace both LD52 and LD53, the only two remaining "*low lift*" projects on the Ohio River.

Figure 12. Comparison of LD52, LD53, & Olmsted Tonnage-Transit Curves
Full Operations with Navigable Pass Schedules



7.2 Comparison of 1990 Benefit Update .vs. 2011 Olmsted Economics Update

7.2.1 Traffic Transit-Time Results

Table 10, shows the six operating or lock configuration conditions modeled for the Olmsted Economics Update: the without-project condition for LD 52 and LD 53 (each having a 1200' x 110' main chamber and 600' x 110' auxiliary chamber) with both projects working at full operation with navigable pass/locking conditions. Under normal operations, LD 52 averages 62% navigable pass and 38% locking, while LD 53 averages 88% navigable pass and 12% locking during a year. WAM simulation runs for LD 52 were also run for three other scenarios; 1) the navigable pass without interference, 2) the without navigable pass with interference and 3) the without navigable pass without interference for purpose of comparison with the 1990 Benefit Update. Lastly, the recommended project, twin 1200' chambers working together at full operation, is displayed.

Table 10. Olmsted Economics Update
Project Conditions

Lock Project	Project Condition – Chamber Sizes	% Nav Pass	Interference	Max Demand Expected (Mtons)	Avg Delay (hrs)	Avg Processing Time (min)	Tons Accommodated at Maximum Demand (MTons)
LD 52	Full Op Existing Condition - 1200'x110' (main) & 600'x110' (auxiliary)	62%	Y	175.3	111.0	32.5	177.1
LD 52	Full Op Existing Condition - 1200'x110' (main) & 600'x110' (auxiliary)	62%	N	175.3	101.0	33.2	178.4
LD 52	Full Op Existing Condition - 1200'x110' (main) & 600'x110' (auxiliary)	0%	Y	175.3	194.0	69.1	95.2
LD52	Full Op Existing Condition - 1200'x110' (main) & 600'x110' (auxiliary)	0%	N	175.3	161.0	69.2	98.0
LD 53	Full Op Existing Condition - 1200'x110' (main) & 600'x110' (auxiliary	88%	Y	141.9	5.2	18.0	144.2
Olmsted	With-Project Condition 1200' x 110' (land) & 1200' x 110' (river)	62%	Y	*165.3	0.7	35.9	166.3

**Traffic Forecast for Smithland's Twin 1200'*

75463

123

Direct comparison of the 2011 Olmsted Economics Update results (see Table 10) with the 1990 Benefit Update (see Table 11) is difficult. Firstly, different models were used; The 1990 Benefit Update lock capacities were computed with an analytical model (LOCALC) for tows either locking through the projects or for navigable pass only. The Olmsted Economics Update's tonnage-transit time curves were created using WAM, which has the capability to incorporate navigable pass within an annual simulation. Secondly, Economic Update WAM runs were based on the relevant range of traffic (during the 50 year period of analysis), which generally did not reach levels high enough to reach capacity.[9] Only one project condition was modeled with the WAM where the relevant range of traffic was equivalent to that condition's capacity. That condition was LD52 at full operation with no interference and no navigable pass. This project condition comparison is discussed in the next paragraph.

Table 11. 1990 Olmsted Benefit Update
Lock Capacity and Delay Parameters

1990 Benefit Update Site/Plan	Capacity (Mtons)	Average Processing Time (hours)	Computed Capacity (with nav pass)	Computed Processing Time (with nav pass)
Without-project				
LD 52 Existing, Locks Only	134.2	62.1	313.2	29.9
LD 52, Nav Pass only	422.9	10.2		
LD52, 1200' Chamber Only	74.2	57.0	*	*
LD52, 600' Chamber Only	60.4	70.0	*	*
LD 53 existing, Locks Only	138.9	56.0	362.1	15.7
LD 53, Nav Pass Only	392.5	10.2		
LD53, 1200 Chamber Only	76.8	51.4	*	*
LD53, 600' Chamber Only	62.5	63.1	*	*
With-project				
Olmsted – twin 1200' locks	173	44.5	309.1	23.2
Olmsted -w/Nav Pass	392.5	10.2		
Olmsted Locks – single 1200'	86.5	46.7	*	*

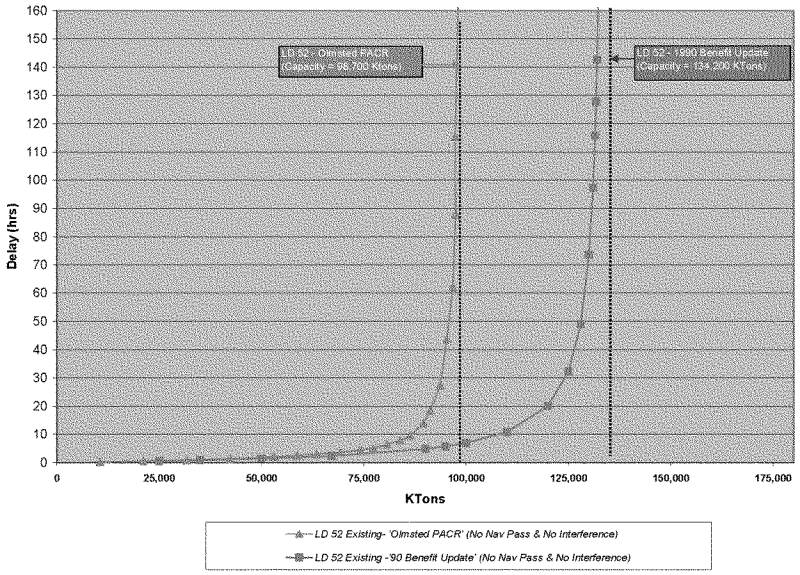
**Capacity Curves not created for long closure events (e.g., 365 day closure of either the main or auxiliary chamber) in this Update.*

[9] Capacity is typically defined as maximum throughput at 200 hours of transit time. Because maximum traffic demands at LD53 do not approach capacity as reported in the 1990 Benefit Update (1990), no capacity estimate is available. The only direct comparison that can be made between lock performance as described in the 1990 Benefit Update and the 2011 Olmsted Economics Update is at LD52's main chamber, where maximum demand does approach the capacity as estimated in the 1990 Benefit Update.

7.2.2 LD52 Full Operations, Existing Condition Without Navigable Pass Operations and Without Interference.

As mentioned above, the 1990 Benefit Update used an analytical (algebraic) model called LOCALC to estimate capacity, while this 2011 Economic Update uses a discrete event simulation model called the Waterways Analysis Model (WAM). Full operation of LD52 without navigable pass was the only project condition where direct comparison can be made between capacity estimates used in the 1990 Benefit Update and this Economic Update. Tonnage-transit curves and capacity estimates used in these two reports for full operation at LD52 - both the 1200' main and 600' auxiliary chamber working together – are shown in Figure 13. The 2011 Economic Update capacity estimate (98.7 million tons) for LD52 is 26% lower than the estimate made in the 1990 Benefit Update (134.2 million tons).

Figure 13. LD52 Existing – 1990 Update vs Olmsted PACR
Full Operations (No Navigable Pass & No Interference)



The difference between the LOCALC model and WAM capacity estimates reflects the continuing physical deterioration of the main chamber at LD52, where processing times have gone from 60.8 minutes in 1990 to 75.4 minutes in 2006 (see Table 12). At LD52 leakage of the coffer wall cells (constructed to temporarily extend the main chamber to 1200' until Olmsted was completed) created some challenging hydraulics for navigation, further complicated by the deterioration of chamber butterfly valves. Both acted to slow processing times. While repairs have been made over the summer of 2007 to the cells and valves, the 2000-2005 processing times serve as a better estimate of long-term performance over the analysis period. These higher main chamber processing times were used in the WAM

capacity simulations made for the Economic Update. It is not surprising that when the current, higher processing times are used, LD52 capacity for the full operation project condition is lower than the capacity estimate used in the 1990 Benefit Update.

Table 12. LD52 Processing Times for Selected Years

	Processing Times (in minutes)				
Description	**1989**	**1990**	**1991**	**2002**	**2006**
Both chambers	62.1	56.5	57.5	71.5	74.3
Main only	67.8	60.8	63.5	72.9	75.4
Aux only	53.7	50.0	50.5	67.6	72.3

Source: US Army Corps of Engineers, Lock Performance Monitoring System

Capacity estimates in the 2011 Economic Update are also lower than the 1990 Benefit Update because the LOCALC analysis assumed unrealistically high auxiliary chamber utilization. Given a better analysis technique (discrete event simulation) and newer understanding of chamber interference effects, the auxiliary chamber is not expected to boost project capacity as much as previously estimated. An analysis of operating policies also demonstrated that limiting the auxiliary chamber to single-cut tows is the best operating policy to maximize project throughput (see Table 13). As a result, at high traffic levels WAM simulations drive the main 1200' chamber to a utilization rate of 100%, with the main chamber processing almost 90 percent of project tonnage. This high level of main chamber utilization coupled with the higher main chamber processing times results in the significantly lower capacity estimates used in the Economic Update.

Table 13. Analysis of Alternative Lockage Policies at LD52

RunID	Tonnage (Mtons)	ProcessTime (Hr)	Delay (Hr)	Transit Time (Hr)
LD52 Allow 1 Cut in Auxiliary, 6U6D	211,955	0.46	151.35	151.81
LD52 Allow 1 Cut in Auxiliary, FIFO	212,242	0.48	232.00	232.48
LD52 Allow 2 Cut in Auxiliary, 6U6D	211,170	0.52	243.22	243.74
LD52 Allow 2 Cut in Auxiliary, FIFO	207,764	0.54	528.58	529.12

**Optimal WOPC Lockage Policy: 1 Cut 6U6D*

8.0 COST AND CLOSURE MATRICES

Louisville District engineering developed cost and closure matrices in order to represent the structural reliability of the lower Ohio projects by indicating the consequences of failure through days a chamber is out of service and the repair costs needed to place the project back into service. The 1990 Benefit Update utilized probability of failure work completed for the 1985 feasibility report in developing near term closure for repair requirements, while the 2011 Olmsted Economics Update closure estimates were based upon engineering judgment informed by condition surveys and assessments. Cost and closure matrices developed in 2007 were updated in 2011 for this revision.

Of particular importance to the system analysis are the days of closure - the more days of closure associated with an alternative, the lower the system transportation benefits. Repair costs are not accounted for in the system analysis, but have a critical influence on the cost side of the overall benefit-cost analysis. Two investment strategies are relevant to the system analysis, namely the without-project condition and the recommended plan (see Section 2.0 for a more detailed discussion).

In general terms the without-project condition in the 1990 Benefit Update addresses structural degradation of these two projects though a major rehabilitation of all four lock chambers in the without condition. These lead to lengthy lock chamber closures at these two lower Ohio projects. Dam failures were not considered in the system analysis.

In the 2011 Olmsted Economics Update the without-project condition is represented by investments necessary to fix components only as they fail and, importantly, this includes the dams at LD52 and LD53. Lock failures cause closures of one or both lock chambers, while dam failures can cause loss of navigation on the lower Ohio for extended periods of time. Both lock chamber and dam failures were incorporated into the 2011 Olmsted Economics Update system analysis, and in its subsequent revision.

In the recommended plan, closure days are greatly diminished in both the 1990 Benefit Update and the Economics Update. Table 14 summarizes the days of closure for the without-project condition and recommended plan and compares them between the 1990 Benefit Update and the 2011 revision of the Olmsted Economics Update. Closures related to dam failure and failures that lead to closure of both chambers account for the significantly higher number of closure days in the Olmsted Economics Update relative to the 1990 Benefit Update.

8.1 Modifications

The original closure cost matrices provided by the engineering team to the economics team needed to be modified to work with the economics spreadsheet. The variation was to convert the "percent of navigation not able to transit the facility annually" into estimated days of closure. The economics team converted the percents to estimated days of closure using the engineering team assumption that 90% of the annual traffic through the locks transited through the main chamber and the remaining 10% utilized the auxiliary chamber. It was agreed upon by both the economics and engineering teams that the following formulas be used to calculate the estimated days closed:

Main Chamber formula

(% of navigation not available to transit annually/ 90% [Main traffic split]) * 365

Auxiliary Chamber formula

(% of navigation not available to transit annually/ 10% [Auxiliary traffic split]) * 365

As seen in Figure 14 the red and the blue highlighted columns show the estimated days of closures for the main and auxiliary chambers, respectively. LD52 is a project where

navigation is served by the navigable pass 60% of the time and the locks 40% of the time, whereas; LD53 is a project where navigation is served by the navigable pass 90% of the time and the locks 10% of the time. As seen in the below example for LD53 the maximum length of chamber closures is 36.5 days (365 days in a year * 10% of the year the locks are utilized). At LD52 the maximum length of chamber closure days is 146 days (365 days in a year * 40% of the time locks are utilized).

Figure 14. Closure Cost Matrices Modification

MAIN CHAMBER MAINTENANCE CLOSURES AND COSTS

	MINOR CLOSURES		MAJOR CLOSURES			
YEAR	Number of Days Closed While Lock is In Use	$26,000 per day	% of Navigation Not Able to Transit Facility Annually	% Adjusted Days	Cost	Component
2013	0	$0	0	0	$0	
2014	0	$0	0	0	$0	
2015	3	$75,000	0	3	$0	
2016	5	$125,000	3	17.3	$10,000,000	Fill/Empty Flume
2017	0	$0	0	0	$0	
2018	0	$0	0	0	$0	
2019	1	$26,000	0	1	$0	
2020	0	$0	9	37	$20,000,000	
2021	3	$75,000	5	28.3	$10,000,000	Lower MG Pintle
2022	0	$0	0	0	$0	
2023	10	$250,000	0	10	$0	
2024	0	$0	9	36.5	$0	
2025	0	$0	4	18.2	$0	Influence due to Dam Construction
2026	1	$25,000	4	18.2	$0	

AUXILIARY CHAMBER MAINTENANCE CLOSURES AND COSTS

	MINOR CLOSURES		MAJOR CLOSURES			
YEAR	Number of Days Closed While Lock is In Use	$26,000 per day	% of Navigation Not Able to Transit Facility Annually	% Adjusted Days	Cost	Component
2013	0	$0	0	0	$0	
2014	0	$0	0	0	$0	
2015	3	$75,000	0	3	$0	
2016	0	$0	0	0	$0	
2017	0	$0	0	0	$0	
2018	5	$125,000	0	5	$0	
2019	0	$0	0	0	$0	
2020	0	$0	0	0	$0	
2021	1	$26,000	0	1	$0	
2022	0	$0	0	0	$0	
2023	5	$125,000	0	5	$0	
2024	1	$26,000	1	36.5	$0	
2025	0	$0	1	36.5	$0	Influence due to Dam Construction
2026	5	$125,000	1	36.5	$0	

Note – The sum of both chambers percents of navigation not available to transit facility annually at LD53 cannot be greater than 10 percent (90% navigable pass – 10% locking).

Table 14 shows a comparison between the 1990 Benefit Update and the 2011 revisions. As can be seen, the reliability of LD 52 and LD 53 has degraded compared to the earlier estimates and the maintenance needs have significantly increased. In this newer analysis, complete river closures are expected. Additionally, the maintenance needs of the new Olmsted project have been reduced slightly. Note that closure day estimates used in the 1990 Benefit Update did not account for navigable pass as did the estimates used in this revision. Locks and Dam 52 estimates from the 1990 Benefit Update were multiplied by 0.4 (Lock usage 40% of the year), and 0.1 for L&D 53, to bring them onto comparable terms with the revised 2008 estimates.

Table 14. Comparison of Closure Days between the 1990 Benefit Update and the 2011 Olmsted Economics Update

Group	Without-Project Condition *				Difference	
	Oct. 1990 Benefit Update		Dec. 2007, rev Nov 2011 Economics Update			
	L&D 52	L&D 53	L&D 52	L&D 53	L&D 52	L&D 53
No Navigation - dam closed & chambers unavail.	0.0	0.0	711.8	511.0	711.8	511.0
No Navigation - both chambers closed & no nav pass	0.0	0.0	390.1	169.9	390.1	169.9
Main Chamber Closed & Aux Open (no nav/open pass)	441.1	113.2	1,791.8	447.8	1,350.7	334.6
Auxiliary Chamber Closed & Main Open (no nav/open pass)	436.4	113.4	776.9	293.6	340.4	180.2
Total Days a Closure Event was Experienced	877.6	226.6	3,670.5	1,422.3	2,793.0	1,195.7
Average % of Year with No Navigation	0.0%	0.0%	6.0%	3.7%	6.0%	3.7%
Average % of Year with Main Chamber Closure	2.4%	0.6%	9.8%	2.5%	7.4%	1.8%
Average % of Year with Aux Chamber Closure	2.4%	0.6%	4.3%	1.6%	1.9%	1.0%

Group	With Project Condition *		Difference
	Oct. 1990 Benefit Update Olmsted	Dec. 2007, rev Nov 2011 Economics Update Olmsted	Olmsted
No Navigation - dam closed & chambers unavail.	0.0	0.0	0.0
No Navigation - both chambers closed & no nav pass	0.0	0.0	0.0
Main Chamber Closed & Aux Open (no nav/open pass)	144.0	291.0	147.0
Auxiliary Chamber Closed & Main Open (no nav/open pass)	144.0	294.0	150.0
Total Days a Closure Event was Experienced	288.0	585.0	297.0
Average % of Year with No Navigation	0.0%	0.0%	0.0%
Average % of Year with Main Chamber Closure	0.8%	1.6%	0.8%
Average % of Year with Aux Chamber Closure	0.8%	1.6%	0.8%

** 1990 Benefit Update period of analysis 2006-2055 and Economics Update period of analysis 2016-2065. Note that the newer data also contains without and with-project differences pre-online (construction period). In the Nov 2011 revisions the period of analysis was shifted to 2020-2069.*

9.0 RESULTS OF ECONOMIC ANALYSIS

Project benefits for the 2011 Olmsted Economics Update were re-evaluated with the Corps Ohio River Navigation Investment Model (ORNIM), the Waterways Analysis Model (WAM), and an enhanced version of the spreadsheet method used in the 1990 Benefit Update.

Lock service disruption in both the without and with-project conditions was handled through a spreadsheet method which consists of several sections. Since the workbook is too large to display in its entirety, each section will be displayed and described separately below.

9.1 General Information Section

This section contains information used to conduct the discounting process, apportion the rate-savings between each chamber of a project, and update ORNIM rate-savings from FY 2003 price levels to current 1 Oct 2011 price levels.

The Discount Rate is the current applicable rate (4.0%) used by the Corps for project formulation and evaluation (Chief Economist, USACE email dated 11 October 2011. EGM is expected).

The ORNIM model calculates system rate-savings for the entire system and for each lock in the system, but not for each chamber of a lock. The percent capacity provided by each chamber is used to apportion the lock rate-savings to each chamber. This is used when one chamber of a lock is unavailable. These percentages were derived from the traffic-transit time analysis conducted for the 2011 Olmsted Economics Update.

Online Year and Analysis Year values are used for present value and annualized costs and system rate-savings calculations. The analysis period begins in 2013 and extends 50 years past Olmsted's anticipated on-line date of 2020, hence there are 57 years in the analysis.

The transportation rate-savings used in ORNIM were at FY 2003 price levels. A Savings Update Index is used to convert the FY 2003 price level model results to a 1 October 2011 price level.

9.2 Analysis Years and Discount Factor Section

This section displays each year in the period of analysis, the associated "n" value used for discounting, and the applicable discount factor. End of year discounting was used in the calculations of "n". Table 15 shows the first few years of this section. Note the "n" value is negative prior to Olmsted's projected on-line year and positive thereafter.

Table 15. Analysis Year and 4.0% Discount Factor

Year	"n"	EOY Discount Factor
2009	-10	1.480
2010	-9	1.423
2011	-8	1.369
2012	-7	1.316
2013	-6	1.265
2014	-5	1.217
2015	-4	1.170
2016	-3	1.125
2017	-2	1.082
2018	-1	1.040
2019	0	1.000
2020	1	0.962
2021	2	0.925
2022	3	0.889
2023	4	0.855
2024	5	0.822
2025	6	0.790

9.3 Transportation Rate-savings Section

This section contains the transportation rate-savings for the entire Ohio River System and those realized by the movements that travel through LD52 and LD53. These values are determined by the ORNIM model for the years 2013 through 2069 and represent the transportation rate-savings expected when the system is "Fully Operational". A Fully Operational system is defined as one in which there are no chamber closures longer than one day. Table 16 shows the first few years of this section. As previously stated, the original update (ORNIM runs) used FY 2003 price level transportation rates. For the 2007 version of this Olmsted Economics Update, the rates were indexed to a FY 2007 price level. For this 2011 Economic Update, the FY 2003 price level model results (rate-savings) were indexed to 1 October 2011 price level using the Savings Update Index**Error! Reference source not found.**. Note "Year" is not part of this section but is shown for informational purposes.

Table 16. Transportation Rate-savings

			FY03 Savings			Indexed to 1 October 2011 Savings		
Year	"n"	EOY Discount Factor	Full Op Total System Savings	Full Op L&D 52 System Savings	Full Op L&D 53 System Savings	Full Op Total System Savings	Full Op L&D 52 System Savings	Full Op L&D 53 System Savings
2009	-10	1.480	$ 1,866,842,515	$ 1,219,667,172	$ 1,224,970,411	$ 3,607,486,477	$ 2,356,884,844	$ 2,367,132,823
2010	-9	1.423	$ 1,865,704,493	$ 1,227,630,391	$ 1,230,787,504	$ 3,605,287,363	$ 2,372,272,967	$ 2,378,373,773
2011	-8	1.369	$ 1,885,921,431	$ 1,237,024,506	$ 1,240,111,044	$ 3,644,354,574	$ 2,390,426,155	$ 2,396,390,582
2012	-7	1.316	$ 1,897,378,640	$ 1,240,850,390	$ 1,243,909,782	$ 3,666,494,484	$ 2,397,819,294	$ 2,403,731,262
2013	-6	1.265	$ 1,909,850,530	$ 1,246,006,813	$ 1,249,027,806	$ 3,690,595,164	$ 2,407,783,565	$ 2,413,621,331
2014	-5	1.217	$ 1,917,931,315	$ 1,248,318,890	$ 1,251,337,390	$ 3,706,210,472	$ 2,412,251,423	$ 2,418,084,373
2015	-4	1.170	$ 1,929,472,850	$ 1,252,251,775	$ 1,255,249,865	$ 3,728,513,335	$ 2,419,851,330	$ 2,425,644,839
2016	-3	1.125	$ 1,956,958,016	$ 1,262,902,970	$ 1,265,394,828	$ 3,781,625,671	$ 2,440,433,699	$ 2,445,248,966
2017	-2	1.082	$ 1,992,065,060	$ 1,278,714,604	$ 1,280,618,223	$ 3,849,466,522	$ 2,470,988,101	$ 2,474,666,654
2018	-1	1.040	$ 2,017,144,363	$ 1,287,199,478	$ 1,288,648,143	$ 3,897,929,766	$ 2,487,384,271	$ 2,490,183,671
2019	0	1.000	$ 2,053,221,997	$ 1,302,264,714	$ 1,303,159,354	$ 3,967,646,186	$ 2,516,496,332	$ 2,518,225,135
2020	1	0.962	$ 2,085,594,691	$ 1,316,910,318	$ 1,317,226,172	$ 4,030,203,181	$ 2,544,797,499	$ 2,545,407,855
2021	2	0.925	$ 2,096,576,451	$ 1,326,507,923	$ 1,326,886,100	$ 4,051,424,334	$ 2,563,343,911	$ 2,564,074,700
2022	3	0.889	$ 2,107,362,832	$ 1,333,851,588	$ 1,334,387,345	$ 4,072,267,937	$ 2,577,534,808	$ 2,578,570,105
2023	4	0.855	$ 2,128,267,802	$ 1,344,783,934	$ 1,345,437,026	$ 4,112,664,700	$ 2,598,660,474	$ 2,599,922,509
2024	5	0.822	$ 2,138,935,939	$ 1,351,663,574	$ 1,352,483,501	$ 4,133,279,808	$ 2,611,954,691	$ 2,613,539,116

9.4 Cost-Closures Section

The spreadsheet contains two Cost Closure sections, one for LD52, the other for LD53. These sections were created by Engineering Division personnel and reflect their estimate of failure or maintenance related closure durations for both chambers and the dam for the period of analysis. In addition to closure durations, these sections also contain the estimated repair or construction cost. It should be noted that these cost-closure estimates are different for each of the three alternatives considered in this Olmsted Economics Update. Table 17 shows the first few years of the cost-closure section for LD52 for the fix-as-fails alternative. Table 18 shows the first few years for LD53 fix-as-fails. Again, the "Year" column is not part of these sections but is shown for information purposes.

Table 17. Cost-Closure Section for LD52, Fix-as-Fails Alternative

LD52								
Year	Days Dam Closed	Dam Repair Cost	Days Both Locks Closed	Both Locks Repair Cost	Days Main Cham Closed	Main Cham Repair Cost	Days Aux Cham Closed	Aux Cham Repair Cost
2013	0	$ -	0	$ -	0	$ -	0	$ -
2014	0	$ -	0	$ -	0	$ -	0	$ -
2015	0	$ -	0	$ -	3	$ 75,000	1	$ 25,000
2016	0	$ -	0	$ -	146	$ 12,000,000	0	$ -
2017	0	$ -	0	$ -	0	$ -	5	$ 125,000
2018	0	$ -	0	$ -	5	$ 125,000	0	$ -
2019	0	$ -	0	$ -	0	$ -	0	$ -
2020	0	$ -	0	$ -	10	$ 250,000	0	$ -
2021	109.5	$ 50,000,000	146	$ -	0	$ 25,000	0	$ 75,000
2022	109.5	$ 50,000,000	0	$ -	73	$ -	73	$ -
2023	54.75	$ 50,000,000	0	$ -	73	$ -	73	$ -
2024	0	$ -	1	$ 25,000	145	$ 5,000,000	0	$ -
2025	0	$ -	0	$ -	146	$ 5,000,000	0	$ -
2026	0	$ -	0	$ -	0	$ -	0	$ -
2027	0	$ -	0	$ -	0	$ -	10	$ 250,000

Table 18. Cost-Closure Section for LD53, Fix-as-Fails Alternative

LD53								
Year	Days Dam Closed	Dam Repair Cost	Days Both Locks Closed	Both Locks Repair Cost	Days Main Cham Closed	Main Cham Repair Cost	Days Aux Cham Closed	Aux Cham Repair Cost
2013	0	$ -	0	$ -	0	$ -	0	$ -
2014	0	$ -	0	$ -	0	$ -	0	$ -
2015	18.25	$ 10,000,000	0	$ -	3	$ 75,000	3	$ 75,000
2016	18.25	$ 10,000,000	0	$ -	12.17	$ 10,125,000	0	$ -
2017	18.25	$ 10,000,000	0	$ -	0	$ -	0	$ -
2018	0	$ -	0	$ -	0	$ -	5	$ 125,000
2019	0	$ -	0	$ -	1	$ 25,000	0	$ -
2020	0	$ -	0	$ -	36.5	$ 20,000,000	0	$ -
2021	0	$ -	0	$ -	20.28	$ 10,075,000	1	$ 25,000
2022	0	$ -	0	$ -	0	$ -	0	$ -
2023	0	$ -	0	$ -	10	$ 250,000	5	$ 125,000
2024	127.75	$ 50,000,000	36.5	$ -	0	$ -	0	$ 25,000
2025	127.75	$ 50,000,000	16.22	$ -	0	$ -	20.28	$ -
2026	127.75	$ 50,000,000	16.22	$ -	0	$ 25,000	20.28	$ 125,000
2027	0	$ -	0	$ -	36.5	$ 5,000,000	0	$ -

9.5 Total Costs

This section summarizes repair and construction costs by lock. Costs are simply summed and displayed by year for each lock. These costs are different for each Alternative considered in this Olmsted Economics Update. Table 19 shows an abbreviated list of repair costs for one of the alternatives.

Table 19. Total Repair Construction Cost

Year	LD52 Total Repair Cost	LD53 Total Repair Cost
2013	$ -	$ -
2014	$ -	$ -
2015	$ 100,000	$ 10,150,000
2016	$ 12,000,000	$ 20,125,000
2017	$ 125,000	$ 10,000,000
2018	$ 125,000	$ 125,000
2019	$ -	$ 25,000
2020	$ 250,000	$ 20,000,000
2021	$ 50,100,000	$ 10,100,000
2022	$ 50,000,000	$ -
2023	$ 50,000,000	$ 375,000
2024	$ 5,025,000	$ 50,025,000
2025	$ 5,000,000	$ 50,000,000
2026	$ -	$ 50,150,000
2027	$ 250,000	$ 5,000,000

9.6 Adjusted Rate-savings

This section combines the full operations rate-savings described in section "Example Annual Transportation Rate-savings" with the closure durations found in section "Cost-Closures".

This section will describe, using the year 2021 closures from the Fix-as-Fails closure matrix listed in Table 17 and Table 18 as an example, how the spreadsheet adjusts the full operations system savings when closures occur. LD52 is a project where navigation is served by the navigable pass 60% of the year and by the locks 40% of the year. LD53 is a project where navigation is served by the navigable pass 90% of the year and by the locks 10% of the year. In 2021 at LD52 the dam is closed 109.5 days, the main chamber is out 146 days and the auxiliary chamber is also out 146 days. The 146 days of closure of the lock chambers represents the locks being closed the entire year (365 days in a year * 40% of year locks used = 146 days available for navigation thru the locks). The 109.5 days of closure of the dam represents the locks being closed for half of the navigable pass year (365 days in a year * 60% of year navigable pass = 219 days available for navigable pass navigation over the dam). In 2021 at LD53 the dam is not closed, the main chamber is out 20.3 days and the auxiliary chamber is also out 1 day. The 20.3 days of closure of the main lock chamber represents the lock being closed for about 56% of the year (365 days in a year * 10% of year lock used = 36.5 days available for navigation thru the main lock). The 1 day of closure of the auxiliary lock chamber represents the lock being closed for about 3% of the year.

At LD52 the dam closure of 109.5 days decreases the system savings by $769,003,173 [(109.5 days/365 days available) * $2,563,343,911 (LD52 full operations savings)]. The 146 day closure of the main adjusts the system savings by $850,004,841 [((146 days * percent of lock capacity provided by LD52's main chamber)/365) * $2,563,343,911 (LD52 full operations savings)]. The 146 day closure of the auxiliary adjusts the system savings by $176,332,724 [((146 days * percent of lock capacity provided by LD52's auxiliary chamber)/365) * $2,563,343,911 (LD52 full operations savings)].

At LD53 the dam is not closed, so no adjustment is needed. The 20.3 day closure (rounded from 20.2777778) of the main adjusts the system savings by $121,604,799 [((20.2777778 days * percent of lock capacity provided by LD53's main chamber)/365) * $2,564,074,700 (LD53 full operations savings)]. The 1 day closure of the auxiliary adjusts the system savings by $1,011,580 [((1 days * percent of lock capacity provided by LD53's auxiliary chamber)/365) * $2,564,074,700 (LD53 full operations savings)].

Table 20 displays the adjustments to the system savings in 2021 by dam and lock chamber. Table 21 shows the resultant string of Total Rate-savings.[10]

Table 20. System Savings Adjustment Calculations for year 2021

LD52	
Dam 109.5 Days Closed Savings Adjustment	$ 769,003,173
Main Chamber 146.0 Days Closed Savings Adjustment	$ 850,004,841
Aux. Chamber 146.0 Days Closed Savings Adjustment	$ 175,332,724
	$ 1,794,340,738
LD53	
Dam 0 Days Closed Savings Adjustment	$ -
Main Chamber 20.3 Days Closed Savings Adjustment	$ 121,935,997
Aux. Chamber 1.0 Days Closed Savings Adjustment	$ 1,011,580
	$ 122,947,577.00
System Savings (Full Operations)	$ 4,051,424,334
Less Savings Adjustments Due to Closures at LD52 & LD53	$ 1,917,288,315
Adjusted Year 2021 System Savings	$ 2,134,136,019

Table 21. Example Rate-savings with Failures

	Indexed to FY11 Savings			
Year	Full Op Total System Savings	Full Op L&D 52 System Savings	Full Op L&D 53 System Savings	Adjusted System Savings
2013	$ 3,690,595,164	$ 2,407,783,565	$ 2,413,621,331	$ 3,690,595,164
2014	$ 3,706,210,472	$ 2,412,251,423	$ 2,418,084,373	$ 3,706,210,472
2015	$ 3,728,513,335	$ 2,419,851,330	$ 2,425,644,839	$ 3,569,672,464
2016	$ 3,781,625,671	$ 2,440,433,699	$ 2,445,248,966	$ 2,780,344,304
2017	$ 3,849,466,522	$ 2,470,988,101	$ 2,474,666,654	$ 3,719,944,984
2018	$ 3,897,929,766	$ 2,487,384,271	$ 2,490,183,671	$ 3,864,770,478
2019	$ 3,967,646,186	$ 2,516,496,332	$ 2,518,225,135	$ 3,961,740,431
2020	$ 4,030,203,181	$ 2,544,797,499	$ 2,545,407,855	$ 3,754,517,991
2021	$ 4,051,424,334	$ 2,563,343,911	$ 2,564,074,700	$ 2,134,136,019
2022	$ 4,072,267,937	$ 2,577,534,808	$ 2,578,570,105	$ 2,783,500,533
2023	$ 4,112,664,700	$ 2,598,660,474	$ 2,599,922,509	$ 3,137,031,395
2024	$ 4,133,279,808	$ 2,611,954,691	$ 2,613,539,116	$ 2,089,839,347

[10] In 2005 82.7 percent of LD52 traffic went through LD53 and 97.5 percent of LD53 traffic went through LD52.

The tables above indicate a closure of the locks at LD52 in 2021 reduces total system rate-savings from $4,051,424,334 to $2,134,136,019, a reduction of $1,917,288,315. The adjustment calculation is robust enough to account for closures of any duration at one or both sites, at either the dam or locks, or of only one of the two lock chambers. Figure 15 and Figure 16 shows the adjusted system savings and system tonnage comparisons between the WOPC (Fix-as-Fails) and the WPC (Finish Olmsted).

Figure 15. Adjusted System Savings Compare

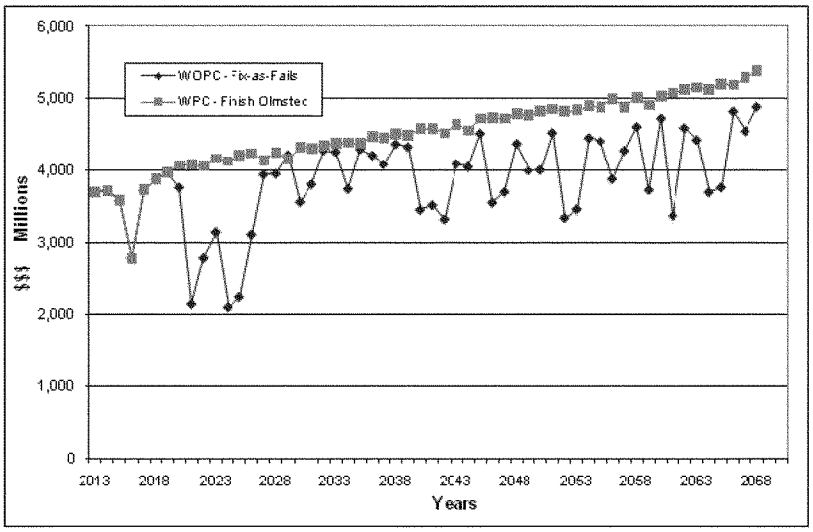
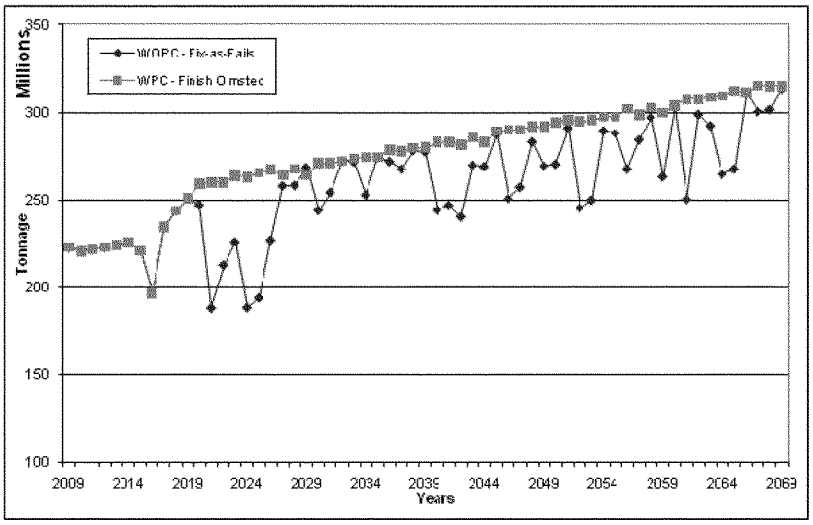


Figure 16. Adjusted System Tonnage



The streams of adjusted savings by year were extracted from the above mentioned spreadsheet and input into separate spreadsheet to complete the financial analysis of the plans. This spreadsheet completed the discounting and the various display Tables for Section 9 - Financial Analysis.

10.0 FINANCIAL ANALYSIS

The benefit streams last reported to Congress are from the Olmsted Locks and Dam (Replacement of Locks and Dams 52 and 52) Benefit Update, dated October 1990. The October 1990 Update benefits and costs were at a 1 October 1990 price level and assumed a 15-year construction and a 2006 - 2055 project analysis period amortized at a Federal Discount Rate of 8.875%. The updated benefits for this PAC Report is at a 1 October 2011 price level and as a result of the 14-year construction schedule extension, the analysis assumes a 36-year construction and a 2020 - 2069 project analysis period. This re-analysis is also amortized at the current FY 2012 Federal Discount Rate of 4.0%. A comparison of the analysis assumptions between the benefit estimates are summarized in Table 22. In addition, the updated benefits in this analysis were amortized at an OMB analysis rate of 7.0% and at the last approved report rate of 8.875% (for comparison).

Table 22. Benefit Analysis Assumptions

	Benefit Update Oct. 1990	Economics Update Dec. 2007, rev Nov 2011
Study Period (GI $)	1986 - 1990	1986 - 1990
Construction Period (CG $)	1991 - 2006	1991 - 2024
Construction Duration	16-years	34-years
Project Analysis Period	2006 - 2055	2020 - 2069
Price Level	1 Oct. 1990	1 Oct. 2011
Federal Discount Rate	8.875%	4.0%

The primary benefits from a replacement project comes from waterway transportation savings, however, additional savings occur from without-project condition costs foregone. Both benefit categories were estimated in the last approved report and in this reanalysis. Comparisons are discussed in the following sections.

10.1 Transportation Rate-savings Benefits

Waterway transportation savings are specifically calculated as the rate-savings for the accommodated waterway traffic. Rate-savings are measured as the difference between the equilibrium waterway rate and a movement's least-costly all-overland mode rate. While the equilibrium waterway rate tends to increase through time as congestion increases on the waterway system (assuming here that the forecasted waterway demands increase through time) while the least-costly all-overland mode rates are assumed constant. Assuming the least-costly all-overland mode rates as constant is a conservative simplifying assumption assumed in estimating the water transportation savings in the original authorizing document, the last approved report and in the current re-analysis update. A comparison of the transportation rate-savings benefit streams between the last approved report and the current re-analysis update are shown in Table 23 and Figure 17. Also a comparison of both cost streams at the OMB 7% rate can be found in Table 24. In addition to the 10-year slippage of the project analysis period, there are also significant differences in the transportation saving levels and patterns as shown in Figure 17.

Looking at the base normal operations with-project condition incremental rate-savings, the re-analysis estimates are higher with the price level difference (current estimates are at a 1 October 2011 price level while the 1990 Benefit Update are at a 1 October 1990 price level), however when these differences in price level are accounted for, incremental rate savings in real terms have in fact decreased. The primary driver of this lower normal operation transportation savings estimate are lower traffic demand forecasts, which more than off-sets the lower without-project condition capacity estimates assumed in the current analysis which would tend to increase incremental with-project benefits.

The next observable pattern in the benefit estimates is that closures are much more severe. This affect occurs because of significant increases, and lumpiness, of the closures in the Louisville District engineering Cost-Closure Matrices. A significant component of the increase in severity and lumpiness of closures, is the inclusion of complete river closure

situations in the Cost-Closure Matrices, as summarized in Table 14, which were not included in the 1990 Benefit Update. This increase in closure severity can be seen by comparison of the benefit streams in Table 23 and in left-hand panel of Figure 17. This figure shows the benefit stream from the last approved report, and that estimated for this revision of the Economic Update. In the figure, these two benefit streams are displayed at their original analysis year price levels (Oct 2009 and Oct 2011, respectively). The right-hand panel illustrates the effect of discounting on the benefits streams, with the 1990 Benefit Update benefits discounted at 8.875% discount rate, and the Economic Update benefits discounted at the FY 2012 4.0% discount rate. The average annual transportation rate-savings benefit for the current re-analysis update, at a 4.0% discount rate is 44.8% higher, at the original respective price levels, than the last approved report at its 8.875% discount rate. When both are discounted at the FY 2012 discount rate of 4.0%, re-analysis benefits are 52.1% higher than in the last approved report.

Table 23. Transportation Rate-savings Benefits Comparisons

	Transportation Benefits (Incremental Transportation Rate Savings)		Present Worth Factors		Present Worth	
	Benefit Update Oct. 1990	Economics Update Dec. 2007, rev Nov 2011	Benefit Update	Economics Update	Benefit Update	Economics Update
Year	(1 Oct. 1990 price level)	(1 Oct. 2011 price level)	8.875%	4.000%	8.875%	4.000%
2006	$412,167,036		0.9185		$ 378,569,034	
2007	$426,333,535		0.8436		$ 359,660,844	
2008	$413,951,792		0.7748		$ 320,748,965	
2009	$434,030,294		0.7117		$ 308,892,506	
2010	$894,497,284		0.6537		$ 584,706,856	
2011	$907,994,499		0.6004		$ 545,147,732	
2012	$707,767,211		0.5514		$ 390,295,247	
2013	$720,706,691		0.5065		$ 365,033,909	
2014	$436,930,523		0.4652		$ 203,263,253	
2015	$801,801,531		0.4273		$ 342,598,298	
2016	$740,673,646		0.3925		$ 290,681,267	
2017	$497,946,861		0.3605		$ 179,491,953	
2018	$581,049,551		0.3311		$ 192,374,270	
2019	$423,321,760		0.3041		$ 128,728,954	
2020	$426,445,082	$308,323,785	0.2793	0.9615	$ 119,107,906	$ 296,465,178
2021	$429,791,500	$1,935,031,716	0.2565	0.9246	$ 110,257,244	$ 1,789,045,595
2022	$535,761,374	$1,266,202,949	0.2356	0.8890	$ 126,238,709	$ 1,125,649,811
2023	$436,930,523	$1,020,631,781	0.2164	0.8548	$ 94,559,542	$ 872,440,324
2024	$508,432,301	$2,033,019,663	0.1988	0.8219	$ 101,064,339	$ 1,670,993,969
2025	$445,185,018	$1,973,693,466	0.1826	0.7903	$ 81,278,781	$ 1,559,838,616
2026	$351,485,340	$1,127,476,806	0.1677	0.7599	$ 58,940,754	$ 856,789,709
2027	$419,417,607	$199,647,609	0.1540	0.7307	$ 64,599,173	$ 145,880,552
2028	$402,573,974	$298,722,279	0.1415	0.7026	$ 56,950,538	$ 209,878,311
2029	$428,229,838	($62,054,691)	0.1299	0.6756	$ 55,641,764	$ (41,921,926)
2030	$373,794,787	$766,740,604	0.1193	0.6496	$ 44,609,673	$ 498,060,076
2031	$290,915,191	$503,257,660	0.1096	0.6246	$ 31,888,496	$ 314,333,250
2032	$397,554,348	$62,883,984	0.1007	0.6006	$ 40,025,427	$ 37,766,491
2033	$333,526,235	$116,489,436	0.0925	0.5775	$ 30,841,912	$ 67,269,747
2034	$401,235,407	$646,150,106	0.0849	0.5553	$ 34,078,650	$ 358,784,217
2035	$310,882,146	$78,221,768	0.0780	0.5339	$ 24,252,178	$ 41,763,241
2036	$265,817,063	$263,877,994	0.0717	0.5134	$ 19,046,257	$ 135,467,902
2037	$483,891,909	$365,193,239	0.0658	0.4936	$ 31,845,420	$ 180,269,652
2038	$354,274,021	$142,535,568	0.0604	0.4746	$ 21,414,590	$ 67,653,428
2039	$479,206,925	$162,917,548	0.0555	0.4564	$ 26,605,129	$ 74,353,442
2040	$383,164,755	$1,126,688,864	0.0510	0.4388	$ 19,538,880	$ 494,428,933
2041	$397,554,348	$1,070,693,709	0.0468	0.4220	$ 18,620,119	$ 451,784,978
2042	$599,231,751	$1,194,192,053	0.0430	0.4057	$ 25,778,201	$ 484,515,163
2043	$426,556,630	$552,152,493	0.0395	0.3901	$ 16,854,129	$ 215,406,545
2044	$532,972,693	$504,246,080	0.0363	0.3751	$ 19,342,224	$ 189,151,177
2045	$455,447,364	$204,040,991	0.0333	0.3607	$ 15,181,388	$ 73,595,389
2046	$407,035,863	$1,176,682,386	0.0306	0.3468	$ 12,461,714	$ 408,092,949
2047	$489,803,912	$1,018,107,028	0.0281	0.3335	$ 13,773,338	$ 339,515,757
2048	$498,839,238	$408,622,620	0.0258	0.3207	$ 12,883,960	$ 131,025,421
2049	$532,861,145	$769,540,550	0.0237	0.3083	$ 12,640,803	$ 237,263,717
2050	$527,729,973	$815,749,098	0.0218	0.2965	$ 11,498,580	$ 241,837,188
2051	$472,514,091	$328,637,249	0.0200	0.2851	$ 9,456,252	$ 93,680,657
2052	$578,595,512	$1,477,877,327	0.0184	0.2741	$ 10,635,335	$ 405,077,564
2053	$571,121,847	$1,377,429,372	0.0169	0.2636	$ 9,642,213	$ 363,024,389
2054	$630,688,071	$440,395,252	0.0155	0.2534	$ 9,779,899	$ 111,602,970
2055	$600,012,581	$475,037,821	0.0142	0.2437	$ 8,545,785	$ 115,751,859
2056		$1,114,906,116		0.2343		$ 261,218,989
2057		$601,641,328		0.2253		$ 135,541,026
2058		$405,745,803		0.2166		$ 87,892,902
2059		$1,180,596,757		0.2083		$ 245,905,371
2060		$304,981,202		0.2003		$ 61,081,003
2061		$1,700,390,234		0.1926		$ 327,452,531
2062		$527,131,283		0.1852		$ 97,607,952
2063		$724,888,687		0.1780		$ 129,063,784
2064		$1,426,025,358		0.1712		$ 244,133,277
2065		$1,431,240,722		0.1646		$ 235,602,056
2066		$362,924,129		0.1583		$ 57,444,559
2067		$734,420,061		0.1522		$ 111,774,888
2068		$716,733,654		0.1463		$ 104,887,606
2069		$398,292,088		0.1407		$ 56,044,721
			TOTAL PRESENT WORTH:		$ 5,990,072,390	$ 16,772,186,906
			AVERAGE ANNUAL EQUIVALENT:		$ 539,300,000	$ 780,748,662

Table 24. Transportation Rate-savings Benefits Comparisons
(1 Oct 2011 price level and at OMB 7% discount rate)

	Transportation Benefits (Incremental Transportation Rate Savings)		Present Worth Factors OMB 7.0% Discount Rate		Present Worth	
	Benefit Update Oct. 1990	Economics Update Dec. 2007, rev Nov 2011	Benefit	Economics	Benefit	Economics
Year	(1 Oct. 2011 price level)	(1 Oct. 2011 price level)	Update	Update	Update	Update
2006	$714,409,124		0.9346		$ 667,672,078	
2007	$738,963,917		0.8734		$ 645,439,704	
2008	$717,502,641		0.8163		$ 585,695,883	
2009	$752,304,709		0.7629		$ 573,929,661	
2010	$1,550,432,142		0.7130		$ 1,105,436,690	
2011	$1,573,826,866		0.6663		$ 1,048,707,294	
2012	$1,226,772,907		0.6227		$ 763,972,511	
2013	$1,249,200,907		0.5820		$ 727,046,301	
2014	$757,331,675		0.5439		$ 411,938,252	
2015	$1,389,762,594		0.5083		$ 706,484,831	
2016	$1,283,809,630		0.4751		$ 609,928,707	
2017	$863,091,293		0.4440		$ 383,222,856	
2018	$1,007,133,187		0.4150		$ 417,924,467	
2019	$733,743,606		0.3878		$ 284,558,421	
2020	$739,157,261	$308,323,785	0.3624	0.9346	$ 267,904,607	$ 288,153,070
2021	$744,957,606	$1,935,031,716	0.3387	0.8734	$ 252,342,915	$ 1,690,131,641
2022	$928,635,189	$1,266,202,949	0.3166	0.8163	$ 293,982,119	$ 1,033,598,779
2023	$757,331,675	$1,020,631,781	0.2959	0.7629	$ 224,067,115	$ 778,635,099
2024	$881,285,707	$2,033,019,663	0.2765	0.7130	$ 243,677,312	$ 1,449,514,922
2025	$771,639,192	$1,973,693,466	0.2584	0.6663	$ 199,406,230	$ 1,315,155,294
2026	$609,229,540	$1,127,476,806	0.2415	0.6227	$ 147,136,907	$ 702,135,890
2027	$726,976,538	$199,647,609	0.2257	0.5820	$ 164,088,175	$ 116,196,726
2028	$697,781,469	$298,722,279	0.2109	0.5439	$ 147,194,826	$ 162,485,127
2029	$742,250,779	($62,054,691)	0.1971	0.5083	$ 146,332,232	$ (31,545,458)
2030	$647,898,505	$766,740,604	0.1842	0.4751	$ 119,374,767	$ 364,272,937
2031	$504,243,301	$503,257,660	0.1722	0.4440	$ 86,828,424	$ 223,452,420
2032	$689,080,952	$62,883,984	0.1609	0.4150	$ 110,894,051	$ 26,094,618
2033	$578,101,023	$116,489,436	0.1504	0.3878	$ 86,947,673	$ 45,176,612
2034	$695,461,331	$646,150,106	0.1406	0.3624	$ 97,756,003	$ 234,194,534
2035	$538,852,024	$78,221,768	0.1314	0.3387	$ 70,787,437	$ 26,496,419
2036	$460,740,715	$263,877,994	0.1228	0.3166	$ 56,566,523	$ 83,537,015
2037	$838,729,846	$365,193,239	0.1147	0.2959	$ 96,236,808	$ 108,047,502
2038	$614,063,160	$142,535,568	0.1072	0.2765	$ 65,848,878	$ 39,412,272
2039	$830,609,363	$162,917,548	0.1002	0.2584	$ 83,243,126	$ 42,100,990
2040	$664,139,470	$1,126,688,864	0.0937	0.2415	$ 62,205,255	$ 272,110,105
2041	$689,080,952	$1,070,693,709	0.0875	0.2257	$ 60,319,016	$ 241,669,666
2042	$1,038,648,394	$1,194,192,053	0.0818	0.2109	$ 84,970,618	$ 251,911,092
2043	$739,350,606	$552,152,493	0.0765	0.1971	$ 56,528,424	$ 108,854,998
2044	$923,801,568	$504,246,080	0.0715	0.1842	$ 66,010,248	$ 92,906,925
2045	$789,426,916	$204,040,991	0.0668	0.1722	$ 52,718,230	$ 35,134,939
2046	$705,515,262	$1,176,882,386	0.0624	0.1609	$ 44,032,316	$ 189,363,929
2047	$848,977,121	$1,018,107,028	0.0583	0.1504	$ 49,519,622	$ 153,125,549
2048	$864,638,052	$408,622,620	0.0545	0.1406	$ 47,133,740	$ 57,437,146
2049	$923,608,223	$789,540,550	0.0509	0.1314	$ 47,054,544	$ 101,092,324
2050	$914,714,361	$815,749,098	0.0476	0.1228	$ 43,552,742	$ 100,151,969
2051	$819,008,674	$328,637,249	0.0445	0.1147	$ 36,444,729	$ 37,708,209
2052	$1,002,879,601	$1,477,877,327	0.0416	0.1072	$ 41,707,220	$ 158,479,730
2053	$989,925,498	$1,377,429,372	0.0389	0.1002	$ 38,475,226	$ 138,045,089
2054	$1,093,171,634	$440,395,252	0.0363	0.0937	$ 39,708,479	$ 41,248,714
2055	$1,040,001,807	$475,037,821	0.0339	0.0875	$ 35,305,731	$ 41,582,653
2056		$1,114,906,116		0.0818		$ 91,209,174
2057		$601,641,328		0.0765		$ 45,999,606
2058		$405,745,803		0.0715		$ 28,992,589
2059		$1,180,596,757		0.0668		$ 78,840,701
2060		$304,981,202		0.0624		$ 19,034,356
2061		$1,700,390,234		0.0583		$ 99,181,333
2062		$527,131,283		0.0545		$ 28,735,341
2063		$724,888,687		0.0509		$ 36,930,493
2064		$1,426,025,358		0.0476		$ 67,898,042
2065		$1,431,240,722		0.0445		$ 63,688,191
2066		$362,924,129		0.0416		$ 15,093,095
2067		$734,420,061		0.0389		$ 28,544,550
2068		$716,733,654		0.0363		$ 26,034,707
2069		$398,292,088		0.0339		$ 13,521,124
				TOTAL PRESENT WORTH:	$ 12,698,259,926	$ 11,361,772,707
				AVERAGE ANNUAL EQUIVALENT:	$ 920,114,004	$ 823,272,341

** 1 Oct 1990 price level indexed to 1 Oct 2011 using www.bls.gov CPI Inflation Calculator 1990 to 2011 (1.7333).*

Figure 17. Transportation Rate-savings Benefits Comparisons – Analysis Year Price Levels

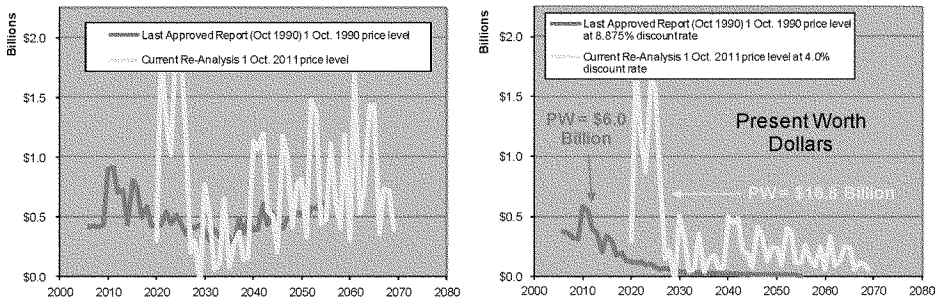
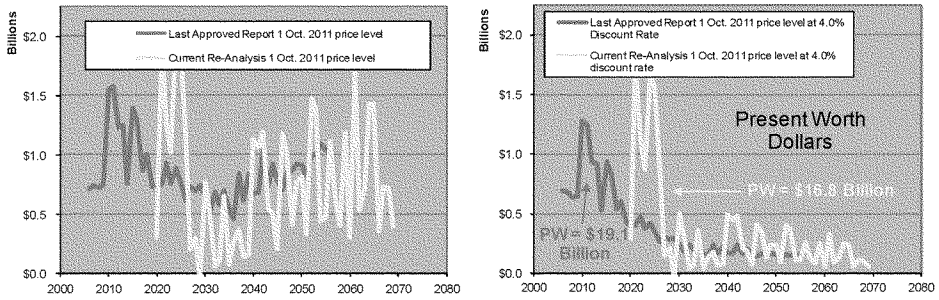


Figure 18. Transportation Rate-savings Benefits Comparisons – 1 Oct 2011 Price Level



10.2 Costs Foregone Benefits

The Louisville District engineering Cost-Closure Matrices not only represents the structural reliability of the exiting lower Ohio projects by indicating the consequences of failure through days a chamber is out of service (which factor into the waterway transportation rate-savings calculation), the Cost-Closure Matrices also estimate the repair costs needed to place the project(s) back into service. Generally, for both the 1990 Benefit Update and the 2011 Economics Update, the repair costs are greater under the without-project condition where L/Ds 52 and 53 are maintained, than under the recommended plan with a newly constructed Olmsted project. As a result, both analyses show a cost foregone benefit as shown in Table 25 and Table 26 and also in Figure 19. As previously noted, the 1990 Benefit Update assumed LD 52 and LD 53 rehabilitations in 2010-2018, while the current analysis assumes a cost-closure matrix. The repairs maintain the project at current levels of reliability.

From Table 25 the 2011 Economic Update costs foregone are 57.5% lower than those assumed in the 1990 Benefit Update ($23.6 million versus $55.4 million average annual). If both cost streams are discounted and amortized at 4.0% the reduction remains at 57.5% since the 1990 Benefit Update costs foregone are flat (and result in the same average annual regardless of the discount rate used). The 1990 Benefit Update costs foregone are flat through time because the year-to-year estimates used in that analysis were not available and only an average annual estimate was available for comparison. If both cost streams are discounted and amortized at 8.875% the reduction reduces to a 46.7% difference. Table 26 displays the costs foregone benefits at 1 Oct 2011 price level and the OMB 7% discount rate.

Table 25. Costs Foregone Benefits Comparisons

	Costs Foregone Benefits *		Present Worth Factors		Present Worth	
	Benefit Update Oct. 1990 **	Economics Update Dec. 2007, rev Nov 2011	Benefit Update	Economics Update	Benefit Update	Economics Update
Year	(1 Oct. 1990 price level)	(1 Oct. 2011 price level)	8.875%	4.000%	8.875%	4.000%
2006	$55,400,000		0.9185		$ 50,884,041	
2007	$55,400,000		0.8436		$ 46,736,203	
2008	$55,400,000		0.7748		$ 42,926,478	
2009	$55,400,000		0.7117		$ 39,427,305	
2010	$55,400,000		0.6537		$ 36,213,369	
2011	$55,400,000		0.6004		$ 33,261,418	
2012	$55,400,000		0.5514		$ 30,550,097	
2013	$55,400,000		0.5065		$ 28,059,790	
2014	$55,400,000		0.4652		$ 25,772,482	
2015	$55,400,000		0.4273		$ 23,671,626	
2016	$55,400,000		0.3925		$ 21,742,021	
2017	$55,400,000		0.3605		$ 19,969,710	
2018	$55,400,000		0.3311		$ 18,341,869	
2019	$55,400,000		0.3041		$ 16,846,722	
2020	$55,400,000	$24,082,274	0.2793	0.9615	$ 15,473,453	$ 23,156,032
2021	$55,400,000	$63,907,274	0.2565	0.9246	$ 14,212,127	$ 59,085,867
2022	$55,400,000	$52,707,274	0.2356	0.8890	$ 13,053,618	$ 46,856,574
2023	$55,400,000	$54,182,274	0.2164	0.8548	$ 11,989,546	$ 46,315,235
2024	$55,400,000	$57,757,274	0.1988	0.8219	$ 11,012,212	$ 47,472,269
2025	$55,400,000	$58,707,274	0.1826	0.7903	$ 10,114,546	$ 46,397,211
2026	$55,400,000	$53,982,274	0.1677	0.7599	$ 9,290,054	$ 41,022,091
2027	$55,400,000	$6,982,274	0.1540	0.7307	$ 8,532,771	$ 5,101,879
2028	$55,400,000	$8,707,274	0.1415	0.7026	$ 7,837,218	$ 6,117,615
2029	$55,400,000	$1,507,274	0.1299	0.6756	$ 7,198,363	$ 1,018,260
2030	$55,400,000	$13,882,274	0.1193	0.6496	$ 6,611,585	$ 9,017,660
2031	$55,400,000	$23,782,274	0.1096	0.6246	$ 6,072,638	$ 14,854,338
2032	$55,400,000	$2,132,274	0.1007	0.6006	$ 5,577,624	$ 1,280,588
2033	$55,400,000	$8,757,274	0.0925	0.5775	$ 5,122,961	$ 5,057,107
2034	$55,400,000	$18,832,274	0.0849	0.5553	$ 4,705,360	$ 10,456,893
2035	$55,400,000	$3,482,274	0.0780	0.5339	$ 4,321,801	$ 1,859,214
2036	$55,400,000	$8,832,274	0.0717	0.5134	$ 3,969,507	$ 4,534,253
2037	$55,400,000	$3,407,274	0.0658	0.4936	$ 3,645,931	$ 1,681,926
2038	$55,400,000	$3,707,274	0.0604	0.4746	$ 3,348,731	$ 1,759,629
2039	$55,400,000	$13,082,274	0.0555	0.4564	$ 3,075,757	$ 5,970,579
2040	$55,400,000	$18,732,274	0.0510	0.4388	$ 2,825,035	$ 8,220,351
2041	$55,400,000	$8,582,274	0.0468	0.4220	$ 2,594,751	$ 3,621,337
2042	$55,400,000	$11,732,274	0.0430	0.4057	$ 2,383,239	$ 4,760,092
2043	$55,400,000	$18,907,274	0.0395	0.3901	$ 2,188,968	$ 7,376,134
2044	$55,400,000	$16,982,274	0.0363	0.3751	$ 2,010,533	$ 6,370,336
2045	$55,400,000	$1,832,274	0.0333	0.3607	$ 1,846,643	$ 660,881
2046	$55,400,000	$24,132,274	0.0306	0.3468	$ 1,696,113	$ 8,369,472
2047	$55,400,000	$13,682,274	0.0281	0.3335	$ 1,557,854	$ 4,562,730
2048	$55,400,000	$18,707,274	0.0258	0.3207	$ 1,430,865	$ 5,998,514
2049	$55,400,000	$63,207,274	0.0237	0.3083	$ 1,314,227	$ 19,487,982
2050	$55,400,000	$63,732,274	0.0218	0.2965	$ 1,207,097	$ 18,894,066
2051	$55,400,000	$4,257,274	0.0200	0.2851	$ 1,108,700	$ 1,213,570
2052	$55,400,000	$8,282,274	0.0184	0.2741	$ 1,018,324	$ 2,270,123
2053	$55,400,000	$13,457,274	0.0169	0.2636	$ 935,315	$ 3,546,693
2054	$55,400,000	$7,882,274	0.0155	0.2534	$ 859,072	$ 1,997,490
2055	$55,400,000	$8,657,274	0.0142	0.2437	$ 789,044	$ 2,109,507
2056		$13,832,274		0.2343		$ 3,240,858
2057		$7,507,274		0.2253		$ 1,691,279
2058		$7,957,274		0.2166		$ 1,723,709
2059		$16,732,274		0.2083		$ 3,485,149
2060		$3,557,274		0.2003		$ 712,443
2061		$18,832,274		0.1926		$ 3,626,624
2062		$13,382,274		0.1852		$ 2,477,972
2063		$23,907,274		0.1780		$ 4,256,603
2064		$8,307,274		0.1712		$ 1,422,192
2065		$9,082,274		0.1646		$ 1,495,068
2066		$2,782,274		0.1583		$ 440,385
2067		$9,282,274		0.1522		$ 1,412,713
2068		$8,782,274		0.1463		$ 1,285,208
2069		$2,782,274		0.1407		$ 391,501
			TOTAL PRESENT WORTH:		$ 615,334,713	$ 506,136,228
			AVERAGE ANNUAL EQUIVALENT:		$ 55,400,000	$ 23,560,743

** Does not include normal O&M costs.*

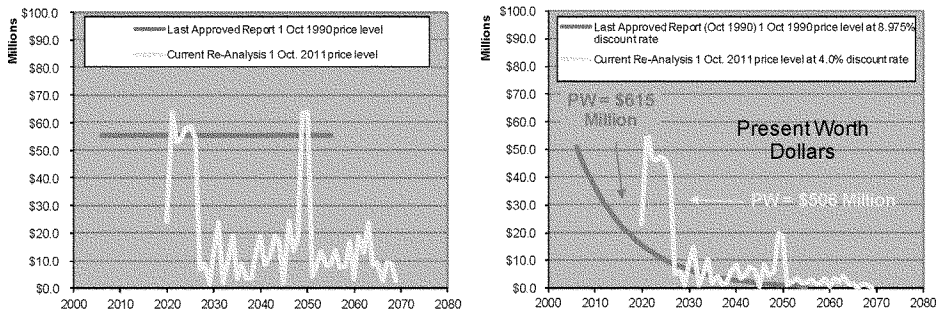
*** Year-to-year estimates from the 1990 Benefit Update could not be found, only average annual values exist.*

Table 26. Costs Foregone Benefits Comparisons
(1 Oct 2011 price level and at OMB 7% discount rate)

	Costs Foregone Benefits *		Present Worth Factors OMB 7.0% Discount Rate		Present Worth	
	Benefit Update Oct. 1990	Economics Update Dec. 2007, rev Nov 2011	Benefit	Economics	Benefit	Economics
Year	(1 Oct. 2011 price level)	(1 Oct. 2011 price level)	Update	Update	Update	Update
2006	$96,024,820		0.9346		$ 89,742,822	
2007	$96,024,820		0.8734		$ 83,871,797	
2008	$96,024,820		0.8163		$ 78,384,857	
2009	$96,024,820		0.7629		$ 73,256,875	
2010	$96,024,820		0.7130		$ 68,464,370	
2011	$96,024,820		0.6663		$ 63,985,392	
2012	$96,024,820		0.6227		$ 59,799,432	
2013	$96,024,820		0.5820		$ 55,887,320	
2014	$96,024,820		0.5439		$ 52,231,140	
2015	$96,024,820		0.5083		$ 48,814,149	
2016	$96,024,820		0.4751		$ 45,620,700	
2017	$96,024,820		0.4440		$ 42,636,168	
2018	$96,024,820		0.4150		$ 39,846,886	
2019	$96,024,820		0.3878		$ 37,240,081	
2020	$96,024,820	$24,082,274	0.3624	0.9346	$ 34,803,814	$ 22,506,798
2021	$96,024,820	$63,907,274	0.3387	0.8734	$ 32,526,929	$ 55,819,088
2022	$96,024,820	$52,707,274	0.3166	0.8163	$ 30,398,999	$ 43,024,836
2023	$96,024,820	$54,182,274	0.2959	0.7629	$ 28,410,279	$ 41,335,397
2024	$96,024,820	$57,757,274	0.2765	0.7130	$ 26,551,663	$ 41,180,138
2025	$96,024,820	$58,707,274	0.2584	0.6663	$ 24,814,638	$ 39,119,135
2026	$96,024,820	$53,982,274	0.2415	0.6227	$ 23,191,251	$ 33,617,447
2027	$96,024,820	$6,982,274	0.2257	0.5820	$ 21,674,066	$ 4,063,747
2028	$96,024,820	$8,707,274	0.2109	0.5439	$ 20,256,137	$ 4,736,180
2029	$96,024,820	$1,507,274	0.1971	0.5083	$ 18,930,969	$ 766,222
2030	$96,024,820	$13,882,274	0.1842	0.4751	$ 17,692,494	$ 6,595,368
2031	$96,024,820	$23,782,274	0.1722	0.4440	$ 16,535,041	$ 10,559,614
2032	$96,024,820	$2,132,274	0.1609	0.4150	$ 15,453,310	$ 884,818
2033	$96,024,820	$8,757,274	0.1504	0.3878	$ 14,442,345	$ 3,396,222
2034	$96,024,820	$18,832,274	0.1406	0.3624	$ 13,497,519	$ 6,825,683
2035	$96,024,820	$3,482,274	0.1314	0.3387	$ 12,614,504	$ 1,179,567
2036	$96,024,820	$8,832,274	0.1228	0.3166	$ 11,789,256	$ 2,796,072
2037	$96,024,820	$3,407,274	0.1147	0.2959	$ 11,017,996	$ 1,008,089
2038	$96,024,820	$3,707,274	0.1072	0.2765	$ 10,297,193	$ 1,025,092
2039	$96,024,820	$13,082,274	0.1002	0.2584	$ 9,623,545	$ 3,380,708
2040	$96,024,820	$18,732,274	0.0937	0.2415	$ 8,993,967	$ 4,524,089
2041	$96,024,820	$8,582,274	0.0875	0.2257	$ 8,405,577	$ 1,937,132
2042	$96,024,820	$11,732,274	0.0818	0.2109	$ 7,855,679	$ 2,474,887
2043	$96,024,820	$18,907,274	0.0765	0.1971	$ 7,341,756	$ 3,727,505
2044	$96,024,820	$16,982,274	0.0715	0.1842	$ 6,861,454	$ 3,128,970
2045	$96,024,820	$1,832,274	0.0668	0.1722	$ 6,412,574	$ 315,509
2046	$96,024,820	$24,132,274	0.0624	0.1609	$ 5,993,080	$ 3,883,616
2047	$96,024,820	$13,682,274	0.0583	0.1504	$ 5,600,991	$ 2,057,844
2048	$96,024,820	$18,707,274	0.0545	0.1406	$ 5,234,571	$ 2,629,547
2049	$96,024,820	$63,207,274	0.0509	0.1314	$ 4,892,122	$ 8,303,357
2050	$96,024,820	$63,732,274	0.0476	0.1228	$ 4,572,077	$ 7,824,603
2051	$96,024,820	$4,257,274	0.0445	0.1147	$ 4,272,969	$ 488,484
2052	$96,024,820	$8,282,274	0.0416	0.1072	$ 3,993,429	$ 888,147
2053	$96,024,820	$13,457,274	0.0389	0.1002	$ 3,732,176	$ 1,348,679
2054	$96,024,820	$7,882,274	0.0363	0.0937	$ 3,488,015	$ 738,277
2055	$96,024,820	$8,657,274	0.0339	0.0875	$ 3,259,827	$ 757,818
2056		$13,832,274		0.0818		$ 1,131,602
2057		$7,507,274		0.0765		$ 573,983
2058		$7,957,274		0.0715		$ 568,587
2059		$16,732,274		0.0668		$ 1,117,388
2060		$3,557,274		0.0624		$ 222,015
2061		$18,832,274		0.0583		$ 1,098,460
2062		$13,382,274		0.0545		$ 729,504
2063		$23,907,274		0.0509		$ 1,217,990
2064		$8,307,274		0.0476		$ 395,538
2065		$9,082,274		0.0445		$ 404,148
2066		$2,782,274		0.0416		$ 115,708
2067		$9,282,274		0.0389		$ 360,772
2068		$8,782,274		0.0363		$ 319,008
2069		$2,782,274		0.0339		$ 94,452
			TOTAL PRESENT WORTH:		$ 1,325,214,179	$ 377,197,840
			AVERAGE ANNUAL EQUIVALENT:		$ 96,024,820	$ 27,331,699

** 1 Oct 1990 price level indexed to 1 Oct 2011 using www.bls.gov CPI Inflation Calculator 1990 to 2011 (1.7333).*

Figure 19. Costs Foregone Benefits Comparisons



1990 Benefit Update costs foregone are a constant $55.4M per year because the year-to-year estimates could not be found, only the average annual values exist.

10.3 Fuel Tax Revenues

Waterway fuel consumption and fuel taxes are calculated in both the TCM/EQ (used for benefit estimation in the 1985 Feasibility Study and in the 1990 Benefit Update) and in ORNIM (used in this 2011 Economics Update). Fuel costs are factored into the model's waterway rate calculation and as fuel costs increase, water rates increase and waterway rate-savings decrease. The tax revenues collected, however, are not lost and are just a transfer payment from the consumer surplus into a Federal tax revenue. As such, the revenues should be added back into the system NED benefits. Neither the 1985 Feasibility Study nor the 1990 Benefit Update itemized these fuel tax revenues to add them back into the recommended plan NED benefit, however, the 2011 Economics Update does as itemized in Table 27 at the various discount/amortization rates. Over the analysis period there is a $0.20 per gallon waterway fuel tax (the Leaking Underground Storage Tank, or LUST tax, ended in 2004 and the Deficit Reduction Tax ended in 2006). Interestingly, while the fuel tax revenues are positive under both the without and with-project conditions, the with-project condition incremental fuel tax revenue is sometimes positive and sometimes negative. While queuing fuel consumption (and thus tax revenues) are less under the recommended plan as closures are reduced, closures in the without-project condition can choke off waterborne traffic (and thus tax revenues). As a result the incremental fuel tax revenues flip from negative to positive depending upon the extent of the closures assumed in the without-project condition. Overall, there is an incremental tax revenue benefit of $16.7 million average annual as shown in Table 27.

Table 27. Incremental Fuel Tax Revenue Comparison

Year	Ohio River System Movement Waterway Fuel Tax Revenues Without Project	Ohio River System Movement Waterway Fuel Tax Revenues With Project	Incremental Waterway Fuel Tax Revenues	Present Worth Factors Benefit Update 8.875%	Present Worth Factors OMB 7.000%	Present Worth Factors Econ Update 4.000%	Present Worth Incremental Waterway Fuel Tax Revenues Benefit Update 8.875%	Present Worth Incremental Waterway Fuel Tax Revenues OMB 7.000%	Present Worth Incremental Waterway Fuel Tax Revenues Econ Update 4.000%
2013	na	na	na	na	na	na	na	na	na
2014	na	na	na	na	na	na	na	na	na
2015	na	na	na	na	na	na	na	na	na
2016	na	na	na	na	na	na	na	na	na
2017	na	na	na	na	na	na	na	na	na
2018	na	na	na	na	na	na	na	na	na
2019	na	na	na	na	na	na	na	na	na
2020	$130,590,422	$138,861,982	$8,271,561	0.9185	0.934579439	0.9615	$ 7,597,300	$ 7,730,430	$ 7,953,424
2021	$74,654,899	$139,661,767	$65,006,868	0.8436	0.873438728	0.9246	$ 54,840,689	$ 56,779,516	$ 60,102,503
2022	$97,918,788	$139,285,677	$41,366,889	0.7748	0.816297877	0.8890	$ 32,052,976	$ 33,767,704	$ 36,775,014
2023	$109,708,061	$141,649,492	$31,941,430	0.7117	0.762895212	0.8548	$ 22,732,211	$ 24,367,964	$ 27,303,669
2024	$73,500,874	$140,758,478	$67,257,605	0.6537	0.712986179	0.8219	$ 43,964,340	$ 47,953,743	$ 55,280,848
2025	$78,596,763	$143,354,329	$64,757,566	0.6004	0.666342224	0.7903	$ 38,879,575	$ 43,150,701	$ 51,178,845
2026	$110,556,013	$145,423,233	$34,867,221	0.5514	0.622749742	0.7599	$ 19,227,382	$ 21,713,553	$ 26,496,222
2027	$141,217,439	$142,780,495	$1,563,055	0.5065	0.582009105	0.7307	$ 791,679	$ 909,712	$ 1,142,109
2028	$140,874,146	$145,422,575	$4,548,429	0.4652	0.543933743	0.7026	$ 2,115,962	$ 2,474,044	$ 3,195,666
2029	$151,219,205	$142,599,935	($8,619,270)	0.4273	0.508349292	0.6756	$ (3,682,890)	$ (4,381,600)	$ (5,822,870)
2030	$127,789,127	$148,316,550	$20,527,423	0.3925	0.475092796	0.6496	$ 8,056,095	$ 9,752,431	$ 13,334,222
2031	$137,952,283	$148,672,456	$10,720,173	0.3605	0.444011959	0.6246	$ 3,864,237	$ 4,759,885	$ 6,695,789
2032	$155,024,440	$149,208,663	($5,815,776)	0.3311	0.414964448	0.6006	$ (1,925,491)	$ (2,413,340)	$ (3,492,804)
2033	$154,959,747	$150,524,424	($4,435,323)	0.3041	0.387817241	0.5775	$ (1,348,748)	$ (1,720,095)	$ (2,561,288)
2034	$137,177,910	$151,643,346	$14,465,437	0.2793	0.36244602	0.5553	$ 4,040,257	$ 5,242,940	$ 8,032,144
2035	$158,179,794	$151,207,665	($6,972,129)	0.2565	0.338734598	0.5339	$ (1,788,606)	$ (2,361,701)	$ (3,722,477)
2036	$156,459,712	$155,476,077	($983,636)	0.2356	0.31657439	0.5134	$ (231,769)	$ (311,394)	$ (504,972)
2037	$151,974,702	$154,188,418	$2,213,716	0.2164	0.295863916	0.4936	$ 479,088	$ 654,959	$ 1,092,752
2038	$162,239,164	$155,357,351	($6,881,814)	0.1988	0.276508333	0.4746	$ (1,367,942)	$ (1,902,879)	$ (3,266,401)
2039	$162,367,314	$156,001,951	($6,365,363)	0.1826	0.258419003	0.4564	$ (1,162,144)	$ (1,644,931)	$ (2,905,069)
2040	$129,256,501	$158,295,579	$29,039,078	0.1677	0.241513087	0.4388	$ 4,869,578	$ 7,013,317	$ 12,743,323
2041	$131,997,854	$158,492,135	$26,494,281	0.1540	0.225713165	0.4220	$ 4,080,679	$ 5,980,108	$ 11,179,404
2042	$126,240,174	$157,486,583	$31,246,409	0.1415	0.210946883	0.4057	$ 4,420,305	$ 6,591,333	$ 12,677,491
2043	$154,586,183	$160,381,763	$5,795,580	0.1299	0.19714662	0.3901	$ 753,045	$ 1,142,579	$ 2,260,980
2044	$154,349,778	$158,133,182	$3,783,404	0.1193	0.184249178	0.3751	$ 451,522	$ 697,089	$ 1,419,218
2045	$173,337,079	$164,480,319	($8,856,760)	0.1096	0.172195493	0.3607	$ (970,828)	$ (1,525,094)	$ (3,194,538)
2046	$137,157,571	$165,307,213	$28,149,642	0.1007	0.160930367	0.3468	$ 2,834,082	$ 4,530,132	$ 9,762,762
2047	$143,493,037	$165,167,971	$21,674,934	0.0925	0.150402212	0.3335	$ 2,004,329	$ 3,259,958	$ 7,228,102
2048	$169,387,154	$166,387,266	($2,999,888)	0.0849	0.140562815	0.3207	$ (254,793)	$ (421,673)	$ (961,918)
2049	$156,151,988	$166,699,858	$10,547,870	0.0780	0.131367117	0.3083	$ 822,848	$ 1,385,643	$ 3,252,105
2050	$157,412,358	$168,888,355	$11,475,996	0.0717	0.122773007	0.2965	$ 822,275	$ 1,408,943	$ 3,402,177
2051	$179,106,484	$170,505,074	($8,601,410)	0.0658	0.114741128	0.2851	$ (566,068)	$ (986,935)	$ (2,451,900)
2052	$133,385,120	$170,117,296	$36,732,176	0.0604	0.107234699	0.2741	$ 2,220,328	$ 3,938,964	$ 10,068,075
2053	$137,780,442	$169,544,177	$31,763,735	0.0555	0.100219345	0.2636	$ 1,763,493	$ 3,183,341	$ 8,371,399
2054	$177,742,871	$171,124,096	($6,618,775)	0.0510	0.093662939	0.2534	$ (337,514)	$ (619,934)	$ (1,677,300)
2055	$176,986,667	$171,958,438	($5,028,229)	0.0468	0.087535457	0.2437	$ (235,505)	$ (440,148)	$ (1,225,222)
2056	$156,813,059	$176,475,930	$19,662,871	0.0430	0.081808838	0.2343	$ 845,872	$ 1,608,597	$ 4,606,949
2057	$174,209,666	$172,926,871	($1,282,795)	0.0395	0.076456858	0.2253	$ (50,686)	$ (98,078)	$ (288,995)
2058	$187,168,290	$176,395,481	($10,772,809)	0.0363	0.071455008	0.2166	$ (390,958)	$ (769,771)	$ (2,333,612)
2059	$153,235,783	$174,149,719	$20,913,936	0.0333	0.066780381	0.2083	$ 697,122	$ 1,396,641	$ 4,356,144
2060	$194,775,752	$178,176,837	($16,598,915)	0.0306	0.062411571	0.2003	$ (508,188)	$ (1,035,964)	$ (3,324,396)
2061	$141,736,546	$183,277,759	$41,541,213	0.0281	0.058328571	0.1926	$ 1,168,143	$ 2,423,040	$ 7,999,796
2062	$190,662,963	$180,881,467	($9,781,496)	0.0258	0.054512683	0.1852	$ (252,635)	$ (533,216)	$ (1,811,222)
2063	$184,163,002	$181,797,304	($2,365,697)	0.0237	0.050946433	0.1780	$ (56,120)	$ (120,524)	$ (421,204)
2064	$157,019,304	$184,377,611	$27,358,307	0.0218	0.047613489	0.1712	$ 596,103	$ 1,302,624	$ 4,683,699
2065	$160,416,066	$186,412,394	$25,996,328	0.0200	0.044498588	0.1646	$ 520,255	$ 1,156,800	$ 4,279,356
2066	$205,881,448	$185,459,031	($20,422,417)	0.0184	0.041587465	0.1583	$ (375,390)	$ (849,317)	$ (3,232,512)
2067	$195,638,178	$189,273,772	($6,364,406)	0.0169	0.03886679	0.1522	$ (107,450)	$ (247,364)	$ (968,629)
2068	$196,658,374	$188,204,678	($8,453,696)	0.0155	0.036324103	0.1463	$ (131,089)	$ (307,073)	$ (1,237,123)
2069	$211,060,088	$189,470,557	($21,589,532)	0.0142	0.033947759	0.1407	$ (307,493)	$ (732,916)	$ (3,037,919)
						TOTAL PRESENT WORTH:	$ 251,459,462	$ 282,852,742	$ 358,431,815
						AVERAGE ANNUAL EQUIVALENT:	$ 22,639,474	$ 20,495,467	$ 16,685,073

11.0 BENEFIT-COST RATIO

Project formulation and selection of a recommended plan is done by calculation and comparison of the alternative's net benefit (costs minus benefits); or more specifically the alternative's incremental net benefit over the base or without-project condition. Despite this, a benefit-to-cost ratio (BCR) is an often referenced performance metric of a cost benefit analysis. For this metric, the analysis period benefit and cost cash flows are discounted, amortized, and divided; the BCR is defined as the average annual equivalent benefits divided by average annual equivalent costs.

The BCR has traditionally only been used as a summary statistic demonstrating the economic viability of the alternative (i.e. BCR $\geq$ 1.0). Traditionally in the Ohio River Division (ORD), and now in the Great Lakes and Ohio River Division which replaced ORD, this BCR has been calculated as an incremental benefit to incremental cost ratio. This means that the without-project condition costs foregone are subtracted from the recommended plan construction cost to reflect an actual incremental cost of the investment over the base condition. This ratio is dependent upon the discount and amortization rate, and upon which specific cash flows are considered benefits and which specific cash flows are considered costs. Depending upon the specific cash flows, an incremental benefit to incremental cost ratio will typically be higher than a straight benefit to cost ratio where costs foregone are counted as a benefit (rather than a negative cost).

11.1 Construction Cost and Interest During Construction

A primary factor in the BCR is the construction cost. This section will itemize the financial implications of the Federal Discount Rate and interest during construction. A comparison of the 1990 Benefit Update and 2011 Economics Update average annual equivalent costs are shown in Table 28. Note that the costs used in this 2011 Economics Update are the remaining project costs.

The 1990 Benefit Update construction cost amortization is shown in Table 29 and the 2011 Economics Update construction cost amortization is shown in Table 30. Table 30 shows the calculation of interest during construction for the remaining period of construction between 2012 and 2024, showing IDC factors at the last approved report discount rate of 8.875%, the OMB discount rate of 7.0%, and the current FY 2012 discount rate of 4.0%. Table 30 also itemizes the total and remaining cost calculations.

Table 28. Average Annual Construction Comparison

	Benefit Update Oct. 1990 (1 Oct. 1990 price level, 8.875% Fedeeral Discount Rate)	Economics Update Dec. 2007, rev Nov 2011 PAC Report Cost (1 Oct. 2011 price level, 4.0% Fedeeral Discount Rate) *
Construction Cost	$ 832,000,000	$ 1,560,074,000
Interest During Construction	$ 901,522,603	$ 137,131,500
Total Investment Cost	$ 1,733,522,603	$ 1,697,205,500
Average Annual Equivalent PROJECT COST	$ 156,073,029	$ 79,005,256
Average Annual Equivalent COSTS FOREGONE	$ 55,400,000	$ 23,560,743
Average Annual Equivalent INCREMENTAL COST	$ 100,673,029	$ 55,444,513

** These are the remaining construction costs. $1,358,103,900 has been spent (sunk) through FY 2011.*

Table 29. Last Approved Report Construction Cost IDC and Amortization

Fiscal Year	Construction Cost Benefit Update Oct. 1990 (1 Oct. 1990 price level)	IDC Factor 8.875%	Interest During Construction
1990 *	$ 13,023,000	3.73583	$ 35,628,658
1991	$ 3,532,000	3.43130	$ 8,587,345
1992	$ 12,292,700	3.15159	$ 26,448,900
1993	$ 106,569,600	2.89469	$ 201,916,383
1994	$ 62,081,900	2.65873	$ 102,976,995
1995	$ 109,850,000	2.44200	$ 158,403,765
1996	$ 117,460,600	2.24294	$ 145,996,442
1997	$ 51,111,100	2.06011	$ 54,183,150
1998	$ 80,314,800	1.89217	$ 71,654,843
1999	$ 38,251,100	1.73793	$ 28,226,759
2000	$ 16,460,000	1.59626	$ 9,814,518
2001	$ 72,927,300	1.46614	$ 33,994,655
2002	$ 29,208,900	1.34663	$ 10,124,708
2003	$ 17,932,800	1.23686	$ 4,247,557
2004	$ 60,873,200	1.13604	$ 8,280,972
2005	$ 31,820,700	1.04343	$ 1,382,031
2006	$ 8,290,300	0.95838	$ (345,076)
	$ 832,000,000		$ 901,522,603
		TOTAL INVESTMENT COST	$ 1,733,522,603
		Av.Ann. IDC	$81,166,154.30
		Av.Ann. Construction Costs	$74,906,874.35
		TOTAL Av.Ann. Costs (including IDC)	$ 156,073,029

** 1986 through 1989 GI expenditures were lumped into the 1990 expenditures.*

Table 30. Construction Cost Interest During Construction and Amortization

Fiscal Year	Current Construction Cost*	Recommended PAC Report Construction Costs	IDC Factors** LAR 8.875%	IDC Factors** OMB 7.000%	IDC Factors** Current 4.000%	Interest During Construction: Current Construction Cost LAR 8.875%	Current Construction Cost OMB 7.000%	Current Construction Cost Current 4.000%	PAC Report Recommended Construction Cost LAR 8.875%	PAC Report Recommended Construction Cost OMB 7.000%	PAC Report Recommended Construction Cost Current 4.000%
1986	$ 206,000	$ 206,000									
1987	$ 2,422,000	$ 2,422,000									
1988	$ 2,822,000	$ 2,822,000									
1989	$ 3,658,000	$ 3,658,000									
1990	$ 3,498,000	$ 3,498,000									
1991	$ 3,296,000	$ 3,296,000									
1992	$ 4,826,000	$ 4,826,000									
1993	$ 16,832,000	$ 16,832,000									
1994	$ 38,942,000	$ 38,942,000									
1995	$ 45,524,000	$ 45,524,000									
1996	$ 49,678,000	$ 49,678,000									
1997	$ 70,080,000	$ 70,080,000									
1998	$ 76,174,000	$ 76,174,000									
1999	$ 51,060,000	$ 51,060,000									
2000	$ 87,163,000	$ 87,163,000									
2001	$ 57,775,000	$ 57,775,000									
2002	$ 56,308,000	$ 56,308,000									
2003	$ 29,858,000	$ 29,858,000									
2004	$ 32,513,000	$ 32,513,000									
2005	$ 58,767,000	$ 58,767,000									
2006	$ 88,250,000	$ 88,250,000									
2007	$ 88,189,900	$ 88,189,900									
2008	$ 107,934,000	$ 107,934,000									
2009	$ 103,730,000	$ 103,730,000									
2010	$ 140,500,000	$ 140,500,000									
2011	$ 138,098,000	$ 138,098,000									
2012	$ 38,108,639	$ 153,792,000	1.81341	1.60578	1.31593	$ 30,998,134	$ 23,085,507	$ 12,039,730	$ 125,096,702	$ 93,164,345	$ 48,587,780
2013	$ 36,182,293	$ 146,018,000	1.66559	1.50073	1.26532	$ 24,082,698	$ 18,117,572	$ 9,599,850	$ 97,188,627	$ 73,115,645	$ 38,741,352
2014	$ 35,572,721	$ 143,558,000	1.52982	1.40255	1.21685	$ 18,847,203	$ 14,319,860	$ 7,706,933	$ 76,060,155	$ 57,789,521	$ 31,102,257
2015	$ 34,927,715	$ 140,955,000	1.40512	1.31089	1.16986	$ 14,149,832	$ 10,855,394	$ 5,932,771	$ 57,103,351	$ 43,808,252	$ 23,942,413
2016	$ 34,274,532	$ 138,319,000	1.29058	1.22504	1.12486	$ 9,959,450	$ 7,713,243	$ 4,279,655	$ 40,192,560	$ 31,127,723	$ 17,271,064
2017	$ 33,605,613	$ 135,619,500	1.18538	1.14490	1.08160	$ 6,229,693	$ 4,869,453	$ 2,742,218	$ 25,140,677	$ 19,651,266	$ 11,066,551
2018	$ 32,909,686	$ 132,811,000	1.08875	1.07000	1.04000	$ 2,920,735	$ 2,303,678	$ 1,316,387	$ 11,786,976	$ 9,296,770	$ 5,312,440
2019	$ 32,245,352	$ 130,130,000	1.00000	1.00000	1.00000	$ -	$ -	$ -	$ -	$ -	$ -
2020	$ 31,645,320	$ 127,708,500	0.91948	0.93458	0.96154	$ (2,579,584)	$ (2,070,256)	$ (1,217,128)	$ (10,410,222)	$ (8,354,762)	$ (4,911,865)
2021	$ 26,903,296	$ 108,571,500	0.84361	0.87344	0.92456	$ (4,207,305)	$ (3,404,916)	$ (2,029,687)	$ (16,979,087)	$ (13,740,947)	$ (8,191,045)
2022	$ 29,947,316	$ 120,856,000	0.77483	0.81630	0.88900	$ (6,742,753)	$ (5,501,386)	$ (3,324,261)	$ (27,211,190)	$ (22,201,504)	$ (13,415,456)
2023	$ 16,437,250	$ 66,334,500	0.71188	0.76290	0.85480	$ (4,739,119)	$ (3,897,351)	$ (2,386,620)	$ (19,125,284)	$ (15,728,228)	$ (9,631,491)
2024	$ 3,816,266	$ 15,401,000	0.65367	0.71299	0.82193	$ (1,321,684)	$ (1,095,321)	$ (679,573)	$ (5,333,814)	$ (4,420,300)	$ (2,742,501)
				TOTAL IDC PRESENT WORTH :		$ 87,597,299	$ 65,295,482	$ 33,980,277	$ 353,509,450	$ 263,507,781	$ 137,131,500
				TOTAL INVESTMENT COST :		$ 1,832,277,199	$ 1,809,976,382	$ 1,778,660,177	$ 3,271,687,350	$ 3,181,685,681	$ 3,055,309,400
				TOTAL REMAINING INVESTMENT COST :		$ 474,173,299	$ 451,871,482	$ 420,556,277	$ 1,913,583,450	$ 1,823,581,781	$ 1,697,205,500
TOTALS											
Sunk :	$ 1,358,103,900	$ 1,358,103,900		Av.Ann. Sunk IDC		$ -	$ -	$ -	$ -	$ -	$ -
Remaining :	$ 386,576,000	$ 1,560,074,000		Av.Ann. Remaining IDC		$ 7,886,586	$ 4,731,301	$ 1,581,789	$ 31,827,269	$ 19,093,734	$ 6,383,499
	$ 1,744,679,900	$ 2,918,177,900		TOTAL Av.Ann. IDC		$ 7,886,586	$ 4,731,301	$ 1,581,789	$ 31,827,269	$ 19,093,734	$ 6,383,499
				Av.Ann. Sunk Construction Cost		$ 122,273,219	$ 98,408,004	$ 63,220,009	$ 122,273,219	$ 98,408,004	$ 63,220,009
				Av.Ann. Remaining Construction Cost		$ 34,804,327	$ 28,011,239	$ 17,995,190	$ 140,457,052	$ 113,042,727	$ 72,621,757
				TOTAL Av.Ann. Construction Cost		$ 157,077,546	$ 126,419,243	$ 81,215,199	$ 262,730,271	$ 211,450,732	$ 135,841,766
				Av.Ann. Sunk Costs (no IDC)		$ 122,273,219	$ 98,408,004	$ 63,220,009	$ 122,273,219	$ 98,408,004	$ 63,220,009
				Av.Ann. Remaining Costs (including IDC)		$ 42,690,913	$ 32,742,540	$ 19,576,979	$ 172,284,321	$ 132,136,461	$ 79,005,256
				TOTAL Av.Ann. Costs (including IDC)		$ 164,964,132	$ 131,150,544	$ 82,796,988	$ 294,557,540	$ 230,544,466	$ 142,225,265

Directed by HQ to exclude sunk IDC in this analysis.

** Section 902 limit is $1744.7 million.*

*** On-line slipped from year 2006 to 2020. End-of-year discounting used, resulting in no IDC for 2019 costs. Post-2020 costs are after on-line, resulting in negative IDC (present worth adjustment).*

11.2 Benefit – Cost Ratio (Benefit to Remaining Cost Ratio)

In the 1990 Benefit Update the Olmsted construction sequence had just begun, however, from the perspective of the 2011 Economics Update, the project has been under construction for 26-years and $1,358,103,900 has been sunk through FY 2011. From the perspective of the Economics Update, the project cost is the remaining construction cost of $1,560,074,000. As such, the BCR can also be described as the benefit to remaining cost ratio. As previously discussed, the BCR can be calculated differently depending upon whether costs foregone are handled as a benefit or a negative cost. The following two sections calculate the BCR in the newer Budget EC RBRCR method and in the traditional incremental benefit to incremental cost fashion (for comparison with the 1990 Benefit Update analysis).

11.2.1 Benefit to Remaining Cost Ratio

As previously discussed, the Budget EC guidance in recent years has specified that the RBRCR be calculated with the without-project costs foregone treated as a benefit. Under this ratio calculation, the cost includes all with-project costs (construction and maintenance) as shown in Table 31.

Table 31. Benefit to Remaining Cost Ratio Calculation

	Authorized Project Last Approved Report / 1990 Benefit Update (1 Oct 1990 price level)			Recommended Project PAC Report / 2007 Economics Update, Revised Nov 2011 (1 Oct 2011 price level)		
	LAR 8.875%	OMB 7.000%	Current 4.000%	LAR 8.875%	OMB 7.000%	Current 4.000%
Annualized Benefits						
Transportation Benefits	$ 539,300,000	$ 530,845,211	$ 513,458,495	$ 854,861,806	$ 823,272,341	$ 780,748,662
Fuel Tax Revenues	$ -	$ -	$ -	$ 21,960,883	$ 19,976,006	$ 16,376,787
Less WOPC Normal O&M	$ 5,000,000	$ 5,000,000	$ 5,000,000	$ 7,664,547	$ 7,664,547	$ 7,664,547
Less LD 52 Repairs	$ 28,350,000 *	$ 28,350,000 *	$ 28,350,000 *	$ 13,444,962	$ 12,291,092	$ 10,462,184
Less LD 53 Repairs	$ 27,050,000 *	$ 27,050,000 *	$ 27,050,000 *	$ 12,875,094	$ 11,860,808	$ 9,947,814
Incremental Annual Benefits	$ 599,700,000	$ 591,245,211	$ 573,858,495	$ 910,807,293	$ 875,064,795	$ 825,199,996
Annualized Costs						
Construction	$ 74,906,874	$ 60,286,585	$ 38,729,767	$ 140,457,052	$ 113,042,727	$ 72,621,757
Interest During Construction	$ 81,166,154	$ 46,991,789	$ 14,949,311	$ 31,827,269	$ 19,093,734	$ 6,383,499
Normal O&M	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 3,832,274	$ 3,832,274	$ 3,832,274
Main Chamber Maintenance	$ -	$ -	$ -	$ 266,268	$ 277,669	$ 295,393
Aux Chamber Maintenance	$ -	$ -	$ -	$ 313,447	$ 314,605	$ 314,515
Dam Maintenance	$ -	$ -	$ -	$ 52,813	$ 60,200	$ 71,621
Incremental Annual Costs	$ 158,573,029	$ 109,778,384	$ 56,179,078	$ 176,749,122	$ 136,621,210	$ 83,519,059
Net Annual Project Benefits	$ 441,126,971	$ 481,466,826	$ 517,679,417	$ 734,058,170	$ 738,443,584	$ 741,680,937
BENEFIT - COST RATIO	**3.8** **	**5.4** ***	**10.2** ***	**5.2**	**6.4**	**9.9**

** The 1990 Benefit Update contained an average annual $36.5 million for without-project condition O&M and replacements. Here it is assumed $2.5M normal O&M for 52 and 53 (since Olmsted was specified as $2.5M). Post report, BERH directed additional analysis which resulted in an additional $12.6M and $11.3M being added to 52 and 53 for unscheduled repairs. The average annual values do not vary by interest rate because only av.ann. values at the report interest rates were available.*

*** Page 53 of the Benefit Update (1990) shows a BCR of 4.3, however, this does not include the BERH adjustment as discussed in the footnote above and costs foregone are subtracted from costs.*

**** Since costs foregone in the Benefit Update (1990) were only presented as average annuals, they could not be re-amortized at the new interest rates.*

11.2.2 **Incremental Benefit to Incremental Remaining Cost Ratio**

Traditionally in the Ohio River Division, and now in the Great Lakes and Ohio River Division, the BCR is calculated as an incremental benefit to incremental cost ratio. In short, the without-project costs foregone are subtracted from the recommended plan construction cost to reflect the actual incremental cost of the investment. The BCR from the 1990 Benefit Update is an incremental benefit to incremental cost ratio.

The BCR for the authorized project (1990 Benefit Update) and for the recommended project (2011 Economics Update) are shown in Table 32. The authorized project BCR is 5.5 to 1 amortized under a 8.875% Federal Discount Rate and the PAC Report recommended plan BCR is 14.4 to 1 amortized under the FY 2012 Federal Discount Rate of 4.0%. The amortizations at the other discount rates are for informational purposes only.

Table 32. Incremental Benefit to Incremental Remaining Cost Ratio Calculation

	Authorized Project Last Approved Report / 1990 Benefit Update (1 Oct 1990 price level)			Recommended Project PAC Report / 2007 Economics Update, Revised Nov 2011 (1 Oct 2011 price level)		
	LAR 8.875%	OMB 7.000%	Current 4.000%	LAR 8.875%	OMB 7.000%	Current 4.000%
Annualized Benefits						
Transportation Benefits	$ 539,300,000	$ 530,845,211	$ 513,458,495	$ 854,861,806	$ 823,272,341	$ 780,748,662
Fuel Tax Revenues	$ -	$ -	$ -	$ 21,960,883	$ 19,976,006	$ 16,376,787
Incremental Annual Benefits	$ 539,300,000	$ 530,845,211	$ 513,458,495	$ 876,822,689	$ 843,248,347	$ 797,125,450
Annualized Costs						
Construction	$ 74,906,874	$ 60,286,595	$ 38,729,767	$ 140,457,052	$ 113,042,727	$ 72,621,757
Interest During Construction	$81,166,154.30	$ 46,991,789	$ 14,949,311	$ 31,827,269	$ 19,093,734	$ 6,383,499
Normal O&M	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 3,832,274	$ 3,832,274	$ 3,832,274
Main Chamber Maintenance	$ -	$ -	$ -	$ 266,268	$ 277,669	$ 295,393
Aux Chamber Maintenance	$ -	$ -	$ -	$ 313,447	$ 314,605	$ 314,515
Dam Maintenance	$ -	$ -	$ -	$ 52,813	$ 60,200	$ 71,621
Less WOPC Normal O&M	$ (5,000,000)	$ (5,000,000)	$ (5,000,000)	$ (7,664,547)	$ (7,664,547)	$ (7,664,547)
Less LD 52 Repairs	$ (28,350,000) *	$ (28,350,000) *	$ (28,350,000) *	$ (13,444,962)	$ (12,291,092)	$ (10,462,184)
Less LD 53 Repairs	$ (27,050,000) *	$ (27,050,000) *	$ (27,050,000) *	$ (12,875,094)	$ (11,860,808)	$ (9,947,814)
Incremental Annual Costs	$ 98,173,029	$ 49,378,384	$ (4,220,922)	$ 142,764,519	$ 104,804,763	$ 55,444,513
Net Annual Project Benefits	$ 441,126,971	$ 481,466,826	$ 517,679,417	$ 734,058,170	$ 738,443,584	$ 741,680,937
BENEFIT - COST RATIO	**5.5** **	**10.8** ***	**-121.6** ***	**6.1**	**8.0**	**14.4**

** The 1990 Benefit Update contained an average annual $36.5 million for without-project condition O&M and replacements. Here it is assumed $2.5M normal O&M for 52 and 53 (since Olmsted was specified as $2.5M). Post report, BERH directed additional analysis which resulted in an additional $12.6M and $11.3M being added to 52 and 53 for unscheduled repairs. The average annual values do not vary by interest rate because only av.ann. values at the report interest rates were available.*

*** Page 53 of the Benefit Update (1990) shows a BCR of 4.3, however, this does not include the BERH adjustment as discussed in the footnote above.*
**** Since costs foregone in the Benefit Update (1990) were only presented as average annuals, they could not be re-amortized at the new interest rates.*

The increase of the BCR from 5.5 to 14.4 is driven primarily by removal of the sunk construction costs ($1,358,103,900) and secondarily by the reduction in the discount rate. As shown in Table 33, if the remaining costs are deflated to a 1 October 1990 price level, the current 1 October 2011 remaining cost of $1,560,074,000 is reduced to $824,037,814, which is a 47% cost reduction.

Table 33. Construction First Cost Comparison

	Price Level	
	1 Oct 2011	1 Oct 1990 *
2007 Economics Update (rev Nov 2011)		
Construction First Cost		
Total	$ 2,918,177,900	$ 1,541,394,151
Sunk	$ 1,358,103,900	$ 717,356,336
Remaining	$ 1,560,074,000	$ 824,037,814
1990 Benefit Update		
Construction First Cost	na	$ 832,000,000

** Costs deflated using the Composite Index (Weighted Average) of EM 1110-2-1304, 31 March 2000. Tables Revised as of 30 Sep 2011*

11.2.3 Sensitivity – No Growth in Traffic

The lowest traffic growth scenario (Clear Skies) was used in this Economic Update. This scenario projected traffic for LD52 and LD53 in 2010 that, like actual 2005, is lower than 1990 traffic. A sensitivity test using no growth in traffic was completed by holding traffic constant at 2010 levels throughout the analysis period. Table 34 below compares benefit to remaining cost ratios for Clear Skies and No Growth using the current interest rate of 4.0 percent and the OMB interest rate of 7.0 percent. The tests indicate results are robust with regard to traffic forecasts.

Table 34. No Growth Sensitivity Test

	Discount / Amortization Rate		
	8.875%	7.000%	4.000%
Incremental Benefit to Incremental Cost Ratio Calculation			
Clear Skies	6.1	8.0	14.4
No Growth Beyond 2010	5.0	6.4	10.6
Benefit to Cost Ratio Calculation (Budget EC Method)			
Clear Skies	5.2	6.4	9.9
No Growth Beyond 2010	4.2	5.1	7.4
Incremental Benefit to Incremental TOTAL Cost Ratio Calculation			
Clear Skies	3.3	4.1	6.7
No Growth Beyond 2010	2.7	3.3	5.0
Benefit to TOTAL Cost Ratio Calculation (Budget EC Method)			
Clear Skies	3.0	3.7	5.6
No Growth Beyond 2010	2.5	3.0	4.2

11.3 Benefit to Total Cost Ratio

As discussed in the 2011 Economics Update the project has been under construction for 27-years and $1,358,103,900 has been sunk through FY 2011. From the perspective of this

Economics Update, the project cost is the remaining construction cost of $1,560,074,000. For information, the BCR is now calculated and compared with the sunk costs added, yielding a total BCR. As before, the BCR can be calculated differently depending upon whether costs foregone are handled as a benefit or a negative cost. The following two sections calculate the BCR in the newer Budget EC RBRCR method and in the traditional incremental benefit to incremental cost fashion (for comparison with the 1990 Benefit Update analysis).

11.3.1 Total Benefit to Total Cost Ratio

As previously discussed, the Budget EC guidance in recent years has specified that the RBRCR be calculated with the without-project costs foregone treated as a benefit. Under this ratio calculation, the cost includes all with-project costs (construction and maintenance) as shown in Table 35. Again, as there were no sunk costs to add to the authorized project BCR, there is no change from Table 31. The PAC Report recommended plan BCR, however, drops from 9.9 to 1 to 5.6 to 1 amortized under the FY 2012 Federal Discount Rate of 4.0%. The amortizations at the other discount rates are for informational purposes only.

Table 35. Total Benefit to Cost Ratio Calculation

	Authorized Project Last Approved Report / 1990 Benefit Update (1 Oct 1990 price level)			Recommended Project PAC Report / 2007 Economics Update, Revised Nov 2011 (1 Oct 2011 price level)		
	LAR 8.875%	OMB 7.000%	Current 4.000%	LAR 8.875%	OMB 7.000%	Current 4.000%
Annualized Benefits						
Transportation Benefits	$ 539,300,000	$ 530,845,211	$ 513,458,495	$ 854,861,806	$ 823,272,341	$ 780,748,662
Fuel Tax Revenues	$ -	$ -	$ -	$ 21,960,883	$ 19,976,006	$ 16,376,787
Less WOPC Normal O&M	$ 5,000,000	$ 5,000,000	$ 5,000,000	$ 7,664,547	$ 7,664,547	$ 7,664,547
Less LD 52 Repairs	$ 28,350,000 *	$ 28,350,000 *	$ 28,350,000 *	$ 13,444,962	$ 12,291,092	$ 10,462,184
Less LD 53 Repairs	$ 27,050,000 *	$ 27,050,000 *	$ 27,050,000 *	$ 12,875,094	$ 11,860,808	$ 9,947,814
Annual Benefits	$ 599,700,000	$ 591,245,211	$ 573,858,495	$ 910,807,293	$ 875,064,795	$ 825,199,996
Annualized Costs						
Construction	$ 74,906,874	$ 60,286,595	$ 38,729,767	$ 262,730,271	$ 211,450,732	$ 135,841,766
Interest During Construction ****	$ 81,166,154	$ 46,991,789	$ 14,949,311	$ 31,827,269	$ 19,093,734	$ 6,383,499
Normal O&M	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 3,832,274	$ 3,832,274	$ 3,832,274
Main Chamber Maintenance	$ -	$ -	$ -	$ 266,268	$ 277,659	$ 295,393
Aux Chamber Maintenance	$ -	$ -	$ -	$ 313,447	$ 314,605	$ 314,515
Dam Maintenance	$ -	$ -	$ -	$ 52,813	$ 60,200	$ 71,621
Annual Costs	$ 158,573,029	$ 109,778,384	$ 56,179,078	$ 299,022,341	$ 235,029,214	$ 146,739,068
Net Annual Project Benefits	$ 441,126,971	$ 481,466,826	$ 517,679,417	$ 611,784,951	$ 640,035,580	$ 678,460,928
BENEFIT - COST RATIO	**3.8** **	**5.4** ***	**10.2** ***	**3.0**	**3.7**	**5.6**

** The 1990 Benefit Update contained an average annual $36.5 million for without-project condition O&M and replacements. Here it is assumed $2.5M normal O&M for 52 and 53 (since Olmsted was specified as $2.5M). Post report, BERH directed additional analysis which resulted in an additional $12.6M and $11.3M being added to 52 and 53 for unscheduled repairs. The average annual values do not vary by interest rate because only av.ann. values at the report interest rates were available.*

*** Page 53 of the Benefit Update (1990) shows a BCR of 4.3, however, this does not include the BERH adjustment as discussed in the footnote above and costs foregone are subtracted from costs.*

**** Since costs foregone in the Benefit Update (1990) were only presented as average annuals, they could not be re-amortized at the new interest rates.*

***** Sunk IDC removed from the PACR costs per Hughs, Thomas E HQ02, Economics Team Lead, OWPR.*

11.3.2 Total Incremental Benefit to Total Incremental Remaining Cost Ratio

As previously discussed, traditionally the BCR is calculated as an incremental benefit to incremental cost ratio, meaning that the without-project costs foregone are subtracted from the recommended plan construction cost to reflect the actual incremental cost of the investment.

The BCR for the authorized project (1990 Benefit Update) and for the recommended project (2011 Economics Update) are shown in Table 36. Since there were no sunk costs to add, the authorized project BCR remains as 5.5 to 1 amortized under a 8.875% Federal Discount Rate. The PAC Report recommended plan BCR, however, drops from 14.4 to 1 to 6.7 to 1 amortized under the FY 2012 Federal Discount Rate of 4.0%. The amortizations at the other discount rates are for informational purposes only.

Table 36. Total Incremental Benefit to Incremental Cost Ratio Calculation

	Authorized Project Last Approved Report / 1990 Benefit Update (1 Oct 1990 price level)			Recommended Project PAC Report / 2007 Economics Update, Revised Nov 2011 (1 Oct 2011 price level)		
	LAR 8.875%	OMB 7.000%	Current 4.000%	LAR 8.875%	OMB 7.000%	Current 4.000%
Annualized Benefits						
Transportation Benefits	$ 539,300,000	$ 530,845,211	$ 513,458,495	$ 854,861,806	$ 823,272,341	$ 780,748,662
Fuel Tax Revenues	$ -	$ -	$ -	$ 21,960,883	$ 19,976,006	$ 16,376,787
Incremental Annual Benefits	$ 539,300,000	$ 530,845,211	$ 513,458,495	$ 876,822,689	$ 843,248,347	$ 797,125,450
Annualized Costs						
Construction	$ 74,906,874	$ 60,286,595	$ 38,729,767	$ 262,730,271	$ 211,450,732	$ 135,841,766
Interest During Construction ****	$81,166,154.30	$ 46,991,789	$ 14,949,311	$ 31,827,269	$ 19,093,734	$ 6,383,499
Normal O&M	$ 2,500,000	$ 2,500,000	$ 2,500,000	$ 3,832,274	$ 3,832,274	$ 3,832,274
Main Chamber Maintenance	$ -	$ -	$ -	$ 266,268	$ 277,669	$ 295,393
Aux Chamber Maintenance	$ -	$ -	$ -	$ 313,447	$ 314,605	$ 314,515
Dam Maintenance	$ -	$ -	$ -	$ 52,813	$ 60,200	$ 71,621
Less WOPC Normal O&M	$ (5,000,000)	$ (5,000,000)	$ (5,000,000)	$ (7,664,547)	$ (7,664,547)	$ (7,664,547)
Less LD 52 Repairs	$ (28,350,000) *	$ (28,350,000) *	$ (28,350,000) *	$ (13,444,962)	$ (12,291,092)	$ (10,462,184)
Less LD 53 Repairs	$ (27,050,000) *	$ (27,050,000) *	$ (27,050,000) *	$ (12,875,094)	$ (11,860,808)	$ (9,947,814)
Incremental Annual Costs	$ 98,173,029	$ 49,378,384	$ (4,220,922)	$ 265,037,738	$ 203,212,767	$ 118,664,522
Net Annual Project Benefits	$ 441,126,971	$ 481,466,826	$ 517,679,417	$ 611,784,951	$ 640,035,580	$ 678,460,928
BENEFIT - COST RATIO	**5.5 ****	**10.8 *****	**-121.6 *****	**3.3**	**4.1**	**6.7**

** The 1990 Benefit Update contained an average annual $36.5 million for without-project condition O&M and replacements. Here it is assumed $2.5M normal O&M for 52 and 53 (since Olmsted was specified as $2.5M). Post report, BERH directed additional analysis which resulted in an additional $12.6M and $11.3M being added to 52 and 53 for unscheduled repairs. The average annual values do not vary by interest rate because only av.ann. values at the report interest rates were available.*

*** Page 53 of the Benefit Update (1990) shows a BCR of 4.3, however, this does not include the BERH adjustment as discussed in the footnote above.*
**** Since costs foregone in the Benefit Update (1990) were only presented as average annuals, they could not be re-amortized at the new interest rates.*
***** Sunk IDC removed from the PACR costs per Hughs, Thomas E HQ02, Economics Team Lead, OWPR.*

ATTACHMENT 1

ENGINEERING COST AND CLOSURE MATRICES

1.0 Introduction

The cost and closure schedules are a series of spreadsheet matrices that detail lock chamber specific costs, closures and other project costs for the period 2013 through 2070. Matrices were developed based upon a few key indicators including historical performance, the Louisville District's current maintenance program for Ohio River projects, as well as for multiple large-scale investment strategies.

2.0 Cost and Closure Categories for Schedules

Closure of either an auxiliary or main chamber at a site can occur for a variety of reasons. Some closures are related to the level of maintenance previously performed on the lock chamber, while others are not affected by maintenance history. In addition, some closures require repair costs, while others are not associated with repairs but are a function of weather, debris, or other non-repair related phenomena. This is more clearly explained within each category of closure. The categories and information used in the cost and closure matrices were based upon an extensive database search of historical records over roughly the last 20 years. The information was developed by reviewing historical records associated with the Corps of Engineers' Lock Performance Monitoring System (LPMS) data, Operations repair reports and field notes, and historical notices to navigation. In general, the Operations repair reports coupled with historical navigation notices generally provided the most reliable set of historical data to draw from when developing the cost and closure information. The LPMS data was also useful but variability among how project personnel input the data required a more careful screening of the information. Each of these historical repairs was logged on a site-specific spreadsheet by lock chamber and then cross-referenced with the other databases. As noted earlier, the quality and availability of data varied considerably, but overall there is a good amount of historic data to use in developing repair costs, categories of closures, and trends associated with the locks.

The information collected reflects individual lock chamber closures in excess of 24 hours from 1983 through 2010 (27 years of data inclusive) at L&D 52 and 53. Any lock chamber closure less than 24 hours in duration is accounted for in the economic modeling and therefore not considered in the cost and closure matrices. In some instances, multiple sources referenced the same historical closure. In these cases, check marks are shown for multiple sources. In general, navigation notices are only sent out for planned, lengthy duration closures. These closures typically had a detailed Operations report completed for them as well. For historical maintenance work related to main chamber culvert valves the Louisville District repair fleet was set up in the existing auxiliary chamber while doing repairs to main chamber culvert valves. Thus, the auxiliary chamber was closed and main chamber was operating at ½ filling/emptying speed while repairs were being made.

For the purposes of this analysis, chamber closures were broken down into three primary categories. The three primary categories of closures are **Random Minor, Major Repair**, and **½ Speed Filling and Emptying Events**.

2.1 Random Minor

Random minor closures are closures that are essentially independent of historical maintenance or replacement/rehabilitation work. These involve down time due to items that are considered unavoidable. Lock chambers are sometimes closed for unforeseen occurrences regardless of historical level of maintenance. Examples of this type of closure would be shutting down the auxiliary chamber to flush ice or debris through the project or weather-related closures (fog, snowstorm, etc...). Some of these can be rather lengthy, but by definition the Engineering Team capped Random Minor closure durations at 15 days since most data supported that these closures did not exceed this limit. Anything over 24 hours in duration is captured by the Engineering Team and used in the development of the cost/closure schedules.

The daily repair cost rate was determined based upon all the known Random Minor closures throughout a district where good cost data was available, averaged across the district, and then used for all Random Minor closures with costs throughout that district. The 20-year database for Louisville District locks indicated that the daily repair costs averaged roughly $25,000 per day for Random Minor closures when indexed to current dollar levels. The Ohio River Navigation Investment Model (ORNIM) handles the Random Minor projected closures and costs by assigning a probability of occurrence that is kept the same in each year of the study period. The district-specific daily repair fleet cost was the same for both the main and auxiliary chambers for Random Minor closures.

2.2 Major Repair

Many features of a lock and dam deteriorate with time and use. As can be expected, the older and high use projects are closed more often for maintenance. These features require more frequent maintenance in order to keep them operational. Some of these features (miter gates, operating machinery, etc...) require the lock chamber to be closed in order to perform maintenance.

The costs and durations of many of these major repairs are dependent upon whether or not they occur in the main or auxiliary chamber. It was noted during the research of historic data that the daily repair fleet costs for major repair closures varies according to which chamber is down for repairs. For example, major maintenance main chamber repairs for Louisville District locks averaged roughly $70,000 per day when indexed to current dollar levels. The auxiliary chamber closures only averaged $34,000 per day for major repairs. The primary difference for this is the need to get main chambers open to navigation traffic as soon as possible. Additional staff is provided and repairs requiring main chamber closures are prepared far in advance with a lot of labor done prior to the closure.
All this means that the cost is high, but the closure duration is kept as short as possible, thus, increasing the daily repair cost since all the preparatory work is also charged to the same repair project. The auxiliary chamber daily operating costs are lower because the repair fleet can afford to sit in the auxiliary chamber for longer and make multiple repairs over the entire project. For example, intake screens for both main and auxiliary chambers recently required replacement at the Louisville District projects and the repair fleet was stationed in the auxiliary chamber during these repairs. While the cost did not necessarily go up, the number of days was increased, thus, a lower daily rate for auxiliary chamber maintenance repairs. The

daily rates for main chamber and auxiliary chamber repairs under this category were $70,000/day and $34,000/day, respectively, for Louisville District locks.

2.3 Major Category – ½ Speed Filling and Emptying Events.

Filling and emptying repairs were further separated into two categories to represent how often and for how long the main chamber operates at ½ filling and emptying speed. Decreased filling and emptying times only occur during valve repairs for 1200-ft chambers on the Ohio River. The auxiliary chambers only have a single filling valve and single emptying valve, and thus, any repairs to valves on the auxiliary chambers require them to be closed. The economic modeling captures this reduced processing time through the facility by computing specific transit delay curves for ½ speed operating periods of various durations. All historical data was evaluated to determine which ½ speed transit delay curve durations the Economics Team had to develop. All projected ½ speed operations are rounded to the closest duration evaluated by the Economics Team.

Most times the repair fleet is stationed in the auxiliary chamber while these main chamber valve repairs are made as this does not cause a main chamber closure, only a slower filling and emptying time. It was determined that the costs of these repairs average $25,000 per day. This is due to having a smaller repair crew completing valve repairs as compared to major miter gate repairs. There are two types of ½ speed filling and emptying events that need to be considered when evaluating this in the economic analysis. The first is when the repair fleet is stationed in the auxiliary chamber while the main chamber continues to operate at ½ speed as valve repairs are made. The second is when the auxiliary chamber remains open while valves in the main chamber are repaired.

3.0 Other Project Costs

Separate large scale dam recapitalization costs are projected for only major work such as replacement of dam gates or complex replacement and repair to the stilling slabs below the gates. These are projected out separately because the investment required to make these repairs is beyond the scope of normal O/M and most likely would require major rehabilitation funds to be provided. Other more routine dam maintenance costs are captured within the daily dam repair and random minor categories.

4.0 Projecting Future Costs and Closures

There are two basic scenarios considered to project future cost/closure schedules for. The first scenario is a 'Fix as Fails' option where the historical maintenance pattern is projected into the future, with increased maintenance required as the structure continues to age. This pattern is based upon the historical data supporting increased maintenance needs. The second scenario will be the 'Advanced Maintenance' schedule following either a major rehabilitation or large-scale improvement (auxiliary lock extension and/or new lock chamber for EDM). Once a major rehab or large-scale capacity improvement is made it is assumed that the chamber returns to a much improved maintenance scenario since all the unreliable features have been replaced as necessary.

4.1 Fix as Fails Schedule

One of the primary purposes and outputs of this analysis is the long-term investment in infrastructure required of the system in order to keep it a safe and reliable transportation link. The more age and operating cycles that the infrastructure sees, the more cumulative damage occurs to the structure. This is evident from the historical database search of the last 20 years of maintenance costs and closures. It is evident that older facilities require more frequent maintenance closures than the newer facilities. Most of these additional closures show up as Emergency Closures and Main at ½ Speed with Auxiliary Closed cases.

4.2 Advanced Maintenance Scenario

An improved maintenance scenario for this analysis means that either a major rehabilitation or large-scale capacity improvement (lock extension/new lock) has taken place and the deteriorated lock that was rehabbed or replaced no longer needs additional closures beyond what history has shown to be "typical" frequencies and durations for reliable locks. The advanced maintenance scenario contains much fewer maintenance closures than those associated with an aged and deteriorated project. This is because it is assumed all unreliable features would be replaced or substantially improved such that the lock can be returned to a maintenance schedule that is more reflective of a "reliable" lock. In addition, there would be no increased "general maintenance repairs" for auxiliary chambers that are required for older auxiliary lock chambers. The other categories of maintenance closures (with the exception of miter gate changeout modifications) are included in the advanced maintenance scenario following a major rehabilitation or lock extension/new lock. The advanced maintenance scenario is input into the ORNIM analysis after a major rehab is analyzed in the model. ORNIM tests different rehabilitation dates in the analysis and "slides" maintenance closures around to determine the optimum mix of maintenance with reliability. All maintenance up to the date of the major rehab uses the 'Fix as Fails' maintenance scenario within the analysis.

5.0 Cost and Closure Projection Results

In the Without Project scenario, it is assumed that the Olmsted project does not nor will not exist and that both Locks and Dams 52 and 53 will remain in operation as the primary channels of navigation for the duration of the study period (2069). Given that both 52 and 53 were renovated with a temporary design intended for 15 years and we are now going on 30+, the overall condition of both chambers are poor and in much need of repair. Degradation of the chambers is assumed to continue and grow more severe throughout the study period.

Therefore, contained in this Without Project condition are the two aforementioned repair scenarios, Fix-As-Fails and Advanced Maintenance. The cost and closure projections for Lock and Dam 52 can be found in Table 1-A (Fix as Fails) and Table 1-B (Advanced Maintenance). The cost and closure projections for Lock and Dam 53 can be found in Table 2-A (Fix as Fails) and Table 2-B (Advanced Maintenance).

At the time of this report repair work is currently being performed at both 52 and 53. All data within the matrices assume the work done retains its integrity and is intact for the beginning of the study period.

In the Without Project Advanced Maintenance Scenario, the cost and closure data for both dams is given as an increasing progression based on the increasing degradation the structures will undergo throughout the 50-year study period. The 15-day closure times take into account time for inspections, maintenance and emergency repairs.

For the Without Project Fix-As-Fails Scenario, the cost and closure data is given with the intention that any major failure will result in the loss of the dam for an entire navigational season. The costs incorporated include the base crew costs plus allowances for extraneous materials that are not generally included in a standard repair.

For the With Project scenario, it is assumed that the Olmsted project will come on-line in the year 2020 and will act as the primary channel of navigation through the duration of the study period. Olmsted will employ the Advanced Maintenance repair schedule throughout the period.

The cost and closure projections for Olmsted Lock and Dam can be found in Table 3 (Advanced Maintenance). Both 52 and 53 will be included in the With Project scenario for their remaining years in operation to sustain river navigation until Olmsted goes on-line (2013-2020). This 52 and 53 data will follow the same 'Fix as Fails' condition from the Without Project scenario for these same years along with additional costs of demolition at each site.

TABLE 1-A
Lock and Dam 52 – Fix As Fails

MAIN CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	MINOR CLOSURES		MAJOR CLOSURES		
	Number of Closures (Work Requires Less Than 1 Week)	Cost	Number of Closures (Work Requires More Than 1 Week)	Cost	Component
2013	0	$0	0	$0	
2014	0	$0	0	$0	
2015	3	$75,000	0	$0	
2016	0	$0	36	$12,000,000	Lower W.O. Sill
2017	3	$0	0	$0	
2018	5	$125,000	0	$0	
2019	0	$0	0	$0	
2020	10	$250,000	0	$0	
2021	1	$25,000	36	$0	Influence due to Dam Construction
2022	0	$0	18	$0	
2023	0	$0	18	$0	
2024	0	$0	39	$5,850,000	Wall Failure
2025	6	$0	39	$5,850,000	
2026	0	$0	0	$0	
2027	0	$0	0	$0	
2028	5	$125,000	0	$0	
2029	1	$25,000	0	$0	
2030	0	$0	20	$5,000,000	Upp.App.Wall
2031	5	$125,000	0	$0	
2032	0	$0	0	$0	
2033	0	$0	0	$0	
2034	5	$125,000	19	$19,000,000	Hollmitre Frame
2035	0	$0	0	$0	
2036	0	$0	0	$0	
2037	0	$0	0	$0	
2038	0	$0	0	$0	
2039	5	$125,000	0	$0	
2040	1	$25,000	36	$9,000,000	Wall Failure
2041	0	$0	36	$9,000,000	
2042	0	$0	0	$0	
2043	0	$0	0	$0	
2044	10	$250,000	0	$0	
2045	0	$0	0	$0	
2046	0	$0	39	$23,500,000	Pintle Failure
2047	0	$0	39	$19,500,000	
2048	0	$0	0	$0	
2049	0	$0	0	$29,500,000	Equipment Failure due to Seismic Event
2050	0	$0	0	$29,500,000	
2051	10	$250,000	0	$0	
2052	0	$0	18	$5,000,000	Wall Failure
2053	5	$125,000	18	$5,000,000	
2054	1	$25,000	0	$0	
2055	0	$0	0	$0	
2056	0	$0	20	$5,500,000	Low.App.Wall
2057	10	$250,000	0	$0	
2058	0	$0	0	$0	
2059	0	$0	36	$18,000,000	Hollmitre Gates
2060	3	$75,000	0	$0	
2061	0	$0	0	$0	
2062	0	$0	0	$0	
2063	10	$250,000	0	$0	
2064	0	$0	36	$9,000,000	Wall Failure
2065	0	$0	36	$9,000,000	
2066	0	$0	0	$0	
2067	0	$0	0	$0	
2068	3	$75,000	0	$0	
2069	0	$0	0	$0	
2070	10	$250,000	0	$0	

AUXILIARY CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	MINOR CLOSURES		MAJOR CLOSURES		
	Number of Closures (Work Requires Less Than 1 Week)	Cost	Number of Closures (Work Requires More Than 1 Week)	Cost	Component
2013	0	$0	0	$0	
2014	0	$0	0	$0	
2015	1	$25,000	0	$0	
2016	0	$0	0	$0	
2017	0	$125,000	0	$0	
2018	0	$0	0	$0	
2019	0	$0	0	$0	
2020	0	$0	0	$0	
2021	1	$25,000	4	$0	Influence due to Dam Construction
2022	0	$0	2	$0	
2023	0	$0	2	$0	
2024	1	$25,000	6	$0	
2025	0	$0	0	$0	
2026	0	$0	0	$0	
2027	10	$250,000	0	$0	
2028	0	$0	0	$0	
2029	0	$0	0	$0	
2030	0	$0	4	$5,000,000	Wall Failure
2031	0	$0	4	$5,000,000	
2032	0	$0	0	$0	
2033	0	$0	0	$0	
2034	3	$75,000	0	$0	
2035	1	$25,000	0	$0	
2036	0	$0	0	$0	
2037	0	$0	0	$0	
2038	0	$0	0	$0	
2039	5	$125,000	0	$0	
2040	0	$0	0	$0	
2041	0	$0	0	$0	
2042	0	$0	0	$0	
2043	10	$250,000	0	$0	
2044	0	$0	0	$0	
2045	0	$0	0	$0	
2046	3	$125,000	0	$0	
2047	0	$0	0	$0	
2048	0	$0	4	$15,000,000	Hollmitre Gates
2049	0	$0	1	$12,000,000	Upstr.Wall Failure due to Seismic Event
2050	0	$0	1	$12,000,000	
2051	10	$250,000	0	$0	
2052	1	$0	0	$0	
2053	0	$0	4	$5,000,000	Wall Failure
2054	0	$0	4	$5,000,000	
2055	0	$0	0	$0	
2056	0	$0	0	$0	
2057	0	$0	0	$0	
2058	3	$125,000	0	$0	
2059	0	$0	0	$0	
2060	1	$25,000	0	$0	
2061	0	$0	0	$0	
2062	0	$0	0	$0	
2063	3	$75,000	0	$0	
2064	0	$0	0	$0	
2065	3	$125,000	0	$0	
2066	0	$0	0	$0	
2067	10	$250,000	0	$0	
2068	3	$0	0	$0	
2069	3	$75,000	0	$0	
2070	0	$0	0	$0	

DAM MAINTENANCE AND CLOSURE COSTS

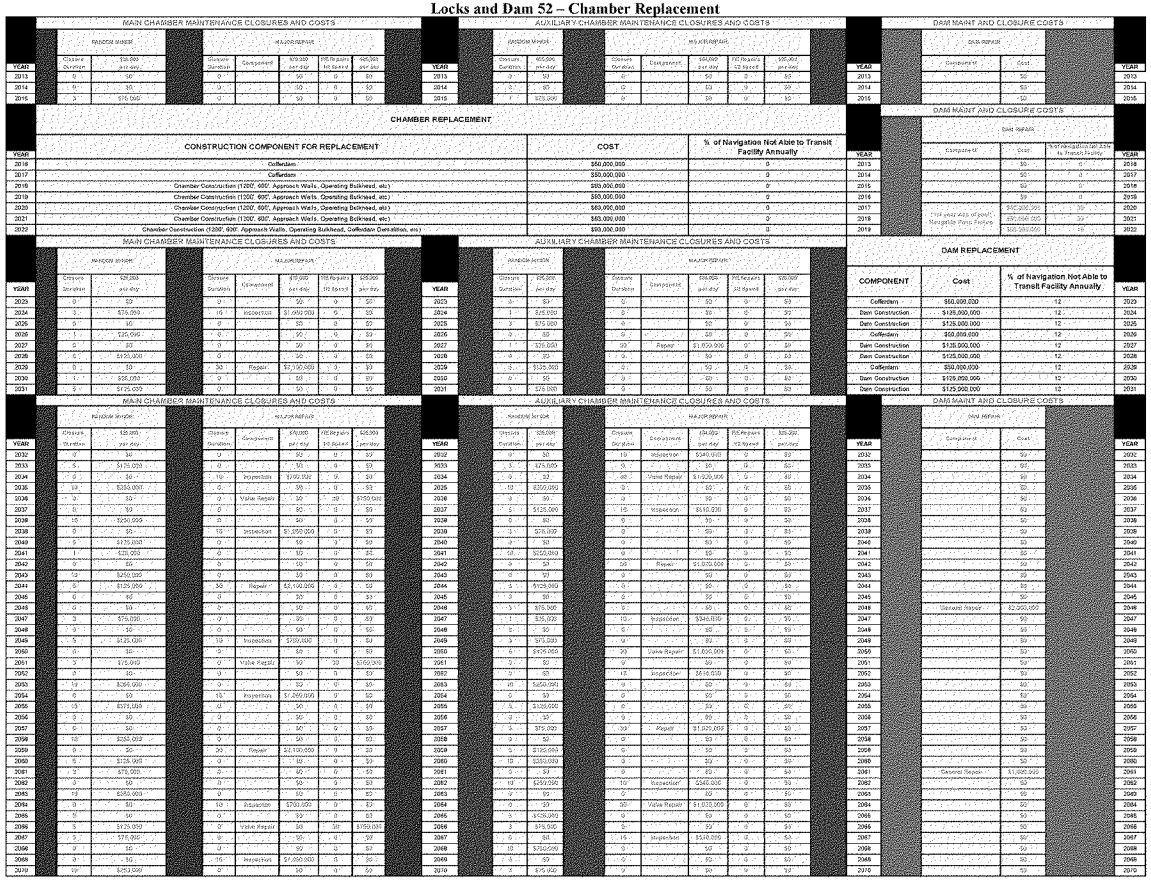
YEAR	DAM CLOSURES		
	Number of Closures (Work Requires More Than 1 Week)	Cost	Component
2013	0	$0	
2014	0	$0	
2015	0	$0	
2016	0	$0	
2017	0	$0	
2018	0	$0	
2019	0	$0	
2020	0	$0	
2021	36	$90,000,000	
2022	36	$90,000,000	134 years loss of gate Radgate Pass Failure
2023	18	$60,000,000	
2024	0	$0	
2025	0	$0	
2026	0	$0	
2027	0	$0	
2028	0	$0	
2029	0	$0	
2030	0	$0	
2031	0	$0	
2032	0	$0	
2033	0	$0	
2034	19	$380,000	Women Failure
2035	0	$0	
2036	0	$0	
2037	0	$0	
2038	0	$0	
2039	0	$0	
2040	0	$0	
2041	0	$0	
2042	39	$10,050,000	
2043	6	$10,050,000	Bearings Failure
2044	5	$10,000,000	
2045	0	$0	
2046	0	$0	
2047	0	$0	
2048	0	$0	
2049	0	$0	
2050	0	$0	
2051	0	$0	
2052	18	$900,000	Anchor Failure
2053	0	$0	
2054	0	$0	
2055	0	$0	
2056	0	$0	
2057	0	$0	
2058	0	$0	
2059	0	$0	
2060	0	$0	
2061	36	$90,000,000	
2062	0	$90,000,000	Bearings Failure
2063	0	$10,000,000	
2064	0	$0	
2065	0	$0	
2066	0	$0	
2067	0	$0	
2068	0	$0	
2069	0	$0	
2070	0	$0	

TABLE 1-B
Lock and Dam 53 – Fix As Fails

	MAIN CHAMBER MAINTENANCE CLOSURES AND COSTS							AUXILIARY CHAMBER MAINTENANCE CLOSURES AND COSTS							DAM MAINTENANCE AND CLOSURE COSTS						
	Incidents causing:							Incidents causing:							No. of Incidents:						
YEAR	Number of Days Closed to Normal Lock Traffic	$M NSD Cost	No. of Navigation Restraint Failures (Annually Assessed)	$M NSD Cost	Comments	YEAR	Number of Days Closed to Normal Lock Traffic	$M NSD Cost	No. of Navigation Restraint Failures (Annually Assessed)	$M NSD Cost	Comments	YEAR	No. of Navigation Restraint Failures (Annually Assessed)	$M NSD Cost	Comments	YEAR	No. of Navigation Restraint Failures (Annually Assessed)	$M NSD Cost	Comments
2013	0	$0	0	$0		2013	0	$0	0	$0		2013	0	$0		2013	0	$0	
2014	0	$0	0	$0		2014	0	$0	0	$0		2014	0	$0		2014	0	$0	
2015	0	$0	0	$0		2015	3	$35,000	0	$0		2015	0	$0		2015	0	$0	
2016	5	$125,000	0	$0	Earthquake Failure	2016	0	$0	0	$0		2016	0	$0		2016	0	$0	
2017	0	$0	0	$0		2017	0	$0	0	$0		2017	0	$0		2017	0	$0	
2018	0	$0	0	$0		2018	0	$0	0	$0		2018	0	$0		2018	0	$0	
2019	0	$0	0	$0		2019	0	$0	0	$0		2019	0	$0		2019	0	$0	
2020	0	$0	0	$0		2020	0	$0	0	$0		2020	0	$0		2020	0	$0	
2021	0	$0	0	$0		2021	0	$0	0	$0		2021	0	$0		2021	0	$0	
2022	0	$0	0	$0		2022	0	$0	0	$0		2022	0	$0		2022	0	$0	
2023	0	$0	0	$0		2023	0	$0	0	$0		2023	0	$0		2023	0	$0	
2024	0	$0	0	$0		2024	0	$0	0	$0		2024	0	$0		2024	0	$0	
2025	0	$0	0	$0		2025	0	$0	0	$0		2025	0	$0		2025	0	$0	
2026	0	$0	0	$0		2026	0	$0	0	$0		2026	0	$0		2026	0	$0	
2027	0	$0	0	$0		2027	0	$0	0	$0		2027	0	$0		2027	0	$0	
2028	0	$0	0	$0		2028	0	$0	0	$0		2028	0	$0		2028	0	$0	
2029	0	$0	0	$0		2029	0	$0	0	$0		2029	0	$0		2029	0	$0	
2030	0	$0	0	$0		2030	0	$0	0	$0		2030	0	$0		2030	0	$0	
2031	0	$0	0	$0		2031	0	$0	0	$0		2031	0	$0		2031	0	$0	
2032	0	$0	0	$0		2032	0	$0	0	$0		2032	0	$0		2032	0	$0	
2033	0	$0	0	$0		2033	0	$0	0	$0		2033	0	$0		2033	0	$0	
2034	0	$0	0	$0		2034	0	$0	0	$0		2034	0	$0		2034	0	$0	
2035	0	$0	0	$0		2035	0	$0	0	$0		2035	0	$0		2035	0	$0	
2036	0	$0	0	$0		2036	0	$0	0	$0		2036	0	$0		2036	0	$0	
2037	0	$0	0	$0		2037	0	$0	0	$0		2037	0	$0		2037	0	$0	
2038	0	$0	0	$0		2038	0	$0	0	$0		2038	0	$0		2038	0	$0	
2039	0	$0	0	$0		2039	0	$0	0	$0		2039	0	$0		2039	0	$0	
2040	0	$0	0	$0		2040	0	$0	0	$0		2040	0	$0		2040	0	$0	
2041	0	$0	0	$0		2041	0	$0	0	$0		2041	0	$0		2041	0	$0	
2042	0	$0	0	$0		2042	0	$0	0	$0		2042	0	$0		2042	0	$0	
2043	0	$0	0	$0		2043	0	$0	0	$0		2043	0	$0		2043	0	$0	
2044	0	$0	0	$0		2044	0	$0	0	$0		2044	0	$0		2044	0	$0	
2045	0	$0	0	$0		2045	0	$0	0	$0		2045	0	$0		2045	0	$0	
2046	0	$0	0	$0		2046	0	$0	0	$0		2046	0	$0		2046	0	$0	
2047	0	$0	0	$0		2047	0	$0	0	$0		2047	0	$0		2047	0	$0	
2048	0	$0	0	$0		2048	0	$0	0	$0		2048	0	$0		2048	0	$0	
2049	1	$25,000	0	$0		2049	0	$0	0	$0		2049	0	$0		2049	0	$0	
2050	0	$0	0	$0		2050	0	$0	0	$0		2050	0	$0		2050	0	$0	
2051	0	$0	0	$0		2051	0	$0	0	$0		2051	0	$0		2051	0	$0	
2052	0	$0	0	$0		2052	0	$0	0	$0		2052	0	$0		2052	0	$0	
2053	0	$0	0	$0		2053	0	$0	0	$0		2053	0	$0		2053	0	$0	
2054	0	$0	0	$0		2054	0	$0	0	$0		2054	0	$0		2054	0	$0	
2055	0	$0	0	$0		2055	0	$0	0	$0		2055	0	$0		2055	0	$0	
2056	0	$0	0	$0		2056	0	$0	0	$0		2056	0	$0		2056	0	$0	
2057	1	$25,000	0	$0		2057	0	$0	0	$0		2057	0	$0		2057	0	$0	
2058	10	$250,000	0	$0		2058	0	$0	0	$0		2058	0	$0		2058	0	$0	
2059	0	$0	0	$0		2059	0	$0	0	$0		2059	0	$0		2059	0	$0	
2060	0	$0	0	$0		2060	0	$0	0	$0		2060	0	$0		2060	0	$0	
2061	0	$0	0	$0		2061	0	$0	0	$0		2061	0	$0		2061	0	$0	
2062	0	$0	0	$0		2062	0	$0	0	$0		2062	0	$0		2062	0	$0	
2063	0	$0	0	$0		2063	0	$0	0	$0		2063	0	$0		2063	0	$0	
2064	10	$250,000	0	$0		2064	0	$0	0	$0		2064	0	$0		2064	0	$0	
2065	0	$0	0	$0		2065	0	$0	0	$0		2065	0	$0		2065	0	$0	
2066	0	$0	0	$0		2066	0	$0	0	$0		2066	0	$0		2066	0	$0	
2067	2	$50,000	0	$0		2067	0	$0	0	$0		2067	0	$0		2067	0	$0	
2068	0	$0	0	$0		2068	0	$0	0	$0		2068	0	$0		2068	0	$0	
2069	0	$0	0	$0		2069	0	$0	0	$0		2069	0	$0		2069	0	$0	
2070	0	$0	0	$0		2070	0	$0	0	$0		2070	0	$0		2070	0	$0	

TABLE 2-A

Locks and Dam 52 – Chamber Replacement



MAIN CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Random Minor: Closure Duration	Random Minor: $28,269 per day	Major Repair: Closure Duration	Major Repair: Component	Major Repair: $79,000 per day	Major Repair: HS Repairs 10 Years	Major Repair: $95,269 per day
2013	0	$0	0		$0	0	$0
2014	1	$0	0		$0	0	$0
2015	1	$79,000	0		$0	0	$0
2016	0	$0	0		$0	0	$0
2017	0	$0	0		$0	0	$0
2018	0	$0	0		$0	0	$0
2019	0	$0	0		$0	0	$0
2020	0	$0	0		$0	0	$0
2021	0	$0	0		$0	0	$0
2022	0	$0	0		$0	0	$0
2023	0	$0	0		$0	0	$0
2024	1	$79,000	15	Inspection	$1,050,000	0	$0
2025	0	$0	0		$0	0	$0
2026	1	$28,000	0		$0	0	$0
2027	0	$0	0		$0	0	$0
2028	0	$28,000	0		$0	0	$0
2029	0	$0	30	Repair	$2,100,000	0	$0
2030	1	$28,000	0		$0	0	$0
2031	0	$28,000	0		$0	0	$0
2032	0	$0	0		$0	0	$0
2033	0	$28,000	0		$0	0	$0
2034	0	$0	15	Inspection	$1,050,000	0	$0
2035	0	$28,000	0		$0	0	$0
2036	0	$0	0	Valve Repair	$0	20	$150,000
2037	0	$0	0		$0	0	$0
2038	0	$0	0		$0	0	$0
2039	0	$0	15	Inspection	$1,050,000	0	$0
2040	0	$28,000	0		$0	0	$0
2041	0	$28,000	0		$0	0	$0
2042	0	$0	0		$0	0	$0
2043	0	$28,000	0		$0	0	$0
2044	0	$28,000	30	Repair	$2,100,000	0	$0
2045	0	$0	0		$0	0	$0
2046	0	$0	0		$0	0	$0
2047	3	$79,000	0		$0	0	$0
2048	0	$0	0		$0	0	$0
2049	5	$28,000	15	Inspection	$1,050,000	0	$0
2050	0	$0	0		$0	0	$0
2051	2	$79,000	0	Valve Repair	$0	20	$150,000
2052	0	$0	0		$0	0	$0
2053	10	$280,000	0		$0	0	$0
2054	0	$0	15	Inspection	$1,050,000	0	$0
2055	13	$371,000	0		$0	0	$0
2056	3	$0	0		$0	0	$0
2057	0	$0	0		$0	0	$0
2058	10	$280,000	0		$0	0	$0
2059	0	$0	30	Repair	$2,100,000	0	$0
2060	5	$28,000	0		$0	0	$0
2061	2	$79,000	0		$0	0	$0
2062	0	$0	0		$0	0	$0
2063	10	$280,000	0		$0	0	$0
2064	0	$0	10	Inspection	$700,000	0	$0
2065	2	$0	0		$0	0	$0
2066	5	$28,000	0	Valve Repair	$0	20	$150,000
2067	2	$79,000	0		$0	0	$0
2068	0	$0	0		$0	0	$0
2069	0	$0	15	Inspection	$1,050,000	0	$0
2070	10	$283,000	0		$0	0	$0

AUXILIARY CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Random Minor: Closure Duration	Random Minor: $95,000 per day	Major Repair: Closure Duration	Major Repair: Component	Major Repair: $84,000 per day	Major Repair: HS Repairs 10 Years	Major Repair: $95,000 per day
2013	0	$0	0		$0	0	$0
2014	1	$95,000	0		$0	0	$0
2015	1	$95,000	0		$0	0	$0
2016	0	$0	0		$0	0	$0
2017	0	$0	0		$0	0	$0
2018	0	$0	0		$0	0	$0
2019	0	$0	0		$0	0	$0
2020	0	$0	0		$0	0	$0
2021	0	$0	0		$0	0	$0
2022	0	$0	0		$0	0	$0
2023	0	$0	0		$0	0	$0
2024	1	$95,000	0		$0	0	$0
2025	1	$95,000	0		$0	0	$0
2026	0	$0	0		$0	0	$0
2027	1	$95,000	0		$0	0	$0
2028	0	$0	0		$0	0	$0
2029	1	$95,000	0		$0	0	$0
2030	0	$0	0		$0	0	$0
2031	1	$95,000	0		$0	0	$0
2032	0	$0	0		$0	0	$0
2033	1	$95,000	0		$0	0	$0
2034	0	$0	0		$0	0	$0
2035	1	$95,000	0		$0	0	$0
2036	0	$0	0		$0	0	$0
2037	1	$95,000	0		$0	0	$0
2038	0	$0	0		$0	0	$0
2039	1	$95,000	0		$0	0	$0
2040	0	$0	0		$0	0	$0
2041	1	$95,000	0		$0	0	$0
2042	0	$0	0		$0	0	$0
2043	0	$0	0		$0	0	$0
2044	1	$95,000	0		$0	0	$0
2045	0	$0	0		$0	0	$0
2046	1	$95,000	0		$0	0	$0
2047	1	$95,000	0		$0	0	$0
2048	1	$0	0		$0	0	$0
2049	1	$95,000	0		$0	0	$0
2050	0	$95,000	0		$0	0	$0
2051	0	$0	0		$0	0	$0
2052	1	$0	0		$0	0	$0
2053	0	$95,000	0		$0	0	$0
2054	0	$0	0		$0	0	$0
2055	1	$95,000	0		$0	0	$0
2056	0	$0	0		$0	0	$0
2057	1	$95,000	0		$0	0	$0
2058	0	$0	0		$0	0	$0
2059	0	$95,000	0		$0	0	$0
2060	1	$95,000	0		$0	0	$0
2061	0	$0	0		$0	0	$0
2062	0	$95,000	0		$0	0	$0
2063	0	$0	0		$0	0	$0
2064	0	$0	0		$0	0	$0
2065	1	$95,000	0		$0	0	$0
2066	0	$0	0		$0	0	$0
2067	1	$95,000	0		$0	0	$0
2068	0	$0	0		$0	0	$0
2069	1	$0	0		$0	0	$0
2070	1	$95,000	0		$0	0	$0

DAM MAINT AND CLOSURE COSTS

YEAR	Dam Repair: Component	Dam Repair: Cost	Dam Repair: % of Navigation Not Able to Transit Facility	YEAR
2013		$0	0	2013
2014		$0	0	2014
2015		$0	0	2015
2016		$0	0	2016
2017		$0	0	2017
2018	100 year rehab of post Navigation Pool Raise	$50,000,000	50	2018
2019		$50,000,000	50	2019
2020		$0	0	2020
2021		$0	0	2021
2022		$0	0	2022
2023		$0	0	2023
2024		$0	0	2024
2025		$0	0	2025
2026		$0	0	2026
2027		$0	0	2027
2028		$0	0	2028
2029		$0	0	2029
2030		$0	0	2030
2031		$0	0	2031
2032		$0	0	2032
2033		$0	0	2033
2034		$0	0	2034
2035		$0	0	2035
2036		$0	0	2036
2037		$0	0	2037
2038		$0	0	2038
2039		$0	0	2039
2040		$0	0	2040
2041		$0	0	2041
2042		$0	0	2042
2043		$0	0	2043
2044		$0	0	2044
2045		$0	0	2045
2046		$0	0	2046
2047		$0	0	2047
2048		$0	0	2048
2049		$0	0	2049
2050		$0	0	2050
2051		$0	0	2051
2052		$0	0	2052
2053		$0	0	2053
2054		$0	0	2054
2055		$0	0	2055
2056		$0	0	2056
2057		$0	0	2057
2058		$0	0	2058
2059		$0	0	2059
2060		$0	0	2060
2061		$0	0	2061
2062		$0	0	2062
2063		$0	0	2063
2064		$0	0	2064
2065		$0	0	2065
2066		$0	0	2066
2067		$0	0	2067
2068		$0	0	2068
2069		$0	0	2069
2070		$0	0	2070

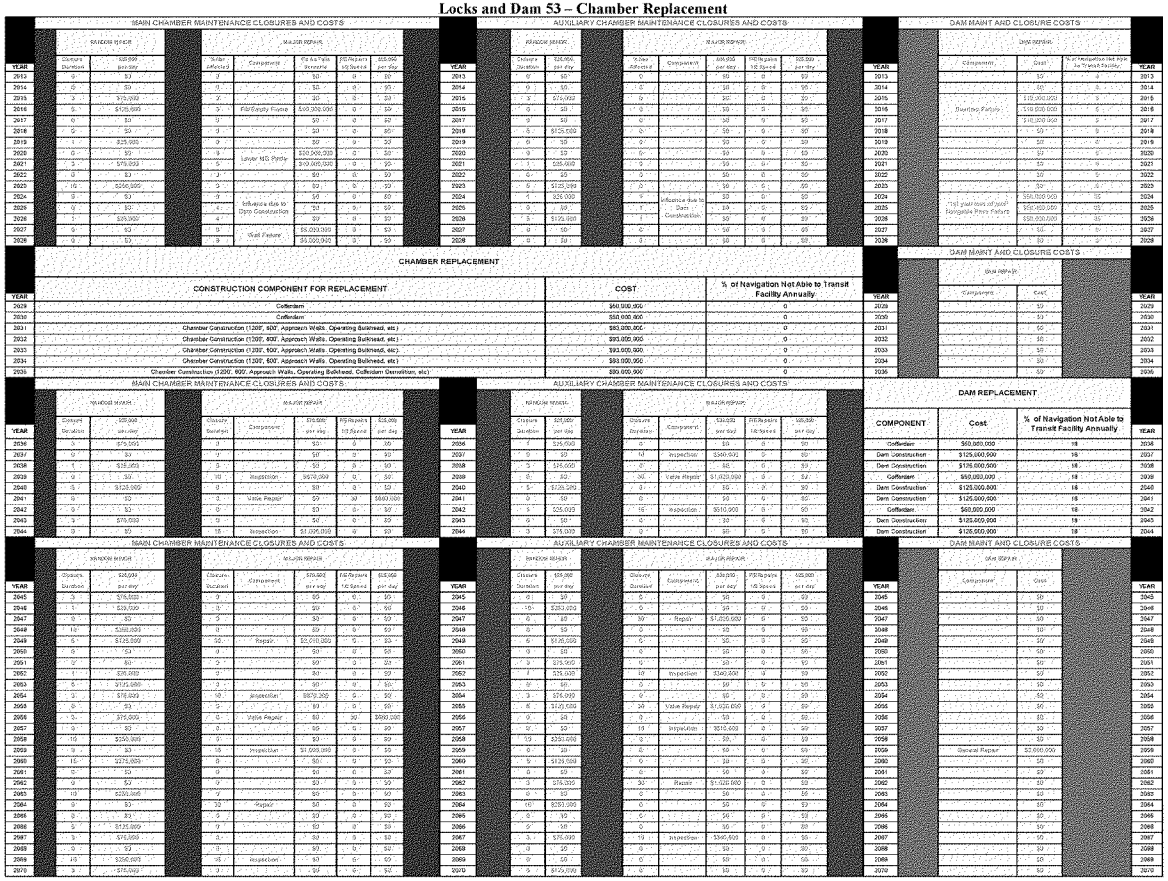
CHAMBER REPLACEMENT

YEAR	CONSTRUCTION COMPONENT FOR REPLACEMENT	COST	% of Navigation Not Able to Transit Facility Annually	YEAR
2016	Cofferdam	$60,000,000	0	2013
2017	Cofferdam	$60,000,000	0	2014
2018	Chamber Construction (1200', 600', Approach Walls, Operating Bulkhead, etc)	$60,000,000	0	2015
2019	Chamber Construction (1200', 600', Approach Walls, Operating Bulkhead, etc)	$65,000,000	0	2016
2020	Chamber Construction (1200', 600', Approach Walls, Operating Bulkhead, etc)	$65,000,000	0	2017
2021	Chamber Construction (1200', 600', Approach Walls, Operating Bulkhead, etc)	$65,000,000	0	2018
2022	Chamber Construction (1200', 600', Approach Walls, Operating Bulkhead, Cofferdam Demolition, etc)	$65,000,000	0	2019

DAM REPLACEMENT

COMPONENT	Cost	% of Navigation Not Able to Transit Facility Annually	YEAR
Cofferdam	$60,000,000	12	2023
Dam Construction	$125,000,000	12	2024
Dam Construction	$125,000,000	12	2025
Cofferdam	$60,000,000	12	2026
Dam Construction	$125,000,000	12	2027
Dam Construction	$125,000,000	12	2028
Cofferdam	$60,000,000	12	2029
Dam Construction	$125,000,000	12	2030
Dam Construction	$125,000,000	12	2031

TABLE 2-B
Locks and Dam 53 – Chamber Replacement



MAIN CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Routine Closure Duration	Routine $25,000 per day	Major Repair Failure Affected	Major Repair Component	Major Repair Fix As Fails Interval	Major Repair Fix Repairs ND Service	Major Repair $25,000 per day
2013	0	$0	0		$0	0	$0
2014	0	$0	0		$0	0	$0
2015	3	$75,000	0		$0	0	$0
2016	5	$125,000	5	Pit/Empty Frame	$50,000,000	0	$0
2017	0	$0	0		$0	0	$0
2018	5	$0	0		$0	0	$0
2019	1	$25,000	0		$0	0	$0
2020	0	$0	0	Lower MS Piers	$50,000,000	0	$0
2021	3	$75,000	0		$50,000,000	0	$0
2022	0	$0	0		$0	0	$0
2023	10	$250,000	0		$0	0	$0
2024	0	$0	0		$0	0	$0
2025	0	$0	0	Influence due to Dam Construction	$0	0	$0
2026	1	$25,000	0		$0	0	$0
2027	0	$0	0		$0	0	$0
2028	0	$0	0	Wall Failure	$5,000,000	0	$0

AUXILIARY CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Routine Closure Duration	Routine $25,000 per day	Major Repair Failure Affected	Major Repair Component	Major Repair $30,000 per day	Major Repair Fix Repairs ND Service	Major Repair $25,000 per day
2013	0	$0	0		$0	0	$0
2014	0	$0	0		$0	0	$0
2015	3	$75,000	0		$0	0	$0
2016	5	$0	0		$0	0	$0
2017	0	$0	0		$0	0	$0
2018	5	$125,000	0		$0	0	$0
2019	0	$0	0		$0	0	$0
2020	0	$0	0		$0	0	$0
2021	1	$25,000	0		$0	0	$0
2022	0	$0	0		$0	0	$0
2023	5	$125,000	0		$0	0	$0
2024	0	$0	0		$0	0	$0
2025	0	$0	1	Influence due to Dam Construction	$0	0	$0
2026	3	$125,000	0		$0	0	$0
2027	0	$0	0		$0	0	$0
2028	0	$0	1		$0	0	$0

DAM MAINT AND CLOSURE COSTS

YEAR	Routine Repair Component	Routine Repair Cost	% of Navigation Not Able to Transit Facility	YEAR
2013		$0	0	2013
2014		$0	0	2014
2015		$0	0	2015
2016	Tainting Facility	$10,000,000	5	2016
2017		$10,000,000	5	2017
2018		$0	0	2018
2019		$0	0	2019
2020		$0	0	2020
2021		$0	0	2021
2022		$0	0	2022
2023		$0	0	2023
2024		$50,000,000	10	2024
2025	Tainting Facility	$50,000,000	10	2025
2026		$50,000,000	10	2026
2027		$0	0	2027
2028		$0	0	2028

CHAMBER REPLACEMENT

YEAR	CONSTRUCTION COMPONENT FOR REPLACEMENT	COST	% of Navigation Not Able to Transit Facility Annually
2029	Cofferdam	$60,000,000	0
2030	Cofferdam	$60,000,000	0
2031	Chamber Construction (1200', 600', Approach Walls, Operating Bullhead, etc.)	$93,000,000	0
2032	Chamber Construction (1200', 600', Approach Walls, Operating Bullhead, etc.)	$93,000,000	0
2033	Chamber Construction (1200', 600', Approach Walls, Operating Bullhead, etc.)	$93,000,000	0
2034	Chamber Construction (1200', 600', Approach Walls, Operating Bullhead, etc.)	$93,000,000	0
2035	Chamber Construction (1200', 600', Approach Walls, Operating Bullhead, Cofferdam Demolition, etc)	$93,000,000	0

DAM MAINT AND CLOSURE COSTS

YEAR	Routine Repair Component	Routine Repair Cost	YEAR
2029		$0	2029
2030		$0	2030
2031		$0	2031
2032		$0	2032
2033		$0	2033
2034		$0	2034
2035		$0	2035

MAIN CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Routine Closure Duration	Routine $25,000 per day	Major Repair Failure Affected	Major Repair Component	Major Repair $75,000 per day	Major Repair Fix Repairs ND Service	Major Repair $25,000 per day
2036	3	$75,000	0		$0	0	$0
2037	0	$0	0		$0	0	$0
2038	1	$25,000	0		$0	0	$0
2039	0	$0	10	Inspection	$570,000	0	$0
2040	5	$125,000	0		$0	0	$0
2041	0	$0	1	Valve Repair	$0	30	$840,000
2042	0	$0	0		$0	0	$0
2043	3	$75,000	0		$0	0	$0
2044	0	$0	15	Inspection	$1,005,000	0	$0

AUXILIARY CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Routine Closure Duration	Routine $25,000 per day	Major Repair Failure Affected	Major Repair Component	Major Repair $30,000 per day	Major Repair Fix Repairs ND Service	Major Repair $25,000 per day
2036	0	$25,000	0		$0	0	$0
2037	0	$0	10	Inspection	$240,000	0	$0
2038	3	$75,000	0		$0	0	$0
2039	0	$0	30	Valve Repair	$1,020,000	0	$0
2040	5	$125,000	0		$0	0	$0
2041	0	$0	0		$0	0	$0
2042	3	$75,000	15	Inspection	$510,000	0	$0
2043	0	$0	0		$0	0	$0
2044	3	$75,000	0		$0	0	$0

DAM REPLACEMENT

COMPONENT	Cost	% of Navigation Not Able to Transit Facility Annually	YEAR
Cofferdam	$60,000,000	10	2036
Dam Construction	$125,000,000	10	2037
Dam Construction	$125,000,000	10	2038
Cofferdam	$60,000,000	10	2039
Dam Construction	$125,000,000	10	2040
Dam Construction	$125,000,000	10	2041
Cofferdam	$60,000,000	10	2042
Dam Construction	$125,000,000	10	2043
Dam Construction	$125,000,000	10	2044

MAIN CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Routine Closure Duration	Routine $25,000 per day	Major Repair Failure Affected	Major Repair Component	Major Repair $75,000 per day	Major Repair Fix Repairs ND Service	Major Repair $25,000 per day
2045	3	$75,000	0		$0	0	$0
2046	1	$25,000	0		$0	0	$0
2047	0	$0	0		$0	0	$0
2048	10	$250,000	0		$0	0	$0
2049	5	$125,000	10	Repair	$2,010,000	0	$0
2050	0	$0	0		$0	0	$0
2051	0	$0	0		$0	0	$0
2052	1	$25,000	0		$0	0	$0
2053	5	$125,000	0		$0	0	$0
2054	0	$0	10	Inspection	$570,000	0	$0
2055	0	$0	0		$0	0	$0
2056	5	$75,000	0	Valve Repair	$0	30	$660,000
2057	0	$0	0		$0	0	$0
2058	10	$250,000	0		$0	0	$0
2059	0	$0	15	Inspection	$1,005,000	0	$0
2060	15	$375,000	0		$0	0	$0
2061	0	$0	0		$0	0	$0
2062	0	$0	0		$0	0	$0
2063	10	$250,000	0		$0	0	$0
2064	0	$0	20	Repair	$0	0	$0
2065	0	$0	0		$0	0	$0
2066	5	$125,000	0		$0	0	$0
2067	3	$75,000	0		$0	0	$0
2068	0	$0	0		$0	0	$0
2069	10	$250,000	15	Inspection	$0	0	$0
2070	3	$75,000	0		$0	0	$0

AUXILIARY CHAMBER MAINTENANCE CLOSURES AND COSTS

YEAR	Routine Closure Duration	Routine $25,000 per day	Major Repair Failure Affected	Major Repair Component	Major Repair $30,000 per day	Major Repair Fix Repairs ND Service	Major Repair $25,000 per day
2045	21	$0	0		$0	0	$0
2046	10	$262,500	0		$0	0	$0
2047	6	$0	30	Repair	$1,020,000	0	$0
2048	6	$0	0		$0	0	$0
2049	6	$150,000	0		$0	0	$0
2050	0	$0	0		$0	0	$0
2051	3	$75,000	0		$0	0	$0
2052	7	$175,000	10	Inspection	$340,000	0	$0
2053	0	$0	0		$0	0	$0
2054	3	$75,000	0		$0	0	$0
2055	6	$150,000	30	Valve Repair	$1,020,000	0	$0
2056	0	$0	0		$0	0	$0
2057	0	$0	10	Inspection	$510,000	0	$0
2058	13	$325,000	0		$0	0	$0
2059	0	$0	0		$0	0	$0
2060	9	$225,000	0		$0	0	$0
2061	0	$0	0		$0	0	$0
2062	3	$75,000	30	Repair	$1,020,000	0	$0
2063	0	$0	0		$0	0	$0
2064	10	$250,000	0		$0	0	$0
2065	0	$0	0		$0	0	$0
2066	2	$0	0		$0	0	$0
2067	3	$75,000	10	Inspection	$340,000	0	$0
2068	0	$0	0		$0	0	$0
2069	0	$0	0		$0	0	$0
2070	3	$75,000	0		$0	0	$0

DAM MAINT AND CLOSURE COSTS

YEAR	Routine Repair Component	Routine Repair Cost	YEAR
2045		$0	2045
2046		$0	2046
2047		$0	2047
2048		$0	2048
2049		$0	2049
2050		$0	2050
2051		$0	2051
2052		$0	2052
2053		$0	2053
2054		$0	2054
2055		$0	2055
2056		$0	2056
2057		$0	2057
2058		$0	2058
2059	General Repair	$2,000,000	2059
2060		$0	2060
2061		$0	2061
2062		$0	2062
2063		$0	2063
2064		$0	2064
2065		$0	2065
2066		$0	2066
2067		$0	2067
2068		$0	2068
2069		$0	2069
2070		$0	2070

TABLE 3
Olmsted Locks and Dam

| RIVERWARD CHAMBER MAINTENANCE CLOSURES AND COSTS | | |

ATTACHMENT 2

COMMODITY-LEVEL WATERWAY TRAFFIC DEMAND FORECASTS FOR LOCKS 52 AND 53

Table 1

Utility-Based -- Projected Lock Traffic Demands

	2000	2010	2020	2030	2040	2050	2060
L&D 53							
Coal	19,979,459	18,522,253	19,726,051	21,699,622	23,880,182	26,116,153	28,532,887
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	10,860,590	13,641,592	15,526,551	16,637,828	17,083,787	17,430,972	17,723,528
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,201,211	10,125,988	10,586,819	11,240,591	12,292,070	13,455,278	14,734,798
Ores & Minerals	7,746,001	8,522,711	9,222,371	10,074,282	11,186,852	12,358,172	13,593,265
Iron & Steel	12,977,650	14,694,154	16,336,242	17,717,280	19,025,627	20,369,822	21,746,914
Other	10,296,308	11,944,371	13,247,950	14,287,077	15,111,755	15,930,491	16,763,220
Total	85,330,430	93,182,659	102,088,969	111,145,093	120,523,003	128,529,218	137,070,428
L&D 52							
Coal	25,738,315	31,930,309	35,265,098	39,702,719	44,269,143	46,518,440	51,159,512
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	12,043,976	15,136,071	17,231,907	18,469,269	18,967,019	19,349,586	19,666,209
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,150,807	10,075,584	10,536,415	11,190,187	12,241,666	13,404,874	14,684,394
Ores & Minerals	7,665,200	8,432,349	9,122,928	9,964,902	11,064,406	12,221,849	13,442,212
Iron & Steel	12,934,006	14,652,283	16,289,693	17,666,797	18,971,418	20,311,782	21,684,946
Other	9,997,269	11,575,016	12,832,698	13,848,382	14,667,626	15,484,782	16,317,657
Total	91,798,784	107,533,202	118,721,724	130,330,669	142,124,008	150,159,643	160,930,746

Appendix A Attachment 2 - 3

Table 2

Utility-Based High -- Projected Lock Traffic Demands

	2000	2010	2020	2030	2040	2050	2060
L&D 53							
Coal	19,979,459	18,522,253	20,658,890	23,051,061	26,381,263	29,633,374	33,427,274
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	10,860,590	13,641,592	15,526,551	16,637,828	17,083,787	17,430,972	17,723,528
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,201,211	10,125,988	10,586,819	11,240,591	12,292,070	13,455,278	14,734,798
Ores & Minerals	7,746,001	8,522,711	9,222,371	10,074,282	11,186,852	12,358,172	13,593,265
Iron & Steel	12,977,650	14,694,154	16,336,242	17,717,280	19,025,627	20,369,822	21,746,914
Other	10,296,308	11,944,371	13,247,950	14,287,077	15,111,755	15,930,491	16,763,220
Total	85,330,430	93,182,659	103,021,808	112,496,532	123,024,084	132,046,439	141,964,815
L&D 52							
Coal	25,738,315	31,930,309	37,735,286	44,039,600	51,002,715	54,770,603	62,605,210
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	12,043,976	15,136,071	17,231,907	18,469,269	18,967,019	19,349,586	19,666,209
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,150,807	10,075,584	10,536,415	11,190,187	12,241,666	13,404,874	14,684,394
Ores & Minerals	7,665,200	8,432,349	9,122,928	9,964,902	11,064,406	12,221,849	13,442,212
Iron & Steel	12,934,006	14,652,283	16,289,693	17,666,797	18,971,418	20,311,782	21,684,946
Other	9,997,269	11,575,016	12,832,698	13,848,382	14,667,626	15,484,782	16,317,657
Total	91,798,784	107,533,202	121,191,912	134,667,550	148,857,580	158,411,806	172,376,444

Table 3

NAAQS -- Projected Lock Traffic Demands

	2000	2010	2020	2030	2040	2050	2060
L&D 53							
Coal	19,979,459	17,396,277	20,451,281	18,557,582	20,410,333	21,564,515	23,521,703
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	10,860,590	13,641,592	15,526,551	16,637,828	17,083,787	17,430,972	17,723,528
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,201,211	10,125,988	10,586,819	11,240,591	12,292,070	13,455,278	14,734,798
Ores & Minerals	7,746,001	8,522,711	9,222,371	10,074,282	11,186,852	12,358,172	13,593,265
Iron & Steel	12,977,650	14,694,154	16,336,242	17,717,280	19,025,627	20,369,822	21,746,914
Other	10,296,308	11,844,233	13,265,286	14,306,798	15,133,799	15,954,060	16,789,218
Total	85,330,430	91,956,545	102,831,535	108,022,774	117,075,198	124,001,149	132,085,242
L&D 52							
Coal	25,738,315	38,590,890	46,195,302	51,289,914	56,795,807	60,008,545	65,625,983
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	12,043,976	15,136,071	17,231,907	18,469,269	18,967,019	19,349,586	19,666,209
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,150,807	10,075,584	10,536,415	11,190,187	12,241,666	13,404,874	14,684,394
Ores & Minerals	7,665,200	8,432,349	9,122,928	9,964,902	11,064,406	12,221,849	13,442,212
Iron & Steel	12,934,006	14,652,283	16,289,693	17,666,797	18,971,418	20,311,782	21,684,946
Other	9,997,269	11,474,878	12,850,034	13,868,103	14,689,670	15,508,351	16,343,655
Total	91,798,784	114,093,645	129,669,264	141,937,585	154,672,716	163,673,317	175,423,215

Table 4

Clear Skies -- Projected Lock Traffic Demands

	2000	2010	2020	2030	2040	2050	2060
L&D 53							
Coal	19,979,459	11,342,341	11,204,234	11,521,294	12,206,343	12,963,862	13,799,489
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	10,860,590	13,641,592	15,526,551	16,637,828	17,083,787	17,430,972	17,723,528
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,201,211	10,125,988	10,586,819	11,240,591	12,292,070	13,455,278	14,734,798
Ores & Minerals	7,746,001	8,522,711	9,222,371	10,074,282	11,186,852	12,358,172	13,593,265
Iron & Steel	12,977,650	14,694,154	16,336,242	17,717,280	19,025,627	20,369,822	21,746,914
Other	10,296,308	11,771,052	13,175,874	14,205,034	15,019,932	15,832,445	16,654,993
Total	85,330,430	85,829,428	93,495,076	100,884,722	108,757,341	115,278,881	122,228,803
L&D 52							
Coal	25,738,315	23,091,629	29,743,053	30,067,163	30,768,522	31,544,676	32,401,044
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	12,043,976	15,136,071	17,231,907	18,469,269	18,967,019	19,349,586	19,666,209
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,150,807	10,075,584	10,536,415	11,190,187	12,241,666	13,404,874	14,684,394
Ores & Minerals	7,665,200	8,432,349	9,122,928	9,964,902	11,064,406	12,221,849	13,442,212
Iron & Steel	12,934,006	14,652,283	16,289,693	17,666,797	18,971,418	20,311,782	21,684,946
Other	9,997,269	11,401,697	12,760,622	13,766,339	14,575,803	15,386,736	16,209,430
Total	91,798,784	98,521,203	113,127,603	120,613,070	128,531,564	135,087,833	142,064,051

Table 5

Modified Clear Skies -- Projected Lock Traffic Demands

	2000	2010	2020	2030	2040	2050	2060
L&D 53							
Coal	19,979,459	18,844,942	21,155,859	18,143,287	20,032,379	21,119,894	23,064,434
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	10,860,590	13,641,592	15,526,551	16,637,828	17,083,787	17,430,972	17,723,528
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,201,211	10,125,988	10,586,819	11,240,591	12,292,070	13,455,278	14,734,798
Ores & Minerals	7,746,001	8,522,711	9,222,371	10,074,282	11,186,852	12,358,172	13,593,265
Iron & Steel	12,977,650	14,694,154	16,336,242	17,717,280	19,025,627	20,369,822	21,746,914
Other	10,296,308	11,856,401	13,203,731	14,236,774	15,055,438	15,870,340	16,696,788
Total	85,330,430	93,417,378	103,474,558	107,538,455	116,618,883	123,472,808	131,535,543
L&D 52							
Coal	25,738,315	40,665,377	43,784,653	48,128,988	53,410,520	56,300,143	61,623,218
Petroleum	5,704,027	5,976,822	6,270,282	6,629,977	6,967,200	7,288,017	7,594,064
Crude Petroleum	34,494	34,336	34,763	36,062	39,023	42,399	46,265
Aggregates	12,043,976	15,136,071	17,231,907	18,469,269	18,967,019	19,349,586	19,666,209
Grains	8,530,690	9,720,432	11,137,940	12,822,374	14,936,507	15,537,914	16,335,487
Chemicals	9,150,807	10,075,584	10,536,415	11,190,187	12,241,666	13,404,874	14,684,394
Ores & Minerals	7,665,200	8,432,349	9,122,928	9,964,902	11,064,406	12,221,849	13,442,212
Iron & Steel	12,934,006	14,652,283	16,289,693	17,666,797	18,971,418	20,311,782	21,684,946
Other	9,997,269	11,487,046	12,788,479	13,798,079	14,611,309	15,424,631	16,251,225
Total	91,798,784	116,180,300	127,197,060	138,706,635	151,209,068	159,881,195	171,328,020

ATTACHMENT 3

WATERWAY ANALYSIS MODEL CERTIFICATION MEMORANDUM

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P

15 August 2011

MEMORANDUM FOR Director, Planning Center of Expertise for Inland Navigation (PCXIN)

SUBJECT: Waterway Analysis Model (WAM), Shallow Draft Version 10-01 (WAM-SD-10-01)

1. The shallow draft version of the inland navigation simulation model, developed to estimate delays at locks and dams, is certified for use. Adequate technical reviews have been accomplished and the model meets the certification criteria contained in EC 1105-2-412. This certification is based on the decision of the HQUSACE Model Certification Panel which considered the PCXIN assessment of the model.

2. The Certification Documentation Report attests that the model is expensive to modify and maintain; it relies on a proprietary computer language that requires a special compiler to create executable code; and that there are a limited base of developers who can read and understand the code. While the model is currently the best we have for its purpose, it was decided that the model certification will elapse after half of the maximum certification period of 7 years. During that period the PCXIN should oversee the development of a more state-of-the-art and user-friendly model or develop a plan for training more technical specialists in the use of WAM.

3. The PCXIN requested certification of the model with the proviso of exclusive use by technical specialists of the PCXIN. The panel did not believe it was responsible for determining who could use the model and therefore chose not to restrict use to the PCXIN. Further, given the limited number of experienced WAM modelers at the PCXIN, the PCXIN will need to ensure the independence of ATR on future model runs for specific studies.

EXPIRES: 30 September 2014

Theodore A. Brown

THEODORE A. BROWN, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX B

Modifications During Construction

Table B-1 Modifications During Construction
Access Road & Resident Engineer's Office Construction Contract

There was a total of $298,072.08 in modifications to the access road and Resident Engineer's Office construction contract. The Table below provides a listing of the modifications to the contract from the award on 19 November 1992 through contract completion in 27 June 1994.

Contract Number: DACW27-93-C-0011

		Award	19-Nov-92
		Physical Completion	27-Jun-94
		Basic Contract Amount =	**$3,455,974.56**
	Mod #	Description	Settled Price
	P00002	Silt Fence Material & Installation	$7,221.00
Date	P00003	Additional Culverts	$2,281.84
17-Aug-93	P00005	Provide Testing Equipment	$37,636.00
11-Feb-94	P00007	Cement Stabilized Subgrade	$73,031.50
25-Oct-93	P00010	Route 37 Widening	$28,327.10
15-Oct-93	P00011	Resident Office Road Repair	$5,854.00
8-Nov-93	P00013	Septic System	$22,984.00
9-Nov-93	P00015	Provide Highway Bond	$575.00
20-Dec-93	P00016	Laboratory Wall	$1,328.20
27-Dec-93	P00020	Picnic Tables	$537.88
4-Mar-94	P00021	Stockpile Excavation	$22,360.00
14-Mar-94	P00023	Water Supply	$3,070.00
11-Mar-94	P00024	Additional Utility Sleeves	$19,547.00
6-Apr-94	P00025	Downspout Drainage Revisions	$5,866.42
15-Apr-94	P00026	Install Vapor Barrier	$2,419.48
15-Apr-94	P00027	Telephone Cable Revisions	$1,401.00
15-Apr-94	P00029	Insulate Above Piping	$3,214.00
20-Apr-94	P00030	Flush Mount Utility Boxes	$2,899.00
4-May-94	P00033	Insulate Exhaust Air Duct	$5,045.00
3-May-94	P00036	Cabinet & Countertop	$3,016.46
18-Oct-94	P00039	More Miscellaneous Changes	$2,332.00
Jul-94	P00041	Revise Floor Plan	$23,120.00
18-Oct-94	P00042	Provide Backflow Preventer	$700.00
1-Feb-95	P00043	HVAC Revisions	$5,907.00
1-Feb-95	P00044	Relocate AC-1	$2,500.00
13-May-94	P00045	Convector Covers and Additional Changes	$5,155.46
2-May-94		***Changes =***	*$288,329.34*
1-Feb-95	P00012	Differing Site Removals	$9,742.74
		Differing Site Condition =	*$9,742.74*
7-Jan-94			
		Total Modifications =	$298,072.08
		TOTAL Contract Amount Paid =	**$3,754,046.64**

Appendix B - 1

Table B-2 Modifications During Construction
Slide Repair & Cofferdam Construction Contract

There was a total of $16,402,254 in modifications to the slide repair and cofferdam construction contract. The Table below provides a listing of the modifications to the contract from the award on 1 June 1993 through contract completion on 1 March 1996.

Contract Number: DACW27-93-C-0072

Award	1-Jun-93
Physical Completion	1-Mar-96
Basic Contract Amount =	**$49,318,885.40**

Date	Mod #	Description	Settled Price
8-Dec-93	P00011	Temporary Unloading Stone	$7,490.00
14-Jan-94	P00013	Sand drain, trench collector & transfer pipe & aggregate	$25,971.37
15-Apr-94	P00015	Access Road Stone	$97,000.00
21-Apr-94	P00016	Access Road Drains	$10,350.00
21-Jul-94	P00019	Scour stone barge winter 1994	$13,241.00
20-Jul-94	P00021	Change Inclinometer requirements	-$4,050.00
21-Jul-94	P00022	Sheet pile inclinometers	$34,457.00
24-Aug-94	P00023	Revise sheet Piling Cells 1-6 Part II	$343,343.00
20-Jul-94	P00024	Inclinometers on cells 5 & 48	$24,524.00
29-Jul-94	P00025	Place rock on cell 10 & A	$17,043.00
30-Aug-94	P00028	Remove cell 10 rock & extend piling Part I	$475,000.00
12-Sep-94	P00030	Extend Piling for CNR 1-2	$44,000.00
12-Sep-94	P00031	Master Piles, Cell 4 & 49	$82,000.00
28-Sep-94	P00033	Riprap Cells 16 & 17 & Arcs 16.5 & 17.5 NTP	$24,000.00
18-Nov-94	P00036	Time Extension - Apr 94 to Sept 94	$121,684.00
28-Nov-94	P00037	Revise Arc Filling Procedures - NTP	$35,000.00
11-Nov-94	P00038	Cell 10 Revisions - NTP	$45,000.00
16-Nov-94	P00039	Bentonite Cement Well Seals	$10,050.00
18-Nov-94	P00041	Land McNairy I Piezometers	$31,200.00
23-Dec-94	P00043	Floodway Change	$55,000.00
27-Mar-95	P00049	Riprap (400#) for U/S of the Deflector	$120,000.00
13-Jan-95	P00044	Miscellaneous Costs	$25,000.00
13-Jan-95	P00044	Riprap, Cells 16 & 17 Arcs 16.5, & 17.5 - Part II	$9,590.00
27-Feb-95	P00046	Addtn'l Pre-Excavation for Cofferdam Cells-Part I	$1,000,000.00
12-Apr-95	P00047	Unwatering Structure, Colored concrete & Inclinometer	$23,000.00
24-Mar-95	P00051	Riprap U/S of Cells 9.5 to 14 - Part I	$43,710.00
24-Mar-95	P00051	Failure of Sheets on Deflector Wall- Part I	$49,500.00
29-Mar-95	P00053	Failure of Sheets on Deflector Wall- Part II	$15,000.00
1-May-95	P00052	Variable frequency Drives	$60,000.00
29-Mar-95	P00053	Temporary Repairs to U/S Deflector Wall - Part I	$10,000.00
30-Mar-95	P00054	Purchase PZ27 Sheet Piles for Deflector Repairs-Part I	$70,000.00
14-Apr-95	P00055	Increase Berm at Cell 10 - Additional Fill	$549,280.00
1-May-95	P00057	Purchase PZ27 Sheet Piles Deflector Repairs-Supplement	$40,000.00

19-May-95	P00058	Corps Damaged Casings	$35,000.00
12-May-95	P00059	Install PZ27 Piling U/S of Cell A - Crew Cost	$60,000.00
12-May-95	P00059	Install PZ27 Piling U/S of Cell A - Material Costs	$15,000.00
5-Jun-95	P00060	19 Extra Sheet Piles	$33,251.00
24-Jul-95	P00062	Sheet Pile Guaging Prior to Delivery	-$29,469.00
19-Sep-95	P00064	CQC Qualifications & Land Surveyor License	-$21,430.00
11-Aug-95	P00065	Filling & Placing Sand Bags	$2,024.00
16-Aug-95	P00066	Two Stair Twoers Added	$78,000.00
11-Sep-95	P00067	Purchase PZ27 Sheet Piles Deflector Repairs-Part II	$25,000.00
3-Aug-95	P00069	Dewatering Pump Revisionss - Part I	$400,000.00
31-Aug-95	P00070	ADR Panel Member Costs	$9,449.00
13-Dec-95	P00076	Deflector Repairs	$85,000.00
8-Jan-96	P00079	Access Road Surfacing	$10,000.00
19-Jan-96	P00082	Final Quantities,Ditch Lining Extra Thickness & added Ditch	$81,696.00
		Changes =	*$4,290,904.37*
9-Nov-95	P00073	Vacuum System	$40,000.00
27-Oct-95	P00072	Lower Bank Stabilization Ditches - Part I	$80,000.00
13-Dec-95	P00077	Lower Bank Stabilization Ditches - Part I, Supplement I	$35,000.00
		Differing Site Condition =	*$155,000.00*
24-Aug-94	P00026	VECP - Deflector Excavation	-$20,250.00
22-Jan-96	P00075	VECP Predrainage	-$23,400.00
		VECP Total =	*-$43,650.00*
		Total Modifications =	**$4,402,254.37**
		Contract amount Paid =	**$53,721,139.77**
		Claim Paid by DOJ =	**$12,000,000.00**
		TOTAL COST of Construction =	**$65,721,139.77**

Table B-3 Modifications During Construction
Locks Construction Contract

There was a total of $50,655,795 in modifications to the locks construction contract. The Table below provides a listing of modifications to the contract from the award on 6 December 1995 through contract completion on 7 November 2001.

Contract Number: DACW27-96-C-0005

Award	6-Dec-95
Physical Completion	7-Nov-01
Basic Contract Amount =	$222,613,685.30

Date	Mod #	Description	Settled Price
3-Feb-00	A00001	Miscellaneous GPS Site Changes	$3,027.00
10-Mar-00	A00005	Grease Line Revisions Miter Gate	$9,145.00
10-Mar-00	A00006	Approach Wall Electrical Revisions	$6,500.00
15-Mar-00	A00007	Add Recess for Culvert Bulkhead Suspenders	$10,500.00
21-Mar-00	A00010	Revisions to Light Standard Pedestals	$4,850.00
20-Apr-00	A00012	Access Revisions to Pier B & C	$3,700.00
21-Apr-00	A00013	Miter Gate Revisions	$34,000.00
21-Apr-00	A00013	Elevator Machinery Room Revisions	$28,420.00
21-Apr-00	A00013	Relocate ROSS Building/Pedestal & Instrumentation	$18,165.00
21-Apr-00	A00013	Control Center Supplemental Lightning Protection	$1,645.00
20-Jun-00	A00016	Emergency Doors for Elevators	$56,277.00
20-Jun-00	A00017	FMB Reinforcing Revisions	-$45,567.00
11-Jul-00	A00018	Modify Fixed Weir Concrete Cell Caps	$98,750.00
20-Jul-00	A00020	Utility Trench Revisions	$1,132,668.00
21-Jul-00	A00021	Bollards & Winch Revisions	$48,000.00
24-Jul-00	A00022	Miscellaneous Miter Gate Revisions	$130,356.00
25-Jul-00	A00023	Revisions to Lifting Assemblies & Trench Covers	$4,500.00
10-Aug-00	A00025	Miscellaneous Revisions	$11,000.00
10-Aug-00	A00025	Pier B Exhaust Stack Enclosure	$1,100.00
17-Aug-00	A00027	Revise Dogging Platform & Jacking Corbel, Dam Piers	$20,000.00
18-Aug-00	A00028	Install Manholes (River wall) Monolith 26	$91,675.00
24-Aug-00	A00029	Revisions Exclusive of Access Bridge	$2,200.00
24-Aug-00	A00029	Access Bridge	$7,260.00
1-Sep-00	A00030	Handrail/Parapet Revisions Land Side Wall	$297,560.00
11-Dec-00	A00033	Culvert Crack Repair	$41,194.00
8-Mar-00	P00181	Furnish Spare Miter Gate	$1,000,000.00
19-Dec-00	A00034	Finish Spare Miter Gate	$1,400,000.00
9-Jan-01	A00035	Relocate KY Bank Cells	$600,500.00
17-Jan-01	A00036	Pylon Revisions Supplement 3	$320,500.00
1-Mar-01	A00040	Cells 1-5 Pinning UL Cells	$22,027.00
2-Mar-01	A00041	Rolled J-Seal at Pintle Area	$32,000.00
6-Mar-01	A00042	Revisions to Miter Gate Bridge Sections	$75,400.00
4-Apr-01	A00043	Expansion Joints & Piping/ Insulation revisions	$29,979.00
6-Apr-01	A00044	Miscellaneous Controls Center Revisions	$44,853.00

9-Jul-01	A00049	Pylon Revisions	$435,884.00
24-Aug-01	A00051	Stops for Miter Gates & Safety Chains	$191,750.00
5-Sep-01	A00052	Furnish Spare Miter Gate - Part II Final	$574,113.00
6-Sep-01	A00053	Miter Gate Cylinder Clevis Interferences	$26,088.00
6-Sep-01	A00053	Miter Gate Cylinder Anchorage Interferences	$5,800.00
12-Sep-01	A00054	Fertilizer, Insulation & Work at Cells 8 and 66	$13,420.00
12-Sep-01	A00055	Contract Deleted Work & Latch Bar Completed Work	-$684.00
20-Nov-01	A00059	Elevator Vestibules & Revised Floor Hatch	$78,000.00
6-Dec-01	A00060	Fixed Weir Seismic Trigger	$58,000.00
7-Jan-03	A00065	Handrail & Parapet Wall Revisions	$25,000.00
7-Jan-03	A00066	Spare Miter Gate Delivery	$69,000.00
8-Jan-03	A00067	Life Safety Revisions - Dam Piers & Control Center	$40,000.00
27-Jan-03	A00068	Misc. Issues & Finalize Case No.128; Damaged Sheet piling Adjust.	$124,000.00
22-Mar-04	A00072	Delete Slurry Seal	-$80,000.00
12-Apr-04	A00073	Delete Cell A Removal	-$15,000.00
26-May-96	P00006	Sheet Pile Cutoff Wall Extension - Part I	$230,000.00
23-May-96	P00007	Partnering Facilitator	$2,278.00
5-Jul-96	P00010	Protection of Power Boxes & Discharge Lines	$2,850.00
25-Jul-96	P00011	Install Slope Drains	$45,000.00
25-Jul-96	P00012	Generator Modifications	$4,082.00
6-Aug-96	P00014	Place Concrete Barriers at Spillway Toe	$58,000.00
21-Aug-96	P00017	Installation of Temporary Construction Piezometers - Area B	$5,100.00
6-Sep-96	P00018	Upgrade Pumps Lower Elevation	$61,631.88
6-Sep-96	P00018	O&M Vacuum System	$210,835.20
6-Sep-96	P00018	O&M Generator 3A/ Additional Floor Pump Electric	$34,722.48
6-Sep-96	P00018	Flood Allowance for Generator 3A	$2,487.46
6-Sep-96	P00018	Flood Allowance for Vacuum System	$20,990.92
12-Sep-96	P00020	Emergency Repair Cofferdam Cell 43.5	$5,367.00
10-Oct-96	P00025	Partnering Facilitator Cost	$967.00
18-Oct-96	P00028	Final Repair for Arc 43.5	$7,000.00
23-Oct-96	P00030	Replacement of Damaged Piezometer FP15-M2	$6,735.04
4-Mar-98	P00031	Revise Reinforcement Revisions	$6,423.00
15-Nov-96	P00034	Production Pile Restrike Test	$17,500.00
16-Dec-96	P00036	Piling for Guide Wall Connections	$231,925.00
5-Dec-96	P00037	Well Video Survey	$9,500.00
16-Apr-97	P00049	Add Seismic Pins in Monolith Number 3	$2,600.00
22-Apr-97	P00051	Sheet Pile Revisions - Fixed Weir	$6,655.00
12-May-97	P00053	Revise Test Pile Lengths/Credit for Out of Tolerance Piling	$15,951.84
12-May-97	P00055	Riprap on Monolith 24 Slope	$17,400.00
30-Sep-97	P00056	Reinforcement Steel Revisions	-$20,342.00
9-Jun-97	P00058	Culvert Bulkheads Alignment Device	$3,100.00
1-Jul-97	P00063	Culver Bulkhead Pickup Frame	$500.00
7-Aug-97	P00067	Revisions to Fuel Oil System & Control Center	$5,600.00
15-Aug-97	P00068	Sheet Pile Cut-Off Wall Extension	$172,000.00
30-Sep-97	P00069	Miter Gate Machinery Anchor Support Frames	$30,500.00
9-Sep-97	P00070	Reinforcement Revisions for Raw Water Intake M-3	$25,465.00
1-Oct-97	P00076	Revise Cut-off Wall in Fleeting Area	$248,000.00
2-Oct-97	P00077	M-4 Reinforcement revisions	$3,737.00
14-Nov-97	P00081	Pre-molded Joint Filler Revision	$135,000.00
14-Nov-97	P00083	Addition of Lifting Sling to Intake Screens	$13,180.00

16-Dec-97	P00085	Revise Lifting System for Miter Gates	$1,134,278.00
14-Sep-99	P00166	Miter Gate Lifting Changes	$536,926.00
22-Dec-97	P00086	Revise Culvert Bulkhead Suspender Assemblies	$62,750.00
15-Jan-98	P00089	MCC Construction vs Switch Gear	-$61,978.00
23-Feb-98	P00090	Railing for Elevator Pump	$1,750.00
17-Feb-98	P00094	Delete Accumulator	-$14,000.00
3-Apr-98	P00095	Excess cost due for deletion of H-piles furnished & installed	$940,273.00
4-Mar-98	P00096	Access for Sluice Gate Hydraulic Cylinder	$3,700.00
17-Apr-98	P00103	Handrail Revisions	$286,500.00
14-May-98	P00105	Delete Reinforcement in Monoliths 9 through 20	-$1,504,303.00
29-Apr-98	P00106	Small Craft Intercom	$3,384.00
17-Jun-98	P00111	Embed Sheet Pile in Monolith 5	$9,250.00
25-Jun-98	P00114	Additional Excavation for Fixed Weir Cell 64 & Arcs	$59,220.00
19-Jun-98	P00115	Revise Elevator Sump Pump Piping	$9,100.00
30-Jun-98	P00116	Additional Reinforcement for Approach Wall Pylons	$440,000.00
10-Jul-98	P00117	water Gauging Sensors	$24,000.00
15-Jul-98	P00118	Hydraulic Unit Revisions	$60,000.00
28-Aug-98	P00124	Replace Existing 15KV Meter Cabinet	$34,500.00
2-Sep-98	P00125	Add Corbel in M26	$21,100.00
25-Sep-98	P00126	Revise Set Bolts for Intake Screens	$4,050.00
23-Sep-98	P00127	Modifications to Horizontal Corner Protection	$975.00
23-Sep-98	P00128	Miscellaneous Electrical Changes	$27,250.00
15-Oct-98	P00133	Pipe Piling Driving & Lateral Load tests	$140,000.00
2-Dec-98	P00134	Revise Winet Protection Requirements for Base Slab Lifts	$98,400.00
15-Oct-98	P00135	Stop Blocks for Floating Mooring Bits	$4,852.00
22-Oct-98	P00139	Revise Culvert Valve Trunnion Bearing Blocks	$31,500.00
8-Feb-99	P00141	March 1997 Flood Consequences & Delays	$4,247,000.00
27-Oct-98	P00142	Revise Culvert Valve Cathodic Protection	$35,615.00
17-Dec-98	P00144	Emergency Generator Transformer & Switchgear Revisions	$152,908.00
3-Feb-99	P00145	Fiber Optics Cable & Monolith 26 Trench Revisions	$295,867.00
3-Feb-99	P00147	Crossover Conduits for Manual Control	$37,035.00
8-Mar-99	P00153	Miscellaneous Control Revisions	$377,500.00
10-Jun-99	P00159	FMB Extension Monolith Numbers 5 & 25	$211,000.00
7-Jun-99	P00160	Strut Arm Weld revisions - Culvert Valves	$90,000.00
27-Jul-99	P00167	Construction Joint Waterstop - Monolith 3	$20,000.00
27-Jul-99	P00171	Bridge Pier Isolation	$18,500.00
26-Jul-99	P00172	Add Cut-off Beam Below Corbel (M26 Land Wall)	$8,700.00
27-Jul-99	P00173	Revise Manhole Covers - Culvert Bulkhead Recesses	$8,670.00
2-Sep-99	P00175	Instrumentation Monitoring of Concrete Forms	$51,000.00
8-Dec-97	P00082	Miscellaneous Office Repairs & Access Road Mowing	$16,500.00
9-Jan-98	P00088	Revise Project Wage Decision	$262,650.00
29-Mar-99	P00154	M26 Base Slab Keyway, Delete Cell LM-1,M26 Bullnose & Revise Pylons	-$635,690.00
30-May-01	A00047	Additional Rip Rap Stone protection on Illinois Bank	$141,089.00
26-Apr-01	A00056	Relocate Kentucky Bank Cells	-$3,743.16
26-Apr-02	A00063	Dryer Boxes-Water Level Sensors: Type "AA" Fixture Credit	$12,024.00
1-Nov-02	A00064	Miscellaneous Work	$2,048,200.50
		Changes =	*$18,458,599.16*
13-Aug-01	A00050	Site Utility Revisions	$12,600.00
23-Oct-01	A00058	Kentucky Bank Differing Site Condition	$222,000.00
		Differing Site Condition =	*$234,600.00*

Appendix B - 6

1-Apr-98	P00100	VECP - Butterfly Valves vs Gate Valves	-$1,273.00
12-Feb-97	P00041	VECP#3 Diesel Fuel Treatment	-$6,837.00
13-May-97	P00047	VECP-Insulation Blankets in lieu of Moist Sand	-$23,040.00
4-Jun-97	P00052	VECP-Seismic Anchors/Pile Cutoffs - Original Work	-$501,296.04
4-Jun-97	P00052	VECP-Seismic Anchors/Pile Cutoffs - Contractor Share	$275,841.72
11-Jul-97	P00060	VECP - 12" diameter CMP Void Forms	-$35,170.00
10-Jul-97	P00062	VECP - Revise Chamfer Detail @ Culvert	-$34,650.00
27-Apr-99	P00156	VECP - Dewatering System O&M Surveillance Personnel	-$202,500.00
26-Jul-00	A00024	VECP - Stainless Steel Ladder Finish	-$40,208.00
17-Nov-00	A00032	VECP – Delete Anodizing of Aluminum Handrail	-$6,142.00
		VECP Total =	*-$575,274.32*
14-Mar-00	P00182	Global Settlement of REA, Changes & Consequences	$12,600,000.00
17-Apr-00	P00184	Global Settlement of REA, Changes & Consequences	$7,400,000.00
22-May-00	P00186	Global Settlement of REA, Changes & Consequences	$10,000,000.00
22-Feb-01	P00196	Global Settlement of REA, Changes & Consequences	$1,187,870.00
23-Apr-04	A00074	Final Payment Settlement of all Issues & Resolutions	$1,350,000.00
		Total REA Settlement =	*$32,537,870.00*
		TOTAL Modifications =	**$50,655,794.84**
		TOTAL Olmsted Contract Amount Paid =	**$273,269,480.14**

Table B-4 Modifications During Construction
Approach Walls Construction Contract

There was a total of $13,595,334 in modifications to the approach walls construction contract. The Table below provides a listing of modifications to the contract from the award on 26 August 1999 through contract completion on 31 March 2004.

Contract Number: DACW27-99-C-0042

Award	26-Aug-99
Physical Completion	31-Mar-04
Basic Contract Amount =	**$92,764,614.40**

Date	Mod #	Description	Settled Price
6-Jun-06	A00001	Partnering Facilator	$1,387.50
6-Feb-01	A00010	Nose Pier Debris Shield Modification	$35,887.00
7-Mar-01	A00011	Revise Handrail & Corner Protection - LLW	$8,398.00
12-Mar-01	A00012	REA to Add Washers / Rethread Bolts (UHMW Panels)	$10,394.00
6-Apr-01	A00013	Add Welding at Nose Pier Bearing Plates	$10,850.00
24-Jul-01	A00017	Credit for Concrete Delivery System	-$57,000.00
24-Aug-01	A00019	Long Distance Telephone Charges @ Graving Yard	$9,841.00
5-Sep-01	A00020	Revise Tendon Geometry & Rebar Splice Lengths	$22,572.00
6-Sep-01	A00021	Gudgeon Plug	$24,500.00
19-Nov-01	A00023	Delete Painting on Bottom of Nose Piers Nos. 3 & 4	-$22,101.00
3-Dec-01	A00024	Rev. UR Pontoons to Accommodate Actual Pylon Location	$3,250.00
11-Dec-01	A00025	Revisions to Tie Bolt Assemblies	$1,886.00
11-Dec-01	A00025	RFI Nos. 192, 194 & 203	$1,785.00
25-Mar-02	A00027	Guage Markers	$11,687.00
17-Apr-02	A00029	Security Gates & Barricades	$11,700.00
3-May-02	A00030	Revised Bar Support Criteria	$201,000.00
19-Aug-02	A00035	Stone Protection for UR Guide Walls	-$45,622.46
19-Aug-02	A00036	Ladder Recess Covers Lock Piers A&D and Removal of Silt	$12,500.00
20-Sep-02	A00039	Type II Pre-Tensioned Anchor Bolt Revision	$14,000.00
8-Jan-03	A00044	Start Up Delay	$259,101.00
12-Feb-03	A00045	Concrete Mix & Curing Revisions	$128,692.00
28-Feb-03	A00046	LLW Drill Shaft Changes	$425,000.00
28-Feb-03	A00047	NP3 Casing Rebar Revisions	$500,000.00
28-May-03	A00048	Revise Pintle / Skirt Attachment Details	$73,315.00
11-Jun-03	A00049	Electrical Cabinet Support	$19,500.00
20-Jun-03	A00050	Pylon Fender Extension	$215,500.00
18-Sep-03	A00052	Revised Pylon Electrical Service	$399,500.00
15-Oct-03	A00054	Additional Form System	$750,000.00
12-Dec-03	A00056	Additional Floatation & Ballasting	$260,000.00
15-Jul-04	A00057	Miscellaneous Revisions: RFI Nos. 153, 352 & 355	$9,350.00
19-Jul-04	A00058	High Mast Lighting Revisions	$7,450.00
27-Jul-04	A00060	LLW Drill Shaft Changes Supplement II	$2,000,000.00
12-Aug-04	A00061	Removal of Parapets from Lock Wall	$28,100.00
20-Oct-04	A00062	Miscellaneous Approach Wall revisions Part II	$3,325,000.00

18-Oct-04	A00064	Miscellaneous Approach Wall revisions Part III	$23,007.00
		Changes =	*$8,680,429.04*
29-Aug-02	A00037	Dredging Modicication	$943,493.54
25-Oct-02	A00042	Dredging Excavation	$3,981,228.48
		Differing Site Condition =	*$4,924,722.02*
12-Nov-00	A00008	VECP - Revise Lift Joint, Noise Pier Pylon - LLW	-$5,537.00
19-Jan-01	A00009	VECP - Revise UM & LR Pylon Crown Height	-$4,280.00
		VECP Total =	*-$9,817.00*
		Total Modifications =	**$13,595,334.06**
		TOTAL Approach Wall Amount Paid =	**$106,359,948.46**
19-Sep-02	A00038	Stabilize L&D 53 Guide Wall	$45,000.00
24-Sep-02	A00040	Stabilize L&D 53 Guide Wall, Supplement 1	$45,000.00
18-Dec-02	A00043	Stabilize L&D 53 Guide Wall, Part II	-$11,521.00
		TOTAL Contract Amount =	**$106,438,427.46**

Table B-5 Modifications During Construction
Dam Prototype Construction Contract

There was a total of $3,890,782 in modifications to the dam prototype construction contract. The Table below provides a listing of modifications to the contract from the award on 17 May 1994 through contract completion on 4 December 1995.

Contract Number: DACW27-94-C-0036

Award	17-May-94
Physical Completion	4-Dec-95
Basic Contract Amount =	**$14,784,715.05**

Date	Mod #	Description	Settled Price
31-Oct-94	P00009	Additional Steel Sheet Piling Type PZ22	$5,120.00
24-Oct-94	P00008	Revise Roadway Base	$2,655.86
31-Oct-94	P00009	PZ22 Small Quantity Premium Plus 2 Spare Sheets	$2,578.00
9-Mar-95	P00015	Pile Driving Analyzer	$5,070.00
6-Mar-95	P00016	Revise Hurter & Embedded Alignment Frame	$84,855.00
8-Mar-95	P00017	Gallery Liner	$29,433.00
8-Mar-95	P00020	Modification of Sheet Pile Anchors	$14,520.00
22-May-95	P00025	Miscellaneous Drafting Corrections	$11,828.00
4-May-95	P00027	Revise Wicket Box Sill Anchor	$8,300.00
16-May-95	P00028	Sill Bearing Frame/Hurter Plate	$18,000.00
12-Oct-95	P00041	Suspension of Work - Channel Excavation	$71,300.00
7-Nov-95	P00044	Reroute Cylinder Recess Reinforcement	$5,400.00
14-Dec-95	P00048	Sling Revisions	$36,500.00
6-Feb-96	P00049	Modification of Prop	$137,000.00
8-Dec-95	P00050	Sill Bearing Frame Slot/Hurter Plate	$3,000.00
8-Dec-95	P00051	Shear Pin Revision	$4,000.00
8-Dec-95	P00052	Stop Log Lifting Lug Revisions	$5,100.00
15-Dec-95	P00053	Filling Wells	$4,800.00
8-Dec-95	P00054	Cup Nut Pillow Block Revision	$2,800.00
14-Dec-95	P00056	Direct Connect Cylinder Alignment	$3,400.00
8-Mar-96	P00058	Equitable Adjustment - Minimum Dewatering System	$49,500.00
1-Apr-96	P00059	Additional Roadway Embankment	$110,000.00
16-May-96	P00060	Grouted 86# Stone, Slab/Deadman Repair & Temporary Bridge	$75,000.00
23-Apr-96	P00061	Extend Sill/Revise Cylinder Recess	$2,500.00
2-May-96	P00062	Precast Concrete Footbridge	$15,000.00
6-May-96	P00063	Wicket Braces	$22,200.00
7-May-96	P00065	Additional Stone Protection	$52,000.00
17-May-96	P00066	Stop Log 5 Revisions	$60,150.00
27-Aug-96	P00068	Tremie Concrete Modification	$1,186,362.00
27-Aug-96	P00068	Under drain Pipe & Weep holes	-$641.64
7-Nov-96	P00069	Sediment Removal	$45,000.00
24-Oct-96	P00073	Revise fencing	$8,345.00
4-Nov-96	P00074	Precast Concrete Footbridge (Final)	$24,914.00

6-Jan-97	P00076	Instrumentation Assistance	$121,500.00
15-Apr-97	P00077	Slab/Dead Man Repair& Temporary Bridge (Final)	$147,000.00
11-Apr-97	P00079	Delete Generator	-$76,664.00
19-Sep-97	P00082	Additional Stone Excavation	$490,000.00
4-Feb-98	P00086	Additional Stone Excavation (Part II)	$991,657.00
		Changes =	*$3,779,482.22*
27-May-97	P00078	Request for Equitable Adjustment - JMW	$126,000.00
		Total REA Settlement =	*$126,000.00*
25-Sep-95	P00024	VECP - Low Heat Cement	-$10,103.94
25-Sep-95	P00024	VECP - Dewatering Engineer	-$4,596.14
		VECP Total =	-$14,700.08
		TOTAL Modifications =	**$3,890,782.14**
		TOTAL Contract amount Paid =	**$18,675,497.19**

Table B-6 Modifications During Construction
Water Management Facilities & Pump #1 Repairs Construction Contract
At Ballard Wildlife Management Area

There was a total of $25,537.44 in deduction modifications to the initial water management facilities at Ballard Wildlife Management Area construction contract and $34,007 in modifications and a pending modification estimated at $30,000 to the repairs to Pump #1 construction contract. The table below provides a listing of modifications to the contract from the award of the first contract on 17 May 1996 through completion of the second contract estimated to occur in the low water season of 2007.

Contract Number: DACW27-96-C-0066

		Award	17-May-96
		Physical Completion	30-Nov-97
		Basic Contract Amount =	$2,360,000.00
Date	Mod #	Description	Settled Price
Aug-97	P00012	Flood Repairs to Turner Landing	$6,475.00
29-Oct-96	P00006	Credit for seeding & additional No.3 stone	-$4,283.77
6-May-96	P00008	Eliminate concrete ditch lining & add fence & valve	-$8,979.04
		Changes =	*-$6,787.81*
6-May-96	P00017	Station#1-Revise slope protection lift & add winch;	-$17,905.88
		Differing Site Condition =	*-$17,905.88*
29-Oct-96	P00007	VECP 36" Discharge Pipe	-$843.75
		VECP Total =	*-$843.75*
		Total Modifications =	*-$25,537.44*
		TOTAL Contract Amount Paid =	**$2,334,462.56**

Contract Number: DACW27-01-D-0005 Delivery Order # 62

		Award	30-Apr-03
		Physical Completion	Sep 2007
		Basic Contract Amount =	**$519,998.20**
Date	Mod #	Description	Settled Price
2-Jun-06	1C	Replace Gate	$34,007.47
30-May-07	11	Winch revisions	$49,247.00
4-Dec-07	1D	Request for Equitable Adjustment/Temporary Pumping	$239,627.02
		Total Modifications =	$322,881.49
		TOTAL Contract Amount =	$842,879.69

Table B-7 Modifications During Construction
Relocation of Olmsted Boat Ramp Construction Contract

There was a total of $14,628 in modifications to the boat ramp construction contract. The table below provides a listing of modifications to the contract from the award on 4 June 2001 through completion on 7 November 2002.

Contract Number: DACW27-01-C-0020

		Award	4-Jun-01
		Physical Completion	7-Nov-02
		Basic Contract Amount =	**$1,359,231.15**
Date	Mod #	Description	Settled Price
14-Jun-02	A00002	Fill Ravines & Bury Concrete Anchor	$12,380.40
		Differing Site Condition =	$12,380.40
17-Oct-02	A00004	Shoulder for Roadway	$2,248.00
		Changes =	**$2,248.00**
		Total Modifications =	$14,628.40
		TOTAL Contract Amount Paid =	**$1,373,859.55**

Table B-8 Modifications During Construction
Maintenance & Operating Bulkheads Construction Contract

There has been a total of $470,785 in modifications to the maintenance and operating bulkheads construction contract. The table below provides a listing of the modifications to the contract from the award on 27 September 2001 through contract completion on 7 July 2005.

Contract Number: DACW27-01-C-0030

		Award	27-Sep-01
		Physical Completion	7-Jul-05
		Basic Contract Amount =	**$24,156,000.00**
Date	Mod #	Description	Settled Price
15-Sep-04	A00006	Dive Suspension of Work	$6,534.00
31-Mar-05	A00013	Miscellaneous Operating Bulkheads Revisions	$47,550.00
12-Sep-03	A00003	Drill Holes in Operating Bulkheads	$98,952.00
16-Sep-04	A00007	Machinery Roof & Water Line	$164,140.00
4-Nov-04	A00008	Part II - Trim Operating Bulkhead	$49,438.00
1-Dec-04	A00009	Air Compressor Revisions	$18,000.00
9-Dec-04	A00011	Lock Power Failure	$15,159.00
3-Mar-05	A00012	Grating Revisions	$6,071.00
31-Mar-05	A00014	Frames & Covers for Machinery	$6,045.00
6-Apr-05	A00015	Replace Rigging	$16,270.00
17-Jan-06	A00016	Computer Display Revision	$8,500.00
23-Sep-09	A00017	Revised Bearing (add feet) of 11' & 18' Bulkheads	$425,000.00
		Changes =	*$861,659.00*
9-Dec-04	A00010	Dogging Beam Recess	$34,126.00
		Differing Site Condition =	*$34,126.00*
14-Dec-09	P00041	Alternative Disputes Resolution of Fabrication Tolerances	$3,300,000.00
		Total Claim Settelements =	*$3,300,000.00*
		Total Modifications =	**$4,195,785.00**
		Total Contract Amount =	**$28,351,785.00**

Table B-9 Modifications During Construction
Miter Gate Storage Yard Construction Contract

There was a total of $3,153,117 in modifications to the miter gate storage yard construction contract. The table below provides a listing of modifications to the contract from the award in 8 March 2002 through contract completion in 15 May 2006.

Contract Number: DACW27-02-C-0005

		Award	8-Mar-02
		Physical Completion	15-May-06
		Basic Contract Amount =	**$8,696,883.00**
Date	Mod #	Description	Settled Price
12-Jul-05	A00011	Miter Gate Fender Support Welds	$100,000.00
13-Jul-05	A00012	Miter Gate Paint	$150,000.00
8-Aug-05	A00013	Miter Gate Paint Part II	$124,940.00
7-Oct-05	A00015	Revise Photo Electric Controls	$4,957.00
9-Feb-05	A00007	Pier Size Increase, Pintle Machining etc.	$77,250.00
29-Apr-05	A00010	Weld Repairs on GFP Miter Gates	$9,400.00
		Changes =	*$466,547.00*
1-Apr-05	A00008	River Excavation	$150,000.00
18-Apr-05	A00009	River Excavation Part 1 Supplement	$150,000.00
		Differing Site Condition =	*$300,000.00*
3-Apr-06	A00016	Global Settlement	$2,386,570.00
		Total REA Settlement =	*$2,386,570.00*
		Total Modifications =	**$3,153,117.00**
		TOTAL Contract Amount Paid =	**$11,850,000.00**

Table B-10 Modifications During Construction
Down Stream Mooring Cells Construction Contract

There was a total of $500,702.76 in modifications to the down stream mooring cells construction contract. The table below provides a listing of modifications to the contract from the award on 4 June 2002 through contract completion on 11 December 2003.

Contract Number: DACW27-02-C-0013

		Award	4-Jun-02
		Physical Completion	11-Dec-03
		Basic Contract Amount =	**$2,040,000.00**
Date	Mod #	Description	Settled Price
13-Feb-03	A00001	Quantity Overrun IL CA1 Stone	$20,250.00
20-Mar-03	A00002	External Painting (Below elevation 300)	$12,389.76
18-Nov-03	A00003	Quantity Overrun 400LB Stone	$126,263.00
		Changes =	*$158,902.76*
12-Mar-04	A00004	Resolution of Miscellaneous	$341,800.00
		Differing Site Condition =	*$341,800.00*
		Total Modifications =	**$500,702.76**
		TOTAL Contract Amount Paid =	$2,540,702.76

Table B-11 Modifications During Construction
Dam Construction Contract

There has been a total of $149,851,040 in modifications to the dam construction contract to date and an over-target budget increase of $122,787,355. In addition, there are pending changes that have not been negotiated but are necessary to complete the contract work. The table below provides a listing of modifications to the contract from the award on 28 January 2004 through March 2007. In addition to the changes listed below, the District will need to have a contingency pool available for unforeseen changes. The amount of contingencies will be addressed elsewhere in this document.

Contract Number: W912QR-04-C-0004

Award	28-Jan-04
Physical Completion	Dec-14
Basic Contract Amount =	**$564,148,484.00**

Date	Mod #	Description	Settled Price
3-Sep-04	A00005	Revise Pipe Supports on Access & Service Bridge	$114,033.87
3-Nov-04	A00007	Replace Automatic Transfer Switch	$55,662.03
1-Apr-05	A00010	Delete Sheet Pile Sealant	-$507,444.00
10-Nov-05	A00025	Revised Bonding Requirements for FFP subcontracts	$31,569.00
2-May-06	A00035	Maintenance Bulkhead Rigging & Lifting Beam	$60,204.00
22-Apr-05	A00012	Delete/revise Telephone System	-$741,618.00
6-Dec-05	A00026	Additional Storage Yard	$72,528.00
11-Aug-04	A00001	Deletion of Prime Contractor Bond Requirements	-$1,545,480.00
31-Mar-05	A00009	Maintenance Bulkhead Storage	$212,023.00
27-Apr-05	A00013	Estimator & Scheduler	$634,259.00
6-May-05	A00014	Marine Superintendent	$102,963.00
16-May-05	A00015	Deletion of Hydraulic Model Studies	-$378,797.00
8-Jul-05	A00018	Bulkhead Rigging	$10,820.00
29-Jul-05	A00019	Silt Removal	$348,962.00
30-Sep-05	A00022	Additional Mix design	$31,196.00
24-Jan-06	A00028	Catamaran Barge Snubbing System design	$148,832.00
9-Sep-05	A00020	Replace floating Batch Plant with land based Batch Plant	-$4,973,862.00
27-Nov-06	P00039	Case No. 77 Delete VECP Clause	$4,630,215.00
15-Dec-06	P00041	Case Nos. 63 & 65 "Rebasline"	$81,648,669.00
16-Mar-07	A00046	High Mast Lighting Anchor - Lock Wall	$12,069.00
29-May-07	P00049	Continuing Contract Clause Staffing	$524,937.00
26-Nov-07	P00056	Conduit Repair	$9,571.00
21-Jan-09	P00074	Sheet Pile Barrier, Lock Wall Protection	$87,078.00
11-Feb-09	P00076	Revised Tremie Seal	$1,065,349.00
12-Mar-09	P00078	Additional Equipment Supervisor	$918,590.00
21-Jul-09	P00086	Continuing Contract	$1,644,467.00
26-Aug-09	P00089	Nose Pier Protection (precast)	$477,933.00
4-Sep-09	P00091	Added Tremie Test	$504,498.00
15-Oct-09	P00093	Isolation Pile Re-work	$30,021.00
6-Apr-10	P00106	Floating Mooring Bit Repair	$77,217.00

2-Dec-10	P00120	Tremie Sensing System	$5,462,618.00
7-Dec-10	P00121	Replace Foam Heads for TG Piling (Part 1)	$400,000.00
8-Feb-11	P00124	Shell Weight Increase & Pier D Concrete Repair	$9,642,281.00
16-Jun-11	P00130	Replace Foam Heads for TG Piling (Part 2)	$780,448.00
8-Jul-11	P00132	Concrete Removal	$15,955.00
		Changes =	*$101,607,766.90*
3-Mar-05	A00008	Slope Stability Precast Yard	$3,355,784.00
19-May-05	A00016	Slope Stability - Sheet Pile Retaining Wall	$1,191,511.00
7-Oct-05	A00023	Slope Stability - 24" Diameter Pin Piles	$460,762.00
2-Feb-06	A00030	Slope Stability - 36" Diameter Pin Piles	$672,441.00
9-Feb-06	A00031	Slope Stability - Marine Skidway	$2,766,319.00
7-Jun-06	A00036	Marine Skidway Foundation Change	$8,013,333.00
11-Apr-07	A00038	Cell A & Upstream of Dam Regrading	$152,816.00
21-Jul-08	P00067	Slope Failure at spoil disposal area	$327,445.00
6-Jul-09	P00084	Added Excavation (sand wave)	$2,537,166.00
3-Jun-10	P00111	Revised Length of TG Foundation Piling	$3,900,104.00
		Differing Site Condition =	*$23,377,681.00*
24-Jun-05	A00017	Funding Delays (FY04 & FY05)	$53,436,155.00
23-Jun-08	P00065	Time Extension & Over Target Budget	$157,938,180.00
		Total Contract Modifications =	$336,359,782.90
		Total Contract Amount =	***$900,508,266.90***
	Pending	Rebaseline 2011 Increase	$551,100,000.00
	Pending	Time Extension Dec 2014 into FY-19	$219,284,733.10
		Current Estimate at Completion (EAC) =	$1,670,893,000.00

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX C

Section 902 Maximum Project Cost Computations

November 2011

(ER 1105-2-100, TABLES G-1 THRU G-4)

Determining the Section 902 Limit

Section 902 allows for project cost increases due to modifications which do not materially alter the scope and function of a project. Project modifications may encompass further engineering and design refinements to project features that are identified in project authorizing documents, as well as, the construction of new project features that are not indentified in authorizing documents. Engineering and design refinements will be necessary to construct project features that are only generally described in authorizing documents. In such cases, the maximum cost of the project can be increased by up to 20 percent to pursue the engineering and design refinements.

The total project cost is the cost of all work associated with preconstruction engineering and design and construction, including real estate and appropriate credit provisions of Section 104 of the WRDA of 1986 and Section 215 of Public Law 90-483. The project was authorized at a cost of $775,000,000 in Section 3(a)(6) of Water Resources Development Act of 1988 (Public Law 100-676).

The construction component of the authorized cost was updated using the composite quarterly index (weighted average) to account for historical inflation using the Civil Works Construction Cost Index System (EM 1110-2-1304), revised 30 Sep 2011. It should be noted that 1-Oct-2011 price level uses the 4th Quarter 2010 index since EM 1110-2-1304 specifies that the 1st Quarter starts on 2-Oct.

The real estate component of the authorized cost was updated to account for historical inflation based on changes to the Consumer Price Index, as published monthly by the U.S. Department of Labor, Bureau of Labor Statistics. Specifically, the unadjusted percentage changes reflected under the "Rent of primary residential" expenditure category from the tables containing the Consumer Price Index, Not Seasonally Adjusted, for All Urban Consumers, U.S. city average.

The maximum project cost limit imposed by Section 902 is a numerical value specified by law which was computed in a legally supportable manner. It is not an estimate of the current cost of the project. The limit on project cost was computed including an allowance for inflation through the construction period and adding an additional 20 percent.

Table C-1 shows the methodology used to calculate the annual inflation factors associated with the construction component of the project. Table C-2 shows the methodology use to calculate the annual inflation factors associated with the real estate component of the project. Table C-3 shows the methodology used to escalate the authorized cost to current price levels based on the current estimated project schedule which includes actual obligations to date. Table C-4 illustrates the methodology used to calculate the new Section 902 maximum limit for the Olmsted project. Table C-5 is the project cost increase fact sheet.

Table C-1 - Olmsted Section 902 Limit
COMPUTATION OF CONSTRUCTION CWCCIS INDICES
(ER 1105-2-100 Appendix G Table G-1)

ILLUST B-2 CWCCIS FACTORS	DATE OF PRICE LEVEL		INDEX	YEARLY INFLAT RATE	CUMULATIVE INFLATION RATE	TOTAL ALLOWED INFLATION (G) CUMULATIVE RATE TO BEGIN FY	1/2 RATE INFLATION FOR FY	AL ALLOWED INFLATION FOR FY
(A)	(B)	(C)	(D)	(E)	(F)	(H)	(I)	(J)
AUTHORIZED ESTIMATE:	1-Oct-85		354.7		1.0000			
1st Fiscal Year:		1986		0.0063		1.0000	1.0032	1.0032
1st Qtr, 2nd Year:	1-Oct-86		356.9		1.0063			
2nd Fiscal Year:		1987		0.0257		1.0063	1.0128	1.0193
1st Qtr, 3rd Year:	1-Oct-87		366.1		1.0322			
3rd Fiscal Year:		1988		0.0341		1.0322	1.0170	1.0498
1st Qtr, 4th Year:	1-Oct-88		378.6		1.0674			
4th Fiscal Year:		1989		0.0370		1.0674	1.0185	1.0871
1st Qtr, 5th Year:	1-Oct-89		392.6		1.1068			
5th Fiscal Year:		1990		0.0296		1.1068	1.0148	1.1232
1st Qtr, 6th Year:	1-Oct-89		404.2		1.1395			
6th Fiscal Year:		1991		0.0112		1.1395	1.0056	1.1459
1st Qtr, 7th Year:	1-Oct-91		408.7		1.1523			
7th Fiscal Year:		1992		0.0228		1.1523	1.0114	1.1655
1st Qtr, 8th Year:	1-Oct-92		418.0		1.1786			
8th Fiscal Year:		1993		0.0320		1.1786	1.0160	1.1975
1st Qtr, 9th Year:	1-Oct-93		431.4		1.2164			
9th Fiscal Year:		1994		0.0267		1.2164	1.0134	1.2326
1st Qtr, 10th Year:	1-Oct-94		442.9		1.2489			
10th Fiscal Year:		1995		0.0278		1.2489	1.0139	1.2662
1st Qtr, 11th Year:	1-Oct-95		455.2		1.2836			
11th Fiscal Year:		1996		0.0264		1.2836	1.0132	1.3006
1st Qtr, 12th Year:	1-Oct-96		467.3		1.3175			
12th Fiscal Year:		1997		0.0160		1.3175	1.0080	1.3281
1st Qtr, 13th Year:	1-Oct-97		474.7		1.3386			
13th Fiscal Year:		1998		0.0069		1.3386	1.0034	1.3432
1st Qtr, 14th Year:	1-Oct-98		478.0		1.3478			
14th Fiscal Year:		1999		0.0252		1.3478	1.0126	1.3648
1st Qtr, 15th Year:	1-Oct-99		490.1		1.3817			
15th Fiscal Year:		2000		0.0213		1.3817	1.0106	1.3965
1st Qtr, 16th Year:	1-Oct-00		500.5		1.4112			
16th Fiscal Year:		2001		0.0112		1.4112	1.0056	1.4191
1st Qtr, 17th Year:	1-Oct-01		506.1		1.4270			
17th Fiscal Year:		2002		0.0342		1.4270	1.0171	1.4515
1st Qtr, 18th Year:	1-Oct-02		523.4		1.4759			
18th Fiscal Year:		2003		0.0232		1.4759	1.0116	1.4930
1st Qtr, 19th Year:	1-Oct-03		535.6		1.5102			
19th Fiscal Year:		2004		0.1111		1.5102	1.0555	1.5940
1st Qtr, 20th Year:	1-Oct-04		595.1		1.6779			
20th Fiscal Year:		2005		0.0434		1.6779	1.0217	1.7144
1st Qtr, 21st Year:	1-Oct-05		620.9		1.7508			
21st Fiscal Year:		2006		0.0535		1.7508	1.0268	1.7977
1st Qtr, 22nd Year:	1-Oct-06		654.2		1.8446			
22nd Fiscal Year:		2007		0.0401		1.8446	1.0200	1.8815
1st Qtr, 23rd Year:	1-Oct-07		680.4		1.9185			
23rd Fiscal Year:		2008		0.0744		1.9185	1.0372	1.9899
1st Qtr, 24th Year:	1-Oct-08		731.0		2.0612			
24th Fiscal Year:		2009		-0.0346		2.0612	0.9827	2.0255
1st Qtr, 25th Year:	1-Oct-09		705.7		1.9898			
25th Fiscal Year:		2010		0.0361		1.9898	1.0180	2.0258
1st Qtr, 26th Year:	1-Oct-10		731.2		2.0617			
26th Fiscal Year:		2011		0.0426		2.0617	1.0213	2.1056
1st Qtr, 27th Year:	1-Oct-11		762.4		2.1496			
26th Fiscal Year:		2012						

INDEX SOURCE: EM 1110-2-1304, 30 Sep 2011

B. Date of the authorized cost and the beginning date of following fiscal years.

C. These entries are the fiscal years.

D. These are the index numbers from the referenced publications and must all be expressed with the same base year.

E. This column equals the index at the beginning of the next year, divided by the index at the beginning of the year, minus one.

F. The cumulative inflation rate equals the index (column (d)) at the beginning of the year divided by the index of the first line of the table.

G. The allowed inflation rate equals the cumulative rate through the beginning of the FY (equals one for the first FY after project authorization) times one plus 1/2 of the rate of inflation through the beginning of the FY. For the remaining balance, it equals the cumulative rate to the beginning of the next fiscal year.

H. These are the cumulative rates through the beginning of the FY. They are the amounts in column (F) one-half line above.

I. This is one plus 1/2 the rate of inflation during the fiscal year, 1 + 1/2 x column (E)

J. The total inflation is the product of the last two entries.

K. The inflation rate for the remaining balance is the last entry in column (F).

Appendix C - 2

Table C-2 - Olmsted Section 902 Limit
CONSUMER PRICE INDEX FOR REAL ESTATE
(ER 1105-2-100 Appendix G Table G-2)

CPI FACTORS						TOTAL ALLOWED INFLATION (G)		
			INDEX	YEARLY INFLATION RATE	CUMULATIVE INFLATION RATE	CUMULATIVE RATE TO BEGIN FY	1/2 RATE INFLATION FOR FY	TOTAL ALLOWED INFLATION FOR FY
(A)	(B)	(C)	(D)	(E)	(F)	(H)	(I)	(J)
DATE OF PRICE LEVEL								
AUTHORIZED ESTIMATE:	1-Oct-85		114.0		1.0000			
FIRST FISCAL YEAR:		1986		0.0544		1.0000	1.0272	1.0272
1st Qtr, 2nd Year:	1-Oct-86		120.2		1.0544			
2nd Fiscal Year:		1987		0.0383		1.0544	1.0191	1.0746
1st Qtr, 3rd Year:	1-Oct-87		124.8		1.0947			
3rd Fiscal Year:		1988		0.0369		1.0947	1.0184	1.1149
1st Qtr, 4th Year:	1-Oct-88		129.4		1.1351			
4th Fiscal Year:		1989		0.0410		1.1351	1.0205	1.1583
1st Qtr, 5th Year:	1-Oct-89		134.7		1.1816			
5th Fiscal Year:		1990		0.0431		1.1816	1.0215	1.2070
1st Qtr, 6th Year:	1-Oct-90		140.5		1.2325			
6th Fiscal Year:		1991		0.0292		1.2325	1.0146	1.2504
1st Qtr, 7th Year:	1-Oct-91		144.6		1.2684			
7th Fiscal Year:		1992		0.0235		1.2684	1.0118	1.2833
1st Qtr, 8th Year:	1-Oct-92		148.0		1.2982			
8th Fiscal Year:		1993		0.0230		1.2982	1.0115	1.3132
1st Qtr, 9th Year:	1-Oct-93		151.4		1.3281			
9th Fiscal Year:		1994		0.0251		1.3281	1.0125	1.3447
1st Qtr, 10th Year:	1-Oct-94		155.2		1.3614			
10th Fiscal Year:		1995		0.0238		1.3614	1.0119	1.3776
1st Qtr, 11th Year:	1-Oct-95		158.9		1.3939			
11th Fiscal Year:		1996		0.0277		1.3939	1.0138	1.4132
1st Qtr, 12th Year:	1-Oct-96		163.3		1.4325			
12th Fiscal Year:		1997		0.0300		1.4325	1.0150	1.4539
1st Qtr, 13th Year:	1-Oct-97		168.2		1.4754			
13th Fiscal Year:		1998		0.0339		1.4754	1.0169	1.5004
1st Qtr, 14th Year:	1-Oct-98		173.9		1.5254			
14th Fiscal Year:		1999		0.0282		1.5254	1.0141	1.5469
1st Qtr, 15th Year:	1-Oct-99		178.8		1.5684			
15th Fiscal Year:		2000		0.0408		1.5684	1.0204	1.6004
1st Qtr, 16th Year:	1-Oct-00		186.1		1.6325			
16th Fiscal Year:		2001		0.0462		1.6325	1.0231	1.6702
1st Qtr, 17th Year:	1-Oct-01		194.7		1.7079			
17th Fiscal Year:		2002		0.0339		1.7079	1.0169	1.7368
1st Qtr, 18th Year:	1-Oct-02		201.3		1.7658			
18th Fiscal Year:		2003		0.0278		1.7658	1.0139	1.7904
1st Qtr, 19th Year:	1-Oct-03		206.9		1.8149			
19th Fiscal Year		2004		0.0285		1.8149	1.0143	1.8408
1st Qtr, 20th Year:	1-Oct-04		212.8		1.8667			
20th Fiscal Year		2005		0.0305		1.8667	1.0153	1.8952
1st Qtr, 21st Year:	1-Oct-05		219.3		1.9237			
21st Fiscal Year		2006		0.0397		1.9237	1.0198	1.9618
1st Qtr, 22nd Year:	1-Oct-06		228.0		2.0000			
22nd Fiscal Year		2007		0.0401		2.0000	1.0200	2.0401
1st Qtr, 23rd Year:	1-Oct-07		237.1		2.0801			
23rd Fiscal Year		2008		0.0368		2.0801	1.0184	2.1184
1st Qtr, 24th Year:	1-Oct-08		245.9		2.1566			
24th Fiscal Year		2009		0.0123		2.1566	1.0062	2.1699
1st Qtr, 25th Year:	1-Oct-09		248.9		2.1832			
25th Fiscal Year		2010		0.0029		2.1832	1.0015	2.1864
1st Qtr, 26th Year:	1-Oct-10		249.6		2.1896			
26th Fiscal Year		2011		0.0201		2.1896	1.0100	2.2116
1st Qtr, 27th Year:	1-Oct-11		254.6		2.2336			
26th Fiscal Year		2012						

INDEX SOURCE: Bureau of Labor Statistics, CPI - All Urban Consumers, not seasonally adjusted, U.S. city average, Rent of primary residence.
b. Date of the authorized cost and the beginning date of following fiscal years.
c. These entries are the fiscal years.
d. These are the index numbers from the referenced publications and must all be expressed with the same base year.
e. This column equals the index at the beginning of the next year, divided by the index at the beginning of the year, minus one.
f. The cumulative inflation rate equals the index (column (d)) at the beginning of the year divided by the index of the first line of the table.
g. The allowed inflation rate equals the cumulative rate through the beginning of the FY (equals one for the first FY after project authorization) time one plus 1/2 of the rate of inflation for the FY. For the remaining balance, it equals the cumultative rate to the beginning of the next fiscal year.
h. These are the cumulative rates through the beginning of the FY. They are the amounts in column (f) one-half line above.
i. This is one plus 1/2 the rate of inflation during the fiscal year, 1 + 1/2 x column (e).
j. The total inflation is the product of the last two entries.
k. The inflation rate for the remaining balance is the last entry in column (f).

DATED: 01-Nov-11

FY	CURRENT PROJECT			CURRENT SCHEDULE %		AUTH. COST SCHEDULE		AUTH. COST INFLATION	
	TOTAL	CONSTR	REAL EST.	CONSTR	REAL EST.	CONSTR	REAL EST.	CONSTR	REAL EST.
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)
1986	239.0	239.0	0.0	0.0082%	0.0000%	63.6	0.0	63.8	0.0
1987	2,635.1	2,635.1	0.0	0.0905%	0.0000%	700.9	0.0	714.5	0.0
1988	2,649.6	2,649.6	0.0	0.0910%	0.0000%	704.8	0.0	739.9	0.0
1989	3,702.3	3,702.3	0.0	0.1271%	0.0000%	984.8	0.0	1,070.6	0.0
1990	3,629.5	3,629.5	0.0	0.1246%	0.0000%	965.5	0.0	1,084.4	0.0
1991	3,236.0	3,112.0	124.0	0.1069%	2.0465%	827.8	7.3	948.6	9.1
1992	5,088.5	4,438.5	650.0	0.1524%	10.7278%	1,180.7	38.3	1,376.0	49.1
1993	22,340.2	22,054.2	286.0	0.7573%	4.7203%	5,866.6	16.9	7,025.2	22.1
1994	38,292.1	38,016.1	276.0	1.3054%	4.5552%	10,112.5	16.3	12,464.9	21.9
1995	48,072.9	45,418.9	2654.0	1.5597%	43.8026%	12,081.7	156.4	15,298.2	215.4
1996	42,488.7	40,962.7	1526.0	1.4066%	25.1857%	10,896.3	89.9	14,171.5	127.1
1997	69,589.0	69,515.0	74.0	2.3871%	1.2213%	18,491.5	4.4	24,557.8	6.3
1998	77,254.2	77,144.2	110.0	2.6491%	1.8155%	20,520.9	6.5	27,563.4	9.7
1999	50,262.0	50,186.0	76.0	1.7233%	1.2543%	13,349.8	4.5	18,219.4	6.9
2000	87,032.9	86,976.9	56.0	2.9867%	0.9242%	23,136.4	3.3	32,308.9	5.3
2001	57,936.7	57,920.7	16.0	1.9890%	0.2641%	15,407.3	0.9	21,864.4	1.6
2002	56,173.8	56,115.8	58.0	1.9270%	0.9573%	14,927.2	3.4	21,666.2	5.9
2003	29,594.4	29,562.4	32.0	1.0152%	0.5281%	7,863.8	1.9	11,740.8	3.4
2004	32,549.1	32,515.1	34.0	1.1165%	0.5611%	8,649.2	2.0	13,787.2	3.7
2005	58,736.5	58,694.5	42.0	2.0155%	0.6932%	15,613.1	2.5	26,766.5	4.7
2006	89,068.7	89,058.7	10.0	3.0582%	0.1650%	23,690.2	0.6	42,587.4	1.2
2007	110,032.5	110,024.5	8.0	3.7782%	0.1320%	29,267.2	0.5	55,067.3	1.0
2008	102,175.5	102,175.5	0.0	3.5086%	0.0000%	27,179.4	0.0	54,083.2	0.0
2009	105,219.5	105,219.5	0.0	3.6132%	0.0000%	27,989.1	0.0	56,692.8	0.0
2010	134,020.6	134,020.6	0.0	4.6022%	0.0000%	35,650.4	0.0	72,219.0	0.0
2011	143,478.9	143,478.9	0.0	4.9270%	0.0000%	38,166.3	0.0	80,363.9	0.0
BALANCE	1,542,679.8	1,542,652.8	27.0	52.9736%	0.4456%	410,355.9	1.6	882,092.8	3.6
TOTAL	2,918,178.0	2,912,119.0	6059.0	100.0000%	100.0000%	774,643.0	357.0	1,496,538.5	498.0

Appendix C - 4

Table C-4 - Olmsted Section 902 Limit
MAXIMUM COST INCLUDING INFLATION THROUGH CONSTRUCTION
(ER 1105-2-100 Appendix G, Table G-4)
($000)

ILLUST B-4 MAXIMUM COST	
LINE 1:	
A. CURRENT PROJECT ESTIMATE AT CURRENT PRICE LEVELS:	2,918,178.0
B. PROJECT COST ESTIMATE, INFLATED THROUGH CONSTRUCTION:	3,098,768.0
C. RATIO, B/A:	1.1
D. AUTH. COST AT CURRENT PRICE LEVELS. (H + I FIG B-1):	1,497,036.5
E. AUTHORIZED COST, INFLATED THROUGH CONSTRUCTION, C X D:	1,589,679.9
LINE 2: COST OF MODIFICATIONS REQUIRED BY LAW:	0.0
LINE 3: 20 PERCENT OF AUTHORIZED COST (.20 X FIG B-1, COL. F+G):	155,000.0
LINE 4: MAXIMUM COST LIMITED BY SECTION 902 (LINES 1.E+2+3):	1,744,679.9

NOTES:

a. Line 1a is the current project cost estimate in 1 Oct price levels.
b. Line 1b requires the current project cost estimate including inflation through the construction period. This is required each year by the annual budget guidance EC. This cost estimate will be developed by the appropriate cost engineering element. The ratio of this inflated project estimate to the current project estimate is used to inflate the totals of column (h) and (i) from Table C-3 to determine the authorized cost including inflation through the construction period.
c. Line 1c is the ratio of the current estimate including inflation through the construction of the current estimate.
d. Line 1d is the authorized cost at current prices. It is the total of columns (h) and (i) from Table C-3.
e. Line 1e is the authorized cost including inflation through construction. It is computed as the authorized cost at current price levels times the ratio on line 1c.
f. Line 2 is the cost of any modification required by law. This is the total cost and includes actual obligation and future obligation including inflation through construction.
g. Line 3 is 20 percent of the cost specified in the authorizing legislation. The Authorized cost is the total of columns (f) and (g) in table C-3.
h. Line 4 is the maximum project cost, including inflation through the construction period, allowed by Section 902. It is the total of lines 1e, 2 and 3.

Table C – 5 Olmsted Section 902 Limit
PROJECT COST INCREASE FACT SHEET
(ER 1105-2-100 Appendix G Exhibit G-11)

1. **Name of Project:** Olmsted Locks and Dam, Illinois and Kentucky

2. **Section and Law That Authorized or Modified the Project:**
Water Resources Development Act of 1988

3. **Section 902 Limit on Project Cost:**

a. Authorized Project Cost: (1 Oct 1987 Price Level)	775,000,000
b. Price level increases from date of authorized cost:	814,680,000
c. Current cost of modifications required by law:	0
d. 20% of line 3a:	155,000,000
e. Maximum project cost limited by Section 902:	1,744,680,000

4. **Current Project Cost Including Inflation Through Construction:** 3,099,000,000

5. **Computation of Percentage Increase:**

a. Current estimate: (Line 4)	3,099,000,000
b. Less total of lines 3a, b and c:	1,589,680,000
c. Subtotal	1,509,320,000
d. Percentage increase: (Line 5c/3a)	194.7%

6. **Explain cost indices used in 3b; whether national or regional for real estate, and single state or two state average for construction:**
Construction cost were updated for historical inflation by applying composite index listed in Table A-1, Quarterly Cost Indexes by CWBS Feature Code of EM 110-2-1304, Civil Works Construction Cos Index System (CWCCIS) 30 Sep 2011. Real estate costs were updated for historical inflation based on Consumer Price Index data for "Rent of primary residence" of All Urban Consumers (not seasonally adjusted) for U.S. city average, published by the U.S. Department of Labor, Bureau of Labor Statistics.

7. **Explain reasons for cost changes other that inflation:**
Design changes were made subsequent to project authorization to account for complex site conditions and to incorporate design improvements. Changes from the authorized Feasibility Plan design have been necessitated as more information has been gathered and problem areas have been better understood. Major elements of these changes include Illinois bank stabilization, lock, lock excavation costs, lock approach walls, mooring cells, lock operating bulkheads, river dikes, buildings, gate storage facilities, dam, gate prototype facility, and operating equipment. Cost increase associated with these aforementioned elements were virtually negated by the innovative design and construction associated with the locks W-frame, top of lock wall and backfill, revised pile foundation criteria, changes in lock concrete criteria, intake screens, lock approach walls, bank stabilization, and In-the-Wet construction of the dam. Consequently, beginning with the award of the Dam construction contract, market conditions, limited competition and an extended period of construction are the

primary reasons for the project cost increases beyond the authorized limits.

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX D

Olmsted L&D FY08 Program Year (PY) PB-3

PROJECT COST ESTIMATE (PB-3)
(Amounts in $1,000's)

Great Lakes & Ohio River Division
Louisville District

P2: 112574
CWIS: 01228
Cat/Class: 220/300/310
Region: Ohio
Basin: Ohio

OLMSTED LOCKS & DAM, ILL & KY

Authorization: PL 100-676
Price Level Basis: 1 Oct 1987
Authorized Cost: 775,000.0

Current Estimate Price Level Basis: 01-Oct-11

Date Prepared: Nov-11

Line No.	Cost Acct No.	Feature	BASE ESTIMATES						FULLY FUNDED ESTIMATE				
			Auth Cost Estimate 1-Oct-87	Amount of Change in Estimate				CURRENT ESTIMATE 1-Oct-11	CURRENT INFLATION	CURRENT ESTIMATE 1-Oct-11			
				Price Level	Other	Justification for "Other"	Total Change						
1	01	LANDS AND DAMAGES	357	1,519	4,183		5,702	6,059	7	6,066			
2	02	RELOCATIONS	3,172	651	-2,229		-1,578	1,594	0	1,594			
3	03	RESERVOIRS	0	0	0		0	0	0	0			
4	04	DAM	330,094	181,916	1,210,942		1,392,858	1,722,952	75,670	1,798,622			
5	05	LOCKS	355,676	82,502	48,770		131,272	486,948	10,088	497,036			
6	06	FISH & WILDLIFE FACILITIES	0	1,058	11,727		12,785	12,785	371	13,156			
7	08	ROADS, RAILROADS, & BRIDGES	700	536	2,408		2,943	3,643	188	3,831			
8	09	CHANNELS AND CANALS -	6,166	4,888	39,348		44,236	50,402	10,568	60,970			
9	16	BANK STABILIZATION	0	2,152	5,570		7,722	7,722	0	7,722			
10	18	CULTURAL RESOURCE PRESER.	0	387	2,739		3,126	3,126	667	3,793			
11	19	BUILDINGS, GROUNDS, UTILITIES	1,624	3,341	40,646		43,986	45,610	2,059	47,669			
12	20	PERMANENT OPERATING EQUIP.	6,803	8,649	28,057		36,706	43,509	4,107	47,616			
13	30	PLANNING, ENGINEERING, DESIGN	42,245	13,515	94,615		108,129	150,374	13,056	163,430			
14	31	CONSTRUCTION MANAGEMENT	28,163	29,805	70,492		100,297	128,460	13,846	142,306			
15	50	CONSTRUCTION FACILITIES	0	337	10,279		10,616	10,616	1,294	11,910			
16	59	CONTINGENCIES	0	29,790	214,410		244,200	244,200	49,079	293,279			
17		PROJECT TOTALS	775,000	361,044	1,781,956		2,143,000	2,918,000	181,000	3,099,000			

75463

202

ANALYSIS OF PROJECT COST CHANGES

(In thousands)

PROJECT: OLMSTED LOCKS AND DAM, ILLINOIS AND KENTUCKY

ORIGINAL ESTIMATE PRICE LEVEL BASIS: $775,000,000

BASIS OF ORIGINAL ESTIMATE: Plan E in Lower Ohio River Navigation Feasibility Study, IL & KY dated April 1985 as authorized in the WRDA 1988.

Budget Year:	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Price Level of Estimate:	Oct 88	Oct 89	Oct 90	Oct 91	Oct 92	Oct 93	Oct 94	Oct 95	Oct 96	Oct 97	Oct 98	Oct-99	Oct-00	Oct 01	Oct 02	Oct 03	Oct 04
Prior Year Annual Project Cost Estimate	775,000	801,000	816,000	832,000	865,000	890,000	890,000	888,000	902,000	910,000	928,000	934,000	917,000	971,000	1,003,000	1,020,000	1,310,000
a. Design Changes												-112,798				1,463	1,515
b. Additional functions added under general authority																	
c. Authorized modifications																	
d. Post contract award and other estimating adjustments						-16,936	-33,600	2,628	-5,800	3,590	-7,796	77,520	42,672	15,231	-1,990	269,960	64,993
e. Schedule changes																	
f. Sundry																	
g. Real Estate																	
Total Changes	0	0	0	0	0	-16,936	-33,600	2,628	-5,800	3,590	-7,796	-35,278	42,672	15,231	-1,990	271,423	66,508
Price level (1 Oct-30 Sept)	26000	15000	16000	33000	25000	16936	31600	11372	13800	14410	13796	18278	11328	16769	18990	18577	5492
Annual Project Cost Estimate	801000	816000	832000	865000	890000	890000	888000	902000	910000	928000	934000	917000	971000	1003000	1020000	1310000	1382000
Inflation/Deflation During Construction		174000	238000	245000	220000	220000	162000	118000	100000	92000	86000	83000	81000	57000	60000	90000	18000
Fully Funded Cost Estimate		990000	1070000	1110000	1110000	1110000	1050000	1020000	1010000	1020000	1020000	1000000	1052000	1060000	1080000	1400000	1400000

Budget Year:	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Analysis of Cost Changes to Authorization Estimate			
Price Level of Estimate:	Oct 05	Oct 06	Oct 07	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15	Oct-16	Total	% of Total	Change in Dollars	%
Prior Year Annual Project Cost Estimate	1,382,000	1,396,500	1,490,000	1,991,000	2,005,000	2,013,000	2,022,000									
a. Design Changes													-109,820	-4.7%	-109,820	-14.2%
b. Additional functions added under general authority													0	0.0%	0	0.0%
c. Authorized modifications													0	0.0%	0	0.0%
d. Post contract award and other estimating adjustments	11,934	78,915	497,718	2,563	-2,485	3,136	889,523						1,891,776	81.4%	1,891,776	244.1%
e. Schedule changes													0	0.0%	0	0.0%
f. Sundry													0	0.0%	0	0.0%
g. Real Estate													0	0.0%	0	0.0%
Total Changes	11,934	78,915	497,718	2,563	-2,485	3,136	889,523	0	0	0	0	0	1,781,956	76.7%	1,781,956	229.9%
Price level (1 Oct-30 Sept)	2566	14585	3282	11437	10485	5864	6477						361044	15.5%		
Annual Project Cost Estimate	1396500	1490000	1991000	2005000	2013000	2022000	2918000	0	0	0	0	0	2143000			
Inflation/Deflation During Construction	53500	45000	75000	119000	31000	24000	181000						181000	7.8%		
Fully Funded Cost Estimate	1450000	1535000	2066000	2124000	2044000	2046000	3099000	0	0	0	0	0	2324000	100.0%		

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX E

Certification of Independent Technical Review

ITR CERTIFICATION OF DECISION DOCUMENT
The Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project, and associated appendices have been reviewed in accordance with the requirements of ER 1105-2-100 for independent technical review of decision documents. All concerns resulting from independent technical review have been considered and addressed. Comments and resolutions are documented in the attachment.

L J Bibelhausen 13 March 2008
(Signature) (Date)
Project Manager for the Product Delivery Team, CELRL-PM-C

Deena Braunstein 12 March 2008
Assistant District Counsel, CELRL-OC

Byron K. McClellan, P.E. 17 MAR 08
Structural Engineer, CELRL-ED-D-S

David K. Kloeckner 18 MAR 2008
Asst. Chief, Construction Division, CELRL-CD

DISTRICT CERTIFICATION OF POLICY COMPLIANCE
I have reviewed the Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project and concur that it is in compliance with current Corps of Engineers policy and guidance.

Sharon M. Bard 17 March 2008
Chief, Planning Branch, CELRL-PM-P

COMPLETION and CERTIFICATION OF LEGAL REVIEW
The Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project has been full reviewed by the Office of Counsel, Louisville District, and is approved as legally sufficient.

R Dale Holmes 3/19/08
(Signature) (Date)
District Counsel, CELRL-OC

Olmsted Locks and Dam, Illinois and Kentucky
Remaining Contract Cost Review

Completion of Remaining Contract Review
The Walla Walla Cost Directory of Expertise performed a quality assurance review of the methodology used in determining contingency calculations for the Olmsted Dam Remaining Contract. The review analyzed the approach by the district in performing a risk assessment for remaining cost of the project. This is not to be considered an independent technical review of the cost and schedule data. The review did not assess the accuracy of the actual input data of the risk assessment.

3-6-08

(Signature) (Date)
Cost Engineer, CENWW-EC-X

Certification
Independent Technical Review
Economic and Formulation
of the Olmsted Locks and Dam Navigation Project
Post Authorization Change Report
dated March 2008

I hereby certify that I reviewed the Olmsted Post Authorization Change Report (PACR) from both an economic and plan formulation perspective and found the report and analysis to conform to Corps requirements and procedures. The computation of the Section 902 cost limit was done in accordance with the method specified in ER 1105-2-100, Appendix G. My comments and the responses from the Louisville District are attached.

Bill Frechione — 21 MAR 08

Bill Frechione, CELRP-BR-E
Regional Technical Specialist in
Inland Navigation Economics

date

Official Olmsted Post Authorization Change Report comments and resolutions as recorded in Dr Checks:

Comment Report: All Comments
Project: Olmsted L&D PACR
Review: Olmsted L&D PACR
Displaying 56 comments for the criteria specified in this report.
2703 ms to run this page

Id	Discipline	DocType	Spec	Sheet	Detail
1766977	Planning - Plan Formulation	Planning Report	n/a'	n/a	n/a

Coordinating Discipline(s): Economics,Economics

A contingency of $295 million for a project where lock construction is complete and dam construction is underway appears very high. Including such a high contingency releases the construction team from financial constraints which is not the purpose of the cost increase. In effect, it increases the authorized cost by $354 million - $295 plus 20 percent. Some rationale for the high contingency is necessary beyond the statement that the cost estimating center in Walla Walla found it acceptable. Please provide the rationale and relate the contingency cost to remaining work items.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

Revised 18-Jan-08.

1-0	Evaluation **Concurred** I totally agree with the intent of the Reviewer's comment. LRL was tasked with determining a sufficient amount of contingency to request to complete the project based upon events (progress, expenditures, production, funding delays, etc.) experienced to date. This calculated amount was developed from the Risk Management Program initiated by the Resident Office shortly after award and mandated for cost reimbursement contract vehicles to mitigate exposure to risk. Each of the identified areas of cost and schedule risk to the project were individually assessed by various assigned Government/Contractor teams. This assessment included various probabilistic determinations as to likelihood/magnitude of the impact and was subsequently used as the basis for the derivation of a weighted cost. This contingent amount was presented to MG Riley/ASA Woodley at which time LRL was directed to perform a cost-risk analysis (and review by Walla Walla) on the Risk Management inputs. This, as the Reviewer astutely points out, is tantamount to adding contingency to contingency. This "Change Request" in the project authorization amount is no substitute for implementing prudent management controls and/or addressing inefficient funding streams. It is likely that as long as USACE measures execution by expenditure of funds any remaining new "authorization" ceiling will be approached by project's end. However, the amount developed and proposed by LRL is consistent with the overall project trending, and as such, represents a necessary funding limit increase to successfully complete the project. (by Mike Braden) Contingency items, as presented in the PB-2A, are as follows ($1,000): Demolition 52 & 53 855 Prototype Demolition 94 Dam & Fixed Weir 262,991 Bulkheads Claim 8,069 Mooring Cells US 423 River Dikes 1,827 Cultural Resources 43 Service Mound Bldgs & Grnds 253 Wicket Lifter 1,067 Shop Equipment 912 Final Road Payment 25 Engineering & Design 2,316 Construction Management 16,449 Total 295,324 Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Good answer - contingency set to virtually eliminate any risk of a second need to increase the authorized cost per directions from HQ. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

Id	Discipline	DocType	Spec	Sheet	Detail
1766978	Planning - Plan Formulation	Planning Report	n/a'	n/a	n/a

Coordinating Discipline(s): Economics,Economics

Many items seemed to have been added to the project, including additional mooring cells, a visitor look-out, a towboat,

spare miter gates, a prototype dam, gate storage facility, and possibly other items that added significantly to the costs. Please list all these items that were not specifically authorized and why they were added to the construction project. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08 Revised 18-Jan-08.	
1-0	Evaluation **Concurred** The original authorization, which is included in Section 2, is a somewhat general authorization to provide the navigation project as described in the 1986 Chief's report. Costs of the Chief's report were based on the 1985 Feasibility report which included Lands and Damages; Relocations; Dams; Locks; Removal of Existing Structures; Roads; Channel and Canals; Buildings, Grounds, and Operating Equipment; Engineering and Design; and Supervision and Administration cost categories. As noted in the comment, there were project items that were not foreseen in the original reports. Mooring Cells - In January 1992 Operations Division (Ken Mathews) requested two additional mooring cells. The additional sites, one upstream and one downstream, would be beneficial to tow movement and would reduce the chances of tows queuing on the banks and causing erosion problems. Visitor Center and Overlook – other locks and dam projects in the region (i.e. Smithland L&D and McAlpine L&D) have needed to safely accommodate visitors and it is anticipated this will be necessary at Olmsted as well. It is located within 7 miles of Interstate 57 and about 40 from Paducah, KY and Cape Girardeau. MO. In addition to safety, the benefits of these are in positive public relations and education regarding the economic benefits to the nation of such a facility. Permanent Operating Equipment including a towboat to raise and lower the navigable pass wickets, a wicket lifter barge, a washdown barge to safely and efficiently clean lock walls after each high water season, and towboat maintenance bulkheads were required for the wicket gate navigable pass. At the time of project authorization a drum gate navigable pass was part of the project design. The decision to have boat operated wicket gates, made during the GDM phase, followed changes to meet seismic design requirements and extensive testing and evaluation of various wicket gate types and materials, and a 1988 study by Beck and Associates Engineers. Gate Storage Facility – after Olmsted was authorized LRD initiated a Gate Lifter program and procured The Shreve, a miter gate lifting crane. Louisville District Operations has been working toward having spare miter gates for each of its Ohio River L&Ds in case of gate damage or failure. The gate lifter crane provides the capability of lifting and setting a completely assembled gate to return the lock to operation quickly. In order to be ready for the quick change out the spare miter gates must be assembled in a vertical position and assessable by river. Thus the gate storage facility was constructed (see paragraph 8.1.4.2). (will continue in Evaluation 2) Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
	Backcheck not conducted
2-0	Evaluation **Concurred** The Prototype dam was added by the vertical team during the GDM phase. When LRL was studying the hydraulic wicket dam, LRD hired outside experts to review the concept and provide comments. One recommendation was to perform tests on the new wickets and hydraulic operation in a 1:5 model and a full scale model before awarding a construction contract. HQ and LRD then authorized LRL to proceed with both models (see paragraphs 1.5 and 8.1.5.3). Other items that were necessary following the feasibility cost estimate include costs for fish & wildlife mitigation for compliance with NEPA and the Endangered Species Act (see section 14), Illinois bank stabilization (see paragraphs 8.1.1 and 8.2.3), cultural resources requirements following the identification of L&D 52 and 53 as historic properties (see paragraph 9.2) and the need to perform maintenance of the completed portions of the project due to prolonged construction (see paragraph 9.10). Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
2-1	Backcheck Recommendation **Close Comment** The explanation is ok. I would like to see a table in the pacr that list each item and its cost. These items seem to be an important part of the reason for the cost increase. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1766979	Planning - Plan Formulation	Planning Report	n/a'	n/a	n/a

Coordinating Discipline(s): Economics

The discussions re: the project and cost should be presented in order by code of accounts throughout the report.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur, this will be done to the extent possible. Some contracts were for multiple work items that have different codes of accounts. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** ok Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766980	Planning - Plan Formulation	Planning Report	n/a'	n/a	n/a

Coordinating Discipline(s): Economics,Economics

State if any thought was given to a standard fixed crest or gated dam rather than one that would allow for open pass. The cost of providing this feature appears to exceed any savings in terms of reduced transit times, or is this not a correct statement?

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

Revised 18-Jan-08.

1-0	Evaluation **Non-concurred** During the Feasibility Study a fixed dam structure was considered. The December 1985 report states "A dam without a pass would require additional gated spillway sections for pool control. Also, a dam without a pass would require that the lock walls be higher to accommodate tow lockage during the entire year. The combined costs of the additional spillway section and increased lock wall height was in excess of $50 million greater than the costs of including a navigable pass section. An evaluation of system navigation rate savings for single site replacement plan with and without a navigable pass revealed that the open river conditions afforded by the pass sections yield an additional $1.95 million in average annual benefits. Therefore the conclusion of the economic assessment was that a replacement plan with a navigable pass was less costly and produced more navigation benefits than a plan without a pass." It should also be noted that the lock construction is complete and raising the height of the lock walls at this point would nearly be impossible. One reason that would complicate increasing the height is the seismic design issues. The current foundation isn't designed for the added dead load much less the significant increase to the seismic loads due to the added height. Additionally, the navigation industry indicated that a fixed dam structure that would eliminate or significantly reduce the availability of open river conditions provided by the existing navigable dams would be unacceptable to them. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Answer indicates analysis was performed. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766981	Planning - Plan Formulation	Planning Report	n/a'	n/a	n/a

Coordinating Discipline(s): Economics

Have someone proof-read for errors and wording.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** This has been done. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1766982	Economics	Planning Report	n/a'	n/a	n/a

Coordinating Discipline(s): Economics,Economics

Will the benefits in reduced shipping times exceed the full cost of operating the dam, including annualized costs for the towboat and other capital equipments. If not has any thought been given to not purchasing this equipment and just have tows navigate the locks year-round.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

Revised 18-Jan-08.

1-0	Evaluation **Non-concurred** The benefits of using the open pass far exceed the operating cost. It is estimated that the navigable pass will be open on an average 60% of the year. The current operation plan for the wicket gate dam is to raise and then later lower these only once per year. The ability to then control river levels with the tainter gates makes this possible. Therefore additional variable operating costs for the navigable pass are minimal. Paragraph 8.1.5.1 of the PACR points out that "The life-cycle costs for the tainter-gated /boat-operated facility were only 1 to 2 percent more than the costs for the hydraulic wicket facility." The towboat has already been purchased. The PB-2A presents the cost of the towboat as $9 mill, expended in FY08 and the cost for the wicket lifter as $20.495 mil, with $10.144 mill expended in FY13 and $10.351 expended in FY14. The annual equivalent cost of these at 4.875% for a 50-year period is $2.09 mill. As noted in response to comment # 1766980, the height of the lock walls prevent year round locking. The Olmsted project is in a high earthquake zone and thus the lock walls were kept as short as possible. Year-round lock navigation would require modifications to the tainter gates, lock walls, and therefore also a greater foundation. The dam is under construction and is currently approximately 20% complete. The costs of these modifications at this stage of construction would be exorbitant. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** The height of the lock walls are not sufficiently high to allow usage of the lock during high water and, therefore, open pass is a necessity during these periods. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766984	Planning - Plan Formulation	Planning Report	n/a'	n/a	n/a

Coordinating Discipline(s): Economics

PACR, Executive Summary: 1. The first table in executive summary should list the original authorized cost, the updated cost, the 902 cost, and the current cost estimate.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur. The suggested table will be created and included as the first table.

	Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1766986	Planning - Plan Formulation	Planning Report	Executive summary	n/a	n/a

Coordinating Discipline(s): Economics

The second table should list the updated and current costs and the difference between the two by code of accounts. All cost at Oct 07 price levels.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur. The suggested table will be provided. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1766988	Planning - Plan Formulation	Planning Report	Executive summary	n/a	n/a

Coordinating Discipline(s): Economics

Explain what current inflation in table es-1 refers to?

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** This is the "Current Inflation" that is shown in the fully funded project cost estimate on the PB-3 that is presented in Appendix D. It is an estimate of the increase of future construction costs for future years of the construction period. This estimate is made with OMB indices that are provided each year in the Budget EC. This table will be replaced with the previously suggested cost table. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766989	Planning - Plan Formulation	Planning Report	Executive summary	n/a	n/a

Coordinating Discipline(s): Economics

Recommend removal of Table es-2 since it is not clear what purpose it serves. The costs have gone up and not down.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur, table will be removed. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766990	Planning - Plan Formulation	Planning Report	Executive summary	n/a	n/a

Coordinating Discipline(s): Economics

Recommend removal of Table es-2 since it is not clear what purpose it serves. The costs have gone up and not down.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur, table will be removed. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766991	Planning - Plan Formulation	Planning Report	Executive summary	n/a	n/a

Coordinating Discipline(s): Economics

Summarize the reasons for increase in costs between the updated current cost estimate, i.e. – market conditions, inflation, etc. and how much each contributed to cost difference.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur a summary of items and their cost will be included in the Executive Summary. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1766995	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics

Organize discussions under code of accounts, and then subdivide as necessary. At a minimum this applies to sections 1, 8, and 9.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur, this will be done to the extent possible. Some contracts were for multiple work items that have different code of accounts. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766996	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics

Page 12 – was the in the wet construction of the dam determined to be more economical based on total costs, including $130 million of the concrete pre-casting yard and marine launching facility?

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** As part of the Feature Design Memorandum (DM #8) a Method of Construction Study was performed. The study concluded that the in-the-wet method was cheaper than the traditional in-the-dry (cofferdams) method. The pre-casting yard and marine facility were included in the study but actual costs exceeded those estimated. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766998	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics

Page 13 – was the gate prototype facility used to test the dam that is under construction, or some conceptual idea for a dam that was abandoned?

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** The prototype was primarily used to prove out the design of the hydraulic wicket dam design. The hydraulic wicket dam was ultimately abandoned. Some of the information learned from the prototype was useful in the design of the wickets currently in the navigable pass. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1766999	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics

Page 13 – the discussion on innovative design and construction would be appropriate if the project cost went down rather than up. As it is, it is not clear what this contributes to the goal of explaining the reasons for the cost increase. Either this should be clarified or the section should be removed. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Non-concurred** The Innovative Design section was included to show that steps were taken to keep cost increases down. This point will be more explicitly made within this section. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1767001	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics Design changes should be discussed under code of accounts. Two sections – 8.1 and 8.2 are unnecessary and confusing. There should be one section that describes the major design changes from those that were authorized. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Concur. These sections will be revised. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767003	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics Table 2 seems to incorrectly list the authorized cost of $775 million as being at Oct 2007 price level. Please check and correct if necessary. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Concur. This table will be revised. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1767005	Planning - Plan	Planning Report	Main Report	n/a	n/a

	Formulation				

Coordinating Discipline(s): Economics

Table 2 should list the authorized cost as 1986 or whatever price level, the updated authorized cost at Oct 07 price levels, the 902 cost, and the current cost estimate. They should be labeled accordingly.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur. The requested table will be provided. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767010	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics

Changes in project cost should be discussed by code of accounts. The changes should compare the current cost estimate to the updated authorized cost and explain any differences.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur. The text will be organized to the extent possible by code of accounts. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767012	Planning - Plan Formulation	Planning Report	Main Report	n/a	n/a

Coordinating Discipline(s): Economics

There should be table following table 2 that list the updated authorized cost and the current cost estimate by code of accounts. The discussions can then follow.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur the table will be provided and discussions will follow that. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767032	Economics	Planning Report	Main Report	n/a	n/a
Coordinating Discipline(s): Economics Page 40 - please explain why processing times increased from 60.8 to 75.4 minutes. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **Concurred** RESPONSE: The LOCALC model used in the 1990 Benefit Update was based on 1990 LPMS data, while the Waterway Analysis Model runs (WAM) used to estimate capacity for the 2007 Economic Update are based on 2000-2005 LMPS data. The difference between the inputs is shown in the table below. All times have increased since 1990, with upbound times showing the biggest increases. This is directly related to the condition of the cells that form the lock wall extensions of the main chamber and deteriorated empty/fill valves. Both result in poor hydraulic conditions that most affect upbound tows. All phases of lock processing take greater care and require slower speeds than observed in 1990 when the physical condition of the structure was better. There is new text in Section 10 of the "Olmsted-PACR_Section10And11_2007-02-09" that explains why processing times are higher. Submitted By: Sharon Weekley (304-399-5334) Submitted On: 11-Feb-08 (Attachment: Comment#17670321.doc)				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08				
	Current Comment Status: Comment Closed				

1767034	Economics	Planning Report	Main Report - Section 10 - Economics	n/a	n/a
Coordinating Discipline(s): Economics Page 41 – please explain the line items 'No Navigation – dam closed' and 'No Navigation – both chambers closed'. These average 52.5 days a year when averaged over 50 years. Has the analysis used to develop these values been independently reviewed? If not please forward this comment to the engineering portion of the team for their response. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **Concurred** Labels "No Navigation – dam closed" and "No Navigation – both chambers closed" have been re-labeled to "No Navigation – dam closed & chamber unavail" and "No Navigation – both chambers closed & no nav.pass". In short, these two categories represent complete river closures. Also note that the Engineering cost-closure matrices have gone through QA/QC (Bryon McCellan) since the PACR was sent for ITR and the cost-closure matrices have been modified, instead of an average of 52.5-days a year of complete river closure, the average is now 35.6-days a year of complete river closure. Vessels can either transit LD 52 and LD 53 by chambering or navigation/open pass. When chambering the lock chamber gates and valves are used to lift/lower the vessel to the next pool. When transiting using navigation/open pass the upper and lower pools are equal and the vessel drives through the chamber (open pass) or passes over the wicket dam (navigation pass) depending on the river level. Note that open pass operations are extremely rare. One can then define a chambering season and a navigation/open pass season. For "No Navigation – dam closed & chamber unavail" the project is operating in the navigation/open pass season, or more specifically in a navigation pass process (i.e. the chambers are under water and unusable) and the dam fails, stopping transit of this point n the river. For "No Navigation – both chambers closed & no nav.pass" the project is operating in the chambering season (i.e. water levels are not sufficient to navigation/open pass) and both chambers fail, stopping transit of this point in the river. Submitted By: Buddy Langdon (304-399-6957) Submitted On: 25-Feb-08				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08				

	Current Comment Status: Comment Closed				
1767036	Economics	Planning Report	Main Report - Section 10 - Economics	n/a	n/a

Coordinating Discipline(s): Economics

Page 43 – the present worth numbers are only meaningful if comparable and the numbers in Table 7 are not comparable. Please add a table or revise the existing table to show the comparison using the same discount rate – would suggest 7 percent. This could be accomplished with the addition of one row that lists the average annual values at 7% for the different benefit streams.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Non-concurred** The intent of this table in the PAC report is not for dollar-to-dollar comparison, but a discounting and amortization comparison under old and new analysis. Old and new analyses were at different price levels and used different discount rates. As structured, the average annual values at the bottom of the table can be cross-referenced to other tables and reports. Other intent of table is to highlight shift of the benefit streams from 2006-2055 to 2016-2065 resulting from construction schedule slippage. Tables at any discount rate could easily be added, however, this would be excessive clutter in the PAC report with little to no usefulness. A 7% table (with both benefit streams at same price level) has been added to Appendix A - Economics Update and section 10.4.1 now states "A comparison of both benefit streams at the OMB 7% rate can be found in Appendix A – Economics Update.". In an attempt to demonstrate the sensitivity of the discount effect (or in this case the lack of sensitivity when comparing change between old and new average annuals), text at end of section 10.4.1 now states "The average annual transportation rate-savings benefit for the current re-analysis update (at 4.875%) is 19.9% lower than the last approved report (at 8.875%). If both transportation rate-savings benefit streams are discounted and amortized using the same discount rate, the current re-analysis update are 16.8% less at 4.875% discount and 16.4% less at 8.875% discount." Submitted By: Buddy Langdon (304-399-6957) Submitted On: 25-Feb-08
1-1	Backcheck Recommendation **Open Comment** I would like to see a table that provides the aae benefits, costs, net, and bcr as appeared in the authorizing document at the applicable rate, the current rate, and a 7% rate. The table should include same data for the economic update. Will such a table be provided in pacr? Submitted By: Bill Frechione (412 395 7207) Submitted On: 03-Mar-08
1-2	Backcheck Recommendation **Open Comment** The requested information has been provided as requested and is in Table 21 and Table 22 on pages 38 and 39, respectively, of Appendix A - Economics Update. Submitted By: Wes Walker (304-529-6938) Submitted On: 10-Mar-08
1-3	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 10-Mar-08

	Current Comment Status: Comment Closed				
1767037	Economics	Planning Report	Main Report - Section 10 - Economics	n/a	n/a

Coordinating Discipline(s): Economics

Page 44 – please verify statement that capacity of 52 and 53 increased. This seems contrary to an earlier statement.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Statement in the report was made in error. Section 10.4.1 now states "The primary driver of this lower

	normal operation transportation savings estimate are lower traffic demand forecasts, which more than off-sets the lower without-project condition capacity estimates assumed in the current analysis which would tend to increase incremental with-project benefits." Submitted By: Buddy Langdon (304-399-6957) Submitted On: 25-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1767039	Economics	Planning Report	Main Report - Section 10 - Economics	n/a	n/a

Coordinating Discipline(s): Economics

Table 8 – use common discount rate.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Non-concurred** Similar to comment-response 1767036, the intent of this table in the PAC report is not for dollar-to-dollar comparison, but a discounting and amortization comparison under old and new analysis. Old and new analyses were at different price levels and used different discount rates. As structured, the average annual values at the bottom of the table can be cross-referenced to other tables and reports. Other intent of table is to highlight shift of the benefit streams from 2006-2055 to 2016-2065 resulting from construction schedule slippage. Tables at any discount rate could easily be added, however, this would be excessive clutter in the PAC report with little to no usefulness. A 7% table (with both cost streams at same price level) has been added to Appendix A - Economics Update and section 10.4.2 now states "A comparison of both cost streams at the OMB 7% rate can be found in Appendix A – Economics Update.". In an attempt to demonstrate the sensitivity of the discount effect (or in this case the lack of sensitivity when comparing change between old and new average annuals), text at end of section 10.4.2 now states "If both cost streams are discounted and amortized at 4.875% the reduction remains at 42.3% since the 1990 Benefit Update costs foregone are flat (and result in the same average annual regardless of the discount rate used). The 1990 Benefit Update costs foregone are flat through time because the year-to-year estimates used in that analysis were not available and only an average annual estimate was available for comparison. If both cost streams are discounted and amortized at 8.875% the reduction reduces to a 36.6% difference." Submitted By: Buddy Langdon (304-399-6957) Submitted On: 25-Feb-08
1-1	Backcheck Recommendation **Open Comment** What "costs" are foregone, ie. repair/maintenance costs? How do these costs affect the reliability of the project; specifically do these expenditures reduce the days of outage listed in the cost/closure matrix? Submitted By: Bill Frechione (412 395 7207) Submitted On: 03-Mar-08
1-2	Backcheck Recommendation **Open Comment** The requested information is provided as requested and is in Tables 23 and 24 on pages 41 and 42, respectively, of Appendix A - Economics Update. Costs foregone are repair costs that enable the project to return to service. These repairs do not alter the project's reliability. Submitted By: Wes Walker (304-529-6938) Submitted On: 10-Mar-08
1-3	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 10-Mar-08
	Current Comment Status: Comment Closed

1767041	Economics	Planning Report	Main Report - Section 10 - Economics	n/a	n/a

Coordinating Discipline(s): Economics

Page 46 – are the fuel tax for traffic thru Olmsted credited entirely to Olmsted or pro-rated between all projects in trip? Crediting all the tax to Olmsted and counting as a benefit would overestimate the benefit.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **For Information Only** The fuel tax benefit is not overstated. Fuel tax revenues are incremental between the without and with-project conditions and as a result reflect only changes at Olmsted. While the incremental is calculated off the system level tax revenues, the calculation result is essentially equivalent to Olmsted with-project transit fuel consumption tax revenues minus the Olmsted without-project transit fuel consumption tax revenues. Per comment 1767036 and 1767039, a 7% table has been added to Appendix A - Economics Update and section 10.4.3 now states "A benefit streams at the OMB 7% rate can be found in Appendix A – Economics Update." Submitted By: Buddy Langdon (304-399-6957) Submitted On: 25-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1767042	Economics	Planning Report	Main Report - Section 10 - Economics	n/a	n/a

Coordinating Discipline(s): Economics

Page 51 – please include only construction costs as the denominator in BCR. Then show the total project BCR and the RBRCR using the discount rate when CG funds first expended, the current rate, and 7%.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Non-concurred** The primary intent of section 11.2.1 Table 13 (page 52) is to compare new estimates with Last Approved Report (LAR) estimates. Comparison is done in an incremental benefit to incremental cost fashion since the LAR estimates were originally done in an incremental benefit to incremental cost fashion. The newer method where only construction costs, construction cost IDC and with-project O&M costs (no WOPC costs foregone costs subtracted) are included in the denominator of the BCR is shown in section 11.2.2 (inappropriately labeled as 11.1.1 in the supplied PACR) Table 15 (page 53). BCRs and RBRCRs are displayed using the applicable rate, current rate and OMB rate. All tables (13, 15, 16 & 17) show amortization at the LAR rate, current and OMB rate (i.e. 8.875%, 4.875% and 7%). The "applicable" rate (Federal Discount rate when CG funds were first expended) is also 8.875%. Submitted By: Buddy Langdon (304-399-6957) Submitted On: 25-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 03-Mar-08
	Current Comment Status: Comment Closed

1767044	Economics	Planning Report	Main Report - Section 10 - Economics	n/a	n/a

Coordinating Discipline(s): Economics

Please show the separable O&M costs required to operate the wicket dam. Show total, fixed, and variable costs on an annualized basis.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Non-concurred** Louisville District Operations Division does not have separate O&M cost records for wicket dam operation for either L&D 52 or 53. However, they estimate wicket dam O&M costs to be relatively minor even for these dams. The current operation plan for the Olmsted wicket dam is to raise and then later lower these only once per year. This is possible because of the ability to control river levels with the tainter gates. Therefore additional variable operating costs for the wicket dam are minimal. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Open Comment** The comment refers to the Olmsted dam. The costs would include the amortized towboat cost and other equipment purchased to allow open pass. A cost of about $2 million was mentioned in response to a different comment. The costs would also include labor costs? I would like to see the O&M costs for the Olmsted Dam included in the pacr. Submitted By: Bill Frechione (412 395 7207) Submitted On: 03-Mar-08
1-2	Backcheck Recommendation **Open Comment** A separable Olmsted wicket dam O&M estimate was not readily available. Historic L&D 52 and 53 O&M costs were investigated for separable wicket dam O&M costs at these projects. These would have then been used to make an Olmsted wicket dam O&M estimate. Since these did not exist, an Olmsted O&M study conducted in 1995 by Black & Veatch, which included O&M estimates for the boat operated wicket dam, was retrieved from archives. Estimates of annual O&M, including major repair and replacement costs, were updated to make a current estimate O&M estimate for the boat operated wicket dam. Assumptions included additional annual fuel usage of 7,608 gallons at $3.50 per gallon, 25% of annual labor for a crew of 10 at current rates with a typical distribution of wage grades with overhead was included, major repairs occur every 20 years and wicket gates are replaced at 40 years, and the number of wicket gates is now 140 instead of 110 in 1995. FY95 costs were brought to FY08 values using the September '07 CWCCIS annual factors for dams. Equivalent annual costs for these were estimated with a life cycle analysis, assuming mid-year expenditures. The $9 mill towboat cost, expended in FY08, and the cost for the wicket lifter of $20.495 mil, with $10.144 mill expended in FY13 and $10.351 expended in FY14 were included. The on-line date of the project was adjusted from the annual equivalent cost calculation made in response to comment #1766982 because the last two years of construction will be demolition of L&Ds 52 and 53. The total annual equivalent cost of the wicket dam items mentioned above, calculated at 4.875% for a 50-year period of analysis, is $2.5 million. This estimate will be included in the PACR in section 9.5.2. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 13-Mar-08
1-3	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 17-Mar-08
	Current Comment Status: Comment Closed

1767045	Economics	Planning Report	Main Report - Section 13-Conclusion	n/a	n/a

Coordinating Discipline(s): Economics Section 13: Conclusion – statement that costs thru end of 07 considered sunk. Please verify that this is correct, particularly with regard to economics analysis. They appear to have used some other year to terminate 'sunk' costs, possibly 08 or 09. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Costs were sunk through FY09 for the analysis. The report will be corrected to reflect this. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08

	Current Comment Status: Comment Closed				
1767046	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a
Coordinating Discipline(s): Economics Table 20 and other tables – please clarify table title, i.e. '1990' benefit update. There are many updates so the date in terms of their use in a report is needed to distinguish them. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **Concurred** Tables 20, 21 and 22 will be re-titled in the final report per this comment. Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08				
	Current Comment Status: Comment Closed				
1767047	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a
Coordinating Discipline(s): Economics Table 23 – again the 'Benefit Update' is 1990. If this correct, please indicate in table. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **Concurred** Tables 23 and 24 will be re-titled in the final report per this comment. Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08				
	Current Comment Status: Comment Closed				
1767048	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a
Coordinating Discipline(s): Economics Please describe the methodology for development of the cost/closure tables, what organizations and disciplines performed the work, and whether the table was internally and/or externally reviewed. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **Concurred** The cost/closure tables were compiled based on historical maintenance records combined with current conditions and likely future events as projected by Operations Division personnel. Three scenarios were chosen: 1) Fix-As-Fails at 52 and 53/ No Olmsted 2) Chamber Replacement at 52 and 53/ No Olmsted 3) Completion of Olmsted/ subsequent decommissioning of 52 and 53. In every scenario the 'Minor Closures' were determined after researching the magnitude and frequency of historical random failures that resulted in closures and projected forward. The cost was determined using the current per day cost of the repair crew by the closure duration. Also in every scenario, the frequency of closures as well as costs increases as the study period progresses to account for age effects. Concerning the Fix-				

	As-Fails scenario, it is assumed that no set routine maintenance program is in place and failures will be repaired on an as-needed basis. Operations Division personnel verified that these 'Major Closures' will not be as frequent as the random 'Minor Closures', but given the lack of routine maintenance, the effects of these failures will be much more significant in terms of both closure durations and costs. Operations Division personnel also verified appropriate life spans of primary components (channel walls, miter gate sills, filling/emptying valves, navigable pass, beartraps, etc) and costs to repair each said component for projection purposes. Concerning the Chamber Replacement scenario, in order to keep the Ohio River open to traffic, construction at both 52 and 53 must be successive and not overlapping. Costs and closure durations for construction were determined based on current projections for Olmsted and cross-referenced with the costs at the McAlpine project. All costs and closures prior to the construction take on the Fix-As-Fails format, whereas all costs and closures upon completion take on the Advanced Maintenance format, which is the equivalent of a set routine maintenance schedule. The Olmsted scenario focuses solely on the completion of the Olmsted project as soon as possible. The costs and schedule of completion is based on the current budget and current schedule. No closures are included prior to completion and the project will take on the Advanced Maintenance format upon completion. Closure costs and frequencies were based on current repair crew rates and verified by Operations Division personnel. The tables were researched and compiled by Structures Section personnel with assistance and data verification from Operations Division personnel. The tables were internally reviewed by Mr. Byron McClellan, former chief of Engineering Design Branch and current rehired annuitant, and Mr. Mark Lisney, with the Institute of Water Resources. (response by Matt Watts) Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** The ITR comments and approval by Mr. McClellan need to be part of the record. Best way is to enter into drchks. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767050	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Page 10 – the forecasts are substantially lower than the previous forecasts, but all five scenarios still show growth. Explain why was a "no growth" scenario was not evaluated, particularly since traffic in 2005 is actually lower than 1990 traffic at both projects.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** The lowest growth scenario was used in the Post Authorization Change Report economic analysis. This scenario projects traffic for LD52 and LD53 in 2010 that, like actual 2005, is lower than 1990 traffic. This low traffic scenario was judged to be the most appropriate. In response to the reviewer's comment, a sensitivity test using no growth in traffic was completed by holding traffic constant at 2010 levels throughout the analysis period. The table below compares benefit to incremental cost ratios for Clear Skies and No Growth using the current interest rate of 4.875 percent and the OMB interest rate of 7.0 percent. The results of this sensitivity test will be included in the 2007 Economic Update. Traffic Scenario Benefit-Cost Ratio 4.875 % 7.0 % Clear Skies 22.4 11.6 No Growth 17.2 9.4 Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767052	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Page 13 – please explain the relative and absolute decline in rate savings over time. Has the waterway become less

efficient or have the overland modes become more efficient? The expectation would be that the waterway would become more efficient since it can move a ton with less fuel than a train or truck, and with rising fuel prices the rate savings would increase. What has happened to negate this fuel-related savings, or is this expectation wrong? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Towboat power plants were superior to rail throughout the 1980s; however, according to transportation analysts at TVA, this differential has been reduced over time as railroads have become more efficient. Locomotive engines have been replaced to meet more stringent environmental regulations and the railroads are hauling an increasing number of larger capacity cars and lighter rail cars (such as aluminum cars). These changes have caused differentials between waterway and overland rates to decline as noted by the reviewer. The remaining rate differential is strongly related to waterway carriers' ability to keep both headhauls and backhauls loaded. Rail's opportunity to move loaded backhauls is extremely limited on trade routes where barge and rail compete directly. It is entirely possible that with higher fuel prices the rate differential between rail and barge will begin to widen again, reversing the trend the reviewer has noted. Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767053	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics Page 14 – clarify what is meant by the "max delay of 120 hours"? Is this maximum delay of all tows delayed? Or is this the average of all tows during the closure period or over the entire year? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **For Information Only** WAM runs were made for LD52 by first determining the average delay expected at the project based on the highest expected demand (175.3 Mtons) during the period of analysis (2010-2060). At this tonnage level, average delay was found to be 109 hours. To determine the maximum delay at the project, the WAM traffic escalation factor was increased by 10% to increase tonnage levels at the project. A 10% increase will drive up the tonnage level enough to determine the maximum delay at the project, which was found to be 129 hours. This is the maximum annual tow delay for all tows given 62% of these tows are in navigable pass and 38% are in the locking mode. Submitted By: Sharon Weekley (304-399-5334) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Open Comment** Please explain how applying a 10% traffic escalation factor allows the determination of the maximum delay at the project. Where does the 10% come from? Could it be 25% instead? Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
1-2	Backcheck Recommendation **Open Comment** Bill, I am e-mailing you a document "Comment_1767053.doc" as my response. Submitted By: Sharon Weekley (304-399-5334) Submitted On: 27-Feb-08
1-3	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 07-Mar-08
	Current Comment Status: Comment Closed

1767055	Economics	Planning Report	Appendix A -	n/a	n/a

			Economic Update		

Coordinating Discipline(s): Economics

Page 16 – how does the capacity of 52 and 53 compare to Myers and other similarly sized lock projects? If more than 10 percent different, then provide explanation.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **For Information Only** The table below shows capacities for various middle and lower Ohio River lock projects with similar lock sizes (1200' main and 600' auxiliary chambers) taken directly from the "Ohio River Mainstem (ORMSS) System Investment Plan (SIP) report. Capacities shown are for the existing condition at full operation and vary from 144.2 Mtons at Greenup to 170.6 Mtons at nearby Myers. The capacity is the tonnage that corresponds with a transit time of 200 hours (delay plus processing time). The 200 hour transit time is an arbitrary value. In this reach of the curve, the difference in tonnage between say, 100 hours and 300 hours is small. For purpose of comparison, if the average delay is 104 hours at LD52, the average tonnage level is 170.1 Mtons in the 2007 Economic Update, which is almost exactly the same as Myers capacity estimate (170.6 Mtons) for the ORMSS SIP. If the average delay at Myers is 92 hours, the average tonnage level is 170 Mtons, which is similar to the capacity at 200 hours. Again, there is not a significant difference in tonnage levels at high traffic levels because as demand reaches capacity, delays tend to infinity with no increase in throughput. In the 2007 Economic Update, WAM runs for LD53 were made using only a 9 hr maximum tow delay. This project on average is 88% navigable pass and 12% locking, which results in higher throughput and significantly lower tow delays. For LD53, an average tow delay of 9.4 hours results in an average tonnage level of 174.9 Mtons. Referring to the ORMSS SIP lock capacity curve, if the average tow delay at Myers is 9.8 hours, the tonnage level is 157.8 Mtons. Thus, LD53 tonnage level is 10.8% higher than Myers. Submitted By: Sharon Weekley (304-399-5334) Submitted On: 11-Feb-08 (Attachment: Comment#1767055.doc)
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 03-Mar-08
	Current Comment Status: Comment Closed

1767057	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Page 20 – what qualifies as a "low lift" project?

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **For Information Only** Generally speaking, projects equipped with gated dams are high lift, while fixed crest and wicket dams, like those at LD52 and LD53, can be characterized as low lift. LD52 has a wooden wicket dam with a lift of 12 feet. The lift is the difference in height between the upper pool (302 feet) and the lower pool (290 feet). Lifts for other lower Ohio River locks are as follows: Smithland (22 feet), Myers(18 feet), and Newburgh (16 feet), Cannelton (25 feet), McAlpine (37 feet). Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767059	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Page 16 – explain what is meant by "interference". Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **For Information Only** In this study, "Interference" refers to "gate area interference" which tends to reduce the capacity of the facility. The WAM model has the capability to account for the 'interference" that may occur between vessels at multi-chamber locks. "Interference" occurs between two tows when a tow, or part of a tow, is waiting along the wall near the gates. This occurs during turnback approaches and multi-cut lockages and is associated with the length of vessel that is waiting at the gates. Interference parameters are determined by experienced lock operators at the facility. The table below lists the type of gate area interference parameters used by WAM. In the case of LD52 and LD53 the interference parameters did not have a dramatic effect on capacity estimates. For example, LD52 capacity with no navigable pass and no interference was 98.7 Mtons, while the capacity with no navigable pass and interference was 95.2 Mtons. Submitted By: Sharon Weekley (304-399-5334) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767060	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics Page 25 – explain if the lockage policy in terms of chamber usage is the most efficient policy. Why is there so little usage of the auxiliary at high utilization rates? This seems counter-intuitive. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** table 1 (see attached) presents the results of 4 operating policies. The best policy from the perspective of delay reduction and transit time is allowing 1 cut (single lockage) tows in the auxiliary chamber using a 6 up/6 down policy. The second best is the 1 cut in auxiliary FIFO policy, which has a slightly higher capacity, but much higher delay. This verifies the wisdom of what is observed, low usage of the auxiliary. Submitted By: Sharon Weekley (304-399-5334) Submitted On: 11-Feb-08 (Attachment: Comment#1767060.doc)
1-1	Backcheck Recommendation **Open Comment** Please clarify; this seems contrary to "interference" response which seemed to indicate that interference was not a significant problem at the projects. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
1-2	Backcheck Recommendation **Open Comment** Closed without comment. Submitted By: Sharon Weekley (304-399-5334) Submitted On: 28-Feb-08
1-3	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 07-Mar-08
	Current Comment Status: Comment Closed

1767061	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics Page 25 – the implication is that the current update of economics is based on reliability analysis of the locks and dams, which results in failures and closure of the project. Is this correct or were the failures assumed to occur in specific years? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **For Information Only** : The point being made in the text is that the 2007 Economic Update incorporates both the reliability of the dam and the reliability of the locks. The 1990 Benefit Update only concerned itself with the locks. No probabilistic-based economic modeling was conducted by the Economics team. The Engineering Team provided costs and closures in specific years for failures of components as well as future periodic maintenance closures and costs relative to all four chambers and the two dams via the cost and closure matrices. These matrices are based upon engineering judgment, founded upon the experiences of operations and engineering personnel with small scale failures of components at these two projects in recent years. Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08				
	Current Comment Status: Comment Closed				
1767063	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a
Coordinating Discipline(s): Economics Page 26 – according to EC 1105-2-407 all planning models in decision documents have to be certified. Has ORNIM been certified? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **For Information Only** The ORNIM model has not been certified per EC 1105-2-407; however, the ORNIM model was peer reviewed by external technical specialists in anticipation of requirements like those in the EC. This review was completed as part of the Ohio River Mainstem System (ORMSS) study. Results of the review are in Dr. Checks and certification letters dated 15 November 2004 are available for examination by the reviewer. A Model Certification Review Report shall be prepared for ORNIM during the Upper Ohio Feasibility study that is underway. Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08				
	Current Comment Status: Comment Closed				
1767065	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a
Coordinating Discipline(s): Economics Page 31 – explain how you adjust rate savings for simultaneous closures at both 52 and 53 without double counting the reduction in rate savings since most traffic, it is surmised, passes thru both projects. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08					
1-0	Evaluation **For Information Only**				

	The methodology employed does not account for simultaneous closures. The reviewer is correct in that to the extent this situation was to occur, the methodology would double count cost reduction savings. The issue is most obviously relevant to the cyclical or scheduled closures, which offer an opportunity for scheduled simultaneous closure. According to the Engineering Team, these are the 3 – 10 day closures in the matrices. While simultaneous scheduled closures would be beneficial, the need to mobilize two repair fleets makes it difficult to successfully schedule a short duration simultaneous closure. Again, according to the Engineering Team, the major closures represent unscheduled events where a planned simultaneous closure could not be made. A cursory review of the historic record indicates that the occurrence of coincident, unexpected closures at contiguous locks has been a rare or non-existent event over the last 30 some years. Nevertheless, a sensitivity analysis was conducted to gauge the limits of the influence on benefits of not incorporating the effect simultaneous closures. For this test all closures at LD53 were removed from the spreadsheet. This sensitivity test in effect makes the extreme assumption that all closures are simultaneous. As can be seen in the table below, the benefit to incremental cost ratios are still high. BCR @ BCR @ 4.875% 7.0 % Closure at Both 52 & 53 22.4 11.6 Closure only at 52 16.0 8.0 Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767066	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics Page 31 – please explain the difference between the full op total system savings indexed to 07 in Table 32 and the number under the same heading in Table 36. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Table 32 was meant as an example of the calculations performed in the spreadsheet and did not contain the actual analysis, input and results. This table has been updated with actual numbers in the final draft to avoid confusion. Submitted By: Timothy Smith (304-399-6937) Submitted On: 14-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767067	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics Page 31 – the reduction of $587 million is .4 times the value in Table 36 and not in Table 32, as the text seems to state. Again, why are the values at full op different in 32 and 36? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Again, Table 32 was meant as an example of the calculations performed in the spreadsheet and did not contain actual analysis, input and results. This table has been corrected in the final draft. Submitted By: Timothy Smith (304-399-6937) Submitted On: 14-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment.

	Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767069	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Page 28 -- I checked present value factor calculations and they are correct.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **For Information Only** No response necessary Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767070	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Page 31 -- include a table that shows the commonality of traffic between 52 and 53 to support the adjustment to rate savings logic.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** In 2005 82.7 percent of LD52 traffic went through LD53 and 97.5 percent of LD53 traffic went through LD52. This information shall be included in the 2007 Economic Update. Submitted By: Timothy Smith (304-399-6937) Submitted On: 14-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767073	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Page 34 -- include a table that shows the year, sunk costs, remaining costs, and total. Confirm that sunk costs are costs expended thru end of fy07 as is stated in main report.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** This table has been included in the Economic Update per the comment (see Table 28.) Submitted By: Timothy Smith (304-399-6937) Submitted On: 14-Feb-08
1-1	Backcheck Recommendation **Close Comment**

	Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 14-Feb-08
	Current Comment Status: Comment Closed

1767076	Economics	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

Economics – the economic model is too complex to review and without reviewing the model it is not possible to review the economics in the amount of detail necessary to recommend approval of the Economic Update. As a general comment I would say that the analysis looked reasonable based on my past experience in inland navigation economics.

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **For Information Only** It is acknowledged that material sufficient for a review of ORNIM was not provided in the PACR, or in the Economics Update in Appendix A of the PACR; however, the model has been reviewed extensively by experts external to the Corps of Engineers prior to the existence of EC1105-2-407. This review is documented in Dr. Checks and certification letters from the reviewers dated 15 November 2004 are available. Submitted By: Wes Walker (304-529-6938) Submitted On: 11-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767079	Planning - Plan Formulation	Planning Report	Appendix A - Economic Update	n/a	n/a

Coordinating Discipline(s): Economics

It appears that the driving force in the economics is the poor and unreliable condition of Locks and Dams 52 and 53. Quantification of the poor condition is captured in the cost and closure table, which is input to the economic model. If the cost/closure table was developed by the engineering team, then please forward to them the following: "given the significance of the cost/closure table to the economics of the project, independent review of the development and values in the table is essential".

Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08

1-0	Evaluation **Concurred** Concur. This comment was forwarded to Mr. Byron McClellan, former chief of Engineering Design Branch and current rehired annuitant, who performed ITR of the cost/closure matrices. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Documentation of review for record needs to be included in drchks or as a separate attachment to the pacr. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767081	Planning - Plan Formulation	Planning Report	Appendix C - 902 Computation	n/a	n/a

Coordinating Discipline(s): Program Management

Site source and date of index and where it can be accessed (web address) – 30 Sep 07 is most recent. Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Civil Works Construction Cost Index System dated 30 September 2007, provided in EM 1110-2-1304 was used. Web address: http://www.usace.army.mil/publications/eng-manuals/em1110-2-1304/entire.pdf Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767082	Planning - Plan Formulation	Planning Report	Appendix C - 902 Computation	n/a	n/a

Coordinating Discipline(s): Program Management What cwccis code of accounts was used - composite or maybe locks, dams, etc. If not composite, how were the codes of account indices weighted? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Composite indices were used. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** CWCCIS for each code of account should be applied to each code of account in the construction cost table. However the composite is frequently used for large projects so I will defer. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767085	Planning - Plan Formulation	Planning Report	Appendix C - 902 Computation	n/a	n/a

Coordinating Discipline(s): Program Management Where the index numbers manually entered into tables? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Yes, index numbers manually entered. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 29-Feb-08
	Current Comment Status: Comment Closed

1767086	Planning - Plan Formulation	Planning Report	Appendix C - 902 Computation	n/a	n/a

Coordinating Discipline(s): Program Management What was used for CPI, i.e. urban rent, and what was this for: national, state, Louisville? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** The CPI Rent of Primary Residence was used to update real estate costs for historic inflation. This was for the US city average. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 28-Feb-08
	Current Comment Status: Comment Closed

1767088	Planning - Plan Formulation	Planning Report	Appendix C - 902 Computation	n/a	n/a

Coordinating Discipline(s): Program Management The District has spent half of money in about 20 years. Cap table indicates other half will be spent in one year ,i.e. updated cost at current price level = 1991000 and cost inflated thru construction = 2067000? Is this correct? Submitted By: Bill Frechione (412 395 7207). Submitted On: 18-Jan-08	
1-0	Evaluation **Concurred** Yes, this is correct. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 23-Feb-08
1-1	Backcheck Recommendation **Open Comment** I would like to see the year and the amount of future expenditures in the report. Will such information be provided? Submitted By: Bill Frechione (412 395 7207) Submitted On: 03-Mar-08
1-2	Backcheck Recommendation **Open Comment** Yes, a table showing the projected remaining project costs, including inflation, will be shown by year and feature code and included in the report. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 06-Mar-08
1-3	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Bill Frechione (412 395 7207) Submitted On: 10-Mar-08
2-0	Evaluation **Concurred** Yes, a table showing the projected remaining project costs, including inflation, will be shown by year and feature code and included in the report. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 06-Mar-08
	Backcheck not conducted
	Current Comment Status: Comment Closed

1820476	Structural	Planning Report	n/a'	n/a	n/a

(Document Reference: General)

I have performed an Independent Technical Review focusing on cost and closure matrices for this report. Comments are contained in a seperate email which was sent to the Planning and Engineering leaders for the report. Methodologies utilized to revise the matrices included development of likely scenarios for future performance of L&D 52/53 and Olmsted. These

scenarios were developed by a multidiciplinary team of PM, engineering and operations personnel with consultation including construction,economics and planning personnel. Submitted By: Byron McClellan (502-315-6240). Submitted On: 05-Mar-08	
1-0	Evaluation **Concurred** Resolution of these comments were developed interactively by the team members from engineering, operations, construction, and planning. This resulted in several changes to the cost/closure matrices, which have been incorporated into the current economic analysis for the project. Submitted By: Mitchell Laird ((502) 315-6874) Submitted On: 05-Mar-08
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Byron McClellan (502-315-6240) Submitted On: 05-Mar-08
	Current Comment Status: Comment Closed

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX F

Baseline Cost Estimate
for the Post-Authorization Change Report

US Army Corps
of Engineers®



BASELINE COST ESTIMATE (FY12)
FOR THE
POST-AUTHORIZATION CHANGE REPORT (PACR)

FINAL CERTIFIED ESTIMATE

OLMSTED LOCKS AND DAM
OHIO RIVER
OLMSTED, ILLINOIS

PREPARED BY: USACE, HUNTINGTON DISTRICT, COST & TECHNICAL SUPPORT BRANCH
10 NOVEMBER 2011

FOR OFFICIAL USE ONLY

Table of Contents

Executive Summary v
1. General 1
1.1. Purpose 1
1.2. Background 1
1.3. Project Location & Description 2
1.4. Cost Sharing Arrangement 3
1.5. References 3
2. Cost Estimating Team 4
3. Project Features 6
3.1. Prior Work 6
3.2. Remaining Work 7
4. Cost Estimate 14
4.1. Estimate for Dam Contract 17
4.2. Estimate Out-Year Contracts 27
4.3. Workflow for Final Integration 33
5. Schedule 34
5.1. Schedule for Dam Contract 34
5.2. Schedule for Out-Year Contracts 35
5.3. Sequencing Logic for Integrating Out-Year and Dam Contracts 35
5.4. Optimal Project Schedule (Unconstrained by Funding) 36
5.5. Most-Likely Project Schedule (Cost Leveled due to Constrained Funding) 37
5.6. Base Project Schedule 38
6. Risk-Based Contingency Development 39
6.1. Purpose 39
6.2. Risk Analysis Process 39
6.3. Methodology 40
6.4. Cost Risk Analysis - Cost Contingency Results 45
6.5. Schedule Risk Analysis - Schedule Contingency Results 51
7. Quality Control/Quality Assurance 53
7.1. Quality Control 54
7.2. Quality Assurance 54
7.3. Quality Documentation 55
8. Total Project Cost Summary 56
9. Certified Cost Estimate 58

List of Appendices

Appendix A – Total Project Cost Summary

Appendix B – MII Reports

Appendix C – Dam Base Cost Estimate Adjustments

Appendix D – Primavera P6 Schedule

Appendix E – Agency Technical Review Documentation

Appendix F – Quality Control Documentation

Appendix G – Prior Expenditures

Appendix H – Team Resumes

Appendix I – Cost & Schedule Risk Analysis

Appendix J – Out-Year Contract Backup

Appendix K – Hill Olmsted Cost and Schedule Review Report with Backup

Appendix L – URS Corporation 2011 Rebaseline Estimate

Appendix M – Backup to URS Corporation 2011 Rebaseline Estimate

List of Tables

Table 1. Project Cost Summary at FY12 Price Level (Construction and Non-Construction) vi
Table 2. Cost Estimating Team 5
Table 3. Review Teams 6
Table 4. Prior Expenditures by Feature Account (Spent thru FY11) 6
Table 5. URS Corporation Packages Reviewed by Hill in Detail 22
Table 6. Type I Base Cost Adjustments 26
Table 7. Davis-Bacon Wage Determinations 29
Table 8. Contractor Strategy and Markups 31
Table 9. 30/31 Account Assumptions 32
Table 10. Defined Work Calendars in Primavera P6. 34
Table 11. Physical Contract Sequencing (excluding funding considerations) 36
Table 12. Key Project Milestones @ 80% Confidence 38
Table 13. Cost Risk Correlations 44
Table 14. Project Cost Contingencies 45
Table 15. Project Schedule Contingencies 51
Table 16. Quality Control/Quality Assurance Documentation 55
Table 17. Total Project Cost Summary (Construction and Non-Construction) 56
Table 18. Total Project Cost Summary by Feature Account (Construction and Non-Construction) 57

List of Figures

Figure 1. Overall Project Schedule vii
Figure 2. 80% Confidence Level: Remaining Estimated Cost at FY12 Price Level viii
Figure 3. Location Map 2
Figure 4. Rendering of Completed Project 3
Figure 5. Estimating Methodologies 16
Figure 6. Existing Dam Contract Estimate Production Flowchart 19
Figure 7. Percentage of Costs Reviewed of the 2011 URS Corporation Baseline Estimate 20
Figure 8. Type I / Type II Changes Required 21
Figure 9. Out-Year Contract Estimate Production Workflow 27
Figure 10. Integration Workflow 33
Figure 11. Optimal Expenditure Outlay (Unconstrained by Funding) 37
Figure 12. Most-Likely Expenditure Outlay (Constrained to Current $150M/yr Funding Level) 37
Figure 13. Summary Implementation Schedule 38
Figure 14. Risk Management Cycle 39
Figure 15. Qualification of Risks 41
Figure 16. Project Confidence Curve for Existing Dam Contract 46
Figure 17. Project Confidence Curve for Out-Year Contracts 46
Figure 18. 80% Confidence Level: Remaining Estimated Cost at FY12 Price Level 47
Figure 19. S-curve of Existing Dam Contract @ 80% Confidence Level 47
Figure 20. S-curve of Out-Year Contracts @ 80% Confidence Level 48
Figure 21. Cost Sensitivity Chart for Dam Contract 49
Figure 22. Cost Sensitivity Chart for Out-Year Contracts 51
Figure 23. The Project Triangle 53

Executive Summary

Background: The Olmsted Locks and Dam (L&D) Project had an original authorized cost of $775M (no escalation) in August 1986. Recent design changes, contract modifications, and other unanticipated increases in project costs have led to USACE to seek Post Authorization Change Request (PACR) to increase the project's maximum cost limit to a necessary level for successful project completion. The Project is economically justified based on projected commercial transportation savings derived from reduced processing and congestion time.

A USACE-manned panel comprised of experts from LRD and Walla-Walla reviewed the existing scope, cost, and schedule data in July 2011 and estimated the project first costs (includes spent-to-date) to be approximately $2.75B (price level FY12). The costs were deemed un-certifiable due to the methodology with respect to the required Agency Technical Review (ATR) that must accompany the PACR. This report has been prepared to determine the TPC to support the PACR. Developing the TPC consists of updating the baseline cost estimate and obtaining certification from the Cost Engineering Directory of Expertise at Walla Walla (Dx).

Project Scope: The contract (cost reimbursable) for the construction of the Dam was awarded 28 January 2004 and work is on-going. Other contracts to be awarded in the future include: Building and Grounds; Dredging; Operations Equipment and Machinery; Demolition of Locks & Dams 52 and 53; Lock Rehab/Operation & Maintenance (O&M) Startup; Final County Road/Site Paving; Project Closeout & Site Restoration; River Dikes; RE Office Conversion to Ops Building; Salvage/Excess of Government Owned Equipment; U/S Mooring Cells; and Wicket Gate Barge contracts. This baseline estimate captures costs expended through September 30, 2011, and for all remaining project features as well as non-construction costs such as engineering & design and contract supervision & administration.

Cost: The most likely cost of remaining work for the Olmsted L&D project was developed using a variety of estimating methodologies by a diverse team of experienced USACE cost engineers and Hill International professional cost engineers and schedulers. At the time of development of this baseline cost estimate the project has completed a significant part of all planned scope.

The team developed the remaining dam contract estimate based upon its historical data to-date for means, methods, productivities and costs expended to-date. The estimate for remaining work was developed using the best data available in a multi-step process:

- Reviewing & adjusting the dam contractor's re-baseline cost estimate,
- Developing the most likely cost of completion of dam contract,
- Developing detailed bottoms-up estimates for the Out-Year Contracts, and
- Developing a cost and schedule risk analysis to establish contingency.

The dam estimate methodology avoids the pit-fall of attempting a bottoms-up estimate, independently of the historical record to-date for a project with such innovative and highly unique construction methods. Developing an independent estimate for the balance of dam work would ignore the vast body of historical data documented to-date. This would go against the spirit of the USACE cost engineering

regulations and the FARs (16.3) regarding estimate development for cost-reimbursable contracts. The basic estimating method for the dam contract was for USACE to review the current contractor-produced construction cost estimate for under-statement, over-statement, errors, and omissions. The USACE team reviewed the application of the historical data for proper crew composition, productivities, scope, and to check quantity calculations among other factors. USACE then developed the most-likely estimate based on the review findings.

The remaining estimated cost is $1,560,080,000 at the FY12 Price Level ($1,733,880,000 fully funded). A total of $1,358,104,000 has been spent up to FY12. The estimated cost for re-authorization, including spent dollars, is $2,918,180,000 at the FY12 price level ($3,091,980,000 fully funded). See Table 1 for a detailed summary by contract. The funding constrained schedule presents the dam completion in FY21 and remaining physical features of the project in FY24.

Table 1. Project Cost Summary at FY12 Price Level (Construction and Non-Construction)

Contract	Project First Cost FY12 Price Level	Total Project Cost (Fully Funded)
Spent	1,358.10 M	1,358.10 M
Remaining	1,560.08 M	1,733.88 M
Existing Dam Contract	1,291.89 M	1,406.14 M
Out-Year Contracts	268.18 M	327.74 M
Building and Grounds	17.01 M	20.06 M
Dredging	7.51 M	8.94 M
Environmental Monitoring	4.79 M	5.18 M
Final County Road / Site Paving	2.14 M	2.78 M
Lock & Dam 52 - Land Demolition	0.81 M	1.02 M
Lock & Dam 52 - Marine Demolition	53.61 M	67.49 M
Lock & Dam 53 - Land Demolition & Historic Restoration	4.60 M	5.83 M
Lock & Dam 53 - Marine Demolition	37.93 M	47.75 M
Lock Rehab/O&M Startup	20.22 M	22.72 M
Operations Equipment and Machinery	1.59 M	1.95 M
Project Closeout & Site Restoration	4.57 M	5.82 M
Project Operations During Construction	8.04 M	8.70 M
RE Office Conversion to Ops Building	0.63 M	0.79 M
River Dikes	70.87 M	87.30 M
Salvage/Excess of Government Owned Equipment	1.80 M	2.12 M
U/S Mooring Cells	7.07 M	8.82 M
Wicket Lifter Barge	24.99 M	30.49 M
Grand Total	**2,918.18 M**	**3,091.98 M**

Schedule: The Total Project Schedule for completing the Olmsted L&D Project has been developed in Primavera P6 Scheduling Software using detailed construction activities and associated network logic to determine the project duration.

The activity-driven critical path for the project schedule represents the ideal duration. It requires a $215M/yr funding commitment for the six year period including FY13 thru FY18 and could achieve dam completion in FY2018 and reduce total project costs (approximately $250M). However, given prior annual funding levels and without increased funding commitment from resource providers this only represents the optimal (best-case) and was not considered as the most-likely condition. Olmsted is currently funded at $150M/yr anticipated for FY12 and FY13. Through discussions with USACE-HQ, LRL Program Office, and the IWTR User's Board, the assumed most-likely funding scenario is for the $150M/yr level to be maintained for the remainder of the dam contract.

> ***The most-likely funding stream of $150M/yr effects a budget-driven construction duration that extends the optimal completion date three years (FY2021) and significantly increases project costs by nearly $250M ($170M first-cost plus $80 escalation).***

A funding stream of $130M/yr was assumed to be worst-case to account for the potential for some funding to go to other navigation projects in the latter years. USACE cost engineering guidance and best practices require the most-likely cost to complete the project to be developed. In this case, the most-likely funding stream is $150M/yr. Cost and schedule are modeled together and the resultant contingency incorporates the resultant effects of each on the overall project. See Figure 1 for further information.

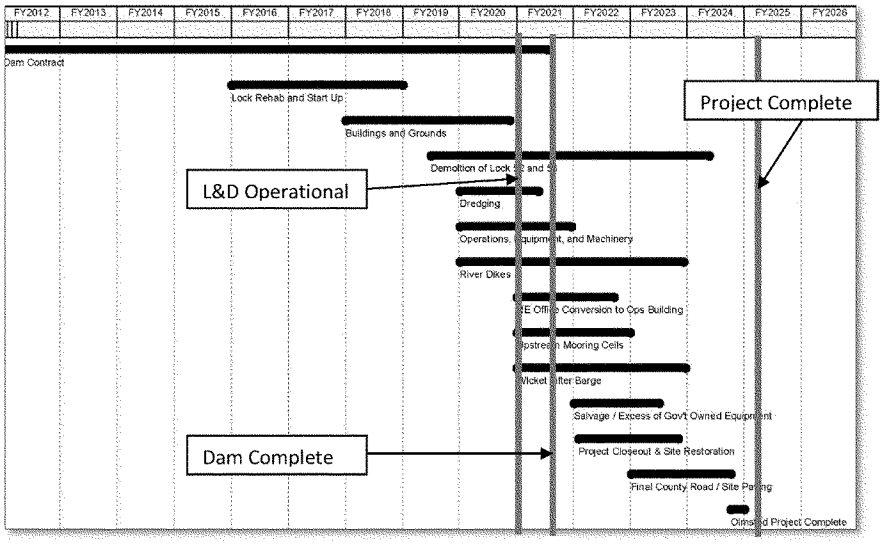


Figure 1. Overall Project Schedule

Risk: A Cost and Schedule Risk Analysis (CSRA) was performed to establish the 80-percent confidence level for both cost and schedule. The risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as provide tools to support decision making and risk management as the project progresses through planning and implementation.

The 80% Confidence Level (P80) is the recommended level for USACE cost estimates. The P80 level is more likely to ensure the funds received will be adequate for implementation. Above the P80 confidence level, most of the risks that could adversely affect the cost occur and drive the S-curve higher. Figure 2 below shows the S-curve for total project cost and highlights the 80-percent confidence estimate.

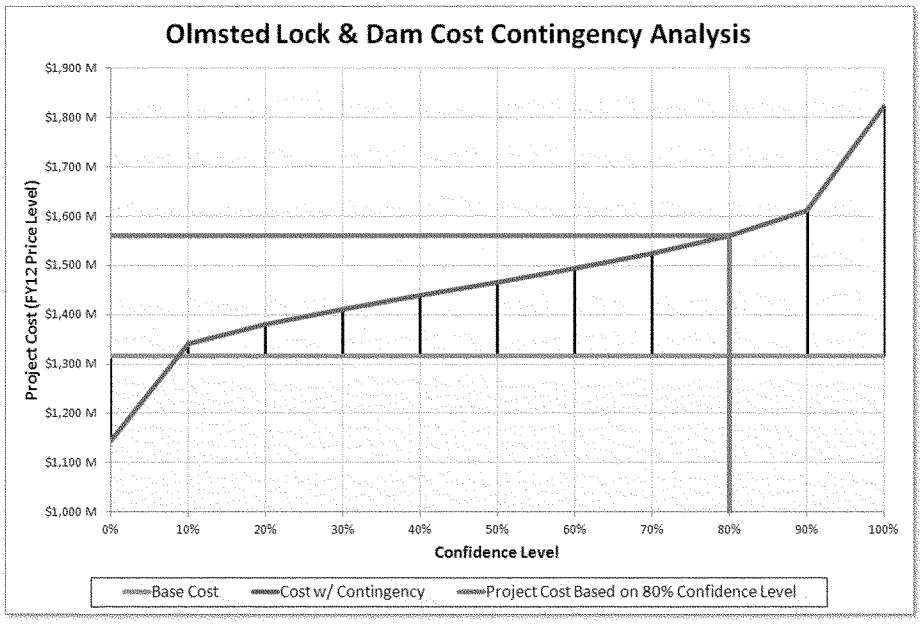


Figure 2. 80% Confidence Level: Remaining Estimated Cost at FY12 Price Level

Key Project Risk Items to Cost and Schedule

- *DAM-001, LD52-MD-009 & LD53-MD-008 - Weather/River Conditions:* River elevations can adversely affect productivity. River conditions could delay the overall schedule for accomplishing key construction activities. These delays could result in risk built into contractor's base bids and spark claims during construction.

- *Dam-021 - Funding differs from $150M per year:* The current estimate and schedule are based on a $150M per year construction cap. Uncertainty exists actual funding levels may vary up or down. Increased funding, sooner in the project schedule would result in reduced escalation over time and potential reduction to contractor's onsite duration and associated extended site overheads. On the other hand, less funding would tend to increase escalation and add contractor's onsite duration and extended site overheads. An unconstrained funding scenario could cut up to three years from the project schedule resulting in significant cost savings of approximately $250M (~$170M first-cost plus ~$80 escalation); approximately $215M per year would be needed for this scenario. Conversely, reduced funding of $130M per year will result in an additional two years of schedule impacts and adversely affect overall project costs (~$175M cost increase including additional overheads and escalation).

- *Dam-035 – Potential variances due to cost-plus procurement/innovative construction:* Risk associated with a cost-plus contract, the contractor has substantial leverage in work performance and payment negotiation. This risk item includes impacts from unknown risk items, quantity variations, & currently unknown potential design changes throughout the construction period.

- *Dam-036 & OYC-001 - Actual inflation varies from USACE method of calculation:* The Total Project Cost Summary (TPCS) escalates construction costs based on future inflation factors published by the OMB. Actual inflation realized could vary from the Section 902 Limit calculation for allowed inflation (based on the CWCCIS publication). This could potentially add $64M to the overall project cost based on the difference of OMB factors utilized in the fully-funded numbers and actual inflation which is captured in these risk items. The risk analysis assumed $28M as the most-likely scenario for contingency purposes.

- *LD52-MD-002 & LD53-MD-002 – Variation to Concrete Demolition Approach:* Significant opportunity exists that concrete could be demolished in place and debris left in the footprint of the existing lock (in-water disposal). Locks 50&51 (deconstructed in 1980) were drilled, shot, and left in place at river bottom. This method represents a cost and schedule opportunity for L&D 52/53.

- *LRS-005 - Scope Definition of Lock Rehab & Startup:* Rehabilitation scope is in early stages of design investigation. Significant uncertainty exists in the current understanding of scope required to make the lock fully operational. Key items to be rehabilitated are HPUs, large hydraulic cylinders, and electrical PLCs.

- *RD- 002 - Opportunity to reduce the number of dikes required:* The seven river dikes on the Kentucky shoreline has the potential to be removed from the scope of the project through additional modeling. The dikes will only be installed after the dam is in operation and sediment deposits are causing excessive dredging. The Illinois dikes are critical to the approach and operation of the locks and will be constructed (6 EA) + (1 EA) DS near lower approach wall. The seven Kentucky dikes will be required once the need is realized. Engineering Research & Design Center (ERDC) modeling suggests the Kentucky dikes are needed.

1. General

1.1. Purpose

The purpose of this report is to summarize and document the Baseline Cost Estimate (FY12) for the Post-Authorization Change Report (PACR) for the Olmsted New Locks and Dam Project, which will be referred to as "the estimate" or "this estimate" throughout this report. Due to the cost growth experienced by the Olmsted project, a PACR has been submitted to USACE-HQ and this estimate is intended to support and substantiate the recommendations thereof. The PACR (formally titled "Locks & Dams 52 and 53 Replacement Project, Olmsted Locks And Dam, Illinois And Kentucky, Post Authorization Change Report, May 2008) includes a discussion on the original project authorities and the history of cost and schedule growth as well as a comparison of this estimate to the previous baseline cost estimate.

1.2. Background

The Olmsted Locks and Dam Project ("Olmsted Project" or "Project") was authorized in the Water Resources Development Act of 1988 (PL 100-676). Initial construction funding was provided by the Energy and Water Development Appropriations Act of 1991. The project is economically justified based on projected commercial transportation savings derived from reduced processing and congestion time, and represents a reinvestment in the nation's inland navigation infrastructure.

A significant portion of the project physical construction is already complete, including cofferdam installation and removal as well as construction of the locks and floating approach walls. While the locks were constructed by means of traditional, "in-the-dry" methods, the majority of other work is being performed via innovative and highly unique "in-the-wet" methods. The floating approach walls, for example, were precast at an offsite facility and floated in the river where they were installed.

In July 1997, Lakes & Rivers Division (LRD) decided to design the dam using a heavy lift-in, prefabrication construction method. The various dam monoliths consist of precast shells, which will be placed using a large crane after the foundation has been completed. Construction started at the existing lock structure and will proceed to the fixed weir on the Kentucky shore.

In 2002, Louisville District (LRL) requested proposals for this contract as a firm fixed-price contract, but received no offers. The contract was re-advertised as a cost-reimbursable contract; LRL received two responsive proposals and the contract was awarded 28 January 2004. The contractor has procured various pieces of specialized equipment required to construct this dam configuration such as the catamaran barge, a 5,000-ton gantry crane, and an excavator barge. The precast yard and marine skidway have also been constructed. Several shells have been fabricated and placed to date.

The dam is currently being constructed in concrete segments using an onsite precast facility and specialized heavy-lift equipment designed and fabricated specifically for this project. Open river conditions prevail at the project site, significantly constraining the work season of the necessary marine operations including pile driving, underwater inspections, diving work, and the transport and installation of the heavy precast segments. The dam contract is a cost-reimbursable contract and thereby transfers to the Government much of the risk inherent to the river conditions and the highly innovative nature of

this project. This contract has experienced significant cost growth, nearly tripling since its award in 2004.

1.3. Project Location & Description

The Olmsted Locks and Dam Project provides for a structure near Ohio River Mile 964.4 that would replace the existing Locks & Dams 52 and 53. The structure features twin 1,200' by 110' locks that have already been constructed along the Illinois bank. The dam portion of the project consists of a gated regulatory dam section composed of five 110' wide tainter gates, a 1,400' wide navigable pass controlled by 140 boat operated wickets and a fixed weir extending to the Kentucky bank. Since the project is located within a region of high seismic hazard potential, each of the main features which have dissimilar seismic responses will be separated by seismic isolation joints to reduce the risk of damage during an earthquake. An upper pool would extend upstream to the Smithland Locks and Dam, a distance of 47 miles (reference Figure 3). Operational objectives are to maintain a pool at elevation 300 Ohio River Datum (ORD) at Paducah and at elevation 302 (ORD) at the Smithland Lock lower sill while maintaining a minimum pool of elevation 295 (ORD) at the Olmsted Dam site. See Figure 4 for a rendering of the general plan and project features and Section 3 for more detail on the physical description of the project.

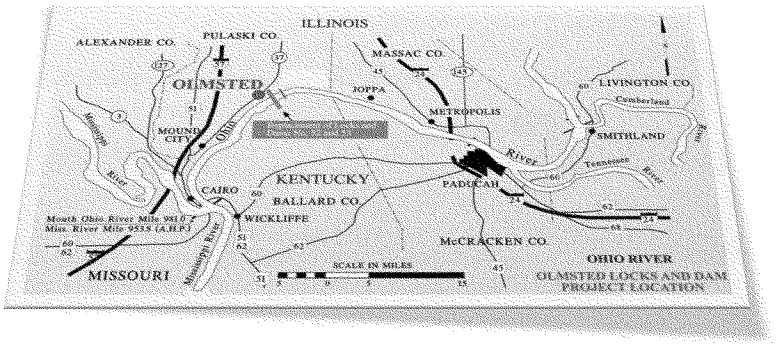


Figure 3. Location Map

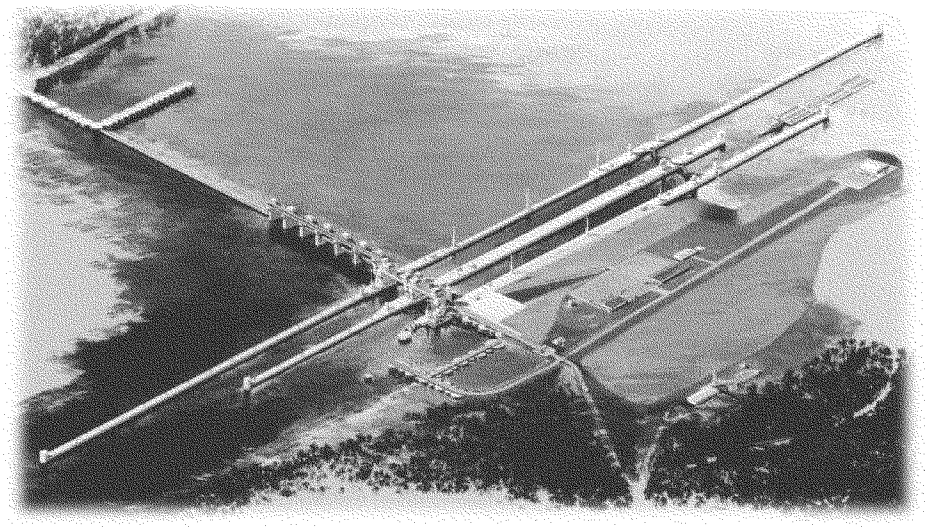


Figure 4. Rendering of Completed Project

1.4. Cost Sharing Arrangement

The Olmsted project was authorized by the Water Resources Development Act of 1988. The authorizing language stated, "... the cost of construction of the project to be paid one half from amounts appropriated from the general fund of the Treasury and one half from amounts appropriated from the Inland Waterways Trust Fund'. While this language negates the requirement for Local Cooperation requirements, 50% of the project construction cost will come from the Inland Waterways Trust Fund (IWTF).

1.5. References

- EC Bulletin No 2007-17, Application of Cost Risk Analysis Methods to develop Contingencies for Civil Works Total Project Costs, 10 September 2007.
- EC 11-2-194, Corps Of Engineers Civil Works Direct Program: Program Development Guidance – Fiscal Year 2011, 1 April 2009.
- EI 01D010, Construction Cost Estimates, 1 September 1997.
- ER 1105-2-100, Planning Guidance Notebook, 22 April 2000.
- ER 1110-1-1300, Cost Engineering Policy and General Requirements, 26 March 1993.
- ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999.
- ER 1110-2-1302, Civil Works Cost Engineering, 15 September 2008.
- EM 1110-2-1304, Civil Works Construction Cost Index Systems (CWCCIS), 30 September 2011.
- ER 1165-2-131, Local Cooperation Agreements for New Start Construction Programs, 15 April 1989.

- EC 1165-2-209, Water Resources Policies and Authorities - Civil Works Review Policy, 31 January 2010.
- EP 1110-1-8 Volume 2, Construction Equipment Ownership and Operating Expense Schedule – Region II, November 2009.
- ETL 1110-2-573, Construction Cost Estimating Guide for Civil Works, 30 September 2008.
- Memorandum, Initiatives to Improve Accuracy of Total Project Costs in Civil Works Feasibility Studies Requiring Congressional Authorization, 19 September 2007.
- PMBoK Guide, Fourth Edition, published by PMI.

2. Cost Estimating Team

The estimate was developed by a diverse and experienced team of cost engineers within the USACE cost engineering community of practice. The team was led by USACE Huntington District and included coordination with the Louisville District Olmsted project delivery team (PDT) for project scope and background information. Significant breadth and depth of technical experience was brought to bear in solving this complex cost engineering problem. The team consisted of USACE and AE Contractor technical subject matter experts with significant experience in cost estimating, scheduling, risk analyses, and construction of technical complex civil works mega-projects. Listed below are some of those representative projects of the team's experience:

- Dam Safety Investment Plan
- New Orleans Hurricane Protection System
- Inner Harbor Navigation Canal
- Western Closure Complex
- San Antonio Military Medical Center
- Uranium Processing Facility
- Waste Treatment Plant
- Salt Waste Processing Facility
- Soo Locks Replacement Project
- Chickamauga Lock Replacement
- Marmet Lock Replacement
- Interagency Performance Evaluation Taskforce
- Kentucky Lock Replacement

Table 2 and Table 3 list the team roster, affiliations, roles, and responsibilities. Resumes for the majority of the team members can be found in Appendix H.

Table 2. Cost Estimating Team

Olmsted L&D Cost Estimate Team		
ROLE/RESPONSIBILITY	NAME	OFFICE
Project Management		
Project Manager	Larry Bibelhauser	LRL
Scoping		
Overall Scoping Lead	Mike Braden	LRL
Existing Dam Contract - URS Interface	Rick Schipp	LRL
Existing Dam Contract - Scope Lead	Justin Tabor	LRL
Out-Year Contracts - Scope Lead	Jim Vermillion/Justin Tabor	LRL
Verification of Sunk Costs thru 31 Sep 2011	Jim Vermillion	LRL
Cost Production		
Cost Production Team - Leadership and General Production		
Cost Lead	Mike Ferguson	LRH
Out-Year Contracts - Estimate / Schedule Production Lead	Jeremy Stevenson	LRH
Existing Dam Contract - Estimate / Schedule Poduction Lead	Dean Hammonds	LRH
Overall Product QA/QC Lead and Plan Development/CSRA & TPCS QC	Don Whitmore	LRH
WBS and MII Setup/Estimate Integration & Control/CSRA Lead/Final Report/TPCS	Dustin Sawyers	LRH
Existing Dam Contract - Cost Validation		
Production Team Lead	Dean Hammonds	LRH
URS Estimate / Schedule Validation Team	Hill International	Contractor
Quality Control	Donald Whitmore	Various
Out Year Contracts - Estimate Development		
Production Team Lead	Jeremy Stevenson	LRH
Buildings & Grounds	Verle Heindselman/Phillip Oloughlin	LRL/MVR
Dredging	Paul Wagener	SWL
Operations Equipment and Machinery	Garrett Mattila	MVR
Lock & Dam 52 - Land Demolition	Stephen Canfield	LRC
Lock & Dam 52 - Marine Demolition	Stephen Canfield	LRC
Lock & Dam 53 - Land Demolition & Historic Restoration	George Chartouni	LRC
Lock & Dam 53 - Marine Demolition	George Chartouni	LRC
Lock Rehab/O&M Startup	Derek Maxey/Ricardo Guzman	LRH/NWW
Final County Road / Site Paving	Paul Wagener	SWL
Project Closeout & Site Restoration	Joe Reynolds	SPK
River Dikes	Paul Wagener	SWL
RE Office Conversion to Ops Building	Garrett Mattila	MVR
Salvage/Excess of Government Owned Equipment	Joe Reynolds	SPK
U/S Mooring Cells	Derek Maxey	LRH
Wicket Gate Barge	Derek Maxey	LRH
Quality Control		
Quality Control Lead	Don Whitmore	LRH
Quality Control	Kevin Kuhar	NWW
Schedule Development		
P6 Schedule Development for Out-Year Contracts	Jeff Huneycutt	SAS
Schedule Review - Existing Dam Contract	Hill International	Contractor
Cost and Schedule Risk Analysis (CSRA)		
CSRA Lead	Derek Maxey	LRH
CSRA	Dustin Sawyers	LRH
CSRA Thresholds - Existing Dam Contract	Hill International	Contractor
OYC Thresholds	Derek Maxey	LRH

Table 3. Review Teams

Olmsted L&D Review Teams		
ROLE/RESPONSIBILITY	NAME	OFFICE
Real Time ATR		
Cost DX Chief	Kim Callan	NWW
Cost DX Co-Lead/ATR - Existing Dam Contract	Mike Jacobs	NWW
Cost DX Co-Lead/ATR - Out-Year Contracts	Jim Neubauer	NWW
ATR - Cost and Schedule Risk Analysis (CSRA)	Glenn Matlock	NWW
External Review		
Review Team	Battelle	Contractor
USACE Coordinator	Rebecca Moyer	LRD

3. Project Features

3.1. Prior Work

The construction of the Olmsted Locks and Dam is currently ongoing. The Louisville District awarded the first construction contract on 19 November 1992 to construct the access road and resident engineer's office. Some of the major contracts that have been awarded and completed since then include the locks cofferdam, the locks, the approach walls, and the operating and maintenance bulkheads contracts. Louisville District awarded the construction of the Dam on 28 January 2004. A more detailed description of project scope completed to-date is contained in Appendix G. Table 4 below summarizes these expenditures by feature account for the project through 30 September 2011.

Table 4. Prior Expenditures by Feature Account (Spent thru FY11)

Feature Account	Prior Expenditures
01 - LANDS & DAMAGES	6,032,000
02 - RELOCATIONS	1,594,000
04 - DAMS	671,947,000
05 - LOCKS	427,632,000
06 - FISH & WILDLIFE FACILITIES	8,393,200
08 - ROADS, RAILROADS, & BRIDGES	2,795,000
16 - BANK STABILIZATION	7,722,000
18 - CULTURAL RESOURCE PRESERVATION	110,000
19 - BUILDINGS, GROUNDS, & UTILITIES	32,522,000
20 - PERMANENT OPERATING EQUIPMENT	22,864,100
30 - PLANNING, ENGINEERING & DESIGN	108,702,000
31 - CONSTRUCTION MANAGEMENT	63,892,600
50 - CONSTRUCTION FACILITIES	3,898,000
Grand Total	**1,358,103,900**

3.2. Remaining Work

3.2.1. Dam Contract

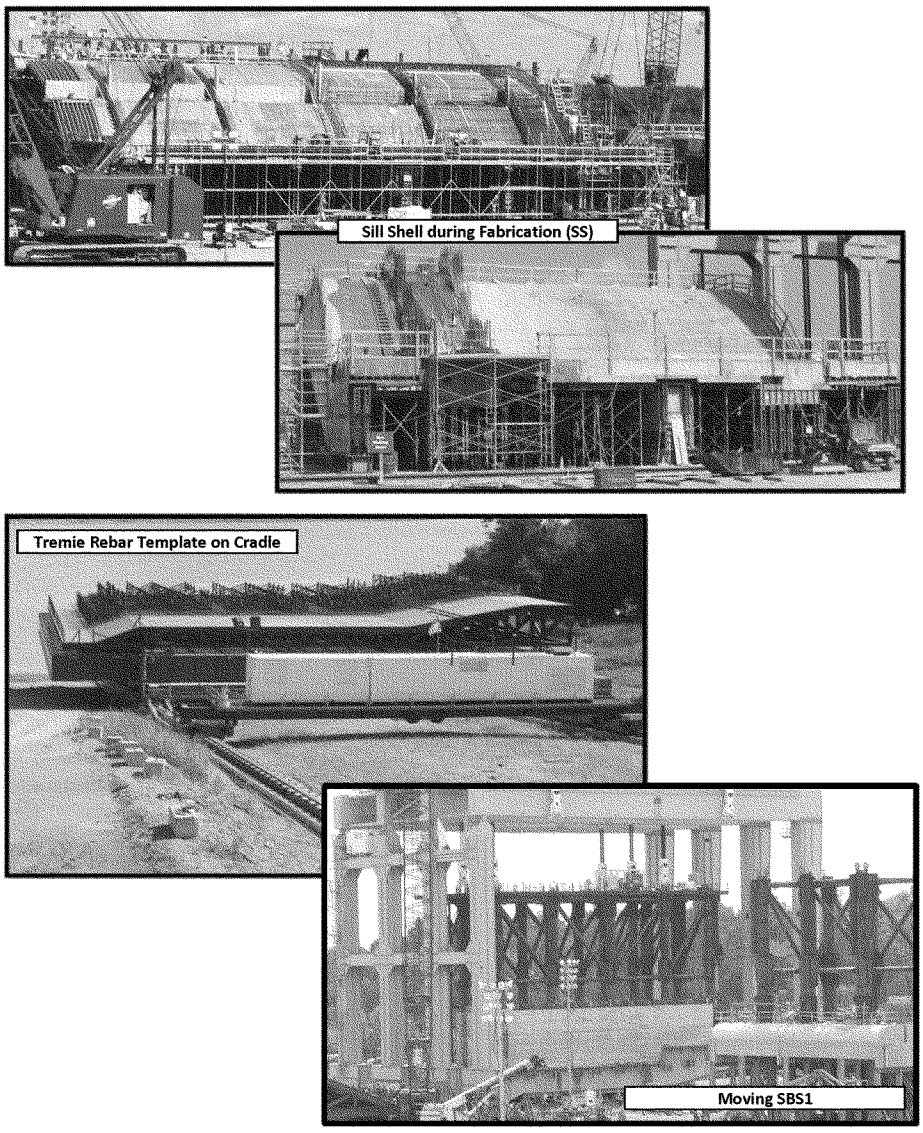
The dam contract will construct an approximately 2,352' long dam from the lock to the fixed weir constructed in an earlier contract. The dam is comprised of five tainter gates (110' wide by 37' high) operated using hydraulic cylinders, a 1,400' navigable pass consisting of wicket gates that are center-hinged (horse-type), and 9'-8" wide flat plate gates at 10-foot centers. Also included in this contract are two boat abutments, a tainter gate stilling basin, navigable pass paving blocks, and riprap.

The Olmsted project involves underwater foundation preparation, lift-in construction of the tainter gate and navigable pass shells for the dam, floating approach walls, directly connected hydraulic cylinder operation of the culvert valves, miter gates, tainter gates, and a central station to operate both the dam and the twin locks.

The spillway portion of the dam includes: six stilling basin shells, six sill shells, six lower pier shells, and two sections of training walls. For the navigable pass: twelve shells with wickets, paving blocks, two pieces for the left boat abutment, six pieces for the right boat abutment, and a training wall. The upper portion of the tainter gates will be cast in place to complete the piers. The tainter gates will be fabricated off site and delivered to the site for installation. Each tainter gate bay will be dewatered and the tainter gates installed along with the machinery for operating the gates. Prior to gate installation the pier will be infilled with concrete including the trunion steel.

The precast yard was established such that all the shells could be fabricated in six years and installed the following lower water season. This infrastructure was a significant capital investment and includes five casting pads, concrete batch plant, re-steel yard, associated cranes and marine lifting equipment to transport and place the shells. The placement of the shells is dependent upon ideal river conditions. Transporting and placing shells in the open river environment is a high risk operation and requires significant coordination amongst related serial and concurrent construction tasks. Adverse conditions often encountered include high water, high velocity current, high turbidity resulting in poor underwater visibility, and inclement weather (high winds, thunderstorms, etc.)

At this time twelve shells (four SS, four SS & four LP) have been cast in the precast yard and are currently scheduled to be completed by the end of January 2012. Seven shells have been set in place including tremie fill. The goal is to set five additional shells before the end of the 2011 low water season. This is not likely to happen due to river conditions (high velocities) not allowing divers to prepare the foundation for setting SS3. The foundation pile driving for the 2011 low water season should conclude by the end of October 2011. At that time the crew will move to the cut off wall that needs to be completed for the 2013 season.


Sill Shell during Fabrication (SS)
Tremie Rebar Template on Cradle
Moving SBS1

3.2.2. Out-Year Contracts

3.2.2.1. Buildings and Grounds

The work consists of constructing a Lockmaster's office, maintenance building, visitor pavilion, fire pump house, water storage tank, and related site work at the Olmsted Locks and Dam. Site work includes a visitor overlook, limited earthwork, concrete hardstands, concrete roadways, concrete parking areas, concrete sidewalks, signage, landscaping, water service, sanitary sewer system, propane gas distribution, electrical distribution and lighting, and site communications. All work is located on the Illinois side of the lock chamber.

3.2.2.2. Dredging

The work consists of dredging in the harbor area and at the downstream end of the Lower River Floating Wall. It is assumed that a clamshell mechanical dredge will be used to excavate the vegetation and sediment in the harbor. The area from the shore to the floating lock wall and the area from the floating lock wall to the end of the footprint of the new rip-rap dike will all be excavated using the clamshell mechanical dredge. For the dredging required under the lock wall, a system was selected using the Drag Scraper Dredging System since a clamshell dredge, cutter dredge, or hydraulic excavator on barge would not provide adequate reach.

Dredging for the outlet bucket area cleanup, lock chamber cleanup, or sediment around miter gates will be done using clamshell excavators into a hopper which will also require dewatering and hand labor to clean around the bulkheads. Quantities of material to be removed at the outlet bucket, lock chamber, miter gates, entry ports, and culverts is unknown therefore the effort to clean these areas will be based on production hours the crews are expected to need to complete the work. All material is assumed to be disposed of in the 118-acre waste yard adjacent to the other dredge spoil piles.

3.2.2.3. Operations Equipment and Machinery

The work consists of procuring tools and equipment for use at Olmsted Locks and Dam. The tools and equipment will be used by LRL Operations personnel to operate and maintain the locks and dam.

3.2.2.4. Locks & Dams 52 & 53 – Land Demolition

The work consists of removal of all landside buildings at Lock and Dam 52 and partial removal of the buildings at Lock and Dam 53. It is assumed that separate contracts will be executed for each of the two sites and that work will begin after the completion of the Olmsted Lock & Dam.

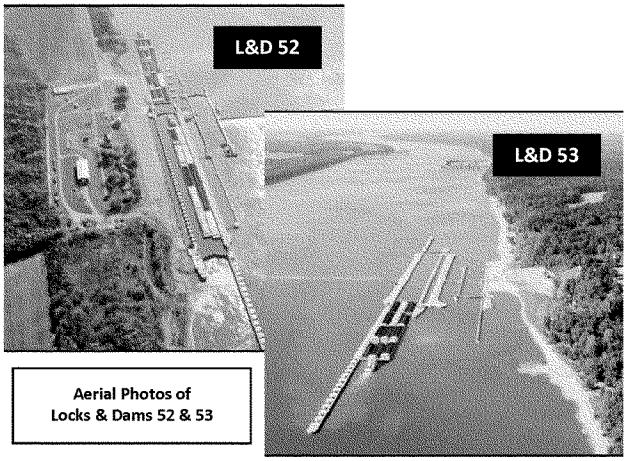
At Lock and Dam 52, all building structures are to be completely demolished and the debris will be hauled offsite and legally disposed.

At Lock and Dam 53, the lock house, worker's residence, and blacksmith shop are to be made weatherproof, and the lockmaster's residence is to be fully restored to the original 1930's condition. A small monument is also to be constructed on site displaying some wicket gates and the original wicket lifter barge (this equipment is all currently on-site). All other buildings will be completely demolished and the debris will be hauled offsite and legally disposed.

The anticipated end use of both facilities will be by a non-government organization. Full documentation of both facilities will be performed prior to turnover, which includes photo documentation, video documentation of wicket operation and steam powered wicket lifter, and measure drawings. A structural assessment will be made of all buildings, both sites, and a mothballing/stabilization plan will be prepared. Testing for Leaking Underground Storage Tanks (LUST) and other hazardous materials is included on both sites.

3.2.2.5. Locks & Dams 52 & 53 – Marine Demolition

The work consists of demolition, removal, and decommissioning of Locks and Dams 52 and 53. The demolition will consist of removing all structures down to elevation 284.0 at Lock 52 and elevation 280.0 at Lock 53.



Aerial Photos of Locks & Dams 52 & 53

The landside wall of the 600' lock at Lock 53 will be left in place, with the exception of the land side upper and lower guide walls which will be demolished. The riverside walls at both locks will be removed to the required elevation. The 1200' locks, including all approach walls and circular cells, will also be removed. The beartraps will be pulled from the water and the piers surrounding them will be removed down to the required elevation. The wickets will be removed from the river.

3.2.2.6. Lock Rehab/O&M Startup

Mechanical Operating Equipment

The work consists of the following:

- Replacing hydraulic cylinders within the navigation lock prior to startup and operations (includes the miter gate cylinders, culvert valve cylinders, and latch pin cylinders),
- Replacing position indicator sensors and wiring for all cylinders,
- Rehabilitation of the HPU system including replacing all seals/bearings that may have degraded due to exposure to the current hydraulic fluid,
- Removing the current hydraulic fluid, thoroughly flushing the system, and replacing with a mineral oil,
- Replacing cathodic protection anodes on miter gates and culvert valves,
- Paint all hydraulic structures that can be reasonably accessed in the dry (dewatered lock, approach walls wall armor above waterline).

- Replace bubbler system piping with stainless piping (located on miter gate),
- Replace grease lines on culvert valves and miter gates,
- Replace miter gate handrails with new drop-in aluminum panels, and
- Minor modifications to the latch pin.

Programmable Logic Control (PLC) Control System

The existing PLC control system is to be replaced. The work consists of upgrading the existing PLC to include a new PLC processor, new input/output modules, and four new PC computers for interfacing with the control system. The existing enclosures, communications backbone, wiring, and input/output devices will all be reused.



Electrical Feeders

The electrical feeders within the navigation lock and mooring lights are to be replaced, which includes removal of four 500 kcmil and four 350 kcmil cables and replacing them with six 600 kcmil and six #2 cables and associated splices.

3.2.2.7. Final County Road / Site Paving

The work consists of resurfacing 2.4 miles of the county road (24' wide asphalt road with 1.5" surface course, application of a stress-absorbing membrane interlayer, and permanent striping), 11,000 SY of new paving for an access road and parking lot (3.5" binder course with 1.5" wearing course), and installing 3,335 LF of security fencing.

3.2.2.8. Project Closeout & Site Restoration

Salvage/Excess of Government Owned Equipment

The work consists of USACE and a contractor managing the salvage/excess of all remaining government furnished equipment and material after the current Dam Contractor has demobilized. The Olmsted project will not see any credits from salvage/excess after the Dam Contract has expired. Any salvage resulting from the excess of government owned equipment and material at that point will return to the government general fund. Some portion of the salvage value estimated for government owned equipment is accounted for in the dam contract and not considered in the OYC here.

Site Restoration

The work consists of restoring and re-planting the project construction site disturbed for all phases per the 1993 Supplemental Environmental Impact Statement. The '93 EIS required reclamation of the former clay mine which has been used as a construction staging and dredged material disposal site since construction began that same year. Conceptually, much of this area will be restored to mostly prairie with several wetlands which will require the placement of suitable soil at a depth of 1 to 2 ft. About one quarter of the area will be restored to upland hardwoods forest, the entire staging area will be rip-plowed to a depth of 3', existing sediment dams in the drainages will be removed, and the sediments

stabilized using plantings of grasses, shrubs, and trees. The graveled area adjoining the Chestnut Hill State Nature Preserve will be partially removed with the remaining area left in place to provide parking for visitors to the preserve. Additional work consists of planting disturbed areas as follows: 10% is to be planted in "wetland" trees, grasses and hardwood trees; 40% of the disturbed areas are to be planted in "prairie grasses"; and the remaining 50% of the areas to be planted in hardwood trees. Grading and gravel disposal will take place prior to all plantings.

3.2.2.9. River Dikes

The work consists of providing 14 river dikes using 691# max riprap. Seven of the river dikes will be at the Kentucky shore across from the lock including 3' thick bank paving. Six of the river dikes will be keyed into the Illinois shore, upstream from the lock including 3' thick bank paving. One dike will be placed adjacent to the downstream portion of the lock wall.

3.2.2.10. RE Office Conversion to Ops Building

This work consists of modifying the Resident Engineer's Building at Olmsted Locks and Dam to function as an unheated storage building and a vehicle storage area. Demolition includes removal of all interior construction and interior finishes from the existing vestibule, private offices, shared offices, conference areas and admin areas. The building is a pre-engineered steel framed building with steel sheet siding on the exterior. Interior walls and exterior steel stud walls with gypsum will be demolished. The wall between the quality control laboratory and the rest of the building remains. HVAC and electrical services in these areas will be modified to accommodate the new storage/work bay and vehicle storage functions. The existing services core area remains, which includes break room, restrooms, copier/storage room, and mechanical room. Exterior closure modification includes the addition of two new 12' x 12' rollup doors and one new pedestrian access door. Site work includes addition of two new short asphalt drives to serve the new roll-up doors, and reconfiguring the existing communications lines to serve the Service Mound Buildings and Locks. All work is located on the Illinois side of the lock chamber.

3.2.2.11. Environmental Monitoring

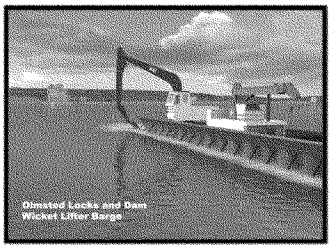
Environmental monitoring for mussel monitoring during dam construction is performed annually. These costs will continue through the dam operational date. The cost for this monitoring is well established for the project and is running $400,000/YR.

3.2.2.12. Upstream Mooring Cell

The work consists of constructing four mooring cells at Olmsted Locks and Dam. The cells will consist of 31.3-foot diameter sheet pile cells filled with concrete (tremie and conventionally placed lifts). Each cell will include nine line hooks embedded into the riverward face. The top of the cell will include a single check post and a high-water navigation buoy. The cells will be painted on the river-side. All work is to be performed by floating plant on the river.

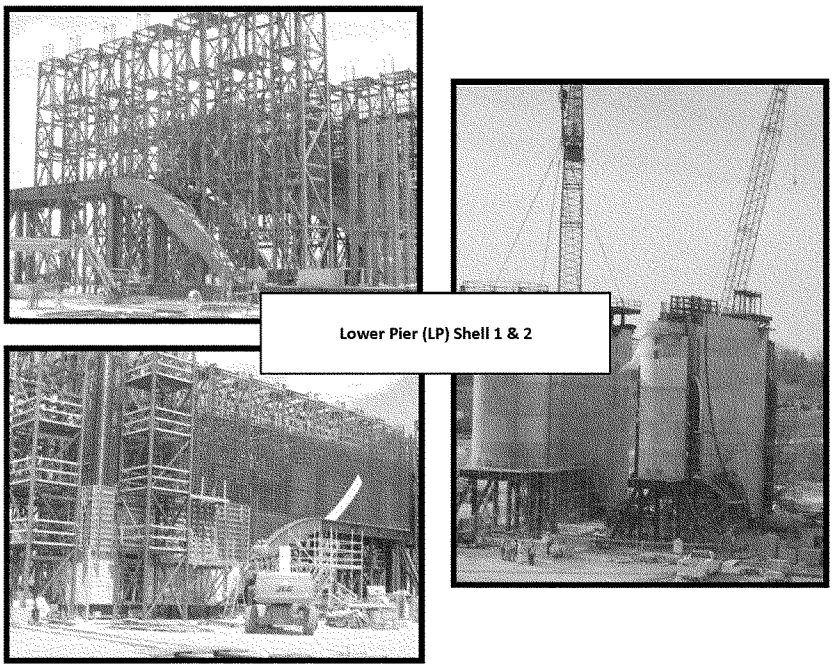
3.2.2.13. Wicket Lifter Barge

The Wicket Lifter Barge entails development of contract plans and specifications, final design, and the construction of a specialty purpose barge of welded steel construction for the Louisville District. The new vessel will be used to mechanically raise & lower wicket gates at the dam. The vessel will include allowances for the deckhouse outfitting, machinery and electrical components. The operational handling of the wickets will be performed by a hydraulic excavator, outfitted with special tools, permanently mounted on the vessel. The barge will not be self-propelled. The existing Government owned MV Gordon Stevens tug will be rehabilitated for full commissioning to the Olmsted Operations purpose following the Dam Construction Contract which it currently supports.



3.2.2.14. Project Operations During Construction

The current Olmsted project consists of on-going construction of the dam. The locks were completed in FY05 and require minimal O&M of the facility until the project is commissioned and transitioned to the USACE O&M budget. Current staff requirements are two full-time maintenance workers which will increase to six once the navigational pass construction begins.



4. Cost Estimate

The most likely cost of remaining work for the Olmsted L&D project was developed using a variety of estimating methodologies by a diverse team of USACE cost engineers. It is important to recognize that at the time of development of this baseline cost estimate for PACR purposes the project has completed a significant part of all planned scope. Completed project features include the navigational lock and downstream mooring cells. The dam contract has been underway for a number of years at the time of this estimate and several out-year contracts remain incomplete. Actual construction productivities and associated costs expended to date are known for several pre-cast concrete shells for the tainter gate dam section.



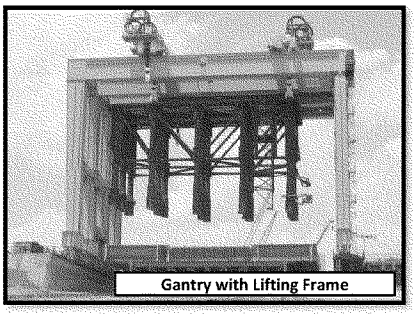
The team developed the remaining dam contract estimate based upon its historical data to-date for means, methods, productivities and costs expended to-date. The estimate was developed using the best data available in a multi-step process:

- Reviewing & adjusting the dam contractor's re-baseline cost estimate,
- Developing the most likely cost of completion of dam contract,
- Developing detailed bottoms-up estimates for the Out-Year Contracts, and
- Developing a cost and schedule risk analysis to establish contingency.

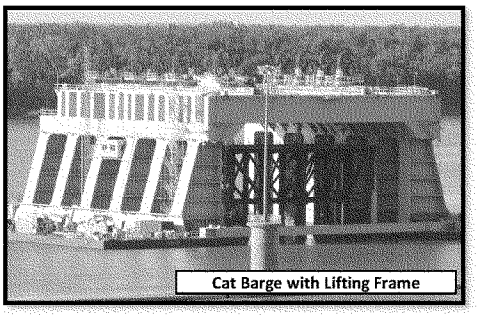
The dam estimate methodology avoids the pit-fall of attempting a bottoms-up estimate, independently of the historical record to-date for a project with such innovative and highly unique construction

methods. Developing an independent estimate for the balance of dam work would ignore the vast body of historical data documented to-date. This would go against the spirit of the USACE cost engineering regulations and the FARs (16.3) regarding estimate development for cost-reimbursable contracts. The basic estimating method for the dam contract was for USACE to review the current contractor-produced, USACE-owned construction cost estimate to ensure that the historical data has been properly interpreted and applied to crew composition and productivities and to check quantity calculations among other factors. USACE then adjusted the estimate as deemed appropriate by the cost engineering team. See Figure 5.

The Olmsted Dam project features are comprised of traditional Ohio River dam components for this section of river: tainter-gates and associated concrete dam sections; navigational pass foundations and wicket gate structures; and abutment sections on either side of the river for both. The construction methodology for the concrete dam base and piers however is not traditional. Construction methods involve highly specialized pre-casting, transport, placement, and tremie concrete filling of very large precast concrete shell sections of varying and complex geometries. This highly unique construction method and sequence specific to the Olmsted dam cost-reimbursable contract should not be lightly set aside when weighing estimating methodologies, more specifically a traditional independently developed bottoms-up cost estimating techniques. Furthermore, the uniqueness of cost estimate development for a post-authorization change request to congress combined with a cost-reimbursable contract in-progress should be recognized.



Gantry with Lifting Frame



Cat Barge with Lifting Frame

The government estimate for the balance of the dam contract was developed via subject matter expert (SME) review, and USACE cost engineer validation or adjustment of the dam contractor re-baseline estimate which is contractually USACE-owned. See Table 4. USACE and its AE contractors performed a breadth and depth validation of the dam contractor's recent re-baseline cost estimate using Pareto's Principle which states that 80% of the cost is contained within 20% of the scope. As part of the review and validation, recommendations by USACE's AE contractor - Hill, International Inc. were made for adjustments to either the base cost or risk items for cost and schedule risk analysis (CSRA) inclusion as contingency. Unlike the OYC cost estimate which used a detailed, bottoms-up methodology, USACE formulated the dam contract most likely cost estimate by reviewing and selectively implementing Hill's recommended adjustments.

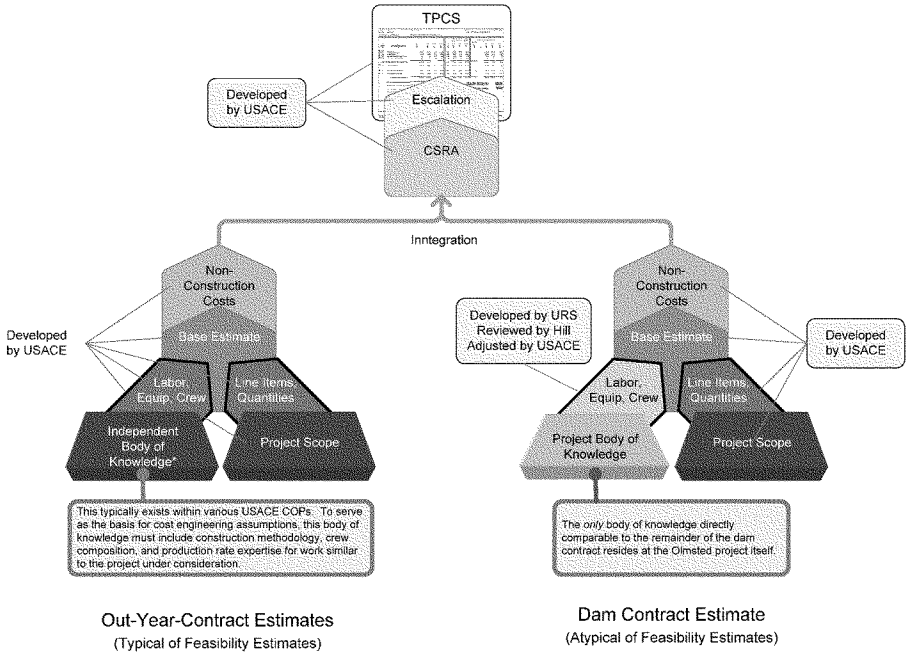


Figure 5. Estimating Methodologies

Development of an independent government estimate by USACE using traditional bottoms-up detailed estimating methodologies was determined impractical for several reasons which warrant explanation. An independent government estimate is traditionally used for contract award, which has already taken place in the case of the Olmsted Dam. Since the dam contract is already awarded and the purpose of this estimate is for programming, the government's responsibility is determining the most likely cost to complete. The reasons for not developing a traditional and completely independent bottoms-up detailed cost estimate and using the methodology described herein includes the following:

- Developing the traditional "independent" bottoms-up estimate is cost and schedule prohibitive by a factor of 3-4 versus the method employed.
- Developing a fully independent programming estimate mid-stream during a cost reimbursable contract for an awarded dam contract is a disconnect given actual construction productivities and expended costs to date are known. This is especially true in the case of highly unique construction.
- Most likely costs incurred to date by USACE incorporate current labor, equipment, and material costs. These are captured in the cost-reimbursable contractor's re-baseline cost estimate reviewed, validated, or adjusted by USACE.

- The review and adjustment of the dam contractor's re-baseline estimate constitutes and establishes government ownership of the estimate. The review process and incorporation of adjustments were based upon USACE's engineering, construction, and cost engineering subject matter expertise.
- The dam contract scope-of-work and construction methodologies are highly innovative, inherently unique and difficult at best to independently estimate. Ignoring Dam Contractor production to date is impractical and a fundamental disconnect when estimating future costs for similar work.

4.1. Estimate for Dam Contract

The cost estimate was prepared in MII, MCACES the 2nd generation, version 4.2, build 4, for all feature accounts and summarized on the Total Project Cost Summary (TPCS). The estimate resulted from reviewing and adjusting work packages from the 2011 URS Corporation Rebaseline Estimate.

4.1.1. USACE Project Controls of Dam Contract

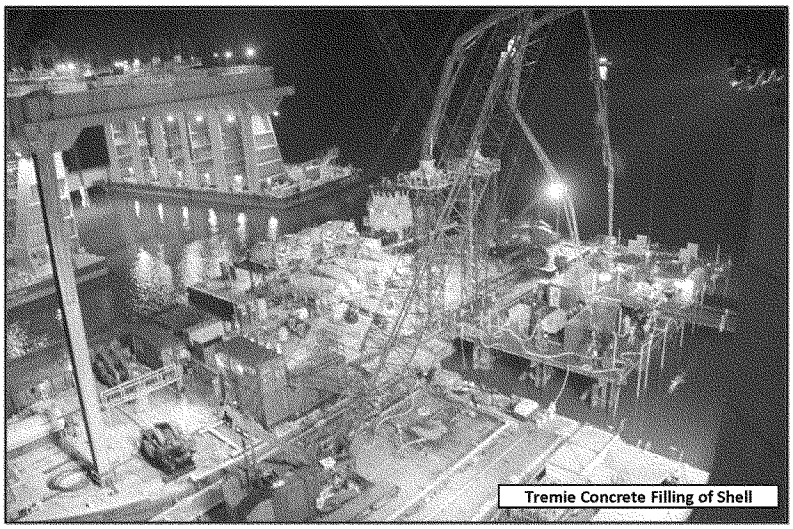
There is a current USACE HQ initiative to study and categorize high dollar, high complexity projects as "mega-projects". This initiative would likely categorize Olmsted as a mega-project In the near future. Based upon this categorization, Louisville District would be required to employ a more expansive and rigorous project controls system.

The current project controls team consists of Olmsted Resident office staff, a full time cost engineer, contracting officer, office of counsel staff, internal review staff, Defense Contract Management Agency (DCMA), Defense Contract Audit Agency (DCAA), a certified public accountant, and construction management service contracts to provide cost and schedule review. The project controls team's job is to manage the cost reimbursable contract and insure that the costs are reasonable, allowable and allocable. The internal controls consist of reviews of payment vouchers, property, procurements, risk management, budgets, schedule, and procedures. Risk register items from this report will be incorporated into the projects risk management plan for better management and mitigation of project risks. The following processes are being implemented currently at Olmsted on the dam contract:

1) Payment vouchers – The contractor submits his vouchers to DCAA and USACE concurrently. USACE staff along with the CPA review fifteen elements of the voucher. The contracting officer approved payment after USACE and DCAA reviews are complete and approved. If adequate support is not provided or the item doesn't appear allocable it is placed into the questionable cost category and it's up to the contractor to provide further justification.
2) Procurement – Initially the contractor had limited authority to award contracts. Procurements over $1M had to be reviewed and approved by USACE before the contract could be awarded. DCMA has since approved the contractor procurement system and USACE approval is not required. USACE now conducts monthly spot checks of various actions to assure the contractor continues to follow the FAR.
3) Property Administration – The Resident office has on staff a Level II certified Professional Property Manager for daily oversight of the property management function for cradle to grave accountability. He monitors the contractors fleet management and maintenance program, he perform analysis and

approval of their property control system and does surveillance on the contractor asset management system.

4) The project management software is Primavera (ver. P6). The contractor does weekly updates and weekly "3 month look-ahead" meeting are held.
5) There a weekly cost control meetings.
6) Earned Value management system data is provided by the contractor. Twice USACE hired a consultant to review the contractor system against the ANSI Standard. The system complies with all ANSI standards. URS Corporation is utilizing a DCAA certified earned-value system.
7) Other quality assurance surveillance reviews performed include: validation of Union Labor Rates Increases, overtime justification, document control, and procedural controls (is the contractor following his SOP).



4.1.2. Existing Dam Contract Estimate Production

The estimate for the dam contract was produced by a qualified, experienced team of USACE cost engineers from Huntington and Louisville Districts. This team was supplemented by subject matter expert support from the Architectural-Engineering firm, Hill International, Inc. This intensive effort took place during the period of August through October 2011, with most of the work performed at the Olmsted Resident Engineer's Office in Olmsted, Illinois. Figure 6 illustrates the production process.

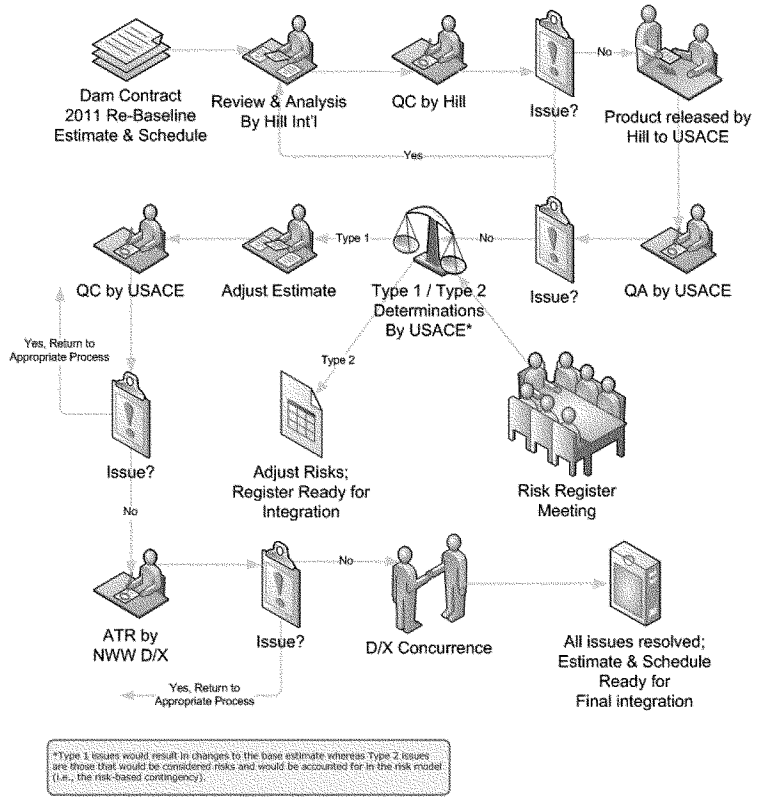


Figure 6. Existing Dam Contract Estimate Production Flowchart

4.1.3. Dam Contract Estimate Methodology

The estimate was developed by reviewing, validating, and adjusting the 2011 URS Corporation Rebaseline Estimate, which is primarily based on historical crew composition and productivities. Base estimate adjustments were made from recommendations based on review of scope, quantities, productivity rates, labor rates, material costs, and equipment costs. Additionally, extended overhead costs and other time dependent costs were added based on the schedule presented in Section 5. The

estimate was adjusted to account for work completed from 28 February 2011 through 30 September 2011.

The 2011 URS Corporation Rebaseline Estimate

In February of this year, USACE requested URS Corporation to supply a revised baseline estimate for the completion of the dam portion of the Olmsted Locks & Dam project. The 2011 URS Corporation Rebaseline Estimate was intended to include all outstanding scope of work from 28 February 2011 to completion and was divided into 94 work packages with an estimated total value of $887,227,899. See Appendix L.

The 94 estimate work packages represent the following general categories of work for completion of the dam:

1. Overhead costs (salaries and home office costs)
2. Land costs (precast yard, batch plant, reinforcing yard, heavy lifting equipment)
3. Marine operations (tugs, barges, floating equipment, pile driving, etc.)
4. Miscellaneous (fee, management reserve, escalation)

These packages vary greatly in value with approximately 85% of the total construction completion costs are contained in 25 work packages. A review of the URS Corporation revised estimate packages was undertaken to deem reasonableness and to identify required adjustments. A detailed review was conducted with respect to scope, quantities, productivity rates, labor rates, material costs, and equipment costs of 85% of the cost, which exceeds the Pareto Principle. The remaining URS Corporation work packages were reviewed at a limited level to ensure that URS Corporation has appropriately included all major scope items in the total estimate. Figure 7 illustrates the breakdown of the percentage of costs reviewed.

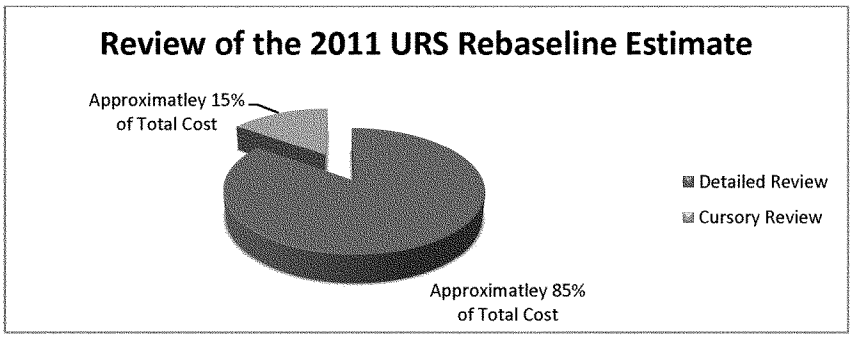


Figure 7. Percentage of Costs Reviewed of the 2011 URS Corporation Baseline Estimate

4.1.3.1. 2011 URS Corporation Rebaseline Estimate Review and Evaluation

The individual package reviews included evaluations of scope, labor, equipment, material, and other direct and indirect costs. A standardized form was prepared for each review in order to: (1) document

the package reviews, (2) maintain consistency between separate package reviews, and (3) facilitate quality control among the reviews. Cost issues were identified as direct changes in USACE estimate (Type I) or for inclusion in the risk register with estimated thresholds (Type II).

Based on the findings of the review, the team categorized any required changes or risks into one of two categories. Type I would result in a change to the base cost estimate; Type II would be included in the risk analysis. See Figure 8.

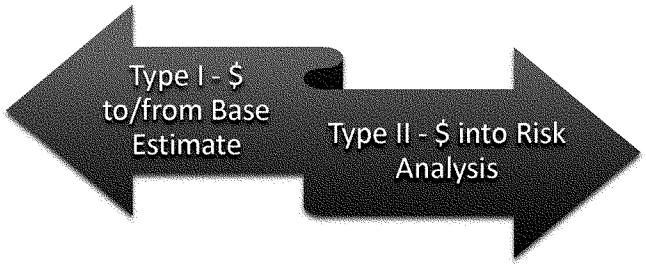


Figure 8. Type I / Type II Changes Required

The information provided by URS Corporation included the following (also see Appendix L and Appendix M):

- The 2011 URS Corporation Rebaseline Estimate summary and detail pages.
- Historical cost data sheets.
- Installed scope of work quantities.
- Quantity take-off and survey data sheets.
- Project detail drawings.
- Construction detail drawings for concrete pours, reinforcing detail drawings, formwork drawings, precast yard layout, planning details, etc.

In addition to the URS Corporation information, the following supplemental actions were taken by the review team:

- Multiple tours of the construction site to verify existing conditions.
- Interviews with the URS Corporation estimators, construction personnel, and key USACE engineer field supervisory staff to verify the estimate structure, scope issues construction details and onsite design change processes.

Hill International Task Order

A directive was given to Hill International (Hill) under Indefinite Delivery / Indefinite Quantity Contract W91237-10-D-0011, Task Order 005 dated August 26, 2011 to perform the estimate reviews as follows:

- Review the largest priced packages (minimum of 25) of the 2011 URS Corporation Rebaseline Estimate, which makes up at least 80% of the Dam Contract (Pareto Principle).

- Review the largest cost drivers of each work package that make up at least 80% of the package cost for the selected packages.
- Perform a limited review of the remaining work packages to review scope of work, costs, and potential duplication.
- Identify risk for the packages reviewed, identify and any other global risks, and apply values to each. These risks would then be classified as Type I or Type II adjustments by USACE.
- Report findings.

Hill was tasked to review a minimum of 25 of the largest of these packages in detail and ensure that more than 80% of the cost to complete the outstanding scope of work is included. In addition to the detailed review the outstanding packages were given a limited review to ensure all remaining scope of work is included. This assured that no double-counting or omission of scope of work occurred in the 2011 URS Corporation Rebaseline Estimate.

Hill sorted the work packages by dollar value in descending order from largest to smallest value and focused on the top 28 work packages for review. The four work packages excluded from the review process were escalation (separate calculation and analysis), award fee (fixed amount of original contract plus modifications), base fee (fixed at 3% of the total cost of original contract plus modifications), and management reserve (contingency calculated separately).

The packages selected for review are listed in the table below. There were a total of 28 packages that were reviewed by Hill with a cumulative value of $671,299,351. This cumulative value represents approximately 85% of the total URS Corporation estimate. The total of the URS Corporation estimated cost reviewed is $790,275,076 (excluding Award Fee, Management Reserve, Base Fee (3%), and Escalation). See Table 5.

Table 5. URS Corporation Packages Reviewed by Hill in Detail

SD No.	Description	Pkg. Value	URS Estimate Date
020	Operational Cost - Marine/ ARRA Operational Cost – Marine	$88,529,615	11-Aug-11
001	Field Overhead Salaries & ARRA Field Overhead Salaries	$78,961,967	18-Jul-11
995	Home Office G&A	$56,039,408	18-Jul-11
635	NP Foundation Piling	$42,275,185	14-Jul-11
685	Fabricate NPS	$38,603,811	2-Aug-11
010	Operations Costs – Misc	$37,845,442	2-Aug-11
590	Tainter Gates	$31,441,003	14-Jul-11
107	Heavy Lift Equipment & ARRA Purchase/Fab Lift Frames	$28,245,843	14-Jul-11
410	Fabricate LPS/LPW	$27,408,474	1-Sep-11
825	NP Furnish Wicket Gates Complete	$25,467,793	18-Jul-11
285	Operate & Maintain Batch Plant & ARRA Oper. & Maint. Batch Plant	$20,851,977	18-Jul-11
755	NP Precast Yard Equipment Operations & Support Costs	$20,537,693	18-Jul-11
357	Left Boat Abutment Shell	$18,005,428	18-Jul-11
355	TG Foundation Piling & ARRA TG Foundation Piling	$15,602,351	3-Aug-11
500	Upper Pier Shells (UPS) - CIP Concrete	$15,349,811	18-Jul-11

SD No.	Description	Pkg. Value	URS Estimate Date
017	Specialized Heavy Lift Services/Equipment	$14,794,570	14-Jul-11
400	Fabricate SS	$14,161,936	18-Jul-11
760	NP Common PCY	$13,927,146	18-Jul-11
530	TG Precast Yard Equipment Operations & Support Costs	$13,649,003	18-Jul-11
405	Fabricate SBS	$11,525,199	18-Jul-11
630	NP Sheet Piling	$10,777,247	18-Jul-11
750	NP Lifting Frames & Erection Systems	$10,768,766	18-Jul-11
015	Operations Cost - Casting yard & ARRA Rebar Fab & Operations	$8,870,202	18-Jul-11
525	TG Lifting Frames & Erection System & ARRA TG Lifting Frames & Erection System	$8,492,988	4-May-11
150	Purchase/Mob Equipment – Marine	$8,422,052	2-Aug-11
225	Excavation - River Channel & ARRA Excavation - River Channel	$8,159,302	14-Jul-11
970	NP AGI Spare Wicket Gates	$2,067,326	18-Jul-11
972	Wicket Gate Needles & Blanks	$517,813	18-Jul-11
	Evaluated Package Total	**$671,299,351**	
	URS Corporation Total Rebaseline Package (in-progress) (Excluding fees, management reserve, and escalation)	**$790,275,076**	
	Percent of Package Price Reviewed	**85%**	

The remaining packages were reviewed in less detail. This limited review of the remaining work packages did not result in any significant findings.

Scope Verification

Each URS Corporation Work Package scope was examined to determine if the scope was all inclusive or contained duplications.

Quantity Verification

Detail worksheets, based on the URS Corporation estimate sheets, were created and quantities reviewed in each of the package estimates. The majority of the elements/structures in the package were surveyed. As an example, the Navigational Shells consists of 12 shells of very similar design. Only one shell was surveyed and the discrepancies/cost differentials between the elements were reviewed and verified. Some packages, such as equipment or field office overhead, did not require a quantity survey. These items used man hours, equipment count, months of operation and personnel count to determine quantities.

Productivity Verification

URS Corporation used historical productivity information as backup to their development of the 2011 URS Corporation Rebaseline Estimate. The URS Corporation on-site historical productivity factors established the standards used in the evaluation process and generally included reasonable increases in productivity due to repetitive work and the learning curve.

Labor Rates

Both the Project Labor Agreement (PLA) and the certified labor payrolls were reviewed. The crew rates, crew make-up, and days of work were confirmed as the same rates used in the estimate.

Material Cost

The available invoices and purchase orders for permanent materials confirmed that the same cost was used in the estimate packages. No escalation was included in the evaluation as this calculation was part of the "Escalation" package (Package SD-990). As stated earlier, escalation will be calculated as part of the final TPCS.

Equipment Cost

Most of the existing on-site equipment is owned by USACE and is therefore considered a sunk cost. Equipment operating and maintenance costs included in the work packages were reviewed and verified.

Conclusions of the Review

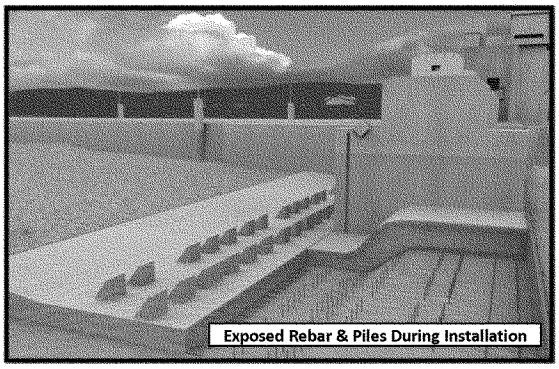
Hill determined that based on the package reviews, the overall estimated cost by URS Corporation was within an acceptable range by estimating standards. The estimate packages do not include any contingency costs; however in a few instances, the 2011 URS Corporation Rebaseline Estimate is conservatively priced due to the use of the same productivity rates for repetitive work items such as the fabrication and setting of the Navigable Pass shells.

Hill also concluded that generally, the scope of work, quantities, productivity, labor rates, and material costs reviewed were verified and correctly stated in the 2011 URS Corporation Rebaseline Estimate. All major findings were quantified as either as base estimate changes (Type I) or risk register items (Type II).

Finally, it was Hill's opinion that the 2011 URS Corporation Rebaseline Estimate reasonably covers the cost to complete based on the parameters provided. The estimate packages do not include time related costs beyond the current November 2015 projected completion. These additional time-related costs are captured in both the base estimate and the CSRA as Type I and Type II adjustments respectively.

4.1.3.2. Development of the Government Estimate (Type I)

Upon review of the 2011 URS Corporation Rebaseline Estimate, several items were identified to be added or deducted to/from the base estimate versus captured by contingency. Some of these items were directly related to a specific work package whereas others were more global in nature and were categorized as "Not WP Specific". The major cost additions/deductions made to the 2011 URS Corporation Rebaseline Estimate are:



Exposed Rebar & Piles During Installation

- **Extended FOOH Due to Longer Construction Schedule.** Additional costs to account for extended FOOH from 1-DEC-15 until the end of the existing dam contract (approximately 6 years). Total cost added: $206.4M.
- **Spent Dollars from 28-FEB-11 to 30-SEP-11 by Work Package.** The 2011 URS Corporation Rebaseline Estimate included costs from 28-FEB-11 to 30-NOV-15 while the spent dollars for the project were up to 30-SEP-11. This amount was deducted from the estimate to avoid double-counting these costs. Total cost deduction: $66.8M.
- **Escalation.** Escalation was removed from the estimate since it will be accounted for in the TPCS (Total Project Cost Summary) sheet which will capture escalation. Total cost deduction: $56.4M.
- **Home Office G&A.** Due to the addition/deletion of costs, HOOH had to be adjusted to account for these adjustments (7.37% of select items). Total cost added: $18.5M.
- **Management Reserve.** Management reserve (contingency) was removed from the estimate since it will be accounted for in the CSRA (Cost and Schedule Risk Analysis). Total cost deduction: $15M.
- **Standby tug for river operations.** Per the contract requirements (Document 00800 page 49, Spec 1.62), a tug is needed 24-7 to assist river traffic for safe passage through the NAV pass section of the dam during construction. Total cost added: $14.8M.
- **Variation of pile length on uncompleted sections.** This was an adjustment made for revising pile lengths for the navigable pass from 42' to 54'. The 2011 URS Corporation Rebaseline Estimate assumes navigable pass piles are equal length to the tainter gate piles. USACE believes that once test piles are driven, the "most likely" case is that the navigable pass piles will be 33% longer than tainter gate piles. Total cost added: $11.3M.

Table 6 is a summary of all the base cost adjustments. For individual work package sheets of these items and additional details, see Appendix C.

Table 6. Type I Base Cost Adjustments

Work Package/Risk No.	Description of Base Adjustment	Contract Cost
SD-001		**(5,500,000)**
DAM-049	Escalation on salary	(5,500,000)
SD-225		**2,901,999**
DAM-006	Not setting all flat shells during that season	56,701
DAM-010	Variation in difficulty setting shells to grade	235,620
DAM-026	Sand waves	2,609,679
SD-357		**(2,160,000)**
DAM-024	LBA re-design	(2,160,000)
SD-590		**4,280,655**
DAM-020	Tainter Gate Quote	4,280,655
SD-635		**11,320,722**
DAM-018	Variation of pile length on uncompleted sections	11,320,722
SD-825		**99,000**
DAM-044	Testing of Wicket Gates	41,000
DAM-045	Securing wicket gates to shells	58,000
SD-905		**339,405**
DAM-006	Not setting all flat shells during that season	339,405
SD-915		**147,305**
DAM-006	Not setting all flat shells during that season	147,305
SD-975		**2,969,559**
N/A	Base Fee (3%)	2,969,559
SD-980		**6,005,438**
N/A	Award Fee	6,005,438
SD-985		**(15,000,000)**
N/A	Management Reserve	(15,000,000)
SD-990		**(56,356,038)**
N/A	Escalation	(56,356,038)
SD-991		**2,906,365**
DAM-017	Variation in scope for filling voids between precast & Tremie concrete	2,906,365
SD-995		**18,470,669**
N/A	Home Office G&A	18,470,669
Not WP Specific		**162,476,214**
DAM-003	Security for jobsite	2,500,000
DAM-011	Pier rebar damage	300,000
DAM-021	Extended FOOH Due to Longer Construction Schedule	206,356,956
DAM-033	Equipment salvage prior to contract completion	(7,000,000)
DAM-040	Standby tug for river operations	14,778,164
DAM-042	Construction Equipment Operations & Possible Replacement	4,544,000
DAM-046	LP infill delay	1,805,253
DAM-051	Variance in tug boat rental costs	6,000,000
N/A	Spent Dollars from 28-FEB-11 to 30-SEP-11 by Work Package	(66,808,159)
Grand Total		**132,901,294**

4.1.3.3. Non-Construction Costs

Planning, Engineering, and Design (E&D)

The work covered under this account includes project management, project planning, engineering during construction, etc. EDC (Engineering During Construction) costs were estimated by analyzing the historical yearly cost expended over the last 2-5 years. This amount, $1.75 million per year, was used to project the remaining EDC costs from FY12 until the end of the dam contract.

Supervision and Administration (S&A)

The work covered under this account includes project management, contract supervision, contract administration, construction administration, technical management activities, and District office supervision and administration costs. S&A costs were estimated by analyzing the historical yearly cost expended over the last 2-5 years. This amount, $5.25 million per year, was used to project the remaining S&A costs from FY12 until the end of the dam contract.

4.2. Estimate Out-Year Contracts

The cost estimate was prepared in MII, MCACES the 2nd generation, version 4.2, build 4, for all feature accounts and summarized on the Total Project Cost Summary (TPCS). Most costs were developed from detail while some were developed using alternate methodologies as appropriate.

4.2.1. Estimate Production

The estimate for the Out-Year Contracts (OYC's) was produced by a diverse and experienced team of USACE cost engineers from various districts who supported this effort during the month of September. Figure 9 depicts the general workflow for development of the OYC cost estimates.

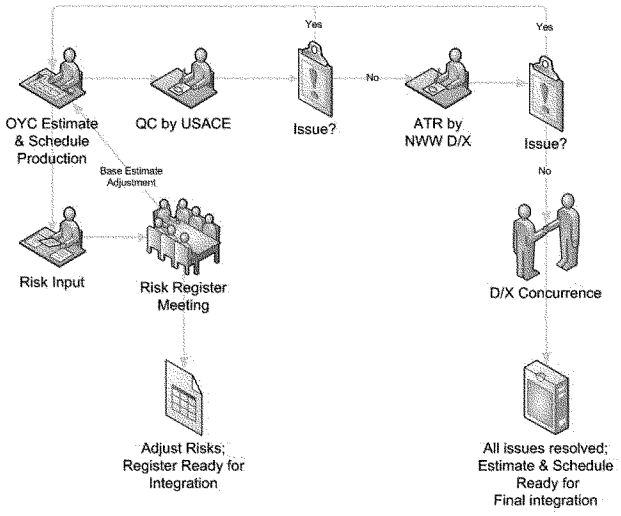


Figure 9. Out-Year Contract Estimate Production Workflow

The OYC cost estimating team began with a kickoff meeting at USACE Louisville District office on Tuesday, 6 September 2011. A project overview and current dam contract presentation were provided to the OYC team for familiarization with the project by the Olmsted project manager. Cost estimating assignments for individual out-year contracts were made to individual estimators to ensure estimate preparation for all known OYC's. The team then performed a site visit the following two days (7 & 8 September 2011) at the Olmsted Lock and Dam Project near Olmsted, IL. During the site visit, estimators familiarized themselves with the current project features, layout, current dam contract construction contract activities and infrastructure, including their respective OYC scope locations and constraints. Cost engineers assigned to the Lock & Dam 52/53 demolition and restoration OYC's made separate site visits to these two projects located upstream of the Olmsted project. Project familiarization was facilitated to these OYC cost engineers by the Olmsted Project Manager and the Lockmasters at L&D 52/53.

Scope of work packages for each OYC were coordinated by the LRL Chief of Cost Engineering with respective Olmsted project delivery team members. These scope of work packages varied from conceptual to 90% plans and specifications levels of design and scoping information for each OYC.

These scope packages were reviewed by the respective OYC cost engineers and any questions were coordinated with the respective OYC designer or team member to discuss and ultimately resolve any scope definition issues to establish bases of OYC estimates.

Each OYC cost estimator captured estimating backup data in a standardized MS Excel cost estimate template to facilitate the estimating, quality control review, and agency technical review processes. An individual OYC file was developed by each cost engineer to capture the following items prior to estimating:

- Scope provided and scope assumptions
- Estimating methodology
- Scope References (Plans, specifications, drawings, etc.)
- Quantity takeoffs
- Class of Estimate
- Sequence of Work and Schedule Input
- Estimator Questions
- Quality Control Checklist for Cost Engineer Input
- Risk Items per Cost Engineer
- Material Quotes and Sources
- Profit & Bond Calculations
- Prime & Sub Markups

Upon completion of each OYC cost estimate template in the MS Excel File, the OYC production team lead provided the files to the Quality Control and Agency Technical Reviewers to accomplish real-time familiarization with the scope and estimating approach and assumptions. This initial blush for the QC and ATR reviewers would facilitate their reviews within the short time-frame to accomplish all

development and review activities by the end of September and to avoid any major re-work. Cost engineers then developed all OYC estimates using a variety of methodologies described below. Detailed, bottoms-up estimating was used as the preferred methodology where detailed scoping information was available.

4.2.2. Estimate Methodology

4.2.2.1. Historical Unit Pricing

In some instances, historical cost information, such as Parametric Cost Engineering System (PACES), was referenced and documented accordingly. These historical references include past contract bid prices for projects of similar design and magnitude, and recent government studies and cost estimates.

4.2.2.2. Quote-in-Place

In some instances, a quote from a subcontractor may have been received that includes all their overhead and profit. In that case, no additional markups have been included for subcontractor's overhead.

4.2.2.3. Detailed MII Cost Estimate

The MII estimating software was used to develop a construction sequence for each item of work and applying detailed line items and crews to perform the work. Crews were developed in correspondence with the work being performed and estimated productivities. The labor rates were adjusted to the local and current Davis-Bacon wage determinations. The latest MII equipment database was also used and adjusted for current fuel and energy costs. Material prices were obtained through telephone solicitations with vendors, Internet suppliers, the MII Cost Book, and R.S. MEANS. A summary of the MII cost estimate can be found in Appendix B.

4.2.2.4. Direct Costs

Direct costs are based on anticipated equipment, labor, and materials necessary to construct this project. Following formulation of the direct cost a determination is made as to whether the work would be performed by the prime contractor or a subcontractor.

Labor - Wage Determination

Pulaski County, Kentucky Davis-Bacon wage rates were obtained from the Department of Labor and used for all craft labor (see Table 7). The base wage rate and taxable fringe were entered into MII and applied accordingly. The total labor rate was developed using the base wage, fringe benefits, FICA, FUTA, and Workers' Compensation rates for each craft computed by MII based on project location and contractor type.

Table 7. Davis-Bacon Wage Determinations

Labor Type	Davis-Bacon Decision Number
Building	General Decision Number: IL100002 07/29/2011 IL2
Dredging & Marine	General Decision Number: IL100018 07/01/2011 IL18
Heavy & Highway	General Decision Number: IL100016 08/05/2011 IL16
Heavy Dredging	General Decision Number: IL100019 01/07/2011 IL19

Equipment Costs

The 2009 Equipment database, based on EP 1110-1-8, Construction Equipment Ownership and Operation Expense Schedule, Region II, was used and adjusted for the current local fuel and energy costs.

Vendor Quotes

Vendor quotes have been acquired and documented for the anticipated material costs for most features of work.

Crews

Project specific crews have been developed and applied to the detailed line items as appropriate. Crew members consist of selected complements of labor classifications and equipment pieces assembled to perform specific tasks. Productivity has been assigned to each crew reflective of the expected output per unit of measure for the specific activities listed in the cost estimate. In considering the crews and productivities, the engineer typically referenced other, similar work found in national reference manuals such as R.S. MEANS construction data, the MII Cost book, and other projects developed by USACE.

Quantities

Quantities were developed by either the cost estimator or PDT for each feature of work. Quantities were checked or verified by the estimator and adjusted to account for construction methodology, shrink, swell, waste, etc. Other associated sub-quantities were also developed by the estimator.

4.2.2.5. Indirect Costs

Contractor Acquisition Strategy

Through discussions with the Project Manager & PDT, each contract had an assumed contractor acquisitions strategy based on the type and cost of each contract. Certain features of work were assumed to be subcontracted as deemed appropriate by the cost engineer. The markups associated with the prime contractor and subcontractors identified in MII are listed in Table 8.

Contractor Markups

Field Office Overhead (FOOH)

For Field Office Overhead (FOOH), the cost estimate includes an allowance applied as a percentage of direct cost based upon the estimator's judgment. This value represents the anticipated prime contractor field overhead costs for such items as project supervision, contractor quality control, contractor field office supplies, personal protective equipment, field engineering, and other incidental field overhead costs.

Table 8. Contractor Strategy and Markups

Contractor Strategy Hierarchy	FOOH	HOOH	Profit
Building and Grounds	12.00%	10.00%	8.00%
Paving Sub	12.00%		10.00%
Erosion Sub	12.00%		10.00%
Grading Sub	12.00%		10.00%
Landscaper Sub	12.00%		10.00%
Structural Sub	11.00%		10.00%
Carpenters	11.00%		10.00%
Electrician	14.00%		10.00%
Masons	11.00%		10.00%
Mechanical	14.00%		10.00%
Plumber	14.00%		10.00%
Utility Sub	14.00%		10.00%
Electric Sub	14.00%		10.00%
Dredging	15.00%	10.00%	8.56%
Lock Wall Dredge	15.00%	10.00%	9.42%
Final County Road / Site Paving	16.00%	8.00%	8.43%
Crack Sealing Sub	17.00%		10.00%
Fencing Sub	17.00%		10.00%
Striping Sub	17.00%		10.00%
Lock & Dam 52 - Land Demo	10.00%	10.00%	8.66%
Lock & Dam 52 - Marine Demo	10.00%	10.00%	9.69%
Diving Sub	15.00%		5.00%
Pile Sub	15.00%		5.00%
Piping Sub	15.00%		5.00%
Stone Placement Sub	15.00%		5.00%
Lock & Dam 53 - Land Demo	10.00%	10.00%	8.66%
Restoration Sub	10.00%		10.00%
Lock & Dam 53 - Marine Demo	10.00%	10.00%	9.69%
Diving Sub	15.00%		5.00%
Pile Sub	15.00%		5.00%
Piping Sub	15.00%		5.00%
Stone Placement Sub	15.00%		5.00%
Lock Rehab/O&M Startup	24.00%	10.00%	9.30%
Electrical Sub	15.00%		9.86%
Painting Sub	19.00%		9.33%
PLC Controls Sub	15.00%		8.05%
Operations Equipment and Machinery	0.00%	15.00%	7.95%
RE Office Conversion to Ops Building	15.00%	12.00%	10.00%
General Contractor	10.00%		7.50%
Electrical Subcontractor	10.00%		7.50%
Mechanical Subcontractor	10.00%		7.50%
Carpentry Subcontractor	10.00%		7.50%
Asphalt Subcontractor	10.00%		7.50%
Restoration Contractor	12.00%	10.00%	7.92%
River Dikes	16.00%	15.00%	8.24%
Bank Work	17.00%		10.00%
Salvage Contractor	5.00% Contractor Fee		
US Mooring Cell	15.00%	8.00%	8.83%
Diving Sub	20.00%	15.00%	10.00%
Painting Sub	9.00%	7.00%	8.00%
Tug Sub	10.00%	15.00%	10.00%
Wicket Lifter Barge	0.00%	0.00%	0.00%

Home Office Overhead (HOOH)

For Home Office Overhead (HOOH) expense, the cost estimate includes an allowance applied as a percentage of direct cost plus FOOH. HOOH includes items such as office rental/ownership costs, utilities, office equipment ownership/maintenance, office staff (managers, accountants, clerical, etc.), insurance, and miscellaneous. In reality, the range of home office overhead can be quite broad and depends largely on the contractor's annual volume of work and the type of work that is generally performed by the contractor.

Profit

For prime contractors, profit was calculated using the Profit Weighted Guidelines methodology and applied as a running percentage of direct cost plus FOOH and HOOH. For subcontractors, profit was based on estimator judgment and applied as a running percentage of direct costs plus subcontractor's overhead and varied by contract.

Bond

Bond was calculated using Table 5-4 of ETL 1110-2-573, performance and payment bond with non-deviating rates, Class B, and included as lump sum amount contractor markup for prime contractors only. Additional bond was not included for subcontracted work and is assumed to be covered by the prime contractor's bond cost.

B&O (Business & Occupation) Tax

There is no B&O tax in Olmsted, IL.

Contractor Fee

On the salvage contract, the estimator assumed that the contractor markups would be very minimal therefore a contractor fee of 5% was assumed due to the nature of the work.

4.2.2.6. Non-Construction Costs

Planning, Engineering, and Design (E&D)

The work covered under this account includes project management, project planning, preliminary design, final design, geotechnical and HTRW investigations, hydraulic modeling, preparation of plans & specifications, engineering during construction, contract advertisement, opening of bids, and contract award. PED (Planning, Engineering, & Design) was estimated based on USACE historical costs as a percentage of construction costs; these assumptions varied contract-by-contract depending on the value and duration of the contract. EDC (Engineering During Construction) was estimated to be 5% of construction (based on USACE historical costs) regardless of the value and duration of the contract. See Table 9 for a summary of these assumptions. The only exception was for the Wicket Lifter Barge contract; for this contract, USACE Marine Design Center had estimated these costs.

Supervision and Administration (S&A)

The work covered under this account includes contract supervision, contract administration, construction administration, technical management activities, and District office supervision and administration costs. The cost for this account has been estimated based on a historical factor of 7.5% of the total construction cost accounts and did not vary by contract.

Table 9. 30/31 Account Assumptions

	30 Account		31 Account
Contracts	PED[1]	EDC[2]	S&A[3]
Percent of Construction			
Building and Grounds	15.00%	5.00%	7.50%
Dredging	15.00%	5.00%	7.50%
Final County Road / Site Paving	15.00%	5.00%	7.50%
Lock & Dam 52 - Land Demolition	20.00%	5.00%	7.50%
Lock & Dam 52 - Marine Demolition	10.00%	5.00%	7.50%
Lock & Dam 53 - Land Demolition & Historic Restoration	20.00%	5.00%	7.50%
Lock & Dam 53 - Marine Demolition	10.00%	5.00%	7.50%
Lock Rehab/O&M Startup	15.00%	5.00%	7.50%
Operations Equipment and Machinery	15.00%	5.00%	7.50%
Project Closeout & Site Restoration	15.00%	5.00%	7.50%
RE Office Conversion to Ops Building	25.00%	5.00%	7.50%
River Dikes	5.00%	5.00%	7.50%
Salvage/Excess of Government Owned Equipment	0.00%	0.00%	0.00%
U/S Mooring Cells	15.00%	5.00%	7.50%
Lump Sum Amount			
Wicket Lifter Barge	-	915,838	366,335

1 – PED: Planning, Engineering, and Design
2 – EDC: Engineering During Construction
3 – S&A: Supervision and Administration

4.3. Workflow for Final Integration

Figure 10 depicts the work process whereby the estimate was developed for the remaining work to complete the Olmsted project. The figure shows the estimate, schedule, and CSRA being integrated resulting in a certified Olmsted PACR baseline cost estimate.

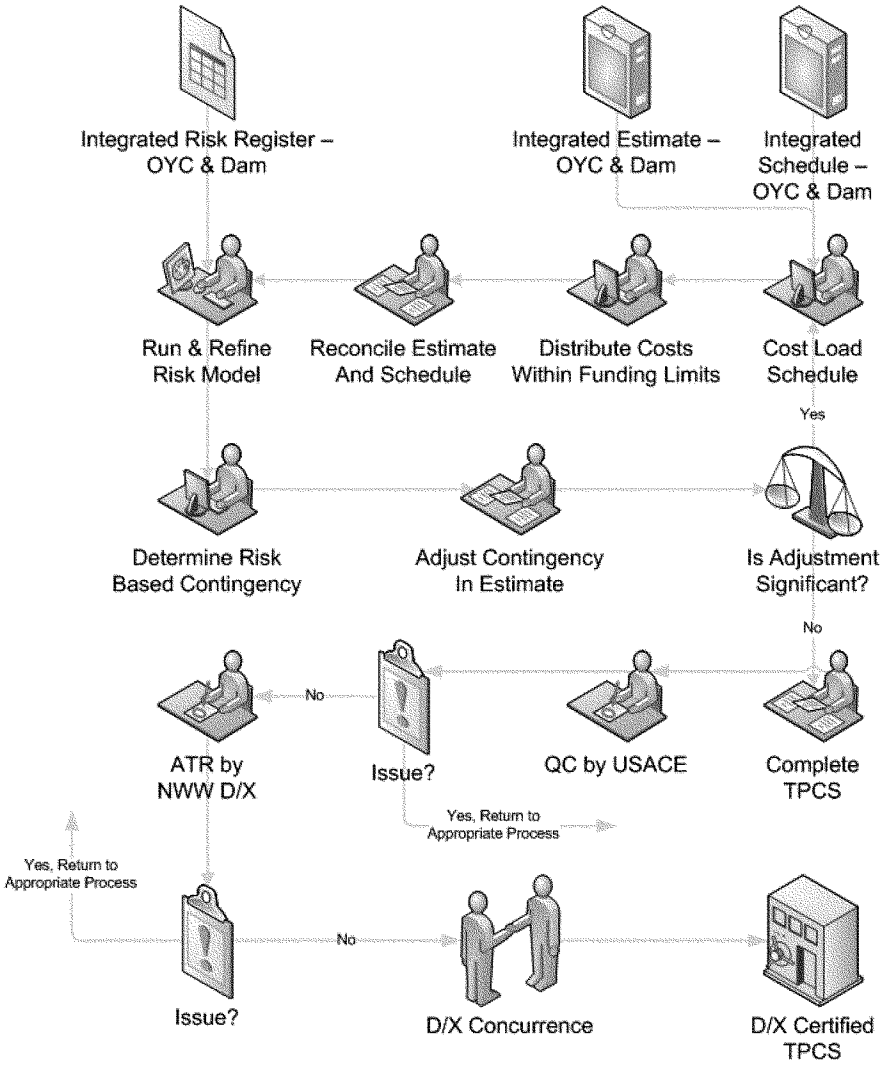


Figure 10. Integration Workflow

5. Schedule

The Total Project Schedule for completing the Olmsted L&D Project was developed in Primavera P6 Scheduling Software using detailed construction activities and associated network logic to determine the logic-based critical path for the project. The schedule work breakdown structure (WBS) is organized by two major phases of remaining construction: the Dam Contract Phase (currently in-progress) and the Out-Year Contracts Phase. The detailed process for developing the schedules for these two phases varies significantly. This is driven by the unique considerations for the existing dam construction contract. Each major item of work is assigned a work calendar as shown in Table 10 to account for anticipated non-work periods or "work windows" due to seasonal weather/river conditions. The final total project schedule also incorporates cost-resource leveling to fit the most-likely annual funding stream.

Table 10. Defined Work Calendars in Primavera P6.

ContractID	Work Windows	Notes
Standard 5 Day 8 hr Work Calendar	5 days per week 8 hrs per day 12 months	Typical construction calendar for land based work
Standard 6 Day Work Calendar	6 days per week 10 hours per day 12 months	Activities where the contractor typically works six days a week.
Standard 7 Day Work Calendar	7 days per week 8 hours per day 12 months	Activities that occur over the weekend.
In-Water Work Calendar – Pre-Dam	5 days per week 8 hrs per day 6 months (June 16 - November 30)	Work done in the river.
In-Water Work Calendar – Post-Dam	5 days per week 8 hrs per day 9 months (May 15 - Feb 15)	Once Dam is in place, the low-pool elevation will be more reliably maintained and likely to result in a slightly extended construction season. This 9 month seasin is for river demo and mooring cells.

5.1. Schedule for Dam Contract

5.1.1. Schedule Production

The schedule was developed by an experienced team of USACE schedulers and cost engineers from Savannah, Huntington, and Louisville Districts. This team was supplemented by subject matter experts from the AE firm, Hill International. This intensive effort took place during the period of August thru October 2011, with most of the work performed at the Olmsted Resident Engineer's Office.

5.1.2. Schedule Methodology

The schedule for the dam contract was prepared in Primavera P6 scheduling software beginning with the existing construction schedule managed by USACE Resident Engineer's Office and URS Corporation. This schedule was updated to reflect the most current progress through July 2011. The team then

performed an in-depth review, analysis, and evaluation of the planned schedule (see Appendix K for further detail). The overall activity logic and work calendars were reviewed for reasonableness and tempered with comparisons of planned progress to actual progress through July 2011. From these analyses, the government made necessary adjustments for reasonable durations to accomplish the remaining dam construction activities excluding the effects of constrained annual funding.

5.2. Schedule for Out-Year Contracts

5.2.1. Schedule Production

The key cost drivers for each OYC were identified as schedule activities and assigned hourly work durations as developed in the MII cost estimate. The OYC estimating team coordinated these activities for schedule input through the Contract Scope and Cost Support Packages. These forms indicated how the crew hours should be distributed into the schedule by recommending the appropriate work schedule and calendar to be applied to each activity.

5.2.2. Schedule Methodology

Each activity and duration was loaded in the schedule software along with their corresponding work calendar and predecessor/successor relationships to determine the critical path durations. Each OYC was then presented to the PDT and discussed for determining the sequence of each contract into the overall Olmsted Project Schedule.

5.3. Sequencing Logic for Integrating Out-Year and Dam Contracts

In order to complete the total project schedule for the Olmsted Project, individual OYCs were evaluated and sequenced relative to one another and the dam contract. The logic for this sequencing was based on the interim and long-term physical requirements of the project. Consideration of annual execution limits were deferred to the subsequent cost-resource leveling effort. A summary of the contract sequencing is presented in Table 11.

Table 11. Physical Contract Sequencing (excluding funding considerations)

ContractID	Out-Year Contracts	Predecessor	Successor
BG	Building and Grounds		Before operational date
DREDGE	Dredging		Operational date
EQP	Operations Equipment and Machinery	To occur FY 2020	L&D Operational / Maint. Bldg Complete
LD52-LD	Lock & Dam 52 - Land Demolition	NTP issued after Dam Complete	
LD52-MD	Lock & Dam 52 - Marine Demolition	Operational date	
LD53-LDHR	Lock & Dam 53 - Land Demolition & Historic Restoration	Operational date	
LD53-MD	Lock & Dam 53 - Marine Demolition	Operational date	
LRS	Lock Rehab/O&M Startup		FF existing contract & lock 1 lock 2 staggered after lock 1
PAVE	Final County Road / Site Paving	FS Lock and Dam complete, FS Demob of existing contractor.	Project close-out
PC	Project Closeout & Site Restoration	FS L&D53 Demo FS B&G	Project complete
RD	River Dikes (Kentucky)	Lock and Dam Complete	
RD	River Dikes (Illinois)	FS Dredging	FF Operational date (upstream area)
REO	RE Office Conversion to Ops Building	Start after dam complete	Project close-out
SLVG	Salvage/Excess of Government Owned Equipment	FS existing dam contract (18-MO duration)	
UMC	U/S Mooring Cells	FS Existing dam contract Concurrent with L&D53 Demo	Project complete
WLB	Wicket Gate Barge	Obligate FY 2022	

5.4. Optimal Project Schedule (Unconstrained by Funding)

The resulting activity-driven critical path for the schedule represents the ideal construction duration assuming unlimited funding. This scenario requires a $215M/yr funding commitment for the six year period including FY13 thru FY18 to achieve dam completion in FY2018 and reduced total project costs (nearly $250M). Further detail regarding the unconstrained schedule analysis is presented in Appendix K. Given prior annual funding levels and without increased annual budget commitment from resource providers this assumption represents the optimal (best-case) and was not considered as the most-likely condition.

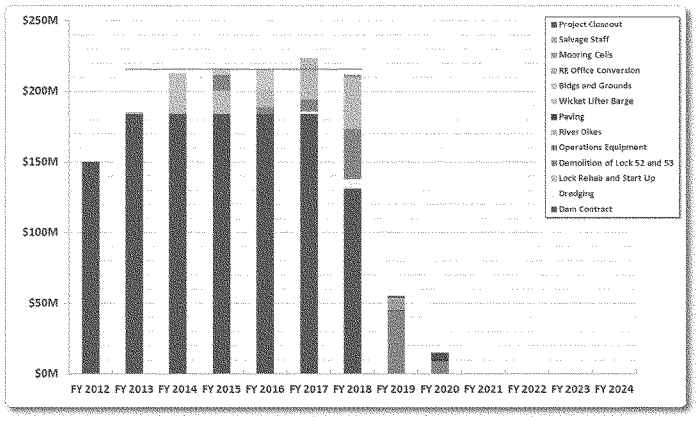


Figure 11. Optimal Expenditure Outlay (Unconstrained by Funding)

5.5. Most-Likely Project Schedule (Cost Leveled due to Constrained Funding)

The most-likely assumption of $150M/yr funding stream was used to cost-level the remaining schedule through completion of the dam contract. Thereafter, a reduced most-likely funding stream of $100M/yr was assumed. This estimated outlay shown in Figure 12 represents the base project schedule carried forward into the CSRA (contingency) and TPCS (escalation) calculations. It is important to note that these annual funding amounts are required to cover the construction placement, on-site overhead costs, design, construction administration costs, and yearly price level increases.

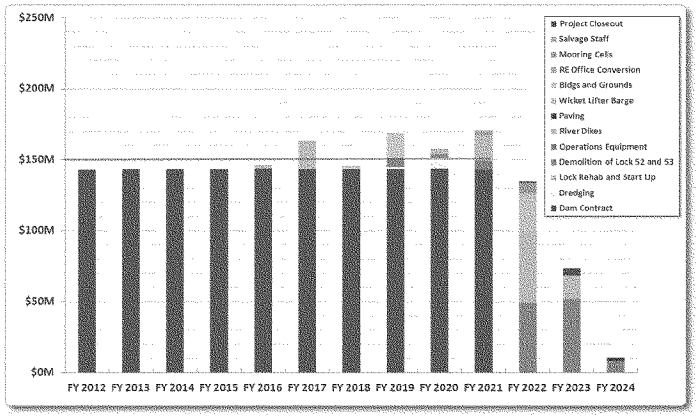


Figure 12. Most-Likely Expenditure Outlay (Constrained to Current $150M/yr Funding Level)

Through this analysis it is apparent that the dam construction duration is cost-driven rather than activity-driven. The assumed annual funding stream of $150M extends the optimal completion date by three years (FY2021) and significantly increases cost by nearly $250M ($170M first-cost plus $80 escalation).

5.6. Base Project Schedule

There are several key milestones of interest for the Olmsted Project as presented in Table 12. The Lock & Dam Operational milestone includes the minimal project features required for the dam to hold the design pool and pass navigation through the locks. Follow-on milestones include physical completion of the dam contract including contractor demobilization and equipment salvage. The final milestone will be the completion of the remaining out-year contracts such as buildings and grounds, river dikes, demolition of L&D 52 and L&D 53, etc. to accomplish physical completion of the Olmsted Project. Figure 13 presents the summary Gant chart of the remaining implementation schedule. See Section 6 for the development of the risk-based schedule contingency.

Table 12. Key Project Milestones @ 80% Confidence

Key Project Milestone	Date
Lock &Dam Operational	FY2020
Dam Contract Physically Complete	FY2021
Project Physically Complete	FY2024

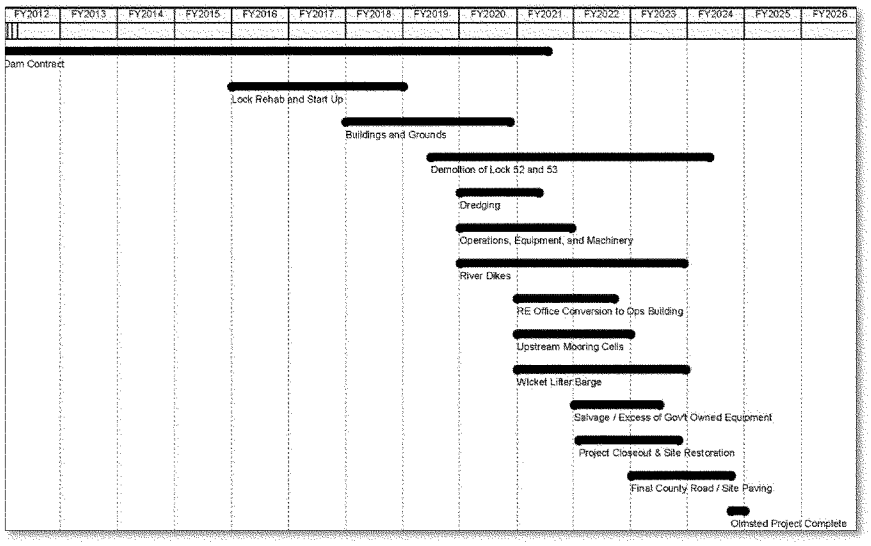


Figure 13. Summary Implementation Schedule

6. Risk-Based Contingency Development

6.1. Purpose

The purpose for a Cost and Schedule Risk Analysis (CSRA) is to identify potential events that could positively or negatively affect project cost or schedule, analyze their impacts, and then be used as a project management tool to plan, track, or control these risks. See Figure 14.

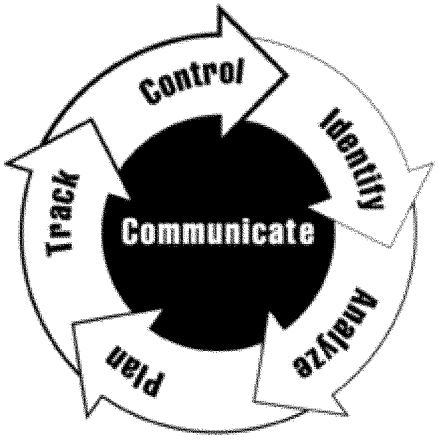


Figure 14. Risk Management Cycle

The purpose of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for both cost and schedule risks for all project features. The study and presentation excludes consideration for operation and maintenance or life cycle costs.

6.2. Risk Analysis Process

The risk analysis process follows USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx). The risk analysis process uses probabilistic cost and schedule risk analysis methods within the framework of the modeling software. The risk analysis results are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted. The results of the CSRA will be provided to the project manager for inclusion in the project management plan.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analyses should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting, and scheduling.

6.3. Methodology

In simple terms, contingency is an amount added to an estimate (cost or schedule) to allow for items, conditions, or events for which the occurrence (event risk) or impact (condition/variant risk) is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept, the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Engineering Dx guidance for cost and schedule risk analysis generally recommend budgeting based on the 80-percent confidence level for cost contingency calculation. It should be noted that use of the 80-percent confidence level as a decision criteria is a risk adverse approach (whereas the use of the 50-percent confidence level would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, an 80-percent confidence level results in greater contingency as compared to a 50-percent confidence level.

The risk analysis process uses Monte Carlo techniques to determine probabilities and contingency. The Monte Carlo techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. Because Crystal Ball is an Excel add-in, the schedules for each option are recreated in an Excel format from their native format. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format (e.g. Primavera P6, Microsoft Project, etc).

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in section 0.

Below is a brief step-by-step summary of the process performed during this analysis:

1. Development of Risk Register. In coordination with the PDT, a risk register was developed to identify the various risks associated with the project.
2. Determination of Risk. During the risk register meeting, risk events were identified along with their likelihood of occurrence, impact to cost, and impact to schedule. These factors determined whether an event's risk level was low, moderate, or high.
3. Event Occurrence. For each event's likelihood of occurrence, a correlation was made to an approximate percentage of time an event would occur; for example, if an event was "likely"

to occur, then the risk model triggered the event 50-75% of the time. Figure 15 below summarizes the event occurrences and their corresponding percentages of occurrence used to trigger an event.

If event occurrence is...	then it's likelihood is thought to be between...
Very Likely	75% and 90%
Likely	50% and 75%
Unlikely	25% and 50%
Very Unlikely	10% and 25%

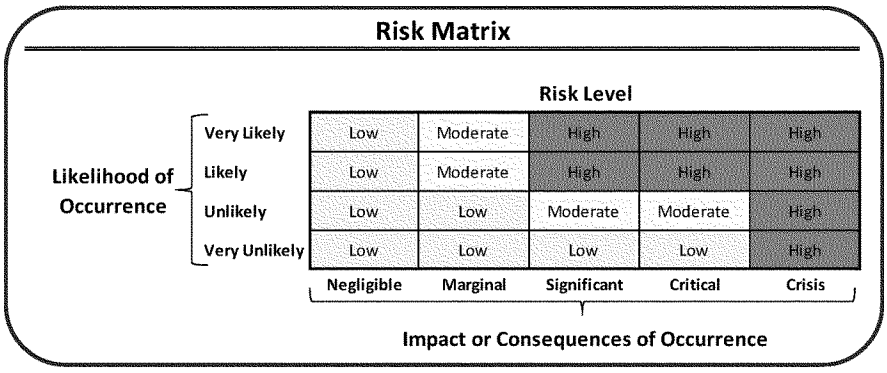


Figure 15. Qualification of Risks

4. Development of Scenarios. Discussions concerning the best case, most-likely case, and worst case scenarios were documented for each risk item. Descriptions of each scenario are described below.
   a. Best Case. The best case scenario was considered to represent a scenario that would offer the most benefit to the project in the form of the least impact to the project should a particular event occur.
   b. Most-Likely. The most-likely scenario was considered to represent a scenario that would most-likely be encountered and its impact to the project should a particular event occur.
   c. Worst Case Estimates. The worst case scenario was considered to represent a scenario that would offer the least benefit to the project in the form of the most impact to the project cost should a particular event occur.
5. Distribution Curves. Each risk item was then analyzed to determine what type of distribution curve would be used for each individual component. The most commonly used

curve was the triangular distribution for the risk events, uniform distribution for likelihood of occurrence, and yes/no distribution for whether an event occurs in the simulation.

6. Summary of Results. Using the simulated costs from each event, the 80% confidence level (taking into account impacts from the identified events) was determined; subtracting the current MII cost from the 80% confidence level cost yielded the appropriate contingency to be applied to the baseline cost estimate. The same methodology was used to determine the 80% confidence level for the schedule.
7. Review/Adjust. After the first trial was complete, the results were reviewed by the estimator and if necessary, adjusted and repeated.
8. Reporting. From the risk analysis results, various reports were generated summarizing contingencies, durations, and identification of the project components causing the most variation in project costs and schedule.

6.3.1. Identify and Assess Risk Factors

Identifying the risk factors via the PDT are considered a qualitative process that results in establishing a risk register that serves as the document for the further study in the risk model. Risk factors are events or conditions (variances) that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

Informal risk identification was initially performed by the estimating team members working through the base estimate and schedule development process. Brainstorming and interview techniques were utilized by estimators working directly with their respective project technical leads. As scope uncertainty and constructability type issues were identified, they were submitted to a draft risk register to be presented to the larger team and presented in the formal PDT meetings.

Formal PDT meetings were held at the Olmsted Project on 7/21/2011-7/22/11 and the Louisville District on 9/27/2011-9/28/11 for the Out-Year Contracts and 10/12/2011-10/13/2011 for the Existing Dam Contract. The meetings focused primarily on assessment and quantification of the draft risks previously identified, however, similar interview techniques were also implemented to further identify new risk factors the total project cost and schedule. The PDT was represented by the following disciplines:

Disciplines Represented in PDT Risk Meetings

- Project management
- Civil design
- Structural design
- Construction
- Contracting
- Cost engineering
- Electrical/mechanical design
- Geology
- Geotech
- Planning
- The USACE Marine Design Center

A full roster of participating team members at each risk meeting is included in Appendix I. Additionally, numerous telephone calls, informal meetings, and coordination through email were conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

6.3.2. Risk Register

A risk register is a tool commonly used in project planning and risk analysis and serves as the basis for the risk studies and Crystal Ball risk models. The risk register and identified events are included in Appendix I. The risk register reflects the results of risk identification and assessment.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls.
- Communicating risk management issues.
- Providing a mechanism for eliciting risk analysis feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.3.3. Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are quantified using probability distributions (density functions) as required by the Crystal Ball Monte Carlo Risk Simulation software. Based on Cost Engineering Dx guidance, only critical path and near critical path tasks are considered to be uncertain for the purposes of contingency analysis.

Similar to the identification and assessment process, risk factor quantification involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The resulting event details as presented in Appendix I for both cost and schedule risks. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential

impacts to the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

6.3.4. Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel. The software performs Monte Carlo simulations on the probability density functions quantified for each risk item with respect to the appropriate estimate and schedule WBS elements. The result of each simulated iteration is then tallied in a forecast field. After a targeted 10,000 trial iterations, the forecast field is able to then present the results in a normalized histogram format (known as a "Confidence-Curve"). This curve presents the project cost/duration along with the percentage occurrence out of the 10,000 trials. The project cost/duration corresponding to the 80% cumulative confidence not to be exceeded is selected as the recommend value. The difference between the base project cost/duration and this 80% confidence value is presented as contingency cost/duration.

For schedule contingency analysis, the duration contingency is calculated as the difference between the 80-percent confidence duration and the base schedule duration. This contingency duration is then used to calculate the time value of money impact of project delays that are included in the presentation of total cost contingency.

6.3.5. Independent Forecasts for Major Project Phases

Due to the dramatic variation in cost magnitude between the dam contract and the several OYCs, risk quantification was segregated into two respective forecasts for defining the confidence curves of both project cost and schedule. These risk models were maintained in a single file such that important correlations could be made between the Dam and OYC risks. Table 13 presents the key risk correlations made within the cost risk model. The schedule risk items for each risk model are discrete items and no correlations were appropriate.

Table 13. Cost Risk Correlations

RISK ID	Risk Title	RISK ID	Risk Title	Strength
DAM-001	Variation of overall site productivity	DAM-021	Funding differs from $150M per year	+0.65
DAM-033	Equipment salvage prior to contract completion	SLVG-001	Variability to the Labor to Manage Equipment to be Salvaged (Post-Dam Contract)	+0.75
LD53-MD-002	Concrete Demolition Approach	LD52-MD-002	Concrete Demolition Approach	+0.75
LD53-MD-005	Opportunity to reduce demo work on the dam's fixed weir	LD52-MD-006	Opportunity to reduce demo work on the dam's fixed weir	+0.75

6.4. Cost Risk Analysis - Cost Contingency Results

The remaining estimated cost without contingency is $1,315,697,000 at the FY12 price level. The 80% confidence level of remaining Project First Costs is $1,560,075,000; this yields a contingency amount of $244,378,000 (19%). Adding prior expenditures to the Project First Cost yields the estimated cost for re-authorization which is **$2,918,179,000** at the FY12 price level. Table 14 presents the full results of the cost risk analysis.

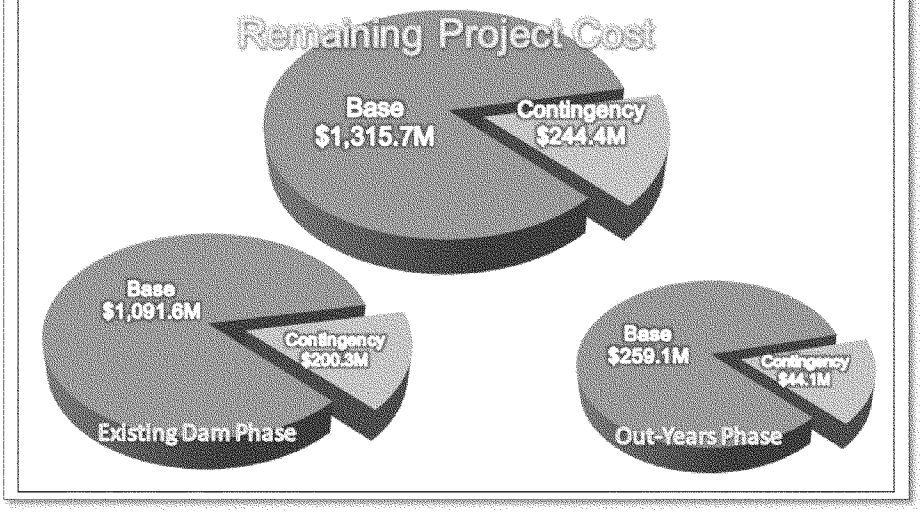
Table 14. Project Cost Contingencies

USACE Lousiville District

Olmsted Lock and Dam
Post Authorization Change Request
FY12 Certified Cost Estimate

Cost Risk Analysis	
Dam Contract	$1,091,589,000
Out-Year Contracts	$224,108,000
Remaining Base Cost (PL Oct 11)	$1,315,697,000
Contingency	$244,378,000
Contingency %	19%
Remaining Cost @ 80% Confidence Level	$1,560,075,000
Prior	$1,358,104,000
Total Estimate @ 80% Confidence Level)	$2,918,179,000

Phase	Base Cost	Contingency	Contingency %	80% Confidence Cost
Dam Contract	$1,091,589,000	$200,303,000	18%	$1,291,892,000
Out-Year Contracts	$224,108,000	$44,075,000	20%	$268,183,000



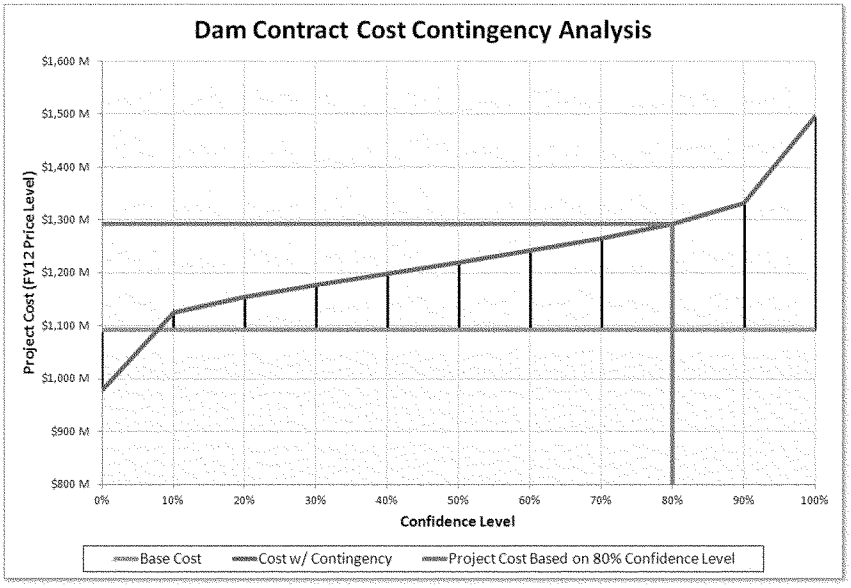


Figure 16. Project Confidence Curve for Existing Dam Contract

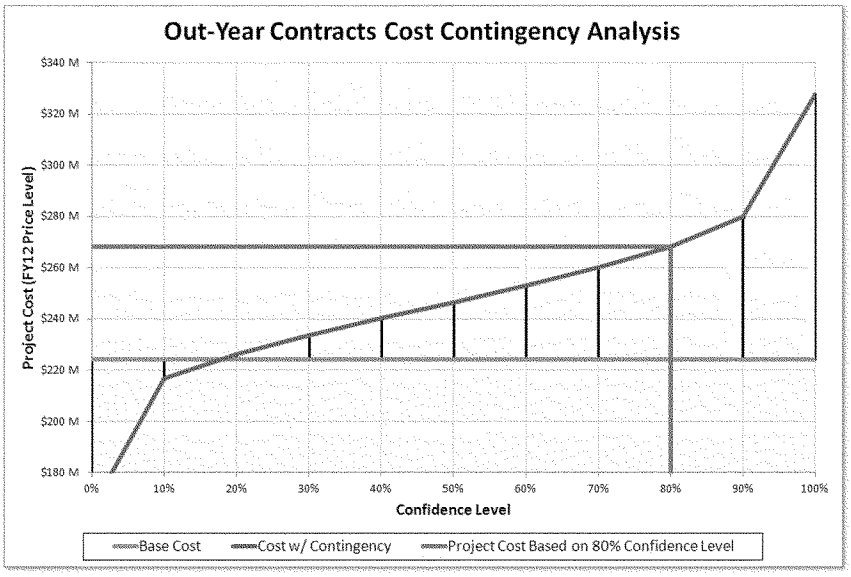


Figure 17. Project Confidence Curve for Out-Year Contracts

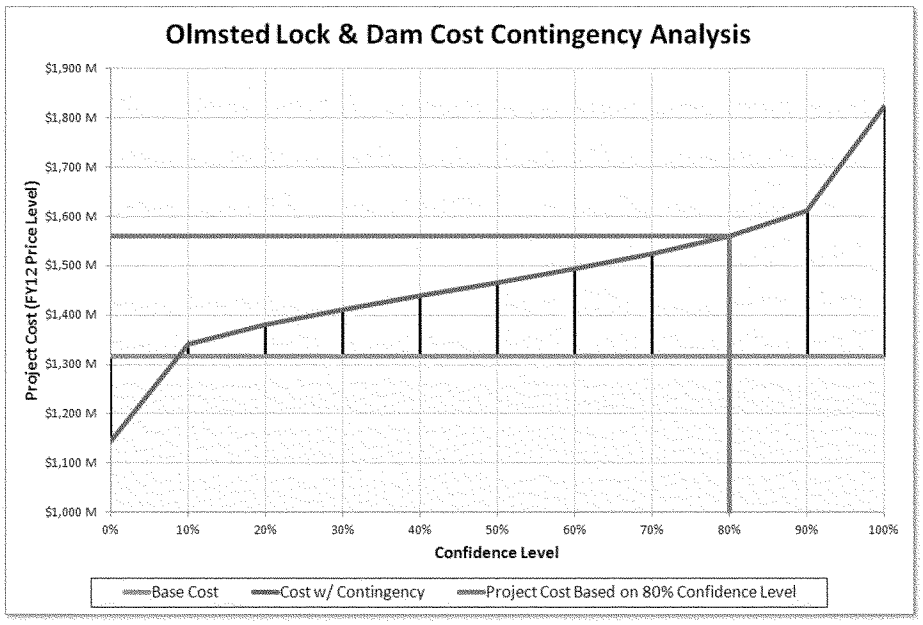


Figure 18. 80% Confidence Level: Remaining Estimated Cost at FY12 Price Level

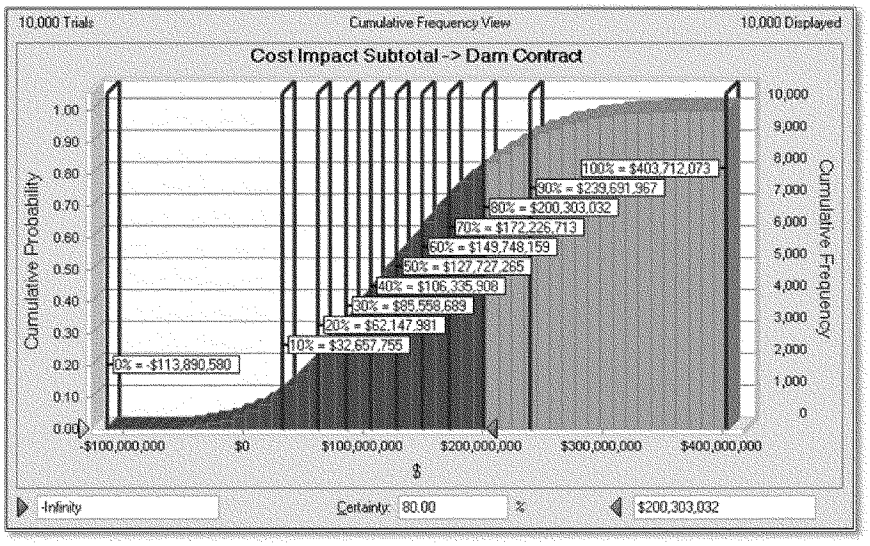


Figure 19. S-curve of Existing Dam Contract @ 80% Confidence Level

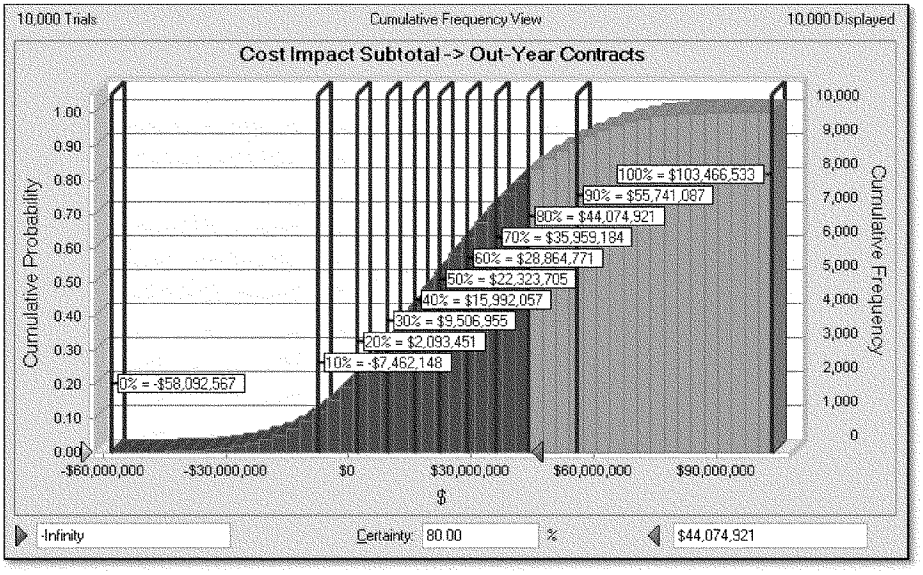


Figure 20. S-curve of Out-Year Contracts @ 80% Confidence Level

6.4.1. Key Cost Risk Items Identified for the Dam Contract

The CSRA identified the following factors as major impacts to the cost for the dam contract. These risks represent key areas for the PDT to focus on future risk management and mitigation. See Appendix I for additional details for these risks and further information regarding CSRA development.

- *DAM-001 -Variation of overall site productivity:* Adverse river conditions and/or inefficient project funding could cause variation to the productivity rates for on-site placement activities.

- *Dam-021 - Funding differs from $150M per year:* The current estimate and schedule are based on a $150M per year construction cap. Uncertainty exists actual funding levels may vary up or down. Increased funding, sooner in the project schedule would result in reduced escalation over time and potential reduction to contractor's onsite duration and associated extended site overheads. On the other hand, less funding would tend to increase escalation and add contractor's onsite duration and extended site overheads. An unconstrained funding scenario could cut up to three years from the project schedule resulting in significant cost savings of approximately $250M (~$170M first-cost plus ~$80 escalation); approximately $215M per year would be needed for this scenario. Conversely, reduced funding of $130M per year will result in an additional two years of schedule impacts and adversely affect overall project costs (~$175M cost increase including additional overheads and escalation).

- *Dam-023 – Claims:* Construction claims could be significant to the total project cost.
- *Dam-035 – Potential variances due to cost-plus procurement/innovative construction:* Risk associated with a cost-plus contract, the contractor has substantial leverage in work performance and payment negotiation. This risk item includes impacts from unknown risk items, quantity variations, & currently unknown potential design changes throughout the construction period.
- *Dam-036 - Actual inflation varies from USACE method of calculation:* The Total Project Cost Summary (TPCS) escalates construction costs based on future inflation factors published by the OMB. Actual inflation realized could vary from the Section 902 Limit calculation for allowed inflation (based on the CWCCIS publication).

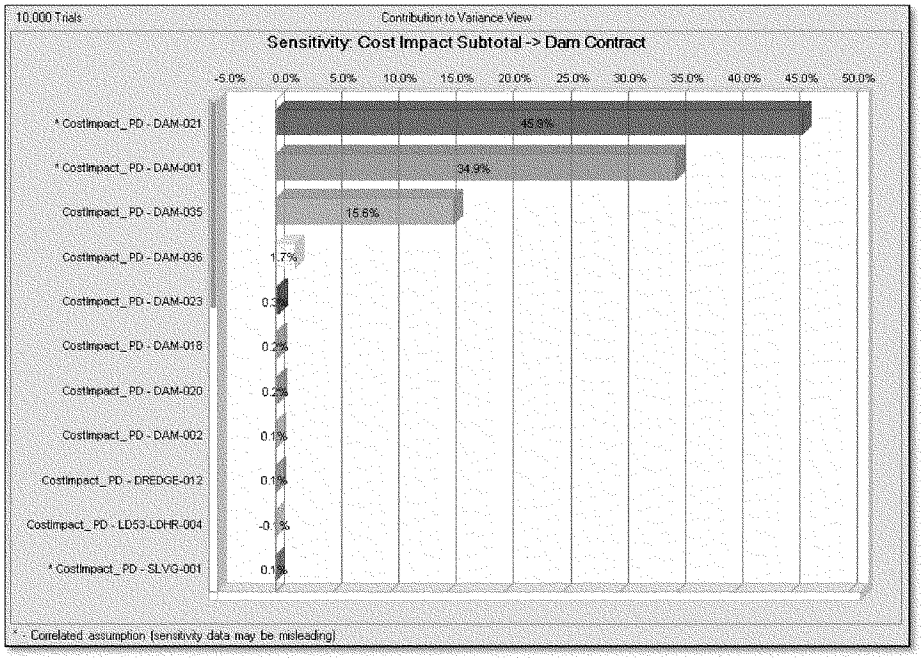


Figure 21. Cost Sensitivity Chart for Dam Contract

6.4.2. Key Cost Risk Items Identified for the Out-Year Contracts

The CSRA identified the following factors as major impacts to the cost for the Out-Year Contract Phase. These risks represent key areas for the PDT to focus on future risk management and mitigation for the project. See Appendix I for additional details for these risks and further information regarding CSRA development.

- *LD52-MD-002 & LD53-MD-002 – Variation to Concrete Demolition Approach:* Significant opportunity exists that concrete could be demolished in place and debris left in the footprint of the existing lock (in-water disposal). Locks 50&51 (deconstructed in 1980) were drilled, shot, and left in place at river bottom. This method represents a cost and schedule opportunity for L&D 52/53.

- *LD52-MD-009 & LD53-MD-008 - Weather/River Conditions:* River elevations can adversely affect productivity. River conditions could delay the overall schedule for accomplishing this demolition work. These delays could result in risk built into contractor's base bids and spark claims during construction.

- *LRS-005 - Scope Definition of Lock Rehab & Startup:* Rehabilitation scope is in early stages of design investigation. Significant uncertainty exists in the current understanding of scope required to make the lock fully operational. Key items to be rehabilitated are HPUs, large hydraulic cylinders, and electrical PLCs.

- *RD- 002 - Opportunity to reduce the number of dikes required:* The seven river dikes on the Kentucky shoreline has the potential to be removed from the scope of the project through additional modeling. The dikes will only be installed after the dam is in operation and sediment deposits are causing excessive dredging. The Illinois dikes are critical to the approach and operation of the locks and will be constructed (6 EA) + (1 EA) DS near lower approach wall. The seven Kentucky dikes will be required once the need is realized. Engineering Research & Design Center (ERDC) modeling suggests the Kentucky dikes are needed.

- *OYC-001 – Actual inflation varies from USACE method of calculation:* The Total Project Cost Summary (TPCS) escalates construction costs based on future inflation factors published by the OMB. Actual inflation realized could vary from the Section 902 Limit calculation for allowed inflation (based on the CWCCIS publication).

- *OYC-002 – Low risk items & expected cost variances:* No one low risk item is expected to cause a significant impact they have not been studied individually, however, cumulatively they do contribution a moderate uncertainty to the project cost and schedule. Additionally, normal expected variances from the base assumptions in quantity, unit costs, and activity durations further contribute to the project uncertainty.

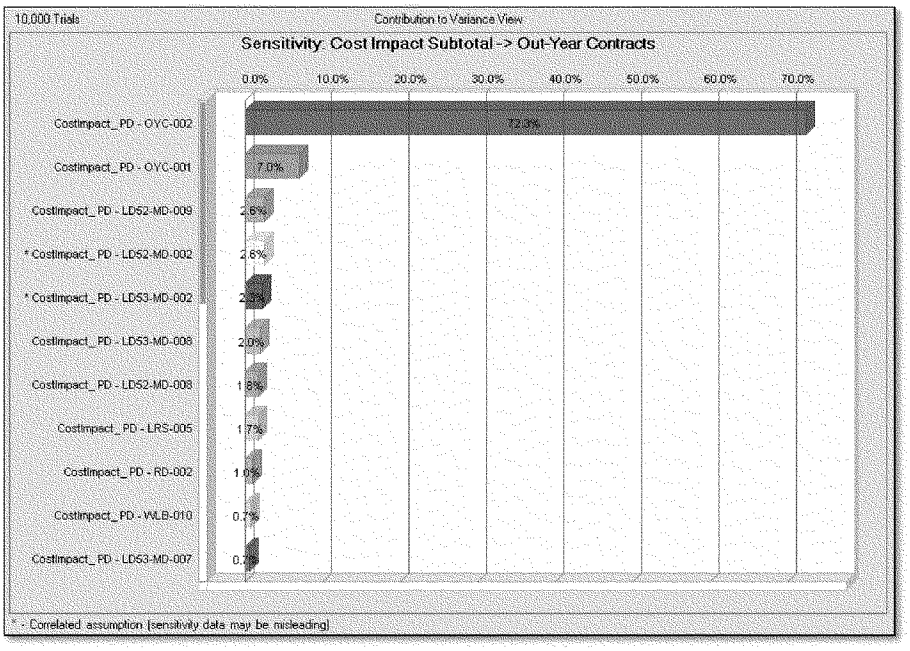


Figure 22. Cost Sensitivity Chart for Out-Year Contracts

6.5. Schedule Risk Analysis - Schedule Contingency Results

The total project schedule without contingency is 156 months beginning October 2011. Results of the Schedule Risk Analysis indicate that the 80% confidence level is 177 months. Included in these results is the overall project completion of the project could extend as far as FY26. The cost impacts associated with the extended schedule are included in the cost risk model. These are presented in Table 15.

Table 15. Project Schedule Contingencies

Schedule Risk Analysis				
Key Milestones	Start Date	Finish Date (Base)		Base Duration
Dam Contract Physically Complete	10/1/2011	9/30/2021		120 months
Olmsted Project Physically Complete	9/30/2021	9/30/2024		36 months
			Base Schedule Duration	156 months
Key Milestones	Start Date	Finish Date (80% Conf)	Contingency Duration	80% Durations
Dam Contract Physically Complete	10/1/2011	10/1/2022	14 months	134 months
Olmsted Project Physically Complete	10/1/2022	4/28/2026	8 months	44 months
			Schedule Duration @ 80% Confidence Level	177 months

6.5.1. Key Risk Items Identified for Project Schedule

The CSRA identified the following factors as major impacts to the project schedule. These risks represent key areas for PDT to focus on future risk management and mitigation for the project. See Appendix I for additional details for these risks and further information regarding CSRA development.

- *Dam-021 - Funding differs from $150M per year:* The current estimate and schedule are based on a $150M per year construction cap. Uncertainty exists actual funding levels may vary up or down. Increased funding, sooner in the project schedule would result in reduced escalation over time and potential reduction to contractor's onsite duration and associated extended site overheads. On the other hand, less funding would tend to increase escalation and add contractor's onsite duration and extended site overheads. An unconstrained funding scenario could cut up to three years from the project schedule resulting in significant cost savings of approximately $250M (~$170M first-cost plus ~$80 escalation); approximately $215M per year would be needed for this scenario. Conversely, reduced funding of $130M per year will result in an additional two years of schedule impacts and adversely affect overall project costs (~$175M cost increase including additional overheads and escalation).

- *Dam-036 - Actual inflation varies from USACE method of calculation:* The Total Project Cost Summary (TPCS) escalates construction costs based on future inflation factors published by the OMB. Actual inflation realized could vary from the Section 902 Limit calculation for allowed inflation (based on the CWCCIS publication).

- *LD52-MD-002 & LD53-MD-002 – Variation to Concrete Demolition Approach:* Significant opportunity exists that concrete could be demolished in place and debris left in the footprint of the existing lock (in-water disposal). Locks 50&51 (deconstructed in 1980) were drilled, shot, and left in place at river bottom. This method represents a cost and schedule opportunity for L&D 52/53.

- *LD52-MD-009 & LD53-MD-008 - Weather/River Conditions:* River elevations can adversely affect productivity. River conditions could delay the overall schedule for accomplishing this demolition work.

- *RD- 002 - Opportunity to reduce the number of dikes required:* The seven river dikes on the Kentucky shoreline has the potential to be removed from the scope of the project through additional modeling. The dikes will only be installed after the dam is in operation and sediment deposits are causing excessive dredging. The Illinois dikes are critical to the approach and operation of the locks and will be constructed (6 EA) + (1 EA) DS near lower approach wall. The seven Kentucky dikes will be required once the need is realized. Engineering Research & Design Center (ERDC) modeling suggests the Kentucky dikes are needed.

7. Quality Control/Quality Assurance

Quality is the deliberate result of careful planning, proper resourcing, and open communication with the clear and concise objective of ensuring that products meet the governing intents and expectations for the product, which are very often determined by the customer, industry standard, or applicable laws and regulations. For the Olmsted project, and therefore for the development of this estimate, "the customer" could be defined as any or all of the US Army Corps of Engineers (including the Louisville District, the Lakes & Rivers Division, and Headquarters), the Inland Waterways User's Board, the U.S. Congress, or the U.S. taxpayers in general. In developing this estimate, all necessary measures have been implemented and documented to ensure that the associated products meet the appropriate requirements and expectations for each of these customers.

Quality can be further characterized as the result of how resources, scope, and time are managed (equating, in this case, scope to the combination of the required goals and tasks as well as the work required to complete them). The development of this estimate indeed consisted of each of these elements: an expected finish date (time) and a budget and team of people (resources) with the expectation of producing an updated total project cost estimate having been certified by the Cost Dx (scope). This trio of basic project elements and their relationship to quality can be illustrated as shown in Figure 23, which is sometimes called the "Project Triangle".

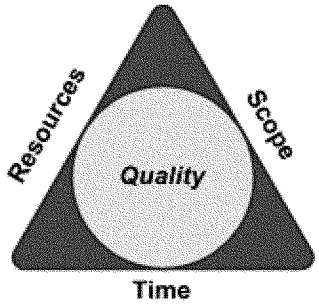


Figure 23. The Project Triangle

When given a fixed scope, minimum quality standards, and an aggressive schedule (such as has been the case for this estimate), the remaining element – resources – must be carefully and strategically managed in order to achieve project success. This section of the report will largely focus on the management of resources to ensure that the quality standards have been met and how such quality has been documented within product.

Basic Element – Resources

USACE executive management established team leadership for this effort and all involved parties agreed to a budget early in the process. The necessary team composition was identified and team members

with the appropriate technical subject matter expertise and experience were mobilized to either the project site or the Louisville District offices as deemed appropriate by team leadership. Team roles were identified and project tasks clearly communicated. Resource commitments were adjusted during this effort to ensure the successful delivery of this estimate.

Basic Element – Scope

The scope of this effort has been well defined by USACE-HQ as a cost estimate certified by the Cost Dx and is described in the various sections throughout this report. In general, applicable USACE regulations relating to cost engineering further clarify the nature of such a product and the process by which it is to be produced, with one major exception – the estimated cost for the remaining work to be performed under the current dam construction contract.

Basic Element – Time

The expected finish date of 31 October 2011 has been clearly communicated to the entire team. Intermediate milestone were established early in the process and communicated to the team. These were revised as necessary as product development progressed.

7.1. Quality Control

In establishing team composition and roles, team leadership identified the need for several individuals with particular areas of expertise and senior levels of experience to serve as the Quality Control agents for this effort, with a single individual being appointed as the lead for all quality concerns. This team of three USACE cost engineers was responsible for the quality control for all USACE-developed products. For AE products, the AE was contractually required to provide the appropriate personnel to fill the role of quality control reviewer while USACE provided a Quality Assurance review for each product submitted. Following is an excerpt from the AE's task order with USACE:

> *"Quality Control & Quality Assurance: The Contractor shall be responsible for Quality Control (QC) of all submittals under this task order. The Contractor shall submit to USACE a quality control plan with the work plan deliverable, which describes the quality control processes and methods of review with anticipated personnel assignments which will ensure a quality check and quality deliverables for all future potential deliverables in subsequent Phases of Work. The Contractor is required to complete any and all QC documentation required by the USACE Lakes and River Division (LRD) Regional Business Process (e.g. checklists)."*

For more information on the quality control reviewers, please see Section 2 for team roles and responsibilities and Appendix H for corresponding resumes.

7.2. Quality Assurance

The USACE Quality Control reviewers were also responsible for the Quality Assurance reviews for all AE-developed products. The focus of these QA reviews were to ensure that the AE was meeting the

objectives described in the task order, had the appropriate quality controls in place, and that the quality control was being performed by a qualified individual.

7.3. Quality Documentation

Quality Control and Quality Assurance reviews were performed at various levels of product development, as shown in Figure 6 on page 19 for the dam contract and in Figure 9 on page 27 for the Out-Year Contracts. Each of these quality checks have been documented and provided as part of this report. See Table 16 for a cross-walk between the QC documentation to the related appendix.

Table 16. Quality Control/Quality Assurance Documentation

Document	Quality Objective	Related Appendix
Dam Contract Estimate	QC	K
Dam Contract Estimate	QA	F
OYC Estimates	QC	F
Schedule	QC	F
CSRA	QC	F
Integrated Estimate	QC	F

8. Total Project Cost Summary

The remaining estimated cost is $1,560,080,000 at the FY12 price level (1,733,880,000 fully funded) as shown in Table 17 (see Table 18 for summary by feature account). A total of $1,358,104,000 has been spent up to FY12. The estimated Project First Cost at the FY12 price level, with the addition of spent costs, is $2,918,180,000; the estimated Total Project Cost, including escalation, is $3,091,980,000. Escalation is calculated per CWCCIS as required by ER 1110-2-1302 and ETL 1110-2-573. Variation in actual local escalation from the rates used is captured in the CSRA and resulting contingencies (see Risk Items DAM-036 & OYC-004). See Appendix A and Appendix B for additional details.

Table 17. Total Project Cost Summary (Construction and Non-Construction)

Contract	Project First Cost FY12 Price Level	Total Project Cost (Fully Funded)
Spent	1,358.10 M	1,358.10 M
Remaining	1,560.08 M	1,733.88 M
Existing Dam Contract	1,291.89 M	1,406.14 M
Out-Year Contracts	268.18 M	327.74 M
Building and Grounds	17.01 M	20.06 M
Dredging	7.51 M	8.94 M
Environmental Monitoring	4.79 M	5.18 M
Final County Road / Site Paving	2.14 M	2.78 M
Lock & Dam 52 - Land Demolition	0.81 M	1.02 M
Lock & Dam 52 - Marine Demolition	53.61 M	67.49 M
Lock & Dam 53 - Land Demolition & Historic Restoration	4.60 M	5.83 M
Lock & Dam 53 - Marine Demolition	37.93 M	47.75 M
Lock Rehab/O&M Startup	20.22 M	22.72 M
Operations Equipment and Machinery	1.59 M	1.95 M
Project Closeout & Site Restoration	4.57 M	5.82 M
Project Operations During Construction	8.04 M	8.70 M
RE Office Conversion to Ops Building	0.63 M	0.79 M
River Dikes	70.87 M	87.30 M
Salvage/Excess of Government Owned Equipment	1.80 M	2.12 M
U/S Mooring Cells	7.07 M	8.82 M
Wicket Lifter Barge	24.99 M	30.49 M
Grand Total	**2,918.18 M**	**3,091.98 M**

Table 18. Total Project Cost Summary by Feature Account (Construction and Non-Construction)

Feature Account	Project First Cost FY12 Price Level	Total Project Cost (Fully Funded)
Spent	1,358.10 M	1,358.10 M
01 - LANDS & DAMAGES	6.03 M	6.03 M
02 - RELOCATIONS	1.59 M	1.59 M
04 - DAMS	671.95 M	671.95 M
05 - LOCKS	427.63 M	427.63 M
06 - FISH & WILDLIFE FACILITIES	8.39 M	8.39 M
08 - ROADS, RAILROADS, & BRIDGES	2.80 M	2.80 M
16 - BANK STABILIZATION	7.72 M	7.72 M
18 - CULTURAL RESOURCE PRESERVATION	0.11 M	0.11 M
19 - BUILDINGS, GROUNDS, & UTILITIES	32.52 M	32.52 M
20 - PERMANENT OPERATING EQUIPMENT	22.86 M	22.86 M
30 - PLANNING, ENGINEERING & DESIGN	108.70 M	108.70 M
31 - CONSTRUCTION MANAGEMENT	63.89 M	63.89 M
50 - CONSTRUCTION FACILITIES	3.90 M	3.90 M
Remaining	1,560.08 M	1,733.88 M
01 - LANDS & DAMAGES	0.03 M	0.03 M
04 - DAMS	1,244.97 M	1,351.48 M
05 - LOCKS	70.98 M	84.22 M
06 - FISH & WILDLIFE FACILITIES	5.25 M	5.75 M
08 - ROADS, RAILROADS, & BRIDGES	1.01 M	1.26 M
09 - CHANNELS & CANALS	60.31 M	72.31 M
18 - CULTURAL RESOURCE PRESERVATION	3.61 M	4.41 M
19 - BUILDINGS, GROUNDS, & UTILITIES	14.94 M	17.25 M
20 - PERMANENT OPERATING EQUIPMENT	24.71 M	29.72 M
30 - PLANNING, ENGINEERING & DESIGN	49.64 M	64.12 M
31 - CONSTRUCTION MANAGEMENT	76.58 M	94.65 M
50 - CONSTRUCTION FACILITIES	8.04 M	8.70 M
Grand Total	**2,918.18 M**	**3,091.98 M**

List of Appendices

Appendix A – Total Project Cost Summary

Appendix B – MII Reports

Appendix C – Dam Base Cost Estimate Adjustments

Appendix D – Primavera P6 Schedule

Appendix E – Agency Technical Review Documentation

Appendix F – Quality Control Documentation

Appendix G – Prior Expenditures

Appendix H – Team Resumes

Appendix I – Cost & Schedule Risk Analysis

Appendix J – Out-Year Contract Backup

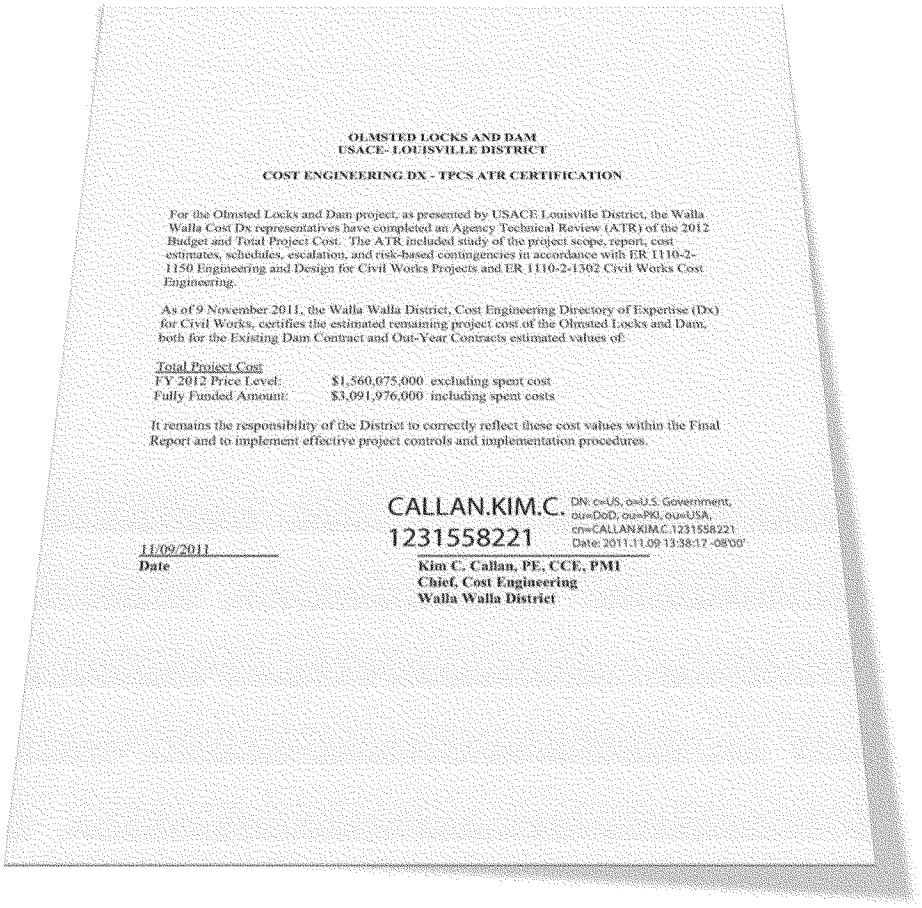
Appendix K – Hill Olmsted Cost and Schedule Review Report with Backup

Appendix L – URS Corporation 2011 Rebaseline Estimate

Appendix M – Backup to URS Corporation 2011 Rebaseline Estimate

9. Certified Cost Estimate

Cost certification for this project was obtained on 27 October 2011 from the Cost Dx. The estimate was re-certified on 9 November 2011 due to changes made to the fully funded amount based on IEPR comments. See Appendix A for the certified document.



OLMSTED LOCKS AND DAM
USACE- LOUISVILLE DISTRICT

COST ENGINEERING DX - TPCS ATR CERTIFICATION

For the Olmsted Locks and Dam project, as presented by USACE Louisville District, the Walla Walla Cost Dx representatives have completed an Agency Technical Review (ATR) of the 2012 Budget and Total Project Cost. The ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies in accordance with ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of 9 November 2011, the Walla Walla District, Cost Engineering Directory of Expertise (Dx) for Civil Works, certifies the estimated remaining project cost of the Olmsted Locks and Dam, both for the Existing Dam Contract and Out-Year Contracts estimated values of:

Total Project Cost
FY 2012 Price Level: $1,560,075,000 excluding spent cost
Fully Funded Amount: $3,091,976,000 including spent costs

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project controls and implementation procedures.

CALLAN.KIM.C.1231558221 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CALLAN.KIM.C.1231558221 Date: 2011.11.09 13:38:17 -08'00'

11/09/2011
Date

Kim C. Callan, PE, CCE, PMI
Chief, Cost Engineering
Walla Walla District

OLMSTED L&D PACR
Certified Cost Estimate Peer Review

November 2011

Id	Discipline	DocType	Spec	Sheet	Detail
4266610	Cost Engineering	Cost Estimate	Significance - High	n/a	n/a

(Document Reference: Comment 1)

The use of the Civil Works Construction Cost Index System (CWCCIS) to estimate cost escalation through the completion of construction activities may not adequately account for future inflation.

(Attachment: Olmsted_IEPR_FPC_1.doc)

Submitted By: Patricia Holowecky (+1 (561) 598-6505). Submitted On: 07-Nov-11

1-0	Evaluation **Non-concurred** Non-Concur 1. Adopt-in-Part - Inflation is captured and presented in accordance to current policy and regulations. USACE will not revise the inflation rates but per discussion with IEPR team on 11/8/11, will update the report to further explain methodology used and how escalation risks were accounted for in the CSRA and contingencies added to the base cost. The future rates in the CWCCIS table are not accurate models for predicating future inflation and fully funded costs. The CWCCIS table is actually a composite table with prior to publication date rates being actual computed inflation values and future rates as set by OMB. These rates are mandated for use and generally are low for future years. (The future rates for CWCCIS should match the annual program EC Table 1 and Table 2 rates for future years.) Current USACE cost engineering guidance and direction requires utilization of CWCCIS escalation factors for estimating future escalation per ER 1110-2-1302 and ETL 1110-2-573. Under WRDA 1986 and the provisions of section 902, this project if reauthorized will receive the ACTUAL inflation allowance as captured by CWCCIS past rates. These past rates are considered to be accurate. In the examination of risk with regards to inflation, the potential for CWCCIS to not capture the actual local inflation is what is studied and added to the contingency value. From studying past inflation rates we think that there most likely will be 3-4% average inflation over the remainder of this contract and that it will be captured by the updates to the CWCCIS Tables as the project progresses subsequently raising the 902 limit of the project each year. 2. Adopt-in-Part - Methodology utilized to capture inflation is in accordance with current policy and regulation. USACE will not revise the inflation rates using the recommended methodology per discussion with IEPR team on 11/8/11, but will update report to further explain methodology used. Submitted By: Jeremy Stevenson (304-399-6948) Submitted On: 09-Nov-11
1-1	Backcheck Recommendation **Close Comment** Concur with Comment. 1. and 2. The Panel notes that verbiage regarding a sensitivity analysis on escalation was included in the revised report in the executive summary. The Panel requests that the discussion from the bullet for Dam-036 and OYC-001 on Page ix regarding the sensitivity analysis conducted on escalation also be included in similar bullets on Page 49, Page 50, and Page 52. Submitted By: Patricia Holowecky (+1 (561) 598-6505) Submitted On: 11-Nov-11
	Current Comment Status: Comment Closed

4266622	Cost Engineering	Cost Estimate	Significance - High	n/a	n/a

(Document Reference: Comment 2)

The project funding assumptions were not developed using a worst-case scenario and therefore may overestimate available funding.

(Attachment: Olmsted_IEPR_FPC_2.doc)

Submitted By: Patricia Holowecky (+1 (561) 598-6505). Submitted On: 07-Nov-11

1-0	Evaluation **Non-concurred** Response to Recommendations: 1. Adopt in Part – USACE will not adopt the specific recommendation of basing the cost estimate on the worst case funding scenarios for the project, per discussion with IEPR team on 11/8/11. USACE will update the report to include verbiage explaining why the $150M/year most-likely funding stream was used and how we accounted for the risk of a lower funding stream in the CSRA and associated contingency dollars. 2. Adopt – USACE will update the report to include verbiage explaining why the $150M/year most-likely funding stream was used and how we accounted for the risk of a lower funding stream in the CSRA and associated contingency dollars. 3. Adopt in Part – USACE will update the report to include a discussion of the two funding streams and their limitations. Submitted By: Jeremy Stevenson (304-399-6948) Submitted On: 09-Nov-11 (Attachment:IEPR_Comment_2_and_detailed_response_by_USACE.docx)
1-1	Backcheck Recommendation **Close Comment** Concur with Comment. 1. and 2. Panel notes that verbiage has been in the included the final report discussing the cost and schedule impacts under the worst-case funding stream. 3. Please include the discussion regarding the development of the most-likely funding scenario from Page vii on Page 37. While this discussion does provide a general origin for the $150 million per year funding assumption for the remaining dam contract, the Panel requests that the report discuss the two funding sources in more detail. It should be noted in the report the assumption that all the funds in the IWTF be diverted to the Olmsted project to meet the 50% cost share for the majority of the remaining project; this appears to be a fundamental assumption in the funding forecasts. Submitted By: Patricia Holowecky (+1 (561) 598-6505) Submitted On: 11-Nov-11
	Current Comment Status: Comment Closed

4266632	Cost Engineering	Cost Estimate	Significance - High	n/a	n/a

(Document Reference: Comment 3)

The estimated contingency for the remaining dam construction costs is low, and may not account for possible delays associated with the construction of a uniquely engineered structure.

(Attachment: Olmsted_IEPR_FPC_3.doc)

Submitted By: Patricia Holowecky (+1 (561) 598-6505). Submitted On: 07-Nov-11

1-0	Evaluation **Non-concurred** Non-concur Response to Recommendations 1. Not Adopt - USACE will not incorporate this IEPR recommedation to use the 90% confidence level and associated contingencies per discussion on 11/8/11. The 80% confidence contingency amount presented for the dam contract is $200M (18%). The IEPR recommendation of 90% confidence contingency amount would be $240M (22%). The USACE business model recommends standard 80% confidence levels for budgetary requests. This level of confidence reflects the organization's management approach to acceptable risk exposure. Per USACE Cost And Schedule Risk Analysis Guidance dated 17 May 2009 published by the Directory of Expertise for Civil Works Cost Engineering: "The PM and management are left to decide what confidence level they prefer to present to Congress for authorization. Historically, Congress and the Assistant Secretary of the Army are accustomed to a contingency value with an 80 percent confidence of successful execution and completion." 2. Not Adopt - Same response for recommendation #1 See attached file for more detail Submitted By: Jeremy Stevenson (304-399-6948) Submitted On: 09-Nov-11 (Attachment:IEPR_Comment_3_and_detailed_response_by_USACE.docx)
1-1	Backcheck Recommendation **Close Comment** Concur with comment. The USACE may opt to use a higher confidence interval rather than 80% as noted by USACE Cost And Schedule Risk Analysis Guidance dated 17 May 2009 published by the Directory of Expertise for Civil Works Cost Engineering: "The PM and management are left to decide what confidence level they prefer to present to Congress for authorization." Given, the past problems estimating the actual costs for the dam component of the project, the use of 90%

	confidence interval should be seriously considered. This value would increase the dam contingency by 20%. With the appropriate explanation, the Congress and the Assistant Secretary of the Army for Civil Works would understand why such a confidence interval was necessary for this project. Submitted By: Patricia Holowecky (+1 (561) 598-6505) Submitted On: 11-Nov-11
	Current Comment Status: Comment Closed

4266649	Cost Engineering	Cost Estimate	Significance - High	n/a	n/a

(Document Reference: Comment 4)

The Planning, Engineering and Design (PED)/Engineering During Construction (EDC)/Supervision and Administration (S&A) costs for the remaining dam construction contract and out-year construction contracts are inconsistent, and TPCs cannot be accurately determined.

(Attachment: Olmsted_IEPR_FPC_4.doc)

Submitted By: Patricia Holowecky (+1 (561) 598-6505). Submitted On: 07-Nov-11

1-0	Evaluation **Non-concurred** Non-concur. EDC and S&A for the remaining dam contract were based on the historical average expended over the last five years. The E&D for the dam contract is conservative since 90% of the design has been completed. The S&A is based on the historical average over the last five years. Total E&D for Out-Year Contracts is $14.44M which is approximately 13.3% of construction costs. Total S&A for OYCs is $8.04M which is approximately 6.7% of construction costs. Although these costs appear to be high, it is not unreasonably high. When factoring in the percent of design development, duration of activities, and yearly costs for each OYC, these costs could be incurred especially if there is earlier design involvement to prepare for this future work. PED costs vary for each OYC based on the amount of design completed and are also dependent on the size of the job and duration of each activity. EDC was assumed to be a 5% of construction costs regardless of size. S&A was assumed to be 7.5% of construction costs and is the historical percentage that USACE is adheres to and is measured against. Response to Recommendations: 1. Adopt in Part – USACE will not re-evaluate PED, EDC, and S&A costs per discussion with IEPR team on 11/8/11. USACE will update the report to add explanation justifying the use of actual historical rates for these costs. 2. Adopt in Part – USACE will not convene a panel to adjust PED/EDC/S&A percentages per discussion with IEPR team on 11/8/11. USACE will update the report to add explanation justifying the use of actual historical rates for these costs. Submitted By: Jeremy Stevenson (304-399-6948) Submitted On: 09-Nov-11 (Attachment:IEPR_Comment_4_and_detailed_response_by_USACE.docx)
1-1	Backcheck Recommendation **Close Comment** Concur with comment. Costs for PED and EDC for the out-year contracts are substantially inconsistent. For the River Dikes project, the PED and EDC costs are the same ($2,520,109). For Marine Demolition project, the PED cost is twice the EDC cost. For RE Office conversion to Ops Building project, the PED cost is five times the EDC cost. From the Panel's experience, EDC costs are usually some percentage of the original PED total unless USACE is expecting to complete 100% redesign during EDC. A reasonable EDC value would likely be 20% to 40% of PED costs. The Panel understands that the PED and EDC costs were developed using assumed percentages of construction costs, however, the proposed dollar value to complete each effort should be reasonable and consistent. In those instances where the EDC value is the same or nearly the same as the corresponding PED cost, the implication is that the same or about the same level of engineering is required during construction as was required to develop the contract documents in the first place. Submitted By: Patricia Holowecky (+1 (561) 598-6505) Submitted On: 11-Nov-11
	Current Comment Status: Comment Closed

4266656	Cost Engineering	Cost Estimate	Significance -	n/a	n/a

			Medium		

(Document Reference: Comment 5)

The cost adjustments made to the URS rebaseline estimate shown in Table 6 of the main Olmsted Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report, Olmsted Locks and Dam, October 2011 report are not thoroughly discussed, and do not provide complete documentation of the cost validation process.

(Attachment: Olmsted_IEPR_FPC_5.doc)

Submitted By: Patricia Holowecky (+1 (561) 598-6505). Submitted On: 07-Nov-11

1-0	Evaluation **Concurred** Concur Response to Recommendation: 1. Adopt - A bulleted list of the major cost adjustments have been added to the report. A more detailed version of Table 6 will be added in the Appendix as well providing further explanation of adjustments. • Extended FOOH Due to Longer Construction Schedule. Added $206,356,956 to account for extended FOOH from 1-DEC-15 until the end of the existing dam contract (approximately 6 years). Total cost added: $206.4M. • Spent Dollars from 28-FEB-11 to 30-SEP-11 by Work Package. The 2011 URS Corporation Rebaseline Estimate included costs from 28-FEB-11 to 30-NOV-15 while the spent dollars for the project were up to 30-SEP-11. This amount was deducted from the estimate to avoid double-counting these costs. Total cost deduction: $66.8M. • Escalation. Escalation was removed from the estimate since it will be accounted for in the TPCS (Total Project Cost Summary) sheet which will capture escalation. Total cost deduction: $56.4M. • Home Office G&A. Due to the addition/deletion of costs, HOOH had to be adjusted to account for these adjustments (7.37% of select items). Total cost added: $18.5M. • Management Reserve. Management reserve (contingency) was removed from the estimate since it will be accounted for in the CSRA (Cost and Schedule Risk Analysis). Total cost deduction: $15M. • Standby tug for river operations. Per the contract requirements (Document 00800 page 49, Spec 1.62), a tug is needed 24-7 to assist river traffic for safe passage through the NAV pass section of the dam during construction. Total cost added: $14.8M. • Variation of pile length on uncompleted sections. This was an adjustment made for revising pile lengths for the navigable pass from 42' to 54'. The 2011 URS Corporation Rebaseline Estimate assumes navigable pass piles are equal length to the tainter gate piles. USACE believes that once test piles are driven, the "most likely" case is that the navigable pass piles will be 33% longer than tainter gate piles. Total cost added: $11.3M. Submitted By: Jeremy Stevenson (304-399-6948) Submitted On: 09-Nov-11
1-1	Backcheck Recommendation **Close Comment** Concur. Submitted By: Patricia Holowecky (+1 (561) 598-6505) Submitted On: 11-Nov-11
	Current Comment Status: Comment Closed

4266660	Cost Engineering	Cost Estimate	Significance - Low	n/a	n/a

(Document Reference: Comment 6)

The use of a calendar year (CY) format in the Primavera P6 schedule may have resulted in minor discrepancies among the selected mid-points used for cost escalation.

(Attachment: Olmsted_IEPR_FPC_6.doc)

Submitted By: Patricia Holowecky (+1 (561) 598-6505). Submitted On: 07-Nov-11

1-0	Evaluation **Concurred** Concur Response to Recommendation: 1. Adopt - The mid-points of select Out-Year Contracts will be reviewed by USACE and adjusted as necessary. Submitted By: Jeremy Stevenson (304-399-6948) Submitted On: 09-Nov-11

1-1	Backcheck Recommendation **Close Comment** Concur. Submitted By: Patricia Holowecky (+1 (561) 598-6505) Submitted On: 11-Nov-11
	Current Comment Status: Comment Closed

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX G

Revised PACR Certification
November 2011

Contents:

A –2011 Agency Technical Review Comments and Certification 1
B – Cost Estimate Certification 6
C – HQUSACE Final Policy Compliance Review Assessment 7
D – Post-Authorization Decision Document Checklist 17
E – IEPR Implementation Memo 22
F – Waterway Analysis Model, Model Certification Memo 24
G - Waterway Analysis Model Routing Sheet 25

A –2011 Agency Technical Review Comments and Certification

STATEMENT OF TECHNICAL REVIEW

COMPLETION OF AGENCY TECHNICAL REVIEW

The District has completed the Agency Technical Review of the Olmsted Locks and Dam Post Authorization Change Request, Illinois and Kentucky, Final Report. Notice is hereby given that (1) a Quality Assurance review has been conducted as defined in the Project Management Plan and (2) an agency technical review that is appropriate to the level of risk and complexity inherent in the project, has been conducted as defined in the project's Peer Review Plan. During the agency technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the result, including whether the product is consistent with law and existing Corps policy. The agency technical review was led by Mr. John P. Carr of Rock Island District. All comments resulting from QA and ATR have been resolved. The DrChecks report documentation of all ATR comments and responses is enclosed.

John P. Carr — 11-14-2011.

Agency Technical Review Team Leader — Date

Larry Bibel Jones P.E. — 11-14-2011

Project Manager — Date

CERTIFICATION OF QUALITY ASSURANCE REVIEW AND AGENCY TECHNICAL REVIEW

As noted above, all concerns resulting from agency technical review of the project have been fully resolved.

for Marilyn W Jones PE — 11-14-11

Chief, Engineering Division — Date

Mike Turner — 11-14-11

acting Chief, Planning Division — Date

Summary of Responses to 2011 Agency Technical Review Comments

November 2011

Reviewer Comments - Jeff Benedict, LRP

1. **Concerning the Without-Project condition, I concur with the assumptions made for the continued operation and maintenance of 52 and 53 as presented in the PACR, and note that it is consistent with the logic used in the current Draft Upper Ohio Navigation Feasibility Study. I would make one observation concerning the update. The update does not account for the infrastructure built, i.e. a future condition "without" the project is now different from 1990 as you now have additional concrete in the Ohio River. My question is if this project were to be scrapped could the concrete in the river could remain would it have to be removed? If it had to be removed, you could add another "cost foregone" of completing this project of not having to remove a partially built structure to Table 37 as yet another negative cost, as I understand it. This would probably increase the net benefits of Olmsted slightly, so obviously would not impact the study conclusion.**

Response: Concur

The removal of currently constructed features was not accounted for in the economic analysis. Current engineering judgment is that these features would not be a significant obstruction to navigation, and may not have to be removed, though likely some costs would be associated with this were the project not completed. These costs were not included as costs foregone in the computation of the benefit-cost ratio.

2. **I do not have any comments on the recommended plan as there were no "with-project" alternatives presented or discussed.**

N/A

3. **I do not have any comments on the benefit and cost evaluations.**

N/A

Reviewer Comments - Jack Carr, MVD

1. **In Executive Summary suggest adding something like: "This one project replaces Locks and Dams 52 and 53 on the Ohio River. Both locks and Dam 52 and 53 have one 600'x110' lock and one 1200'x110' lock. The new project will have two 1200' locks."**

Response: Concur

The Executive Summary was expanded to better summarize the purpose of the project and to describe the Olmsted Project as well as the two lock projects (52 and 53) it will replace.

2. **Page A-6, 3.3 says: "No conditions representing closures of any one of the four chambers in the without or the two chambers of the recommended plan were run." Please provide a short discussion explaining further, and indicating why model runs were not run with chamber closures.**

Response: Concur

Chamber closures for the without and with-project conditions were not included in the initial model runs largely due to schedule and budgetary reasons. Instead, chamber closure 'schedules' for both conditions were forecasted by Louisville District engineering based on anticipated future repair and maintenance requirements, and a weighting technique assigning project capacity to main and auxiliary chambers was used to adjust benefits for the anticipated complete dam closures and main and auxiliary lock closures in the cost and closure matrices. This approach had the additional effect of enabling the analysis to be more quickly adapted to changing expectations of future closure scenarios, as evident by the change between the major rehab assumed in the 1990 Benefit Update and the fix-as-fails approach deemed a more likely future scenario in the 2007 Economic Update.

The discussion in Section 3.3 was expanded to better explain this process, with references added to the relevant sections later in the appendix.

3. **Tables 4 and 5 pages A-13 and A-14. Please discuss Benefit Update column from the tables briefly. Which forecast does Benefit Update represent.**

Response: Concur

The Benefit Update column on Tables 4 and 5, for the period 2010 – 2050 represent the most likely traffic forecasts used in the 1990 benefit update (referred to as the May 1990 forecasts), for comparison to the forecasts used in the 2007 (and subsequent) Economics Update. Prior year tonnages are actual.

An additional paragraph was added to Section 4.2 explaining this.

4. **Page A-14 says "For example, the current forecasts do not reflect specifically, the implementation of the Clean Air Interstate Rule and Mercury Rule." If referenced forecasts included these rules indicate if recommended plan would still have a benefit-cost ratio greater than 1.0. Or discuss why these rules don't apply.**

Response: Concur

A sensitivity analysis was performed, described in Section 4.4 (and with the resulting BCR tabulated in Section 10.2.3), using the flat, or no growth forecast resulting in a BCR (at FY12 discount rate) of 7.4. This flat forecast is consistently lower than the 'Low Case' forecast described in Section 4.4 which does include both the Clean Air Interstate Rule and the MACT mercury emissions reductions, as well as implementation of the Waxman-Markey Bill.

Sections 4.2 and 4.4 were expanded to better explain this.

5. **Page A-16 top of page states "The sensitivity test using the flat forecast indicates that the Olmsted project remains justified." Please discuss further and indicate if project remains justified with no traffic growth and based only on navigation (rate savings minus delay cost) benefits.**

Response: Concur

Though the project remains justified using the no growth assumption, no quantitative analysis has been performed to assess whether or not it would remain justified only on the basis of navigation rate savings benefits (i.e. without the benefit of increased system reliability / reductions in closures). It is the judgment of the study economist that the project is primarily justified by the increased reliability it would offer over the two existing, aging projects it would replace, and thus may not remain justified if there was no accounting for this benefit.

6. **Page A-25 – A-37 Capacity Analysis. Explain how you incorporate navigable pass into the lock capacity analysis in both without and with project condition.**

Response: Concur

Navigable pass was modeled in the Waterway Analysis Model using historical data, including seasonal variation. Navigable pass was also accounted for in the adjusting of system benefits for lock closures described in the cost and closure matrices. This process is described in Section 8.6.

Section 6.1 was expanded to define navigable pass and to briefly describe how it was incorporated into the WAM modeling.

7. **Page A-16 – A-37. The steep delay curves brings up question of elasticity of demand for water transportation. Please provide a paragraph discussing how this subject was addressed.**

Response: Concur

Section 3.1, page A – 5, introduces the notion of consumer surplus and willingness-to-pay, which is of particular interest in responding to the reviewer's comment. The empirical data used to represent willingness-to-pay the modeling done for the Olmsted PACR is the alternative route/mode transportation rate. Annual flows of a particular origin-destination-commodity triplet are allowed by the model to move on the waterway as long as the waterway transportation cost does not exceed the alternate rate. When it does, the entire annual flow, or movement, is diverted to that alternate route. Individual annual movements are in effect represented with an inelastic demand curve that when

accumulated across the entire set of movements on the Ohio River System represents a downward sloping system-level demand curve.

Subsequent to this analysis, empirical data was developed that provided shipper response (in terms of tons shipped) to increases, or decreases, in waterway prices - allowing as little as one ton to be diverted from an annual movement in response to transit cost increases (generally caused by lock closures and traffic delays these cause). This much finer level of data and resulting schedule of prices and associated tons shipped yields a downward sloping demand curve for each movement. While this refinement in data describing the demand curve has been incorporated in subsequent lock improvement studies (specifically the lock improvement, feasibility-level study for the Upper Ohio River), shipper response data supporting a downward sloping demand curve was not available at the time of the analysis performed for the Olmsted PACR.

8. **Pages A-38 – A-39 indicate Lock 52 Navigable Pass = 60%, and Lock 53 Navigable Pass = 90%. How is this condition incorporated in capacity and/or system modeling? What assumptions do you make in modeling? How does this impact project benefits? Please discuss.**

Response: Concur

See response to comment 6 – navigable pass was incorporated both into the lock capacity analysis using the WAM model, and into the adjustment of benefits for closures described in Section 8.6. The incorporation of navigable pass substantially reduces benefits of the Olmsted project over the without project condition.

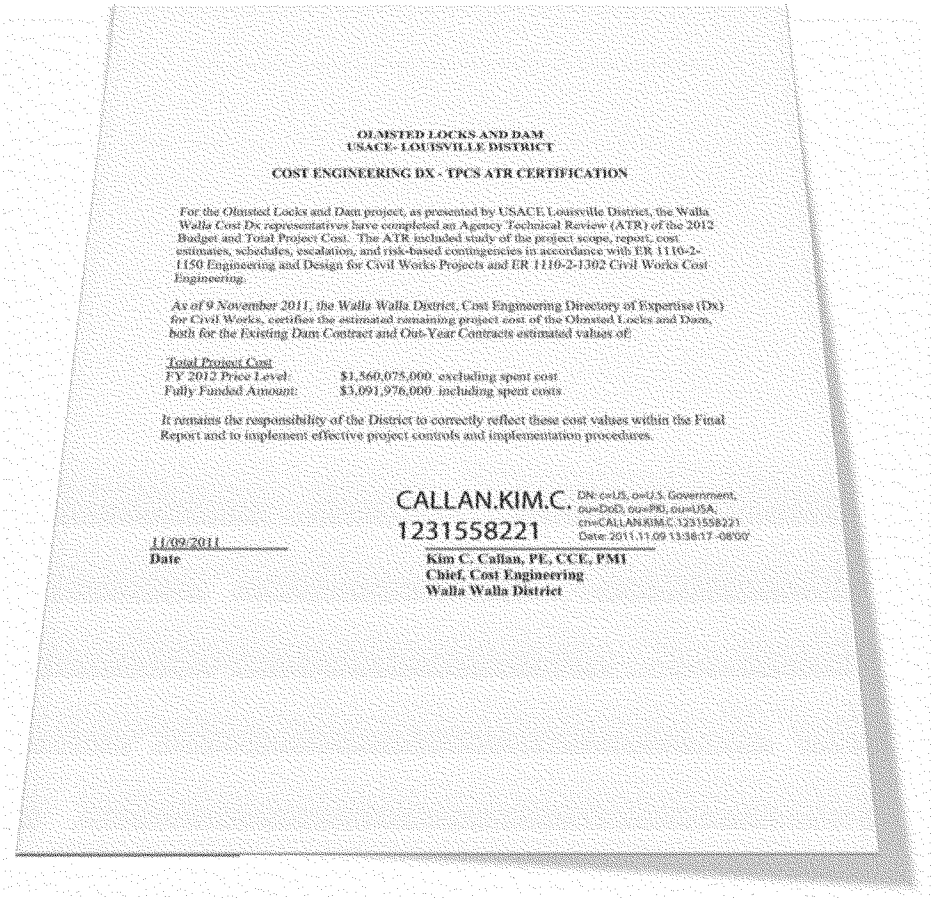
9. **Does the report discuss calculations of interest during construction with changing schedules and costs. I didn't notice this discussion, but something to consider.**

Response: Concur

Interest during construction was calculated based on the cost schedule developed by LRH-NC, using the base year of 2020. Total IDC computed and IDC factors at the last approved report discount rate of 8.875%, the OMB discount rate of 7.0%, and the current FY 2012 discount rate of 4.0% are shown in Table 31.

Section 10.1 was expanded to reference this table.

B – Cost Estimate Certification



OLMSTED LOCKS AND DAM
USACE - LOUISVILLE DISTRICT

COST ENGINEERING DX - TPCS ATR CERTIFICATION

For the Olmsted Locks and Dam project, as presented by USACE Louisville District, the Walla Walla Cost Dx representatives have completed an Agency Technical Review (ATR) of the 2012 Budget and Total Project Cost. The ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies in accordance with ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of 9 November 2011, the Walla Walla District, Cost Engineering Directory of Expertise (Dx) for Civil Works, certifies the estimated remaining project cost of the Olmsted Locks and Dam, both for the Existing Dam Contract and Out-Year Contracts estimated values of:

Total Project Cost
FY 2012 Price Level: $1,360,075,000 excluding spent cost
Fully Funded Amount: $3,091,976,000 including spent costs

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project controls and implementation procedures.

CALLAN.KIM.C.1231558221 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CALLAN.KIM.C.1231558221 Date: 2011.11.09 13:38:17 -08'00'

11/09/2011
Date

Kim C. Callan, PE, CCE, PMI
Chief, Cost Engineering
Walla Walla District

C – HQUSACE Final Policy Compliance Review Assessment

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P. O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

http://www.lrl.usace.army.mil

CELRL-PM-C

NOV 07 2011

MEMORANDUM THRU Commander, U.S. Army Corps of Engineers, Great Lakes and Ohio River Division, 550 Main Street, Cincinnati, Ohio 45202-3222 (Attn: CELRD-PDS-R, Ms. Adrienne Gordon)

FOR Commander U.S. Army Corps of Engineers, Headquarters (Attn: CECW-LRD Mr. Jay Warren)

SUBJECT: Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam), Illinois and Kentucky, Post Authorization Change Report (PACR).

1. Reference CECW-LRD Memorandum dated 14 January 2010; subject "Olmsted Locks Replacement Project, Illinois and Kentucky, Post-Authorization Change Report, Implementation of Independent External Peer Review".

2. Please find enclosed 4 copies of the subject document and pertinent attachments. Responses to all HQ, USACE required actions within the referenced memo are enclosed. The Olmsted PACR was prepared according to the approved review plan. District quality control and legal certification are complete. The final agency technical review is scheduled concurrent to the LRD quality assurance/policy compliance review. An independent external peer review has been completed; a second IEPR of the 2011 certified cost estimate is nearing completion on or about 11 November 2011.

3. The Louisville District requests LRD review and endorsement of the final PACR and its recommendation for additional authorization to increase the total cost of the Olmsted Locks and Dam Project from $775,000,000 to $2,918,000,000. The Benefits to Total Cost Ratio is 5.6:1 at 4% with Net Annual Project Benefits of $680,723,000.

4. If you need additional information, please contact one of these members of my staff: Larry Bibelhauser at (502) 315-6778 or Matthew Lowe at (502) 315-6877.

Sincerely,

Encl

LUKE T. LEONARD
COL, EN
Commanding

CECW-LRD

DEC 18 2009

MEMORANDUM THRU Chief Planning & Policy Division

FOR Director of Civil Works

SUBJECT: HQUSACE Final Policy Compliance Review Assessment -- Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam), Illinois and Kentucky, Post Authorization Change Report (October 2008)

1. References:

a. Memorandum, CECW-LRD, 14 May 2009, subject: Olmsted Locks Replacement Project, Illinois and Kentucky, Post Authorization Change Report October 2008 that transmitted HQUSACE policy compliance review comments on the subject Post Authorization Change Report (PACR) to the Louisville District.

b. Decision Document, October 2008, Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam), Illinois and Kentucky, Post Authorization Change Report.

c. Electronic mail, CELRDOR, 30 November 2009, that transmitted Louisville District responses to HQUSACE policy compliance review comments.

2. The Headquarters policy compliance review team final assessment of Louisville District responses to review comments is enclosed. As noted in the enclosure, the review team and the Louisville District have reached an impasse in working to resolve two significant issues: (1) the need for Independent External Peer Review of the PACR, and (2) the requirement to complete certification of the Waterways Analysis Model used to assess economic benefits displayed in the PACR.

3. It is the position of the policy compliance review team that per EC 1105-2-410, this report is required to undergo an Independent External Peer Review (IEPR). The report has an underlying EIS, is well beyond the estimated Section 902 limit, and requires congressional authorization. These factors all point to the need for an IEPR. An IEPR is desirable because it would provide independent confirmation of the USACE explanations for the substantial cost growth on this project. The external peer review team should also evaluate USACE processes to identify process improvements to avoid significant future cost increases. The District must make the case why the policy or the law (Section 2034, WRDA 2007) does not apply in this case, or request a waiver of the policy.

4. LRD RIT supports the Louisville District position that an IEPR is not required for the following reasons: The project scope, purpose, and location have not changed since the initial authorization. What has changed is the construction duration of the project, due in part to inefficient funding. By stretching out the period of performance, the cost of the project has

CECW-LRD
SUBJECT: Olmsted Locks Replacement Project, Illinois and Kentucky, Post-Authorization Change Report (PACR), October 2008

significantly escalated. The overall project is approximately 50 percent complete at this time. The dam construction is the primary driver of the cost increase. The dam construction is under contract. The estimated amount for the dam construction and the dam contingencies comes from a joint effort of the contractor and LRL. The Walla Walla Cost Engineering Center of Expertise reviewed and concurs with the current cost estimate contingency amount. The dam design is complete, the dam is under construction, and the Center of Expertise has reviewed the cost estimate.

5. It is the position of the policy compliance review team that the Waterways Analysis Model (WAM) should be certified as required in EC 1165-2-407. WAM is an extremely useful Corps legacy model that is often employed in Corps inland navigation studies and properly belongs in the Corps toolbox of certified models. CELRD states that Model documentation is currently underway. The MSC is proceeding with concurrent preparation of a Model Review Plan and documentation that conforms to the requirements of the draft "Protocols for Certification of Planning Models under the Planning Models Improvement Program (PMIP)", dated 6 October 2005 in FY2009. Selection of a review team and completion of the review process will occur in CY 2010. LRD RIT supports the MSC position.

6. Request your concurrence that IEPR is not required for this project and certification of the WAM Model should proceed as stated in the paragraph above.

Encl
as

MICHAEL G. ENSCH
Chief, Regional Integration Team
Great Lakes and Ohio River Division
Directorate of Civil Works

		Concur	Non-concur
CECW-P	IEPR		TAB Reauthorization Required 902 bust
	WAM Model	TAB	
DCW	IEPR		12/23
	WAM Model	12/23	

HQUSACE FINAL POLICY COMPLIANCE REVIEW ASSESSMENT

Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam), Illinois and Kentucky, Post Authorization Change Report

1. **BACKGROUND**

a. Project Authorization. The Water Resources Development Act of 1988 (PL 100-676) authorized the Olmsted Locks and Dam Project. The Energy and Water Development Appropriations Act of 1991 provided initial construction funding. The Project is economically justified based on projected commercial navigation transportation savings derived from reduced processing and congestion time, and represents a reinvestment in the nation's inland navigation infrastructure.

b. Project Description. The Olmsted Locks and Dam Project provides for a structure near Ohio River Mile 964.4 that will replace the existing Locks and Dams 52 and 53. The structure will consist of twin 110-foot-wide by 1,200-foot-long locks adjacent to the Illinois bank, five tainter gates, a 1,400-foot-wide navigable pass, and a fixed weir extending to the Kentucky bank. During low flow conditions, an upper pool having an elevation of 300 feet Ohio River Datum at the dam will extend upstream to the Smithland Locks and Dam, a distance of 47 miles. Open river conditions will exist from the Olmsted Locks and Dam site downstream to the mouth of the Ohio River, a distance of approximately 17 miles.

Louisville District awarded the first construction contract on 19 November 1992 to construct the Access Road and Resident Engineer's Office. The major contracts that have been awarded and completed since then include the Locks Cofferdam, the Locks, the Approach Walls and the Operating and Maintenance Bulkheads contracts. Louisville District awarded the construction of the Dam on 28 January 2004 and work is ongoing. Other contracts to be awarded in the future include the Operation Buildings, Demolition of Locks and Dams 52 and 53, and various equipment contracts.

c. Study Purpose. The purpose of the Post Authorization Change Report is to recommend an increase in the maximum amount that the U.S. Army Corps of Engineers is authorized to spend to complete the Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam), and to document the reasons for the recommendation. The report is required because the current estimated cost of completing the Project exceeds the maximum cost limit, as defined in Section 902 of the Water Resources Development Act of 1988 ("Section 902 cost limit"). The authorized cost for the Olmsted Locks and Dam Project, as stated in the Water Resources Development Act of 1988, is $775,000,000. The fully-funded cost was estimated at $1,389,031,000. The Section 902 cost limit is currently $1,544,031,000.

The current cost estimate, without inflation and at the October 2007 price level, is $1,991,000,000, of which, $867,842,000 are sunk costs through September 2007. The current cost estimate with inflation applied to the remaining cost to complete construction (i.e., fully-

funded cost), at the October 2007 price level, is $2,067,000,000. The $2,067,000,000 figure exceeds the current Section 902 cost limit of $1,554,031,000. The report documents the history and background of project costs, and serves as a basis for requesting approval of an increase in the authorized cost.

d. Report Recommendation: The District Engineer, Louisville, recommends increasing the authorized project cost to $1,991,000,000 and t recommends hat the remaining portion of the Project be completed. The Division Engineer, Great Lakes and Ohio River, endorses the District Engineer's recommendation.

2. **HQUSACE Comments**:

a. Delegated Approval Authority

HQUSACE Comment: Based on ER 1105-2-100, Appendix H and ER 1165-2-502 the Division office does not have approval authority for this report. This is primarily because action is required by the Assistant Secretary of the Army for Civil Works (ASA(CW)). The report should be approved at HQUSACE.

ER 1165-2-502, Page 2, Paragraph 6 states that, "Effective 31 March 2004, review and approval authority of post-authorization decision documents that are in accordance with law and policy are delegated to the MSC with the exception of dam safety reports and any reports requiring action by the Chief of Engineers, Secretary of the Army (acting through the Assistant Secretary of the Army for Civil Works (ASA(CW)) or specific congressional modification." This project is part of the exception that appears in ER 1165-2-502. This project will exceed the Section 902 limit and must go to Congress for authorization to increase the limit. The document should be submitted as a recommended action to HQ and not as an approved document.

District Response: Concur. The final report will be submitted to HQUSACE for approval.

HQUSACE Final Assessment. **The District response is satisfactory. The issue is resolved.**

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b. Independent External Peer Review

HQUSACE Comment: Per EC 1105-2-410, this report is required to undergo an Independent External Peer Review (IEPR). The report has an underlying EIS, is well beyond the estimated Section 902 limit, and requires Congressional authorization. These factors all point to the need for an IEPR. An IEPR is desirable because it would provide independent confirmation of the USACE explanations for the substantial cost growth on this project. The external peer review team should also evaluate USACE processes to identify process improvements to avoid significant future cost increases.

District Response: Concur that EC 1105-2-410 applies to any project study that leads to a decision document that requires authorization by Congress. Paragraph 6.a states that the review approaches will be customized for each effort, commensurate with the level of complexity and

relative importance of the actions being supported. The Project scope, purpose, and location have not changed since the initial authorization. What has changed is the construction duration of the project, largely due to inefficient funding. By stretching out the period of performance the cost of the project has significantly escalated. The overall project is approximately 50% complete at this time. The Dam construction is the primary driver of the cost increase. The dam construction is under contract. The estimated amount for the dam construction and the dam contingencies comes from a joint effort of the contractor and LRL. The contingency amount was reviewed by the Walla Walla Cost Engineering Center of Expertise. Since the dam design is complete, the dam is under construction, and the Center of Expertise has reviewed the cost estimate, performing an IEPR would appear to offer little value at this time. With regard to lessons learned, the Corps has completed an internal review of three navigation projects under construction, one of which was Olmsted. This Corps report, also known as "The Good, the Bad, and the Ugly" identified a number of process improvements.

HQUSACE Final Assessment. The policy compliance review team does not concur with the District response. Normal Corps policy (EC 1105-2-410) is to conduct an IEPR for this type study. If the District disagrees with the need to conduct an IEPR they should explain why they believe the policy or the law (Section 2034, WRDA 2007) does not apply in this case, or they should request a waiver of the policy. **This issue remains un-resolved**.

District Response (Nov 2011): An IEPR was performed by Battelle. Appendix G contains the IEPR comments and their resolutions. The PACR was revised accordingly.

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c. NEPA Compliance

HQUSACE Comment: The last National Environmental Policy Act (NEPA) document in this report was cited as an Environmental Assessment (EA) resulting in a Finding of No Significant Impact (FONSI) in 2002. Assuming there have been many field changes and even some project changes since that NEPA document, please itemize efforts to ensure that on-going construction has verified that the previous Environmental Impact Statements and EA are being adhered to as well as the status and adherence to State and local permits for the project's implementation. What is the plan or process for ensuring that all of these environmental compliance efforts are kept fresh and relevant vs. project implementation and any field changes needed on the project?

District Response: There have not been any changes resulting in significant environmental impact of any kind. Project changes, such as the location of a construction activity within the boundaries of the government property, or field changes, such as removal of an osprey nest constructed atop a light standard, are undertaken only after the Resident Engineer consults with Olmsted PDT environmental manager (Chief, Environmental Resources) who then consults with appropriate agencies as necessary. In these two examples, best management practices for runoff and erosion control were installed around the construction activity fulfilling NPDES requirements while removal of the osprey nests was delayed until the young had fully fledged and the nest was no longer used ensuring compliance with the Raptor and Migratory Bird Protection Acts. Other situational questions have been addressed in dealing with dredged material, placement of rock, filling of former clay mine, to name a few. Copies of all permits are

provided to each contractor's environmental staff on site and are held by the Resident Engineer's staff in addition to the environmental manager. Other activities conducted annually as per the Supplemental Final EIS include diver monitoring of mussel beds, hydrographic surveys of scour and deposition, and monitoring of bald eagle and migratory waterfowl on surrounding lands and waters. All such activities are coordinated with the US Fish and Wildlife Service, Kentucky Department of Fish and Wildlife Resources, Illinois Nature Preserves, and both states' Division of Water.

HQUSACE Final Assessment. The District response is satisfactory. The issue is resolved.

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d. Clarity on dates

HQUSACE Comment: There is a discrepancy with the dates of submission to HQ. The PACR is dated October 2008, the letter from the MSC Commander is dated June 2008, and the PACR was transmitted to HQ in February 2009. This is rather confusing. It would stand to reason that the PACR would have been completed prior to the MSC Commander's signature, not after. This requires some clarification and correction.

District Response: Clarification. See response to comment 2.a.

HQUSACE Final Assessment. The District response is satisfactory. The issue is resolved.

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e. Contracting Strategy

HQUSACE Comment: It appears from the discussion in the report that the problem with ballooning costs has multiple sources. One source is the funding stream provided since the project's authorization. The main source of cost growth on a project of this scale may have been the contract vehicle chosen for the implementation. A cost reimbursable contract was used rather than a fixed priced contract. The team should strongly consider alternate contract arrangements at least on some separable elements and possibly executing these as fixed price contracts to avoid further cost growth.

District Response: The PMP defines the acquisition strategy for the Olmsted project. To date the District has awarded seventeen significant construction contracts with five future contracts identified. Out of the seventeen only one cost reimbursable contract was awarded, all other contracts have been firm fixed price. The remaining contracts are planned to be awarded as firm fixed price.

In September 2002 the Olmsted Dam construction contract was advertised as a firm fixed price contract. The District received no bids and thus was forced to reconsider the method of construction and method of procurement. After meetings with Division, Headquarters and the PARC it was agreed to re-advertise the dam construction contract as a cost reimbursable contract. We received two proposals and awarded a contract on 28 January 2004.

Consideration was given back in 2003 to splitting the dam construction into two contracts but a feasible break could not be determined. The in-the-wet method of construction does not lend itself to deleting anything from the current contract and awarding a separate firm fixed price contract for the deleted scope of work.

HQUSACE Final Assessment. The District response is satisfactory. The issue is resolved.

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f. Benefit to Cost Ratio Formulation

HQ Comment: What is the sensitivity of economic models to tonnage shifts? Are there thresholds that lead to large incremental costs or benefits for this project?

District Response: Economic models and economic analysis are extremely sensitive to tonnage shifts (a.k.a. traffic demand forecasts). The future is never known with certainty and often forecast scenario and/or forecast sensitivity analysis is performed to determine how project formulation and justification changes under this uncertainty.

Being only an economic update, only the best available Ohio River System forecasted demand scenario was utilized; the Clear Skies initiative forecast scenario. When compared to the forecasts used in the 1990 analysis, and when compared to the other available ORS forecast scenarios, the Clear Skies initiative forecast scenario is the lowest, with growth running approximately 0.6 percent annually. The forecasts used in this PACR are dated, however they are the best available.

As a forecast sensitivity analysis test, a benefit-cost analysis was done assuming no-growth in traffic beyond 2010 (noting that 2010 forecasted tonnage level is below actual 1990 tonnage levels). As shown in Table 35 (page 52) of Appendix A, the 7% amortized incremental benefit to incremental cost ratio drops from 11.6 to 9.4 to 1.

Tonnage "thresholds" where large incremental costs and/or benefits occur were not identified. Assuming navigation would be maintained under the without-project condition, costs would not change significantly as long as at least 1 ton of traffic moved through the Olmsted 52/53 region. Only benefits would be affected; tonnage "threshold" would only impact benefits. Certainly there would be a future tonnage level that would drop the benefit-cost ratio to 1.0 to 1; however, as the no-growth sensitivity test shows, this would have to be a significant drop in traffic levels, and given the discounting effect, it would have to be an immediate and significant drop in traffic levels from current levels. Given the location of Olmsted at the lower ORS and its diverse tonnage, a precipitous drop in traffic levels is highly unlikely short of a national/global catastrophe.

HQUSACE Final Assessment. The District response is satisfactory. The issue is resolved.

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g. Modeling

HQUSACE Comment: The Waterways Analysis Model (WAM) should be certified as required in EC 1165-2-407. WAM is an extremely useful Corps legacy model that is often employed in Corps inland navigation studies and properly belongs in the Corps toolbox of certified models.

District Response: Concur. Model documentation is underway. Concurrent preparation of a Model Review Plan and documentation that conforms to the requirements of the draft "Protocols for Certification of Planning Models under the Planning Models Improvement Program (PMIP)", dated October 6, 2005 in FY2009. Selection of a review team and completion of the review process will occur in CY 2010.

The WAM has been used and reviewed on numerous occasions over the past 20 plus years. Reviews have been conducted both internally by the Corps and by outside experts. This assessment is supported by the category descriptions in Table 5 of the draft protocols; the lowest level of review (Level 4) appears warranted in the case of the WAM. A Level 4 review would also suggest that the documentation and review (and therefore funding) burden may not be as great as ordinarily expected for a national model.

HQUSACE Final Assessment. The policy compliance review team does not concur with the District response. Since it is not presently certified, the WAM model should be "approved for use" for this study as required by EC 1105-2-407. None of the information provided in the response (i.e. WAM has been used and reviewed on numerous occasions over the past 20 plus years; reviews have been conducted both internally by the Corps and by outside experts; and an attempt at certification is underway) releases the District from the requirement to obtain approval for this use of the model. **This issue remains un-resolved**

LRD Response: On 1 September 2010, the Planning Center of Expertise for Inland Navigation (PCXIN) submitted a completed model certification review package with its endorsement for certification as a corporate model to be maintained by the PCXIN. The review was conducted by outside experts who evaluated the simulation model per the guidelines of EC 1105-2-412. The outside review team concluded that the model is fit for certification. Additionally, the PCXIN provided its own endorsement of the WAM, based on its long history of testing, use and confidence in the tool. The Waterway Analysis model was certified for use on 15 August 2011, a copy of the certification can be found in Appendix G.

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h. Project Component Clarity

HQUSACE Comment: The team should consider a table or other means of displaying the various project features, the planned acquisition strategy to contract and implement these elements and how much funding is needed to complete each element. Which contract will put this project over its current 902 limit?

District Response: The PMP included twenty-two contracts of which sixteen are complete and five remain to be awarded. Only the dam construction contract is active at this time. The dam contract contains the continuing contract clause thus funds are added each year based on the amount appropriated. The dam contract will put the project over the 902 limit. Based on our estimate of future appropriations we estimate hitting the 902 limit by the end of 2012.

HQUSACE Final Assessment. The District response is satisfactory. The issue is resolved.

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i. Formatting

HQUSACE Comment: It is necessary to ensure that this report is in the proper format needed for a Limited Reevaluation Report (LRR) or a General Reevaluation Report (GRR). A thorough discussion of what report processing needs to be followed as per the Planning Guidance Notebook (PGN) would also be prudent.

District Response: Clarification. The prescribed report format for Post Authorization Change reports provided in ER 1105-2-100, paragraph G-16 is stated to be a guide. Even so, the draft report that underwent technical review was initially prepared generally according to this format. The report subsequently underwent extensive format alterations to provide descriptions of project expenditures and explanations for cost changes according to cost codes of accounts per review comments.

HQUSACE Final Assessment. The District response is satisfactory. The issue is resolved.

D – Post-Authorization Decision Document Checklist

ER-1165-2-502
31 Mar 07

POST-AUTHORIZATION DECISION DOCUMENT CHECKLIST

I. BASIC INFORMATION

A. Name of Authorized Project: Locks & Dams 52 & 53 Replacement Project

B. Name of Separable Element: N/A

C. PWI Number : 010228

D. Authorizing Document: 1988 WRDA

E. Law/Section/Date of Project Authorization (attach copy to checklist):

PL100-676 Section 3(a)(6)

F. Laws/Section/Dates of Any Post-Authorization Modification: N/A

G. Non-Federal Sponsor(s): N/A

H. Project/Separable Element Purpose(s): N/A

I. Congressional Interests (Senator(s), Representative(s) and District(s):
SENATORS: McConnell (KY), Paul (KY), Durbin (IL), Kirk (IL)
REPRESENTATIVES: Costello (IL-12), Shimkus (IL-19), Whitfield (KY-1)

II. PROJECT DOCUMENTS

A. Type of Decision Document: PACR

B. Approval Authority of Decision Document : HQ

C. Project Management Plan Approval Date: Sep 1990

D. Independent Technical Review (ITR) (ATR per EC 1165-2-209 Appendix C, Para 3)
Approval Date: Nov 2011

E. Mitigation Authorized: _X_ Yes ___ No Cost of Mitigation: $12.8 M
Describe type of mitigation and whether included in project report: Yes, environmental and historical mitigation are included in the report.
(Note: Project report is the one that supports the authorization for the mitigation. Ensure that mitigation is authorized as part of the project cost.)

F. Current M-CACES Estimate:$2,918,178,000 Date Prepared & Price Level: Oct'11

G. Section 902 Cost Limit: $1,744,679,900 Full Funded as of 28 Oct 2011: $3,098,768,000

H. Date of Latest Economic Analysis: November 2011

I. Current Economics: BCR 5.6 @ 4 % FY12 (Note: list period of analysis)

RBRCR 9.9 @ 4 % FY 12

III. COST SHARING SUMMARY: N/A

Purpose(s)	Non-Fed Cash	Non-Fed LERRD	Non-Fed Const. Credit	Total Non-Fed Share	Federal Share (%)	Total Project Cost
Total						

a. Projected Credit for Section 215 Work and Date 215 Agreement Signed: _____

b. Projected Credit for Section 104 or Other Authorized Creditable Work and Date Work Approved by ASA (CW) or Agreement Addressing Work Signed:_____

c. Annual Non-Fed OMRR&R Costs (1 Oct FY___ Price Levels):_____

IV. FUNDING HISTORY

a. Appropriations History for Project/Separable Element:

Fiscal Year	Budget Amount	Appropriated Amount
2012	$150,000,000	TBD
2011	$136,000,000	$136,000,000
2010	ARRA	$ 24,405,000
2010	$109,790,000	$101,521,000
2009	ARRA	$ 4,906,000
2009	$114,000,000	$109,094,000
2008	$104,000,000	$102,336,000
2007	$110,000,000	$110,000,000
2006	$ 90,000,000	$ 90,000,000
2005	$ 75,000,000	$ 69,000,000
2004	$ 73,000,000	$ 63,000,000
2003	$ 77,000,000	$ 65,000,000
2002	$ 34,000,000	$ 40,000,000
2001	$ 38,142,000	$ 56,000,000
2000	$ 28,634,000	$ 34,000,000
1999	$ 54,500,000	$ 54,500,000
1998	$ 98,440,000	$ 98,440,000
1997	$ 56,600,000	$ 70,352,000
1996	$ 51,000,000	$ 32,100,000
1995	$ 26,000,000	$ 26,000,000
1994	$110,314,000	$110,314,000
1993	$ 60,000,000	$ 60,000,000
1992	$ 11,400,000	$ 11,400,000
1991	$ 5,000,000	$ 4,000,000

V. CERTIFICATION FOR DELEGATED DECISION DOCUMENTS: YOU MUST ANSWER "YES" TO ALL OF THE FOLLOWING QUESTIONS TO APPROVE THE DECISION DOCUMENT UNDER DELEGATED AUTHORITY.

a. PROJECT PLAN

Has the project study issue checklist been completed and all issues resolved?
YES __X__ NO ____. (Note: Is the project the same as contained in the project report supporting authorization; if not, is it within the 9002 limit, who has the authority to allow the change by regulation district, division, Chief, Congress)

Does the non-Federal sponsor concur in the project plan as submitted?
YES _____ NO_____. N/A

Has project plan as submitted been reviewed and concurred in by the non-Federal sponsor's counsel? YES ____NO ____. N/A

b. AUTHORITY

Has authority been delegated to the MSC for approval of the project report?
YES _____NO __X__.

Is authority adequate to complete the project as proposed? N/A YES____NO_____.

c. POLICY/LEGAL/TECHNICAL COMPLIANCE

Has the District Counsel reviewed and approved the decision document for legal sufficiency?
YES (Certification included in decision document package submittal)_X_NO____.

Have all aspects of ITR (ATR per EC 1165-2-209 Appendix C, Para 3) been completed with no unresolved issues remaining?
YES _X___ NO_____.

Has the District Commander documented policy/legal/technical compliance of the decision document? YES __X__ NO_____.

Has the MSC certified the policy/legal/technical compliance of the decision document?
YES_____ NO_____.

VI. AUTHENTICATION

Project Manager — Date: 4 Nov 11

Chief, Planning Division — Date: 04 Nov 2011

District Counsel — Date: 4 Nov 11

DDE (PM) — Date: 4 Nov 11

District Engineer — Date: 4 Nov 11

MSC Planning and Policy CoP Leader — Date: 9 Nov 2011

MSC Counsel — Date: 9 Nov 2011

MSC Commander — Date: 14 Nov 2011

DISTRICT CERTIFICATION OF POLICY COMPLIANCE

I have reviewed the revised Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project and concur that it is in compliance with the current Corps of Engineers policy and guidance.

Roger Dale Setters 04 NOV 2011

Roger Setters
Chief Planning Branch, CELRL-PM-P Date

COMPLETION and CERTIFICATION OF LEGAL REVIEW

The Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project has been reviewed by the Office of Counsel, Louisville District, and is approved as legally sufficient.

J D Lengel 14 Nov 11

Janice Lengel
District Counsel, CELRL-OC Date

E – IEPR Implementation Memo



DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
WASHINGTON, D.C. 20314-1000

CECW-LRD

JAN 14 2010

MEMORANDUM THRU

CHIEF PLANNING AND POLICY DIVISION

COMMANDER, GREAT LAKES AND OHIO RIVER DIVISION (CELRD-PDC)

FOR COMMANDER, LOUISVILLE DISTRICT (CELRL-PM-C)

SUBJECT: Olmsted Locks Replacement Project, Illinois and Kentucky, Post-Authorization Change Report, Implementation of Independent External Peer Review

1. References:

a. Memorandum, CECW-LRD, 18 December 2009, subject: HQUSACE Final Policy Compliance Review Assessment -- Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam), Illinois and Kentucky, Post Authorization Change Report (October 2008).

b. EC 1165-2-209, 31 December 2009, *Water Resources Policies and Authorities, Civil Works Review Policy.*

2. The Post Authorization Change Report (PACR) recommends increasing the maximum amount that the U.S. Army Corps of Engineers is authorized to spend to complete the Locks and Dams 52 and 53 Replacement Project (Olmsted Locks and Dam), and documents the reasons for the recommendation. The report is required because the current estimated cost of completing the project exceeds the maximum cost limit as defined in Section 902 of the Water Resources Development Act of 1988.

3. The authorized cost for the Olmsted Locks and Dam Project, as stated in the Water Resources Development Act of 1988, is $775,000,000. The fully-funded cost was estimated at $1,389,031,000. The Section 902 cost limit is currently $1,544,031,000.

4. The current cost estimate, without inflation and at the October 2007 price level, is $1,991,000,000, of which, $867,842,000 are sunk costs through September 2007. The current cost estimate with inflation applied to the remaining cost to complete construction (i.e., fully-funded cost), at the October 2007 price level, is $2,067,000,000. The $2,067,000,000 figure exceeds the current Section 902 cost limit of $1,554,031,000.

CECW-LRD
SUBJECT: Olmsted Locks Replacement Project, Illinois and Kentucky, Post-Authorization Change Report (PACR), Implementation of Independent External Peer Review

5. Reference 1.a (enclosure 1) notes the following: (1) project scope, purpose, and location have not changed since initial authorization and the overall project is approximately 50 percent complete; (2) dam construction is under contract and has been determined to be the primary driver of the cost increase; and, (3) the current estimated cost for dam construction including dam contingencies was developed as a joint effort of the contractor and CELRL. Reference 1.a. sought concurrence from the Director of Civil Works (DCW) that these factors negate the need for Independent External Peer Review (IEPR) of the PACR.

6. As indicated in reference 1.a., the DCW does not concur that the requirement for IEPR should be waived. Given the DCW non-concurrence, CELRL shall proceed with revising the project Review Plan to reflect the requirements for conducting a Type I IEPR per guidance of reference 1.b. (enclosure 2). The District/MSC should insure vertical team involvement in developing the revised Review Plan.

7. To avoid the appearance of conflicts and strengthen the Corps position in any future defense of the conduct and results of IEPR, the District/MSC should consider seeking the assistance of the Deep Draft Navigation Planning Center of Expertise to serve as the Review Management Organization.

8. Please direct questions to Jay Warren at (202) 761-4589.

FOR THE COMMANDER:

2 Encls

MICHAEL G. ENSCH
Chief, Regional Integration Team
Great Lakes and Ohio River Division
Directorate of Civil Works

F – Waterway Analysis Model, Model Certification Memo

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P

15 August 2011

MEMORANDUM FOR Director, Planning Center of Expertise for Inland Navigation (PCXIN)

SUBJECT: Waterway Analysis Model (WAM), Shallow Draft Version 10-01 (WAM-SD-10-01)

1. The shallow draft version of the inland navigation simulation model, developed to estimate delays at locks and dams, is certified for use. Adequate technical reviews have been accomplished and the model meets the certification criteria contained in EC 1105-2-412. This certification is based on the decision of the HQUSACE Model Certification Panel which considered the PCXIN assessment of the model.

2. The Certification Documentation Report attests that the model is expensive to modify and maintain; it relies on a proprietary computer language that requires a special compiler to create executable code; and that there are a limited base of developers who can read and understand the code. While the model is currently the best we have for its purpose, it was decided that the model certification will elapse after half of the maximum certification period of 7 years. During that period the PCXIN should oversee the development of a more state-of-the-art and user-friendly model or develop a plan for training more technical specialists in the use of WAM.

3. The PCXIN requested certification of the model with the proviso of exclusive use by technical specialists of the PCXIN. The panel did not believe it was responsible for determining who could use the model and therefore chose not to restrict use to the PCXIN. Further, given the limited number of experienced WAM modelers at the PCXIN, the PCXIN will need to ensure the independence of ATR on future model runs for specific studies.

EXPIRES: 30 September 2014

Theodore A. Brown

THEODORE A. BROWN, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

Printed on Recycled Paper

G - Waterway Analysis Model Routing Sheet

ROUTING SHEET FOR CIVIL WORKS CORRESPONDENCE*

Date Circulated 15 August 2011

SUBJECT: Waterway Analysis Model (WAM) - Model Certification

Location of Electronic Version in **"S" Drive:**

File Folder: S:\CECW-PC\Model Certification

File Subfolder: Waterway Analysis Model (WAM)

File Name: Model Approval

Electronic Read Copy File: Same as above

MFR:

Routing / Coordination:

for Wes Coleman 8/15/11 x4102
Chief, Office of Water Project Review (ext)

Jeremy LaDart 8/16/11
Subject Matter Expert

Bruce Carlson 8/16/11
Senior Policy Analyst

Susan Hughes 8/15/11
Deputy Chief, Planning Community of Practice

Harry Kitch 8/15/11
Deputy Chief, HQUSACE Planning & Policy Division

Theodore A. Brown
Chief, HQUSACE Planning & Policy Division

Pls advise LRD / PCX IN
They need plan to set
updated model in
3 yrs.

*** After review, initial, or signature, please call the following person for pick up:**

Name: Trish Bee **Phone #** 4701

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX H

Review Plan and Review Plan Approval Memo

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DIVISION, GREAT LAKES AND OHIO RIVER
CORPS OF ENGINEERS
550 MAIN STREET ROOM 10-032
CINCINNATI, OH 45202-3222

MAR 1 3 2010

CELRD-PDS P (1105)

MEMORANDUM FOR Commander, Louisville District, Attn: Ms. Sharon M. Bond (CELRL-PM-P)

SUBJECT: Review Plan Approval for Locks and Dams 52 and 52 Replacement Project (Olmsted Locks and Dam) Post Authorization Change Report (PACR)

1. The enclosed Review Plan for the Olmsted PACR has been prepared in accordance with EC 1165-2-209 dated 31 January 2010. The Review Plan has been coordinated with the Planning Center of Expertise for Inland Navigation (PCXIN) which is the lead entity to execute this Review Plan. The Review Plan includes independent external peer review.

2. I hereby approve this Review Plan, which has been endorsed by the technical directors of the PCXIN. This Review Plan is subject to change as study circumstances require, consistent with study development under the Project Management Business Process. Subsequent revisions to this Review Plan or its execution will require new written approval from this office.

3. Questions may be directed to Ms. Becky Moyer at phone (513) 684-3598.

Encl

JOHN C. ZIMMERMAN, P.E.
Chief, Planning & Policy Division

REVIEW PLAN

LOCKS AND DAMS 52 AND 53 REPLACEMENT PROJECT (OLMSTED LOCK AND DAM), IL & KY
POST-AUTHORIZATION CHANGE REPORT

LOUISVILLE DISTRICT



US Army Corps
of Engineers ®

FEBRUARY 2010

REVIEW PLAN
LOCKS AND DAMS 52 AND 53 REPLACEMENT PROJECT (OLMSTED LOCK AND DAM), IL & KY
POST-AUTHORIZATION CHANGE REPORT
LOUISVILLE DISTRICT

Table of Contents

1. PURPOSE AND REQUIREMENTS 1
   A. Purpose. 1
   B. Requirements. 1
2. STUDY INFORMATION 3
   A. Decision Document. 3
   B. General Site Description. 4
   C. Study Scope. 4
   D. Problems and Opportunities. 4
3. AGENCY TECHNICAL REVIEW (ATR) 5
4. INDEPENDENT EXTERNAL PEER REVIEW PLAN 5
   A. Project Magnitude. 6
   B. Project Risk. 6
   C. Vertical Team Consensus. 6
   D. Products for Review. 6
   E. Communication and Documentation. 6
   F. Funding 7
5. MODEL CERTIFICATION 7
6. PUBLIC REVIEW 8
7. POINTS OF CONTACT 9
   A. Project Delivery Team. 9
   B. Vertical Team. 9
   C. PCX. 9
8. APPROVALS 9

APPENDICES

Appendix A Statement of Technical Review
Appendix B Review Plan Teams
Appendix C Acronyms and Abbreviations

REVIEW PLAN
LOCKS AND DAMS 52 AND 53 REPLACEMENT PROJECT (OLMSTED LOCK AND DAM), IL & KY
POST-AUTHORIZATION CHANGE REPORT
LOUISVILLE DISTRICT

1. PURPOSE AND REQUIREMENTS

A. Purpose.
This document outlines the Review Plan for the Locks and Dams 52 and 53 Replacement Project (the construction of Olmsted Lock and Dam) Post-Authorization Change Report (PACR). EC 1165-2-209, *Civil Works Review Policy*, dated 31 January 2010, outlines the policy on review of decision documents, particularly with regards to Independent External Peer Review (IEPR) and Safety Assurance Review (SAR), which is also referred to as a Type II IEPR. As this is the most current guidance available on review policy, this review plan and the performance of the reviews described herein will conform to the formats, procedures and guidance laid down in EC 1165-2-209.

B. Requirements.
EC 1165-2-209 outlines the requirement of the three review approaches (DQC, ATR, and IEPR) and provides guidance on Corps Planning Centers of Expertise (PCX) involvement in the approaches. This document addresses review of the decision document as it pertains to both approaches and planning coordination with the appropriate PCX. This Post-Authorization Change document deals with an existing Inland Navigation Project, and therefore falls under the purview of the Planning Center of Expertise for Inland Navigation (PCXIN).

(1) District Quality Control. DQC is the review of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). It is managed in the District and may be conducted by in-house staff as long as the reviewers are not doing the work involved in the study, including contracted work that is being reviewed. Basic quality control tools include a Quality Management Plan (QMP) providing for seamless review, quality checks and reviews, supervisory reviews, Project Delivery Team (PDT) reviews, etc. Additionally, the PDT is responsible for a complete reading of the report to assure the overall integrity of the report, technical appendices and the recommendations before the approval by the District Commander. For the Study, non-PDT members and/or supervisory staff will conduct this review for major draft and final products following review of those products by the PDT. The Major Subordinate Command (MSC)/District are directly responsible for the QM and QC respectively, and to conduct and document this fundamental level of review. A Quality Control Plan (QCP) was included in the PMP for the subject study and addresses DQC by the MSC/District. DQC is not addressed further in this Review Plan.

(2) Agency Technical Review (ATR). The purpose of this review is to ensure the proper application of clearly established criteria, regulations, laws, codes, principles and

professional practices. The ATR is an in-depth review, managed within USACE, and conducted by a qualified team outside of the home district that is not involved in the day-to-day production of a project/product. The ATR team reviews the various work products and assures that all the parts fit together in a coherent whole. ATR teams will be comprised of senior USACE personnel (Regional Technical Specialists (RTS), etc.) and may be supplemented by outside experts as appropriate. To assure independence, the leader of the ATR team shall be from outside the home MSC. EC 1105-2-408 first established the requirement that DrChecks (https://www.projnet.org/projnet/) be used to document all ATR comments, responses, and associated resolution accomplished. An ATR of all work products, including review of all methodologies, assumptions and plans as well as policy review, has previously been accomplished for the L&D 52 and 53 Replacement Project Post Authorization Change Report, predating this Review Plan. As no changes to these assumptions, methods, or application of policy have occurred since the certification of ATR on 21 March 2008, this RP will focus instead on the Independent External Peer Review process. No further ATR is envisioned for this report.

(3) Independent External Peer Review. EC 1165-2-209 delineates the definition of IEPR, into Types I and II, the latter of which being synonymous with Safety Assurance Review. IEPR is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. Type I IEPR is managed by an outside eligible organization (OEO) that is described in the Internal Review Code Section 501(c)(3), is exempted from Federal tax under Section 501(a), of the Internal Revenue Code of 1986; is independent; is free from conflicts of interest; does not carry out or advocate for or against Federal water resources projects; and has experience in establishing and administering IEPR panels. The scope of review will address all the underlying planning, engineering, including safety assurance, economics, and environmental analyses performed, not just one aspect of the project. The IEPR will focus on the technical aspects of the project. This Review Plan outlines the planned approach to meeting this requirement for the Study. Type I IEPR is required for this study.

(4) Safety Assurance Review / Type II IEPR. In accordance with Section 2035 of WRDA 2007 and EC 1165-2-209, all projects addressing flooding or storm damage reduction are required to undergo a safety assurance review during design and construction. Per EC 1165-2-209, "A Type II IEPR (SAR) shall be conducted on design and construction activities for hurricane and storm risk management and flood risk management projects, as well as other projects where existing and potential hazards pose a significant threat to human life." Safety assurance factors must be considered in all reviews for those studies. Type II IEPR / SAR is not required for this study.

(5) Policy and Legal Compliance Review. In addition to the technical reviews, decision documents will be reviewed throughout the study process for their compliance with law and policy. These reviews culminate in Washington-level determinations that the recommendations in the reports and the supporting analyses and coordination comply with law and policy, and warrant approval or further recommendation to higher authority

by the Chief of Engineers. Guidance for policy and legal compliance reviews is addressed further in Appendix H, ER 1105-2-100. Technical reviews described in EC 1165-2-209 are to augment and complement the policy review processes by addressing compliance with published Army polices pertinent to planning products, particularly polices on analytical methods and the presentation of findings in decision documents. DQC and ATR efforts are to include the necessary expertise to address compliance with published planning policy. Counsel will generally not participate on ATR teams, but may at the discretion of the district or as directed by higher authority. When policy and/or legal concerns arise during DQC or ATR efforts that are not readily and mutually resolved by the PDT and the reviewers, the District will seek issue resolution support from the MSC and HQUSACE in accordance with the procedures outlined in Appendix H, ER 1105-2-100. IEPR teams are not expected to be knowledgeable of Army and administration polices, nor are they expected to address such concerns. An IEPR team should be given the flexibility to bring important issues to the attention of decision makers.

(6) Planning Center of Expertise (PCX) Coordination. EC 1165-2-209 outlines PCX coordination in conjunction with preparation of the Review Plan. This Review Plan is being coordinated with the PCX for Inland Navigation (PCXIN). The PCXIN is responsible for the accomplishment of IEPR for the Study. The DQC is the responsibility of the MSC/District. The PCXIN will manage the IEPR review to be conducted by others.

(7) Review Plan Approval and Posting. In order to ensure the Review Plan is in compliance with the principles of EC 1165-2-209 and the MSC's QMP, the Review Plan must be endorsed by the PCXIN and approved by the applicable MSC, in this case the Commander, Great Lakes and Ohio River Division (LRD). Once the Review Plan is approved, the District will post it to its district public website and notify LRD and the PCXIN.

2. STUDY INFORMATION

A. Decision Document.

The Locks and Dams 52 and 53 Replacement Project Post Authorization Change Report is intended to recommend an increase in the maximum amount that the U.S. Army Corps of Engineers is authorized to spend to complete Olmsted Locks and Dam, and to document the reasons for the recommendation. The report is required because the current estimated cost of completing the Project exceeds the maximum cost limit, as defined in Section 902 of the Water Resources Development Act of 1988 ("Section 902 cost limit"). The authorized cost for the Olmsted Locks and Dam Project, as stated in the Water Resources Development Act of 1988, is $775,000,000. The fully-funded cost was estimated at $1,389,031,000. The Section 902 cost limit is currently $1,544,031,000.

The current cost estimate, without inflation and at the October 2007 price level, is $1,991,999,999, of which, $867,842,000 are sunk costs through September 2007. The

current cost estimate with inflation applied to the remaining cost to complete construction (i.e., fully-funded cost), at the October 2007 price level, is $2,067,000,000. The $2,067,000,000 figure exceeds the current Section 902 cost limit of $1,554,031,000. The report documents the history and background of project costs, and serves as a basis for requesting approval of an increase in the authorized cost.

B. General Site Description.
The Olmsted locks and dam project provides for a structure near the community of Olmsted, Illinois at Ohio River Mile 964.4 that will replace the existing Locks and Dams 52 and 53, located between Paducah, KY and Cairo, IL. The structure will consist of twin 110-foot-wide by 1,200-foot-long locks adjacent to the Illinois bank, five tainter gates, a 1,400-foot-wide navigable pass, and a fixed weir extending to the Kentucky bank. During low flow conditions, an upper pool having an elevation of 300 feet Ohio River Datum at the dam will extend upstream to the Smithland Locks and Dam, a distance of 47 miles. Open river conditions will exist from the Olmsted Locks and Dam site downstream to the mouth of the Ohio River, a distance of approximately 17 miles.

C. Study Scope.
Construction of Olmsted Locks and Dam is currently ongoing. Louisville District awarded the first construction contract on 19 November 1992 to construct the Access Road and Resident Engineer's Office. The major contracts that have been awarder and completed since then include the Locks Cofferdam, the Locks, the Approach Walls and the Operating and Maintenance Bulkheads contracts. Louisville District awarded the construction of the Dam on the 28th of January, 2004. Other contracts to be awarded in the future include the Operation Buildings, Demolition of Locks and Dams 52 and 53, and various equipment contracts.

The cost of this project is being equally shared by Congressional appropriation and the navigation industry. Industry pays a tax on diesel fuel, which goes to the Inland Waterways Trust Fund. The trust fund then pays 50 percent of the project cost. The fully funded cost estimate for the construction of the project exceeds the Section 902 cost limit, and approval of an increase will be required before the project can be completed.

The Post Authorization Change Report represents no change to the authorized scope or purpose of the Olmsted L&D / L&D 52 and 53 Replacement Project, as well as no change to local cooperation requirements or the location of the project. Design changes however have been made post-authorization (Feasibility Report), as well as changes to project costs and benefits.

D. Problems and Opportunities.
The continuing growth in demand for waterborne commerce on the Ohio River requires periodic improvements in the waterways transportation infrastructure. Locks and Dams No. 52 and 53 were completed in 1929, and temporary 1200-foot long lock chambers were added later. The antiquated design and age of these structures however make it impossible to meet current traffic demands without significant delays.

The strategic reach of the Ohio River where these projects are located provides a connection between the Ohio, Tennessee, Cumberland, and Mississippi rivers. Barge traffic moving between the Mississippi River system and the Ohio, Tennessee, and Cumberland rivers must pass through this stretch of river. More tonnage passes this point than any other place in America's inland navigation system. The U.S. Army Corps of Engineers and the navigation industry, in a continuing effort to provide for the nation's future navigation needs, have undertaken to replace these aged facilities with the Olmsted Locks and Dam project, one of the largest civil works projects undertaken by the Corps.

The Corps of Engineers estimates that the Olmsted Locks and Dam project will produce average annual economic benefits to the nation of more than $700 million. The new locks will operate more efficiently and will pass tows with fewer delays. Delays ultimately raise the price of commodities, which move on the waterways. Total lockage time will be reduced from approximately five hours through Locks and Dams No. 52 and 53 to less than one hour in the new project. The Corps estimates lockage wait times of 150 hours per tow by the year 2025 at Lock and Dam 52 without the new locks.

3. AGENCY TECHNICAL REVIEW (ATR)

An ATR has previously been completed for the Olmsted Locks and Dams Project PACR, and the reviewed report products have not changed since the approval of this review. The ATR approval memorandum is included as Appendix A.

4. INDEPENDENT EXTERNAL PEER REVIEW PLAN

The decision document will present the details of post-authorization changes during the course of design and construction of the Olmsted Locks and Dam project, including the cost increases above the Section 902 limit that have mandated the PACR. EC 1165-2-209 states thresholds that trigger an IEPR: "where there are public safety concerns, a high level of complexity, novel or precedent-setting approaches; where the Chief of Engineers determines that the project is controversial, has significant interagency interest, or has significant economic, environmental and social effects to the nation". IEPR is further mandatory in such cases as the total estimated project cost, including mitigation, exceeds $45 million, or an EIS is required for the study.

Due to the size and complexity of the project, the Locks and Dams 52 and 53 Replacement Project has significant agency and public interest. Additionally the total fully-funded project cost exceeds the $45 million (current fully-funded cost estimate, at Oct 2007 price levels, exceeds $2 billion) threshold. An environmental impact statement was prepared in May of 1993, and a supplemental environmental assessment later completed in June 2002, to cover the alternative, in-the-wet construction techniques. The study does not however involve significant public safety concerns. In consideration of these factors, IEPR will be conducted. The cost of IEPR is currently estimated to be $100,000. IEPR is a project cost. The IEPR panel review will be Federally-funded. In-house costs associated with obtaining the IEPR panel contract as well as responding to IEPR comments will be cost-shared expenses. It is not anticipated that the public,

including scientific or professional societies, will be asked to nominate potential external peer reviewers.

A. Project Magnitude.
For reasons described in the preceding paragraphs, the magnitude of this project is determined as high.

B. Project Risk.
This project is considered to have moderate overall risk. The replacement Locks and Dam structure is at the date of this Review Plan roughly 50% complete, however the size and complexity are considered to contribute to overall project risk.

C. Vertical Team Consensus.
This Review Plan will serve as the coordination document to obtain vertical team consensus. Subsequent to PCX endorsement, the plan will be provide to the vertical team for approval. MSC approval of the plan will indicate vertical team consensus.

D. Products for Review.
The full IEPR panel will receive the entire Post Authorization Change Report for review. The District will draft a response to the IEPR final report and process it through the vertical team. The Corps will issue final response to the IEPR panel and notify the public.

Disciplines that are anticipated to undergo IEPR are economics and cost engineering. The economics review(s) will review the analysis and assumptions used by study economists to revise and update project benefits, including the Waterways Analysis Model (WAM), and revisions to the without-project condition, including an assumption that major rehab work could be done within the analysis period to address the risk of structural failure. In addition, time-sensitive model input data, such transportation rates and waterway traffic demand forecasts, were updated from the 1990 report, as were the cost-closure matrices. The cost engineering reviewer(s) will review the changes in project costs across all feature codes, and the underlying justifications for these increases.

IEPR panel members will be identified in Appendix B after they have been selected. Work undertaken as part of these technical disciplines is relevant to justification of the project cost, complexities of design, and other potentially controversial aspects of the project. Of the products that will undergo IEPR, all have previously been reviewed by the PDT and undergone ATR prior to submittal for IEPR. This includes all relevant contractor work products.

E. Communication and Documentation.
The communication plan for the IEPR is as follows:

(1) The panel will use DrChecks to document the IEPR process. The lead planner will facilitate the creation of a project portfolio in the system to allow access by all PDT and a qualified Outside Eligible Organization (OEO). An electronic version of the document, appendices, and any significant and relevant public comments shall be posted in MS Office compatible or Adobe Acrobat format at:

ftp://ftp.usace.army.mil/pub/ at least one business day prior to the start of the comment period.

The OEO will compile the comments of the IEPR panelists, enter them into DrChecks, and forwards the comments to the District. The District will consult the PDT and outside sources as necessary to develop a proposed response to each panel comment. The District will enter the proposed response into DrChecks, and then return the proposed response to the panel. The panel will reply to the proposed response through the OEO, again using DrChecks. This final panel reply may or may not concur with the District's proposed response and the panels final response will indicate concurrence or briefly explain what issue is blocking concurrence. There will be no final closeout iteration. The District will consult the vertical team and outside resources to prepare an agency response to each comment. The initial panel comments, the District's proposed response, the panel's reply to the District's proposed response, and the final agency response will all be tracked and archived in DrChecks for the administrative record. However, only the initial panel comments and the final agency responses will be posted.

(2) Each IEPR panel member shall download the appropriate documents.

(3) The lead planner shall inform the IEPR panel when all responses have been entered into DrChecks and conduct a briefing to summarize comment responses to highlight any areas of disagreement.

(4) A revised electronic version of the report and appendices with comments incorporated shall be posted at ftp://ftp.usace.army.mil/pub/ for use during back checking of the comments.

(5) PDT shall contact the OEO for the IEPR as appropriate to seek clarification of a comment's intent or provide clarification of information in the report. Discussions shall occur outside of DrChecks but a summary of discussions may be provided in the system.

(6) The IEPR panel shall produce a final Review Report to be provided to the PDT. This report shall be scoped as part of the effort to engage the IEPR panel. The District will draft a response report to the IEPR final report and process it through the vertical team. Upon satisfactorily resolving any relevant follow-on actions, the Corps will finalize its response to the IEPR Review Report and will post both the Review Report and the Corps final responses to the public website.

F. Funding

The PCXIN will identify someone independent from the PDT to scope the IEPR and develop an Independent Government Estimate. The District will provide funding to the IEPR panel.

5. MODEL CERTIFICATION

For the purposes of this RP section, planning models are defined as any models and analytical tools that planners use to define water resources management problems and

opportunities, to formulate potential alternatives to address the problems and take advantage of the opportunities, to evaluate potential effects of alternatives and to support decision-making. It includes all models used for planning, regardless of their scope or source, as specified in the following sub-paragraphs.

The computational models employed in the Study have either been developed by or for the USACE. Model certification and approval for all identified planning models will be coordinated through the PCXIN as needed. Project schedules and resources will be adjusted to address this process for certification and PCXIN coordination. Models used were:

1. Ohio River Navigation Investment Model (ORNIM) – Developed by the Center for Transportation Analysis (CTA) in cooperation with the Great Lakes and Ohio River Division of the Corps of Engineers (LRD), ORNIM is a three component model; the Waterway Supply and Demand Module (WSDM), the Lock Risk Module (LRM), and the Optimization Module. The three components of the ORNIM model determine shipper equilibrium, use a Monte Carlo simulation to determine closure probabilities, and optimize investments, respectively. *Certification of ORNIM is currently in progress.*

2. Waterways Analysis Model (WAM) – The Waterways Analysis Model is used to estimate traffic/delay relationships, lock capacities, and simulating closure impacts on traffic. *Certification of WAM is currently in Progress.*

3. Barge Costing Model – The Barge Costing Model, which contains three modules; one-way general towing service, roundtrip general towing service, and a roundtrip dedicated towing service module, is used for rate estimation. *Certification of the Barge Costing Model is in Progress.*

6. PUBLIC REVIEW

Private individuals, elected officials, agencies, and all levels of government have been publically involved in the development of the project. The primary vehicle for public involvement has been the process of complying with the National Environmental Policy Act and its provisions for public involvement. The 1985 and 1993 Environmental Impact Statements each had a 45-day comment period for the draft documents followed by a 30-day comment period for the final documents. The 2002 Environmental Assessment had a 30-day comment period.

Public involvement is also part of the permitting process whether for Section 401 water quality certification under the Clean Water Act or for some other law or regulation. For example, changes involving Historic/Cultural Mitigation issues resulted from coordination with consulting parties undertaken in accordance with the National Historic Preservation Act (NHPA). Changes involving cultural resources/archaeology sites resulted from coordination with the Illinois and Kentucky State Historic Preservation Officer and Native American tribes in accordance with NHPA and the Native American

Graves Protection and Repatriation Act.

Public involvement and coordination was maintained with residents of local communities such as Paducah, KY and Olmsted, IL on Project features such as the disposition of L&D 52 and 53, construction of a new boat ramp at Olmsted, construction and operation of a contractor facility in Paducah, and purchase of mitigation lands in Ballard County, Kentucky.

In addition, this Review Plan, The IEPR Review Report, and the Corps' final responses will be posted to a public website for review and comment.

7. POINTS OF CONTACT

A. Project Delivery Team.
The PDT is comprised of those individuals directly involved in the development of the decision document. Individual contact information and disciplines are presented in Appendix B.

B. Vertical Team.
The Vertical Team includes District management, District Support Team (DST) and Regional Integration Team (RIT) staff as well as members of the Planning of Community of Practice (PCoP). Specific points of contact for the Vertical Team can be found in Appendix B.

C. PCX.
The appropriate PCX for this document is the Planning Center of Expertise for Inland Navigation, located in LRH. This Review Plan will be submitted to the PCXIN Program Manager for review and comment. Since an IEPR will be required, the PCX will be asked to manage the IEPR review. The approved Review Plan will be posted to the District's public website for public comment and consideration of public comments

D. Review Plan Points of Contact
The Points of Contact for questions and comments to this Review Plan are as follows:

1. District Point of Contact: Larry Bibelhauser, 502-315-6778
2. MSC Point of Contact: Rebecca Moyer, 513-684-3598
3. PCXIN Point of Contact: Dave Weekly, 304-399-6955

8. APPROVALS

The PDT will carry out the Review Plan as described. The lead planner will submit the Review Plan to the PCXIN for review and recommendation for approval. After PCXIN review and recommendation, the PDT District Planning Chief will forward the Review Plan to their respective MSC for commander approval. Formal coordination with PCX will occur through the PDT District Planning Chief.

REVIEW PLAN
LOCKS AND DAMS 52 AND 53 REPLACEMENT PROJECT (OLMSTED LOCK AND DAM), IL & KY
POST-AUTHORIZATION CHANGE REPORT
LOUISVILLE DISTRICT

APPENDIX A
STATEMENT OF TECHNICAL REVIEW

ITR CERTIFICATION OF DECISION DOCUMENT
The Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project, and associated appendices have been reviewed in accordance with the requirements of ER 1105-2-100 for independent technical review of decision documents. All concerns resulting from independent technical review have been considered and addressed. Comments and resolutions are documented in the attachment.

13 March 2008
(Signature) (Date)
Project Manager for the Product Delivery Team, CELRL-PM-C

Deena Braunstein 12 March 2008
Assistant District Counsel, CELRL-OC

Byron K. McClellan, P.E. 17 Mar 08
Structural Engineer, CELRL-ED-D-S

18 MAR 2008
Asst. Chief, Construction Division, CELRL-CD

DISTRICT CERTIFICATION OF POLICY COMPLIANCE
I have reviewed the Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project and concur that it is in compliance with current Corps of Engineers policy and guidance.

17 March 2008
Chief, Planning Branch, CELRL-PM-P

COMPLETION and CERTIFICATION OF LEGAL REVIEW
The Post Authorization Change Report for the Olmsted Locks and Dam, IL & KY, navigation project has been full reviewed by the Office of Counsel, Louisville District, and is approved as legally sufficient.

3/19/08
(Signature) (Date)
District Counsel, CELRL-OC

Olmsted Locks and Dam, Illinois and Kentucky
Remaining Contract Cost Review

Completion of Remaining Contract Review

The Walla Walla Cost Directory of Expertise performed a quality assurance review of the methodology used in determining contingency calculations for the Olmsted Dam Remaining Contract. The review analyzed the approach by the district in performing a risk assessment for remaining cost of the project. This is not to be considered an independent technical review of the cost and schedule data. The review did not assess the accuracy of the actual input data of the risk assessment.

3-6-08

(Signature) (Date)

Cost Engineer, CENWW-EC-X

Certification
Independent Technical Review
Economic and Formulation
of the Olmsted Locks and Dam Navigation Project
Post Authorization Change Report
dated March 2008

I hereby certify that I reviewed the Olmsted Post Authorization Change Report (PACR) from both an economic and plan formulation perspective and found the report and analysis to conform to Corps requirements and procedures. The computation of the Section 902 cost limit was done in accordance with the method specified in ER 1105-2-100, Appendix G. My comments and the responses from the Louisville District are attached.

Bill Frechione — 21 MAR 08

Bill Frechione, CELRP-BR-E
Regional Technical Specialist in
Inland Navigation Economics

date

REVIEW PLAN
LOCKS AND DAMS 52 AND 53 REPLACEMENT PROJECT (OLMSTED LOCK AND DAM), IL & KY
POST-AUTHORIZATION CHANGE REPORT
LOUISVILLE DISTRICT

APPENDIX B
PROJECT DELIVERY TEAM

Name	Discipline
Larry Bibelhauser	Project Manager
Mitch Laird/ Jane Ruhl	Lead Planner
Buddy Langdon, Sharon Weekly, Tim Smith, Wes Walker	Economics
Mike Turner	Environmental Resources
Jan Marie Hemberger	Cultural Resources
Steve McNamara	Floating Plant
Byron McClellan	Engineering
Mike Braden	Cost Engineering
Matt Watts	Cost Closure Matrices
Rick Schipp	Construction
Gene Dowell	Operations
Patty Smith	Real Estate
Deena Braunstein	Legal

INDEPENDENT TECHNICAL REVIEW TEAM

Name	Discipline
Bill Frechione	Economics
Kim Callan	Cost Engineering [1]

[1] The Walla Walla Cost Directory of Expertise performed a quality assurance review of the methodology used in determining contingency for the remaining contract. This is not to be considered an ITR of the cost and schedule data. The review did not assess the accuracy of input data for the risk assessment.

INDEPENDENT EXTERNAL PEER REVIEW PANEL

Name	Discipline
TBD	Economics
TBD	Cost Engineering

VERTICAL TEAM

Name	Phone	Email
Larry Brotherton	513-684-6899	Larry.J.Brotherton@usace.army.mil
Becky Moyer	513-684-3598	Rebecca.J.Moyer@usace.army.mil

PLANNING CENTER OF EXPERTISE
INLAND NAVIGATION

Name	Discipline	Phone	Email
Dave Weekly	Civil Engineer	304-399-6955	David.A.Weekly@usace.army.mil

REVIEW PLAN
LOCKS AND DAMS 52 AND 53 REPLACEMENT PROJECT (OLMSTED LOCK AND DAM), IL & KY
POST-AUTHORIZATION CHANGE REPORT
LOUISVILLE DISTRICT

APPENDIX C
ACRONYMS AND ABBREVIATIONS

Term	Definition	Term	Definition
ASA(CW)	Assistant Secretary of the Army for Civil Works	OEO	Outside Eligible Organization
ATR	Agency Technical Review	OMB	Office and Management and Budget
CELRL (LRD)	Corps of Engineers, Ohio River and Great Lakes Division	ORNIM	Ohio River Navigation Investment Model
CELRD (LRL)	Corps of Engineers, Louisville District	PACR	Post Authorization Change Report
CTA	Center for Transportation Analysis	PCoP	Planning Community of Practice
CWRB	Civil Works Review Board	PCX	Planning Center of Expertise
DQC	District Quality Control	PDT	Project Delivery Team
DX	Directory of Expertise	PPA	Project Partnership Agreement
EA	Environmental Assessment	QA	Quality Assurance
EC	Engineer Circular	QC	Quality Control
EIR	Environmental Impact Report	QMP	Quality Management Plan
EIS	Environmental Impact Statement	RIT	Regional Integration Team
EO	Executive Order	SAR	Safety Assurance Review
FDR	Flood Damage Reduction	WAM	Waterways Analysis Model
FRM	Flood Risk Management	WRDA	Water Resources Development Act
IEPR	Independent External Peer Review	WSDM	Waterway Supply and Demand Module
ITR	Independent Technical Review		
LRM	Lock Risk Module		
MSC	Major Subordinate Command		
NED	National Economic Development		
NEPA	National Environmental Policy Act		
O&M	Operation and maintenance		

OLMSTED LOCKS AND DAM PROJECT, IL & KY

POST AUTHORIZATION CHANGE REPORT

APPENDIX I

Independent External Peer Review Documentation

November 15, 2010

Mr. David A. Weekly
U.S. Army Corps of Engineers
Huntington District, ATTN: CELRH-NC
502 8th Street, Huntington, WV 25701-2070

CONTRACT NO. *W912HQ-10-D-0002*
IWR TASK ORDER: *0005*
SUBMITTAL OF DELIVERABLE: *Final IEPR Report*

Dear Mr. Weekly:

This letter accompanies the submission of the Final IEPR Report for the Independent External Peer Review (IEPR) Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report. These are being delivered to you under Contract No. W912HQ-10-D-0002, Task Order: 0005. This deliverable is being submitted electronically in pdf format.

Please call me at (561) 656-6304 (office) or 202-302-0516 (cell) if you have any technical questions regarding this submittal.

Sincerely,

Karen Johnson-Young

Karen Johnson-Young
Project Manager

encl.

cc: Larry Bibelhauser

Battelle
The Business of Innovation

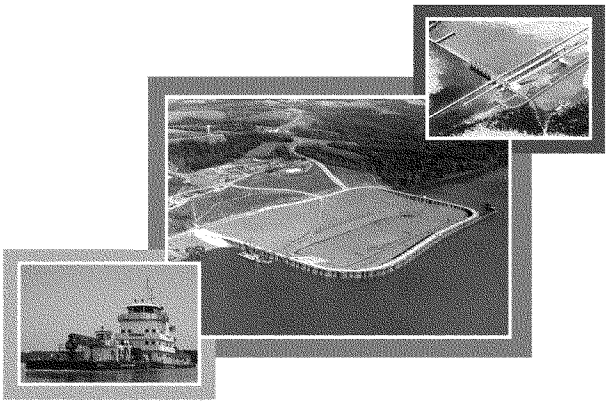
Final Independent External Peer Review Report Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report

Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Inland Navigation Planning Center of Expertise
Huntington District

Contract No. W912HQ-10-D-0002
Task Order: 0005

November 15, 2010



Final Independent External Peer Review Report
Olmsted Locks and Dam 52 and 53 Replacement Project
Post Authorization Change Report

by

Battelle
505 King Avenue
Columbus, OH 43201

for

Department of the Army
U.S. Army Corps of Engineers
Inland Navigation Planning Center of Expertise
Huntington District

November 15, 2010

Contract Number W912HQ-10-D--0002
Task Order: 0005

FINAL
INDEPENDENT EXTERNAL PEER REVIEW REPORT
for the
Olmsted Locks and Dam 52 and 53 Replacement Project
Post Authorization Change Report

EXECUTIVE SUMMARY

The purpose of the Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report (Olmsted Locks and Dam PACR) is to recommend an increase in the maximum amount of funding that the U.S. Army Corps of Engineers (USACE) is authorized to spend on completion of the project, to document the reasons for the recommendation, and demonstrate continued feasibility of the overall project. The report is required because the current estimated cost of completing the project exceeds the maximum cost limit, as defined in Section 902 of the Water Resources Development Act (WRDA) of 1988 ("902 cost limit"). The Olmsted Locks and Dam project was authorized in the WRDA of 1988 (PL 100-676). Initial construction funding was provided by the Energy and Water Development Appropriations Act of 1991.

The Olmsted Locks and Dam project is economically justified based on projected commercial transportation savings derived from reduced processing and congestion time, and represents a reinvestment in the nation's inland navigation infrastructure. The Olmsted Locks and Dam project provides for a structure near Ohio River Mile 964.4 that would replace the existing Locks and Dam 52 and 53. The structure will consist of twin 110-foot by 1,200-foot locks adjacent to the Illinois bank, five tainter gates, a 1,400-foot navigable pass, and a fixed weir extending to the Kentucky bank. During low flow conditions, an upper pool having an elevation 300 feet at the dam would extend upstream to the Smithland Locks and Dam, a distance of 47 miles. Open river conditions will exist from the dam site to the mouth of the Ohio River, a distance of approximately 17 miles. The first construction contract was awarded on November 19, 1992 to construct the access road and resident engineer's office. Since then, several contracts have been awarded and completed including those for the locks cofferdam, the locks, the approach walls and the operating and maintenance bulkheads. The contract for the construction of the dam was awarded January 28, 2004 and construction work is ongoing. Other contracts to be awarded in the future include the operation buildings, demolition of Locks and Dam 52 and 53, and various equipment contracts.

The Olmsted Locks and Dam PACR was prepared in accordance with the Planning Guidance Notebook, ER-1105-2-100 dated June 2004. The original authorized cost of the project as reported in the Report of the Chief of Engineers dated August 20, 1986 and the Water Resources Development Act of 1988 was $775,000,000. The authorized cost to construct the Olmsted Locks and Dam project was adjusted for inflation using the method described in ER 1105-2-100, Appendix G. The authorized cost at the October 2007 price level is $1,337,959,000. The Section 902 maximum cost limit for the Olmsted Locks and Dam project is $1,544,031,000. Based on cost increases described in the Olmsted Locks and Dam PACR, the revised estimated cost at the October 2007 price level is $1,991,000,000. The current cost estimate with inflation applied to the remaining cost to complete, at the October 2007 price level, is $2,067,000,000. The

increases in costs are not associated with changes in project purpose, local cooperation requirements, location of project, or because of modifications required by law. The changes in costs are a result of design changes, contract modifications, less than efficient funding, time extensions and other unanticipated increases in project first costs.

USACE is conducting an Independent External Peer Review (IEPR) of the Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report (hereinafter Olmsted Locks and Dam PACR). Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels for USACE, was engaged to coordinate the IEPR of the Olmsted Locks and Dam PACR. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2010), USACE (2007), and OMB (2004). This final report describes the IEPR process, describes the panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel (the Panel).

Four panel members were selected for the IEPR from more than 31 identified candidates. Based on the technical content of the Olmsted Locks and Dam PACR and the overall scope of the project, the final panel members were selected for their technical expertise in the following key areas: economics (two experts) and cost engineering (two experts). Although the Panel was disclosed to USACE, Battelle made the final decision on selecting the Panel.

The Panel received electronic versions of the Olmsted Locks and Dam PACR documents, along with a charge that solicited comments on specific sections of the documents to be reviewed. Battelle did not develop the charge questions for this project. Charge questions were provided by USACE to guide the peer and were included in the draft and final Work Plans.

The USACE Project Delivery Team briefed the Panel and Battelle during a kick-off meeting held via teleconference prior to the start of the review. In addition to this teleconference, a teleconference with USACE, the Panel, and Battelle was held halfway through the review period to provide the Panel an opportunity to ask questions of USACE and clarify uncertainties regarding the project. The Panel produced more than 128 individual responses to the 33 charge questions and formulated 19 Preliminary Panel Comments.

IEPR panel members reviewed the Olmsted Locks and Dam PACR documents individually. The panel members then met via teleconference with Battelle to review individual technical comments and Preliminary Comments, and discuss charge questions for which there were conflicting responses. In this teleconference, the panel members also reached agreement on which Preliminary Panel Comments would be carried forward as Final Panel Comments. Each Final Panel Comment was documented using a four-part format consisting of: (1) a comment statement; (2) the basis for the comment; (3) the significance of the comment (high, medium, or low); and (4) recommendations on how to resolve the comment. Overall, eight Final Panel Comments were identified and documented. Of these, seven had medium significance, and one had low significance. There were no issues or comments identified with a high level of significance.

Table ES-1 summarizes the Final Panel Comments by level of significance. Detailed information on each comment is contained in Appendix A of this report.

Table ES-1. Overview of 9 Final Panel Comments Identified by the Olmsted Locks and Dam PACR IEPR Panel

Significance – Medium	
1	The contingency cost should expand existing line items to account for cash flow issues that may arise over the next 5 years.
2	The lock closure days assumptions and estimated lock closure costs used in calculating project benefits are not well supported in the report.
3	The PACR does not include an update on historical tonnages and traffic projections by commodity or sensitivity tests, nor does it consider the impact of potential environmental constraints on coal tonnage projections.
4	The transportation rate analysis in Appendix A does not clearly describe the rate analysis methodology and derivation of project benefits.
5	The cost risk analysis and contingency determination does not include remaining work or consider experience with the dam construction methods, changes in dam construction assumptions, or changes in the economic climate that have occurred in the nearly four years since it was completed.
6	The without project future condition is not properly specified and authorized changes since the 1990 update are not clearly described.
7	The PACR does not include a report section that identifies, describes, and analyzes areas of risk and uncertainty for the project.
Significance – Low	
8	National Economic Development (NED) costs may not accurately reflect project implementation costs.

The Panel agreed on its "assessment of the adequacy and acceptability of the economic and cost engineering methods, models, and analyses used" (USACE, 2010; p. D-4) in the Olmsted Locks and Dam PACR document. The Panel generally agreed that the project is well justified under a range of possible future scenarios, and that the assumptions that underlie the economic and cost engineering analyses are sound. Furthermore, it was apparent and appreciated that a great deal of effort went into the cost risk analysis for the remaining dam costs, the benefit analysis, and the determination of the benefit-cost ratio for the Olmsted Locks and Dam project. However, the Panel believes that the Olmsted Locks and Dam PACR should provide updated key cost and economic data, a better explanation of the derivation of the benefits of the project, a risk and uncertainty section, and greater detail on the application of contingencies for all portions of the remaining work. The Panel also notes that the Executive Summary does not provide a complete synopsis of the information and analyses contained in the PACR, including significant design changes, reasons for cost increases, changes in project benefits, determination of the benefit-cost ratio, and recommendations. Inclusion of those items in the Executive Summary would improve the overall understanding of the PACR.

The following statements summarize the Panel's findings, which are described in more detail in the Final Panel Comments (see Appendix A).

Economics:

The Panel agreed that the Olmsted Locks and Dam PACR economics analysis clearly demonstrated the economic justification for completing the project. The Panel was impressed by the detailed development of five alternative coal forecasts and with the detailed rate studies that support project benefits. However, the Panel has concerns that the commodity forecasts are dated. The Panel believes that the inclusion of historic traffic tonnages from 2006-2009 and the display of projections by commodity would provide further support for the project. Additional sensitivity testing should also be conducted to include potential uncertainties such as environmental issues, concerns, and other variables, such as carbon dioxide emissions. This additional testing will provide the needed accounting for potential uncertainties but will not change the economic justification of the project. The Panel also notes that the description of the rate studies in the PACR should be expanded to improve the report's understanding.

In addition, the PACR provides some risk and uncertainty evaluations but the analyses could be better supported by the inclusion of a risk and uncertainty section that discusses and analyzes all areas of risk and uncertainty associated with the project. Finally, the Panel had concerns regarding the uncertainty of the coal projections and the sensitivity of potential environmental constraints on coal tonnage projections, as well as the use of the "fix-as-fail" operation and maintenance scenario for the without project condition and the treatment of "foregone costs" as negative costs in the benefit cost analysis.

Cost Engineering:

The Olmsted Locks and Dam PACR provides a significant level of detail to support the cost increases and the remaining construction costs. The cost risk analysis performed on the remaining dam costs was thorough and developed appropriate contingency estimates for the remaining unconstructed dam features. The PACR makes it clear this contingency is largely due to the dam construction methods, contracting mechanism, and funding inefficiencies. However, the cost risk analysis was completed in 1997 and does not clearly incorporate changes in construction, improved understanding of construction techniques, funding assumptions, and the economic climate in the intervening years. The contingencies for remaining work beyond the dam should also be based on a cost risk analysis, taking into account the complexity of the project and the remaining schedule. The Panel notes that the level of technical support with regard to the lock closure estimates could be enhanced by including documentation to clarify the lock closure estimates that are critical to the cost-benefit analysis.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
1. INTRODUCTION 1
2. PURPOSE OF THE IEPR 2
3. METHODS 2
3.1 Planning and Schedule 3
3.2 Identification and Selection of IEPR Panel Members 4
3.3 Preparation of the Charge and Conduct of the IEPR 7
3.4 Review of Individual Comments 7
3.5 IEPR Panel Teleconference 8
3.6 Preparation of Final Panel Comments 8
4. PANEL DESCRIPTION 9
5. SUMMARY OF FINAL PANEL COMMENTS 13
6. REFERENCES 16

APPENDICES

APPENDIX A A-1
APPENDIX B B-1

LIST OF TABLES

Table ES-1. Overview of 8 Final Panel Comments Identified by the Olmsted Locks and Dam PACR IEPR Panel iii
Table 1. Olmsted Locks and Dam PACR IEPR Schedule 3
Table 2. Olmsted Locks and Dam PACR IEPR Panel: Technical Criteria and Areas of Expertise 10
Table 3. Overview of 8 Final Panel Comments Identified by the Olmsted Locks and Dam PACR IEPR Panel 15

LIST OF ACRONYMS

ATR	Agency Technical Review
CBO	Congressional Budget Office
COI	Conflict of Interest
CPM	Critical Path Method
CWWBS	Civil Works Work Breakdown Structure
DrChecks	Design Review and Checking System
EC	Engineering Circular
ERDC	Engineer Research and Development Center
IEPR	Independent External Peer Review
IWTF	Inland Waterways Trust Fund
MCACES	Microcomputer Aided Cost Engineering System
NED	National Economic Development
NTP	Notice to Proceed
OMB	Office of Management and Budget
ORNIM	Ohio River Navigation Investment Model
PACR	Post Authorization Change Report
P&G	Principles and Guidelines
PERT	Program Review and Evaluation Technique
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
TVA	Tennessee Valley Authority
WRDA	Water Resources Development Act

1. INTRODUCTION

The purpose of the Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report (Olmsted Locks and Dam PACR) is to recommend an increase in the maximum amount of funding that the U.S. Army Corps of Engineers (USACE) is authorized to spend on completion of the project, to document the reasons for the recommendation, and demonstrate continued feasibility of the overall project. The report is required because the current estimated cost of completing the project exceeds the maximum cost limit, as defined in Section 902 of the Water Resources Development Act (WRDA) of 1988 ("902 cost limit"). The Olmsted Locks and Dam project was authorized in the WRDA of 1988 (PL 100-676). Initial construction funding was provided by the Energy and Water Development Appropriations Act of 1991.

The Olmsted Locks and Dam project is economically justified based on projected commercial transportation savings derived from reduced processing and congestion time, and represents a reinvestment in the nation's inland navigation infrastructure. The Olmsted Locks and Dam project provides for a structure near Ohio River Mile 964.4 that would replace the existing Locks and Dam 52 and 53. The structure will consist of twin 110-foot by 1,200-foot locks adjacent to the Illinois bank, five tainter gates, a 1,400-foot navigable pass, and a fixed weir extending to the Kentucky bank. During low flow conditions, an upper pool having an elevation 300 feet at the dam would extend upstream to the Smithland Locks and Dam, a distance of 47 miles. Open river conditions will exist from the dam site to the mouth of the Ohio River, a distance of approximately 17 miles. The first construction contract was awarded on November 19, 1992 to construct the access road and resident engineer's office. Since then, several contracts have been awarded and completed including those for the locks cofferdam, the locks, the approach walls and the operating and maintenance bulkheads. The contract for the construction of the dam was awarded January 28, 2004 and construction work is ongoing. Other contracts to be awarded in the future include the operation buildings, demolition of Locks and Dam 52 and 53, and various equipment contracts.

The Olmsted Locks and Dam PACR was prepared in accordance with the Planning Guidance Notebook, ER-1105-2-100 dated June 2004. The Section 902 limit for the Olmsted Locks and Dam project is currently $1,544,031,000, based on the authorized cost of $775,000,000 as reported in the Report of the Chief of Engineers dated August 20, 1986 and the WRDA of 1988. The authorized cost to construct the Olmsted Locks and Dam project was adjusted for inflation using the method described in ER 1105-2-100, Appendix G. The fully funded cost was estimated at $1,389,031,000. Based on cost increases described in the Olmsted Locks and Dam PACR, the revised estimated cost is $2,067,000,000. The WRDA of 1988 authorized the Olmsted Locks and Dam project cost of $775,000,000. These authorized costs, when brought to current price levels and inflated per Section 902 guidance, are $1,337,959,000. The current cost estimate without inflation at the October 2007 price level is $1,991,000,000. The current cost estimate with inflation applied to the remaining cost to complete, at the October 2007 price level, is $2,067,000,000. The increases in costs are not associated with changes in project purpose, local cooperation requirements, location of project, or because of modifications required by law.

The changes in costs are a result of design changes, contract modifications, less than efficient funding, time extensions and other unanticipated increases in project first costs.

The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the Olmsted Locks and Dam PACR in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers Engineer Circular *Civil Works Review Policy* (EC No. 1165-2-209) (USACE, 2010), USACE CECW-CP memorandum *Peer Review Process* (USACE, 2007), and Office of Management and Budget (OMB) bulletin *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels, was engaged to coordinate the IEPR of the Olmsted Locks and Dam PACR. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

This final report details the IEPR process, describes the IEPR panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel on the existing environmental, economic, and engineering analyses contained in the Olmsted Locks and Dam PACR. Detailed information on the Final Panel Comments is provided in Appendix A.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the Agency Technical Review (ATR), as described in USACE (2010) and USACE (2007).

In general, the purpose of peer review is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. IEPR provides an independent assessment of the economic, engineering, and environmental analysis of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to make a good decision regarding implementation of alternatives and recommendations.

In this case, the IEPR of the Olmsted Locks and Dam PACR was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization under Section 501(c)(3) of the U.S. Internal Revenue Code with experience conducting IEPRs for USACE.

3. METHODS

This section describes the method followed in selecting the members for the IEPR Panel (the Panel) and in planning and conducting the IEPR. The IEPR was conducted following procedures described by USACE (2010) and in accordance with USACE (2007) and OMB (2004) guidance. Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

3.1 Planning and Schedule

At the beginning of the Period of Performance (POP), Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, discuss the IEPR process, and address any questions regarding the scope (e.g., clarify expertise areas needed for panel members). Any revisions to the schedule were submitted as part of the final Work Plan.

Table 1 defines the schedule followed in executing the IEPR. Due dates for milestones and deliverables are based on the Notice to Proceed (NTP) date of September 10, 2010. Note that the work items listed in Task 6 occur after the submission of this report. Battelle will enter the eight Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle.

Table 1. Olmsted Locks and Dam PACR IEPR Schedule

TASK	ACTION	DUE DATE
1	**Notice to Proceed (NTP)**[a]	9/10/2010
	Review documents available	9/10/2010
	Battelle submits draft Work Plan[b]	9/21/2010
	USACE provides comments on draft Work Plan	9/28/2010
	Teleconference (if necessary)	9/28/2010
	Battelle submits final Work Plan[b]	10/5/2010
2	Battelle requests input from USACE on the conflict of interest (COI) questionnaire	9/15/2010
	USACE provides comments on COI questionnaire	9/16/2010
	Battelle submits list of selected panel members[b]	9/28/2010
	USACE provides comments on selected panel members	9/29/2010
	Battelle completes subcontracts for panel members	10/12/2010
3	USACE/Battelle kick-off meeting	9/15/2010
	Battelle sends review documents to panel members	10/13/2010
	USACE/Battelle/IEPR Panel kick-off meeting	10/14/2010
	Battelle convenes mid-review teleconference for Panel to ask clarifying questions of USACE	10/18/2010

TASK	ACTION	DUE DATE
4	Panel members complete their review and submit responses to charge questions and Preliminary Panel Comments to Battelle for review	10/21/2010
	Battelle provides comments on Preliminary PanelComments to Panel/IEPR Final Panel Comments finalized (iterative process)	10/25/2010-11/5/2010
5	**Battelle submits Final IEPR Report to USACE[b]**	**11/15/2010**
6[c]	Battelle inputs IEPR Final Panel Comments to DrChecks; Battelle provides IEPR Final Panel Comment response template to USACE	11/17/2010
	USACE provides draft Evaluator responses and clarifying questions	11/22/2010
	Teleconference between Battelle, IEPR Panel, and USACE to discuss IEPR Final Panel Comments, draft Evaluator responses, and clarifying questions	12/6/2010
	USACE inputs final Evaluator responses in DrChecks	12/13/2010
	Battelle inputs the Panel's BackCheck responses in DrChecks	12/22/2010
	Battelle submits pdf printout of DrChecks project file and closes out DrChecks[b]	12/23/2010
	Project closeout/period of performance ends	3/3/2011

[a] Requested to start on recruitment to meet the aggressive schedule
[b] Deliverable
[c] Task occurs after the submission of this report.

3.2 Identification and Selection of IEPR Panel Members

The candidates for the Panel were evaluated based on their technical expertise in the following key areas: economics (two experts) and cost engineering (two experts). These areas correspond to the technical content of the Olmsted Locks and Dam PACR and overall scope of the project.

To identify candidate panel members, Battelle reviewed experts in Battelle's Peer Reviewer Database, sought recommendations from colleagues, contacted former panel members, and conducted targeted Internet searches. Battelle initially identified more than 31 candidates for the Panel, evaluated their technical expertise, and inquired about potential COIs. Of these, Battelle chose six of the most qualified candidates and confirmed their interest and availability. Of the six candidates, four were proposed for the final Panel and two were proposed as backup reviewers (one expert for each area expertise). Information about the candidate panel members, including brief biographical information, highest level of education attained, and years of experience, was provided to USACE for feedback. Battelle made the final selection of panel members according to the selection criteria described in the Work Plan.

The four proposed primary reviewers constituted the final Panel. However, after the USACE/Battelle/IEPR Panel kick-off meeting, one of the cost engineering panel members requested to be removed from the Panel due to an unexpected illness. The back-up cost engineering candidate was then contacted and added to the Panel. The candidates were screened

for the following potential exclusion criteria or COIs.[1] These COI questions were intended to serve as a means of disclosure, and to better characterize a potential candidate's employment history and background. Providing a positive response to a COI screening question did not automatically preclude a candidate from serving on the Panel. For example, participation in previous USACE technical peer review committees and other technical review panel experience was included as a COI screening question. A positive response to this question could be considered a benefit.

- Involvement by you or your firm[2] in the Olmsted Lock and Dam PACR.
- Involvement by you or your firm[2] in flood control, navigation or ecosystem restoration projects in Ballard County (KY), Pulaski County (IL), or in the vicinity of Ohio River Mile 964. Including:
    - Smithland Locks and Dam
    - Olmsted Dam Design & Construction
    - Olmsted Locks and Dam Project- Locks Cofferdam,
    - Olmsted Locks and Dam Project - Locks,
    - Olmsted Locks and Dam Project - Approach Walls
    - Olmsted Locks and Dam Project - Operating & Maintenance Bulkheads
- Involvement by you or your firm[2] in the Olmsted Lock and Dam PACR, or related projects.
- Current employment by USACE.
- Involvement with paid or unpaid expert testimony related to Olmsted Lock and Dam PACR.
- Current or previous employment or affiliation with members of the cooperating agencies or local sponsors, including:
    - Kentucky Department of Fish and Wildlife Resources
    - City of Olmsted, IL
    - City of Paducah, KY
    - City of Cairo, IL
    - Illinois State Historic Preservation Agency
    - Kentucky State Historic Preservation Office
    - Inland Waterways Trust Fund

    (for pay or *pro bono*).

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[1] Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See OMB (2004, p. 18), "....when a scientist is awarded a government research grant through an investigator-initiated, peer-reviewed competition, there generally should be no question as to that scientist's ability to offer independent scientific advice to the agency on other projects. This contrasts, for example, to a situation in which a scientist has a consulting or contractual arrangement with the agency or office sponsoring a peer review. Likewise, when the agency and a researcher work together (e.g., through a cooperative agreement) to design or implement a study, there is less independence from the agency. Furthermore, if a scientist has repeatedly served as a reviewer for the same agency, some may question whether that scientist is sufficiently independent from the agency to be employed as a peer reviewer on agency-sponsored projects."

[2] Includes any joint ventures in which your firm is involved.

- Past, current or future interests or involvements (financial or otherwise) by you, your spouse or children related to Ballard County (KY), Pulaski County (IL), or in the Ohio River System in the vicinity of river mile 964.
- Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, Engineer Development and Research Center (ERDC), etc.), and position/role. Please highlight and discuss in greater detail any projects that are specifically with the Louisville District.
- Current firm[2] involvement with other USACE projects, specifically those projects/contracts that are with the Louisville District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role.
- Any previous employment by the USACE as a direct employee or contractor (either as an individual or through your firm[2]) within the last 10 years, notably if those projects/contracts are with the Louisville District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning flood risk management, navigation, or ecosystem review, and include the client/agency and duration of review (approximate dates).
- Pending, current or future financial interests in Olmsted Lock and Dam PACR, or related contracts/awards from USACE.
  Including:
  - Smithland Locks and Dam
  - Olmsted Dam Design & Construction
  - Olmsted Locks and Dam Project- Locks Cofferdam
  - Olmsted Locks and Dam Project - Locks,
  - Olmsted Locks and Dam Project - Approach Walls
  - Olmsted Locks and Dam Project - Operating & Maintenance Bulkheads
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last three years came from USACE contracts.
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to Olmsted Lock and Dam PACR.
- Participation in relevant prior Federal studies relevant to this project and/or Olmsted Lock and Dam PACR including:
  - The Lower Ohio River Feasibility Study
  - Smithland Locks and Dam
  - Olmsted Dam Design & Construction
- Participation in prior non-Federal studies relevant to this project and/or Olmsted Lock and Dam PACR.

- Is there any past, present or future activity, relationship or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project? If so, please describe.

In selecting the final members of the Panel from the list of candidates, Battelle chose experts who best fit the expertise areas and had no COIs. The four final reviewers were either affiliated with academic institutions or consulting companies or were independent engineering consultants. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. Although the Panel was disclosed to USACE, Battelle made the final decision on selecting the Panel. Section 4 of this report provides names and biographical information on the panel members.

Prior to beginning their review and within 1 day of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication, and other pertinent information for the Panel. Once the need for the backup cost engineer was confirmed, a separate teleconference was held with the cost engineer experts, including the departing primary cost engineer, the second primary cost engineer, and the added (backup) cost engineer. This teleconference allowed the original primary cost engineers to brief the backup cost engineer on information on the PACR they had reviewed to date, the results of their review, and any other pieces of information to share on the IEPR process to ensure a seamless transition between the panel members.

3.3 Preparation of the Charge and Conduct of the IEPR

Charge questions were provided by USACE and included in the draft and final Work Plans. In addition to a list of 33 charge questions/discussion points, the final charge included general guidance for the Panel on the conduct of the peer review (provided in Appendix B of this final report).

Battelle planned and facilitated a final kick-off meeting via teleconference during which USACE presented project details to the Panel. Before the meeting, the IEPR Panel received an electronic version of the Olmsted Locks and Dam PACR documents and the final charge. A full list of the documents reviewed by the Panel is provided in Appendix B of this report. The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle and to develop Preliminary Comments on the key technical issues.

3.4 Review of Individual Comments

Prior to completion of the review of the Olmsted Locks and Dam PACR documents, a teleconference with USACE, the Panel, and Battelle was held halfway through the review period to provide the Panel an opportunity to ask questions of USACE and clarify uncertainties regarding the project. At the end of the review period, the Panel produced approximately 128 individual comments and 19 Preliminary Panel Comments in response to the charge questions. Battelle reviewed the comments and provided discussion points and a summary of the concerns

not identified in the Preliminary Comments. Each panel member's individual comments and Preliminary Comments were shared with the full Panel.

3.5 IEPR Panel Teleconference

Battelle facilitated a 3-hour teleconference with the Panel so that the panel experts, many of whom are from diverse scientific backgrounds, could exchange technical information. The main goal of the teleconference was to identify which Preliminary Panel Comments should be carried forward as Final Panel Comments in the IEPR report and decide which panel member would serve as the lead author for the development of each Final Panel Comment. This information exchange ensured that the Final IEPR Report would accurately represent the Panel's assessment of the project, including any conflicting opinions. The Panel engaged in a thorough discussion of the overall positive and negative comments, added any missing issues of high-level importance to the findings, and merged any related individual comments. In addition, Battelle confirmed each Final Panel Comment's level of significance to the Panel.

The Panel also discussed responses to four specific charge questions where there appeared to be disagreement among panel members. The conflicting comments were resolved based on the professional judgment of the Panel, and all sets of comments were determined not to be conflicting. Each comment was either incorporated into a Final Panel Comment, determined to be consistent with other Final Panel Comments already developed, or determined to be a non-significant issue.

At the end of these discussions, the Panel identified eight comments and discussion points that should be brought forward as Final Panel Comments.

3.6 Preparation of Final Panel Comments

Following the teleconference, Battelle prepared a summary memorandum for the Panel documenting each Final Panel Comment (organized by level of significance). The memorandum provided the following detailed guidance on the approach and format to be used to develop the Final Panel Comments for the Olmsted Locks and Dam PACR:

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged individual comments table, a summary detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.
- Directive to the Lead: Each lead was encouraged to communicate directly with other IEPR panel members as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.

- Format for Final Comments: Each Final Panel Comment was presented as part of a four-part structure:
  1. Comment Statement (succinct summary statement of concern)
  2. Basis for Comment (details regarding the concern)
  3. Significance (high, medium, low; see description below)
  4. Recommendation for Resolution (see description below).
- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
  1. High: Describes a fundamental problem with the project that could affect the recommendation or justification of the project (e.g., "showstopper")
  2. Medium: Affects the completeness or understanding of the reports/project
  3. Low: Affects the technical quality of the reports but will not affect the recommendation of the project.
- Guidance for Developing the Recommendation: The recommendation was to include specific actions that the USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

At the end of this process, eight Final Panel Comments were prepared and assembled. Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in Appendix A of this report.

4. PANEL DESCRIPTION

Candidates for the Panel were identified using Battelle's Peer Reviewer Database, targeted Internet searches using key words (e.g., technical area, geographic region), searches of websites of universities or other compiled expert sites, and referrals. Battelle prepared a draft list of primary and backup candidate panel members (who were screened for availability, technical background, and COIs), and provided it to USACE for feedback. Battelle made the final selection of panel members.

An overview of the credentials of the final four primary members of the Panel and their qualifications in relation to the technical evaluation criteria is presented in Table 2. More detailed biographical information regarding each panel member and his or her area of technical expertise is presented in the text that follows the table.

Table 2. Olmsted Locks and Dam PACR: IEPR Panel: Technical Criteria and Areas of Expertise

	Brown	Schlebusch	Burns	Shoudy
Cost Engineering (two experts needed)	X	X		
Minimum 10 years demonstrated experience in cost engineering analysis for public works projects	X	X		
Minimum 5 years experience with development of estimated construction costs and construction methods related to large civil works navigation projects	X			
Familiar with all applicable USACE regulations that require extensive knowledge of MCACES[a] 2nd Generation (MII)	X[b]	X		
Familiar with all applicable USACE regulations that require extensive knowledge of CWWBS	X	X		
Familiar with all applicable USACE regulations that require extensive knowledge of critical path construction scheduling	X	X		
Licensed professional engineer, certified cost consultant/certified cost engineer, or certified estimating professional	X	X		
Minimum M.S. degree in appropriate field of study	X	X		
Economics (two experts needed)				
Minimum 10 years experience directly related to water resource economic evaluation or review			X	X
Minimum 5 years of experience dealing with USACE planning processes as outlined in ER-1105-2-100 Planning Guidance Notebook, specifically in regard to inland navigation studies, outlined in Appendix E			X	X
Minimum 2 years experience reviewing federal water resource economic documents justifying construction efforts			X	X
Minimum 5 years experience directly working for or with USACE is highly recommended			X	X
Minimum M.S. degree in economics			X	X

[a] Microcomputer Aided Cost Engineering System (MCACES)
[b] Panel member experienced with MCACES I only.
[c] Civil Works Work Breakdown Structure (CWWBS)

Christopher Brown, P.E., Ph.D.
Role: This panel member was chosen primarily for his cost engineering experience and expertise.
Affiliation: University of North Florida

Dr. Christopher Brown is a professor at the University of North Florida teaching civil engineering, fluid mechanics, hydraulics, and engineering geology. He earned his Ph.D. in civil engineering in 2005 from the University of Florida and is a licensed professional engineer in FL and Pennsylvania. He has over 20 years of experience working on public works projects for the USACE (1991-2006) and as a private consultant focusing on geotechnical engineering, water resources planning, and civil engineering projects. He is experienced in developing estimated construction costs and construction methods related to large civil works navigation projects involving canals, ocean harbors, inland navigation, dredged material disposal, water borne construction, and subsurface barrier walls. Large Civil Works projects supported include C&D Canal Deeping Project in Maryland and Delaware and the Delaware Main Channel Deeping Project in Pennsylvania and New Jersey. Dr. Brown is familiar with all applicable USACE regulations that require an extensive knowledge of cost engineering applications. He is familiar with Microcomputer Aided Cost Engineering System (MCACES) I model estimates, and understands the assumptions and outputs associated with it. He was has worked on a team developing the replacement of bridge sections along the Tamiami Trail in south Florida, a complex project costing over $100 million and involving multiple contracts over a three year period. He is familiar with the basic Civil Works Work Breakdown Structure (CWWBS) and has utilized it on studies such as the Liquid Natural Gas tank foundation improvement in Martin County in 2009 as a part of a five part feasibility-level cost study. He has also utilized the CWWBS to develop feasibility-level cost estimates for the rehabilitation of embankments, outlets structures, and structures for the Iluka Mine, Green Cove, Florida. Dr. Brown is familiar with CPM scheduling, utilizing various software tools including Microsoft Project, Timeline, and self-programming inside Microsoft Excel. He developed PERT charts for the Iluka Mine project and has used Gantt charts for numerous projects including the New Jersey Coast Guard helicopter landing facility rehabilitation and replacement project.

Marc Schlebusch, P.E.
Role: This panel member was chosen primarily for his cost engineering experience and expertise.
Affiliation: CDM, Inc.

Marc Schlebusch is a cost engineer for CDM, Inc., specializing in cost estimates, construction schedules, and project controls for complex projects. He earned his M.S. in environmental engineering from the University of Iowa in 1997, has received formal training in MCACES, 2nd generation (MII), and is a licensed professional engineer in Kansas and Missouri. He has more than 10 years of demonstrated experience in civil cost engineering analysis, design, cost estimation, construction, and operations and maintenance. He is familiar with large, high visibility, complex, civil works projects, having provided cost estimating support for such projects as Louisiana Coastal Area Ecosystem Restoration and the Covent/Blind River Diversion Project, Louisiana and the Central City Project in Ft. Worth, Texas. Mr. Schlebusch is experienced with the development of estimated construction costs and construction methods

related to large civil works navigation projects including the Baptiste Collette Bayou Navigation Channel Deepening, Plaquemines Parish, Louisiana, an eight mile channel enlargement project; and the Central City Project in Ft. Worth, Texas, involving the relocation of a channel and installation of new dam structures. He is familiar with all applicable USACE regulations that require an extensive knowledge of cost engineering applications. He has extensive experience preparing MCACES MII cost estimates for USACE projects with values from $1M to more than $100M including feasibility, design, and construction level estimates for bypass channel/flood control, ecosystem restoration, floodwall demolition and construction, and hazardous site remediation. He is experienced in, and has completed cost estimates requiring, the use of CWWBS. Specific projects utilizing both MII and CWWBS include the Central City Project, Ft. Worth, Texas (estimated cost of $681 million) and the Convent/Blind River Diversion Project, St. James Parish, Louisiana (estimated cost of $123 million). Mr. Schlebusch is experienced in the use of CPP, and has prepared preliminary construction schedules for numerous projects including the Central City Project, Ft. Worth, Texas; and Hurricane Protection Projects, Jefferson Parish, Louisiana.

John Burns

Role: This panel member was chosen primarily for his economics experience and expertise.
Affiliation: CDM, Inc.

John Burns is a senior economist and program manager for CDM, Inc. specializing as a planner and economist. He earned his M.A. in Economics from Michigan State University in 1972. He has over 38 years of experience in the planning and economic analysis of multi-purpose water resources projects that provide navigation, flood damage reduction, water supply, water quality, and ecosystem restoration for USACE (1972-2000) and most recently in the private sector. He was the national manager for USACE's planning program for large-scale water resources projects, responsible for execution of USACE's $140 million General Investigations Program, and for identifying areas requiring new policy direction. He provided expert assistance and policy direction to subordinate offices, helping them resolve complex issues and ensuring that engineering, economic, and environmental analyses guiding navigation, flood damage reduction, ecosystem restoration and other multi-purpose water resources investments and project operational changes were developed to meet the changing needs and priorities of the nation. Mr. Burns is recognized as one of the preeminent experts in federal water resources project policy, planning, and economics. He is experienced with high visibility, large, complex civil works projects as an economist, including his participation in the 2004 Economics Independent Technical Review Team for the Ohio River Mainstem System Study where he was the economics chairman. This study, conducted by the USACE Ohio River Division, was undertaken to develop a comprehensive plan for managing, maintaining, and improving the Ohio River navigation system. He is experienced in dealing with the USACE planning process as outlined in ER-1105-2-100 Planning Guidance Notebook, specifically in regard to inland navigation studies, outlined in Appendix E "Navigation". He has extensive experience analyzing navigation related projects, having applied his expertise to them as both a practitioner and a reviewer.

Harry Shoudy
Role: This panel member was chosen primarily for his economics experience and expertise.
Affiliation: Harry Shoudy Consulting

Harry Shoudy is the chief executive officer for Harry Shoudy Consulting in Henrico, NC. He earned a M.S. in water resources planning from Colorado State University in 1980 and has over 40 years of water resources planning, policy, and economics experience. Before forming his consulting firm in 2003, Mr. Shoudy worked for the USACE for more than 30 years. He performed and directed economic evaluations for the Buffalo District from 1972-1975 as the chief of economics. He served initially as a senior economist and ultimately as the chief economist for the South Atlantic Division, reviewing economic evaluations from 1975-1990. He served as a Senior Policy Advisor to the Board of Engineers for Rivers and Harbors from 1990-1992 as the Board economist and acted as study review manager performing economic and plan formulation reviews for the Board. He worked for USACE Headquarters from 1992-2003 providing project reviews, developing policy, issuing implementation guidance, and providing guidance and training, retiring as senior policy advisor and chief economist for USACE. Mr. Shoudy's USACE career was dedicated to water resources economic, planning, and policy areas and he has over 40 years experience applying Principles and Standards, Principles and Guidelines, and ER 1105-2-100 from its inception. He has participated in the planning and economic analysis of all types of water resources projects to include inland and deep draft navigation, hurricane/storm damage reduction, flood damage reduction, water supply, water quality, and ecosystem restoration. He has performed navigation studies for the Cleveland harbor navigation study, the Lake Erie/Lark Ontario Waterway study, and small boat harbor studies. His inland waterways experience includes Cross Florida Barge Canal, the Apalachicola River, and the Tennessee/Tom Bigbee Waterway. At the request of the U.S. State Department, Mr. Shoudy also provided technical planning, economic and plan formulation advice to the Commission for the Study of Alternatives to the Panama Canal, and assisted in the preparation of scopes of work as well as the review of the contractor reports.

5. SUMMARY OF FINAL PANEL COMMENTS

The Panel agreed on its "assessment of the adequacy and acceptability of the economic and cost engineering methods, models, and analyses used" (USACE, 2010; p. D-4) in the Olmsted Locks and Dam PACR document. The Panel generally agreed that the project is well justified under a range of possible future scenarios, and that the assumptions that underlie the economic and cost engineering analyses are sound. Furthermore, it was apparent and appreciated that a great deal of effort went into the cost risk analysis for the remaining dam costs, the benefit analysis, and the determination of the benefit-cost ratio for the Olmsted Locks and Dam project. However, the Panel believes that the Olmsted Locks and Dam PACR should provide updated key cost and economic data, a better explanation of the derivation of the benefits of the project, a risk and uncertainty section, and greater detail on the application of contingencies for all portions of the remaining work. The Panel also notes that the Executive Summary does not provide a complete synopsis of the information and analyses contained in the PACR, including significant design changes, reasons for cost increases, changes in project benefits, determination of the benefit-cost ratio, and recommendations. Inclusion of those items in the Executive Summary would improve the overall understanding of the PACR.

The following statements summarize the Panel's findings, which are described in more detail in the Final Panel Comments (see Appendix A).

Economics:

The Panel agreed that the Olmsted Locks and Dam PACR economics analysis clearly demonstrated the economic justification for completing the project. The Panel was impressed by the detailed development of five alternative coal forecasts and with the detailed rate studies that support project benefits. However, the Panel has concerns that the commodity forecasts are dated. The Panel believes that the inclusion of historic traffic tonnages from 2006-2009 and the display of projections by commodity would provide further support for the project. Additional sensitivity testing should also be conducted to include potential uncertainties such as environmental issues, concerns, and other variables, such as carbon dioxide emissions. This additional testing will provide the needed accounting for potential uncertainties but will not change the economic justification of the project. The Panel also notes that the description of the rate studies in the PACR should be expanded to improve the report's understanding.

In addition, the PACR provides some risk and uncertainty evaluations but the analyses could be better supported by the inclusion of a risk and uncertainty section that discusses and analyzes all areas of risk and uncertainty associated with the project. Finally, the Panel had concerns regarding the uncertainty of the coal projections and the sensitivity of potential environmental constraints on coal tonnage projections, as well as the use of the "fix-as-fail" operation and maintenance scenario for the without project condition and the treatment of "foregone costs" as negative costs in the benefit cost analysis.

Cost Engineering:

The Olmsted Locks and Dam PACR provides a significant level of detail to support the cost increases and the remaining construction costs. The cost risk analysis performed on the remaining dam costs was thorough and developed appropriate contingency estimates for the remaining unconstructed dam features. The PACR makes it clear this contingency is largely due to the dam construction methods, contracting mechanism, and funding inefficiencies. However, the cost risk analysis was completed in 1997 and does not clearly incorporate changes in construction, improved understanding of construction techniques, funding assumptions, and the economic climate in the intervening years. The contingencies for remaining work beyond the dam should also be based on a cost risk analysis, taking into account the complexity of the project and the remaining schedule. The Panel notes that the level of technical support with regard to the lock closure estimates could be enhanced by including documentation to clarify the lock closure estimates that are critical to the cost-benefit analysis.

Table 3 lists the eight Final Panel Comment statements by level of significance.

Table 3. Overview of 8 Final Panel Comments Identified by the Olmsted Locks and Dam PACR IEPR Panel

Significance – Medium	
1	The contingency cost should expand existing line items to account for cash flow issues that may arise over the next 5 years.
2	The lock closure days assumptions and estimated lock closure costs used in calculating project benefits are not well supported in the report.
3	The PACR does not include an update on historical tonnages and traffic projections by commodity or sensitivity tests, nor does it consider the impact of potential environmental constraints on coal tonnage projections.
4	The transportation rate analysis in Appendix A does not clearly describe the rate analysis methodology and derivation of project benefits.
5	The cost risk analysis and contingency determination does not include remaining work or consider experience with the dam construction methods, changes in dam construction assumptions, or changes in the economic climate that have occurred in the nearly four years since it was completed.
6	The without project future condition is not properly specified and authorized changes since the 1990 update are not clearly described.
7	The PACR does not include a report section that identifies, describes, and analyzes areas of risk and uncertainty for the project.
Significance – Low	
8	National Economic Development (NED) costs may not accurately reflect project implementation costs.

6. REFERENCES

Congressional Budget Office (CBO) (2010). October 2010 Monthly Budget Review. Accessed November 1, 2010. www.cbo.gov

Inland Waterways Trust Fund (IWTF) (2010). Inland Waterways Trust Fund Fact Sheet. http://www.waterways.org/2010%20Website/IWTF/IWTF%20Fact%20Sheet.pdf. November 2, 2010.

OMB (2004). Final Information Quality Bulletin for Peer Review. Executive Office of the President, Office of Management and Budget, Washington, DC. Memorandum M-05-03. December 16.

The National Academies (2003). Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports. The National Academies (National Academy of Science, National Academy of Engineering, Institute of Medicine, National Research Council). May 12.

USACE (2000b). Planning Guidance Notebook (ER 1105-2-100), April 22.

USACE (2007). Peer Review Process. Department of the Army, US Army Corps of Engineers, Washington, DC. CECW-CP Memorandum. March 30.

USACE (2010). Water Resources Policies and Authorities: Civil Works Review Policy. Department of the Army, US Army Corps of Engineers, Washington, DC. Engineer Circular (EC) No. 1165-2-209. January 31.

APPENDIX A

Final Panel Comments

on the

Olmsted Locks and Dam PACR IEPR

Comment 1:
The contingency cost should expand existing line items to account for cash flow issues that may arise over the next 5 years.
Basis for Comment:
The Post Authorization Change Report (PACR) contains information on the construction cash flow (yearly work allowance) that the project has received over the last 15 years; this ranges from $30,000,000 to $110,000,000 and has fluctuated markedly as administration budgetary restrictions and focus areas change over time. The Crystal Ball software used by Walla Walla District to develop the Cost Risk Model has the capability of using the actual cash-flow distribution directly to create a customized variable distribution to forecast possible future trends. Using this option would more accurately model possible cost consequences from poor cash flow in the future. If the cash flow is reduced year to year, the overall schedule is lengthened resulting in additional costs in design, construction management, labor, supplies, and possibly interest during construction. Lastly, future federal budgets may be constrained significantly due to large structural budget deficits that currently exist (CBO, 2010). Matching funds from the Inland Waterways Trust Fund (IWTF) also may be similarly constrained. According to the IWTF 2010 fact sheet: "From its inception, the IWTF contained a surplus, with collections exceeding expenditures. In FY2009, for the first time, the Fund contained less than was needed. Collections are expected to be below need for the foreseeable future."
Significance – Medium:
The unknown contingency line items could increase the PACR cost estimate.
Recommendation(s) for Resolution:
1. Develop additional contingency scenarios with the risk model to determine if the contingency cost could be larger than currently forecast if the cash flow is less than assumed. 2. Use the past historical cash flow (work allowance) to define cash flow itself as a variable distribution in the primary new risk model scenario. Alternatively, reduce cash flow by 25% from currently assumed values. 3. Expand the discussion of funding inefficiencies to include a potential shortage in matching funds from the Inland Waterways Trust Fund.

Literature Cited:

Congressional Budget Office (CBO) (2010). www.cbo.gov website, October 2010 Monthly Budget Review, reviewed November 1, 2010.

Inland Waterways Trust Fund (IWTF) (2010). Inland Waterways Trust Fund Fact Sheet. http://www.waterways.org/2010%20Website/IWTF/IWTF%20Fact%20Sheet.pdf. November 2, 2010.

Comment 2:
The lock closure days assumptions and estimated lock closure costs used in calculating project benefits are not well supported in the report.
Basis for Comment:
The PACR bases the lock closure estimates on engineering judgment with little to no discussion of underlying data (PACR, page 49). The Panel assumes that the needed information is contained within periodic inspection reports and annual inspection reports regarding the existing lock and dams developed by the U.S. Army Corps of Engineers (USACE) over the last 20 years. This information would better justify the underlying lock closure projections and project benefit assumptions by providing necessary supporting data. Since the actual lock closure assumptions are formulated based upon the supporting data, a firm understanding linking the assumptions to the data is critical. The PACR does not provide a discussion of how the repair construction costs for the existing Locks and Dam 52 and 53 were determined. There is no indication in the PACR whether these costs were solely based on engineering judgment tied to historic periodic inspections and annual inspections or if additional cost information (e.g., from other sources) was used to develop cost estimates used in the analysis.
Significance – Medium:
Assumptions on lock closures drive the overall benefit calculations because the time savings in using the locks is a function of the number of closures.
Recommendation(s) for Resolution:
1. Provide supporting data regarding lock closure estimates. The addition of excerpts from periodic/annual inspection reports or rehabilitation summaries in the main report would be very valuable supporting data. 2. Include full supporting data as an appendix to the PACR or as an attachment to Appendix A. 3. Provide a cross reference in Section 8.4 of Appendix A to the cost closure matrices in Attachment 1.

Comment 3:
The PACR does not include an update on historical tonnages and traffic projections by commodity or sensitivity tests, nor does it consider the impact of potential environmental constraints on coal tonnage projections.
Basis for Comment:
The historical tonnages displayed in the report are only up to the year 2005. Historical tonnages are available for lock and dam 52 and 53 by month, on an Excel spreadsheet supplied by the Nashville District during the Panel review, for years 2006 through 2009 and should be added to update the PACR. This information would provide a better foundation to support the waterborne traffic projections. Projected waterborne tonnages are available by commodity from the Ohio River System forecasts published in April 2003. These projected tonnages were updated for the PACR and combined together as one total traffic tonnage. The projections should be shown by commodity in order to more fully understand the importance of each commodity relative to the total tonnage. While the uncertainty of the coal projections is the primary concern regarding future tonnage projections, it is important to report the tonnages by commodity to demonstrate that the variations in coal projections will not impact the projections of the other commodities, with the exception of sorbent materials. A no-growth sensitivity test was included in the PACR that held all traffic constant at the 2010 projection level of traffic. This sensitivity test does not address potential uncertainties related to the possible future environmental issues and concerns related to coal such as carbon dioxide emissions. Potential future coal-related environmental uncertainties should be identified and sensitivity analyses conducted to more fully capture the uncertainty of the coal projections and the impact on project justification.
Significance – Medium:
Reporting projections by commodity groups, updating existing tonnages, and focusing on additional coal sensitivity analysis will improve the understanding, completeness, and credibility of the economic analysis in the PACR report and more fully support the economic justification.
Recommendations for Resolution:
1. Update the recent historic traffic and include the historic traffic and traffic forecasts by commodity for Locks and Dam 52 and 53 in Appendix A. 2. Revise Appendix A to include a reporting of separate projections for coal. 3. Revise Appendix A to include a sensitivity analysis of future coal-related environmental uncertainties.

Comment 4:
The transportation rate analysis in Appendix A does not clearly describe the rate analysis methodology and derivation of project benefits.
Basis for Comment:
Rate data for the PACR were supplied by the Tennessee Valley Authority (TVA). A comparison of waterborne and land-based transportation rate data is essential in calculating the rate differential and the ultimate transportation savings of an inland navigation project. By adding a discussion of the TVA rate analysis methodology and an explanation of why the TVA rates are appropriate for use in the PACR analysis, the report would document USACE's consideration of the rates and the conclusion that the TVA rates were the best available for this analysis. The PACR should also provide further explanation of the Ohio River Navigation Investment Model (ORNIM) and how it relates to the derivation of the rate savings and transportation benefits. The resulting expanded discussion of the rate analysis methodology and the application of the rates in calculating the transportation savings would provide increased documentation and understanding and add credibility to the report. The PACR identifies commodity rates; however, a total rate is shown for all commodities. The Panel assumed that the total rate is a result of the summation of individual commodity rates weighted by tonnage for each commodity. By providing a sample calculation to include the tonnage by commodity, the rate analysis evaluation would be better documented, supported, and understood.
Significance – Medium:
A more comprehensive discussion of the rate analysis methodology and benefit derivation will provide valuable documentation, increase the credibility, and provide an improved understanding of the total rate savings per ton and transportation savings estimates.
Recommendations for Resolution:
1. Expand the rate analysis methodology discussion (Appendix A) to include an explanation of why the rates are appropriate for this study and provide a sample calculation of the total rate. 2. Expand the discussion of the ORNIM in Appendix A, including how the ORNIM relates to the application of the rate savings and ultimate transportation benefit estimation.

Comment 5:
The cost risk analysis and contingency determination does not include remaining work or consider experience with the dam construction methods, changes in dam construction assumptions, or changes in the economic climate that have occurred in the nearly four years since it was completed.
Basis for Comment:
With the cost growth that has occurred on this project due to a variety of issues, some foreseen and some unforeseen, the contingency analysis should be revised to ensure that another PACR is not needed before the project is completed. The 2007 cost risk analysis was primarily performed to determine the level of contingency for the remaining work on the dam construction. However, a cost risk analysis was not conducted for the future work items. The cost risk analysis is a significant component of the current construction cost; however, it was not included as an appendix to the PACR. The PACR does not give the reader a sense of the detailed cost risk analysis that was undertaken for the project. The remaining dam and future work costs and the associated contingencies are not well presented. The PACR does not provide the remaining dam construction costs associated with the contingency until Table 7 in Section 9, nor does the report present a schedule other than future funding allocations in Table 7. Contingency is presented as a single line item in Table 7 rather than being allocated by feature account. This makes it difficult to determine the level of contingency being applied for the various work items. The 2007 cost risk analysis was thorough and considered issues that could impact the project related to the construction of the dam. The cost risk analysis resulted in a contingency of nearly 38% on the remaining dam work. However, nearly four years have passed since the cost risk analysis was initially prepared and in the intervening years the dam construction has progressed and the economic climate has changed. Items identified as risks in 2007 may no longer be project uncertainties (e.g., Item No. 1 - Sand Wave) and new risks may have been identified as construction has progressed (e.g., Item No. 61 – Spare Parts cited in the USACE presentation). Previous concerns relating to the dam construction techniques (e.g., Item No. 27 – Grout Mat Laying System) may now be diminished because of several years' worth of work experience. The economic downturn may have resulted in lower materials costs or resulted in a decrease in the shortage of skilled labor. Continuation of funding shortfalls may have resulted in additional project delays. Also, the cost-reimbursable contract vehicle itself may warrant higher contingencies on certain items based upon recent project experience with dam construction. It is important to revisit the cost risk analysis to ensure that the construction realities are adequately reflected in the contingencies and the 902 Cost Limit. Considering the issues encountered on the project, including schedule delays due to design changes and an inadequate funding stream, the stated 5% contingency on remaining work may be low. It does not appear that the remaining work, valued at nearly

$80 million before escalation, was subjected to a cost risk analysis to determine appropriate contingencies. While the future work is not as complex as the dam itself and may indeed have a low contingency, it may not be appropriate to apply a general 5% contingency to all categories.
Significance – Medium:
It is important to update the cost risk analysis to ensure that the PACR reflects the current project status and that the contingencies are adequately reflected in the 902 Cost Limit.
Recommendation(s) for Resolution:
1. Provide the cost risk analysis as an appendix to the PACR. 2. Expand the explanation of the development of the cost risk analysis and determination of contingencies in Section 8.2 of the PACR. 3. Provide a tabulation of the costs and contingencies to explain the project cost breakdown and the applicable contingencies by feature account. 4. Review and revise the contingency scenarios in the risk model to determine if the contingency cost needs to be increased or decreased from that currently forecast. Include new scenarios as needed. 5. Provide an explanation of how costs were escalated according to the remaining project schedule. 6. Conduct a cost risk analysis for future work to determine an appropriate contingency for individual feature accounts.

Comment 6:
The without project future condition is not properly specified and authorized changes since the 1990 update are not clearly described.
Basis for Comment:
Paragraph 2.1 of the Economics Appendix states that "The without project condition used in the 1990 Benefit Update was essentially the same as that outlined in the November 1985 feasibility report, except for authorized changes that had occurred to the waterway system in the intervening years." It is not clear what authorized changes are referred to in paragraph 2.1 of the Economics Appendix. Since "…impact assessment is the basis for plan evaluation, comparison and selection, clear definition and full documentation of the without-project condition are essential" (Page 2-3 of ER 1105-2-100). The without project condition assumes a "fix-as-fail" scenario. It is not clear that this assumption is consistent with ER 1105-2-100. The without project condition should assume normal operation and maintenance practices (Page 3-6 of ER 1105-2-100). Additionally, the without project condition should reflect rational economic behavior (Page 126 of the "Planning Manual").
Significance – Medium:
The assumption that the without project condition is based on the Federal government not efficiently funding Ohio River navigation operation and maintenance may overstate project benefits.
Recommendation(s) for Resolution:
1. Compute the remaining benefits-remaining cost ratio assuming a least-cost without project future and include in the report. 2. Include, as part of the without project condition description, a list and description of the authorized changes referred to in paragraph 2.1 of the Economics Appendix.

Comment 7:
The PACR does not include a report section that identifies, describes, and analyzes areas of risk and uncertainty for the project.
Basis for Comment:
The Principles and Guidelines (P&G) requires a risk-based approach to project analysis. The P&G requires that "planners shall identify areas of risk and uncertainty in their analysis and describe them clearly, so that decisions can be made with knowledge of the degree of reliability of the estimated benefits and costs and of the effectiveness of alternative plans." (Page 1-3 of ER 1105-2-100). The Panel recognizes that several risk related areas were identified and analyzed in the PACR. Specifically, the Panel noted that the cost contingencies were determined using a risk-based approach, project benefits were computed using a "no growth" assumption, and alternative coal forecasts were considered in the analysis. However, a specific and more comprehensive "Risk and Uncertainty" section could be included in the report that identifies, describes, and analyzes these and other areas of risk and uncertainty for the project in order to be more responsive to the intent of P&G and provide a clearer understanding of the degree of reliability of the estimated benefits and costs.
Significance – Medium:
A section on areas of risk and uncertainty for the whole project would aid the reader in more clearly understanding the reliability of the analysis.
Recommendation(s) for Resolution:
1. Include a risk and uncertainty section in the PACR that discusses and analyzes all areas of risk and uncertainty associated with the project. Key areas to emphasize include engineering risks, environmental risks, institutional risks, and economic risks. (Page 1-3 of ER 1105-2-100) 2. At a minimum, incorporate the following variables required by ER 1105-2-100 (Page E-28): a) commodity forecasts, b) alternative mode costs, c) reliability of existing and proposed structures, and d) system delays associated with capacity constraints. 3. Include the following variables: a) cost and schedule risk, b) lock closure assumptions, and c) any other areas of risk and uncertainty identified by the Project Delivery Team.

Comment 8:
National Economic Development (NED) costs may not accurately reflect project implementation costs.
Basis for Comment:
National Economic Development (NED) costs should reflect the opportunity costs of direct or indirect resources consumed by project implementation. "In order to capture the opportunity costs of proposed plans, NED costs include three types of costs: implementation costs, other direct costs and associated costs" (Page 2-11 of ER 1105-2-100). Reducing project costs to reflect foregone costs results in the cost estimate no longer reflecting implementation costs. The benefit-cost ratio has been calculated two different ways in the PACR. First, treating without-project condition costs foregone as a negative cost and, second, treating without-project condition costs foregone as a benefit. The discussion favors the calculation of costs foregone as a negative cost and only includes the calculation of costs foregone as benefits for informational purposes because it is required by Budget Engineering Circular (EC) guidance (Page 58 PACR). If costs foregone are treated as negative costs then NED costs may not reflect implementation costs.
Significance – Low:
In order to satisfy the requirements of ER 1105-2-100, the method for calculating NED costs should reflect implementation costs.
Recommendation(s) for Resolution:
1. Revise the report to state that costs foregone have been calculated as a benefit in accordance with the latest budget EC and that because costs foregone were calculated as a negative cost in the 1990 update that calculation is included for informational purposes.

APPENDIX B

Final Charge to the Independent External Peer Review Panel
as
Submitted to USACE on October 5, 2010

on the

Olmsted Locks and Dam PACR

APPENDIX B
Final Charge Questions and Guidance to the Peer Reviewers
for the
Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report (Olmsted Locks and Dam PACR)

BACKGROUND

The purpose of Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report (Olmsted Locks and Dam PACR) is to recommend an increase in the maximum amount of funding that the U.S. Army Corps of Engineers (USACE) is authorized to spend on completion of the project, and to document the reasons for the recommendation. The report is required because the current estimated cost of completing the project exceeds the maximum cost limit, as defined in Section 902 of the Water Resources Development Act of 1988 ("902 cost limit"). The Olmsted Locks and Dam PACR project was authorized in the Water Resources Development Act of 1988 (PL 100-676). Initial construction funding was provided by the Energy and Water Development Appropriations Act of 1991.

The Olmsted Locks and Dam project is economically justified based on projected commercial transportation savings derived from reduced processing and congestion time, and represents a reinvestment in the nation's inland navigation infrastructure. The Olmsted Locks and Dam project provides for a structure near Ohio River Mile 964.4 that would replace the existing Locks and Dam 52 and 53. The structure will consist of twin 110-foot by 1,200-foot locks adjacent to the Illinois bank, five tainter gates, a 1,400-foot navigable pass, and a fixed weir extending to the Kentucky bank. During low flow conditions, an upper pool having an elevation 300 feet at the dam would extend upstream to the Smithland Locks and Dam, a distance of 47 miles. Open river conditions will exist from the dam site to the mouth of the Ohio River, a distance of approximately 17 miles. The first construction contract was awarded on November 19, 1992 to construct the access road and resident engineer's office. Since then, several contracts have been awarded and completed including those for the locks cofferdam, the locks, the approach walls and the operating and maintenance bulkheads. The contract for the construction of the dam was awarded January 28, 2004 and construction work is ongoing. Other contracts to be awarded in the future include the operation buildings, demolition of Locks and Dam 52 and 53, and various equipment contracts.

The Olmsted Locks and Dam PACR was prepared in accordance with the Planning Guidance Notebook, ER-1105-2-100, Appendix G dated June 2004. The Section 902 limit for the Olmsted Locks and Dam project is currently $1,544,031,000, based on the authorized cost of $775,000,000 as reported in the Report of the Chief of Engineers dated August 20, 1986 and the Water Resources Development Act of 1988. The authorized cost to construct the Olmsted Locks and Dam project was adjusted for inflation using the method described in ER 1105-2-100, Appendix G. The fully funded cost was estimated at $1,389,031,000. Based on cost increases described in the Olmsted Locks and Dam PACR, the revised estimated cost is $2,067,000,000. The Water Resources Development Act of 1988 authorized the Olmsted Locks and Dam project cost of $775,000,000. These authorized costs, when brought to current price levels and inflated per Section 902 guidance, are $1,337,959,000. The current cost estimate without inflation, at the

October 2007 price level, is $1,991,000,000. The current cost estimate with inflation applied to the remaining cost to complete, at the October 2007 price level, is $2,067,000,000. The increases in costs are not associated with changes in project purpose, local cooperation requirements, location of project, or because of modifications required by law. The changes in costs are a result of design changes, contract modifications, less than efficient funding, time extensions and other unanticipated increases in project first costs.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report (Olmsted Locks and Dam PACR) in accordance with the Department of the Army, U.S. Army Corps of Engineers, Water Resources Policies and Authorities' *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010, and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates the clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

This purpose of the IEPR is to assess the "adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (EC 1165-2-209; p. D-4) for the Olmsted Locks and Dam PACR. The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR panel members) with extensive experience in cost engineering and economics, and environmental issues relevant to the project. They should also have experience applying their subject matter expertise to inland navigation.

The IEPR Panel will be "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-209, Appendix D, review panels should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. Review panels should be able to evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable. Reviews should focus on assumptions, data, methods, and models. The panel members may offer their opinions as to whether there are sufficient analyses upon which to base a recommendation.

DOCUMENTS PROVIDED

The following is a list of documents and reference materials that will be provided for the review. **The documents and files presented in bold font are to be reviewed**. All other documents are provided for reference.

- **Olmsted Locks and Dam PACR Main Report**
- **Olmsted Locks and Dam PACR Appendices**
  - **Appendix A: Economics Update**
  - **Appendix B: Modifications During Construction**
  - **Appendix C: Section 902 Maximum Project Cost Computations, January 2008**
  - **Appendix D: Olmsted Locks and Dam FY08 Program Year (PY) PB-3**
  - **Appendix E: Certification of Independent Technical Review**
- Olmsted Locks and Dam Benefit Update, October 1990
- MCASES, 9 May 2007
- An Analytical Approach for Computing Lock Capacity, Technical Report H-78-25, December 1978
- Olmsted Dam Remaining Contract Contingency Analysis Quality Assurance Review, 8/21/2007
- Upper Ohio Navigation Study, Economics Appendix, Attachment 1, Ohio River Navigation Investment Model (ORNIM) Version 5.1, June 2010
- USACE guidance *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010
- CECW-CP Memorandum dated March 31, 2007
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

SCHEDULE
Deliverables are noted with an asterisk (*)

TASK	ACTION	DUE DATE
Conduct Peer Review	Battelle sends review documents to panel members	10/13/2010
	Battelle/IEPR Panel kick-off meeting	10/13/2010
	USACE/Battelle/IEPR Panel kick-off meeting	10/14/2010
	Battelle convenes mid-review teleconference for Panel to ask clarifying questions of USACE	10/18/2010
	Panel members complete their review and submit responses to charge questions and Preliminary Panel Comments to Battelle for review	10/21/2010
Prepare Final Panel Comments and Final IEPR Report	Battelle provides comments on Preliminary Panel Comments to Panel	10/25/2010
	Battelle convenes panel review teleconference to discuss Preliminary Panel Comments	10/27/2010
	IEPR Final Panel Comments finalized	11/5/2010
	Battelle provides Final IEPR Report to Panel for review	11/9/2010
	Panel provides comments on Final IEPR Report	11/10/2010
	*Battelle submits Final IEPR Report to USACE	11/15/2010
Comment/ Response Process	Battelle inputs IEPR Final Panel Comments to DrChecks; Battelle provides IEPR Final Panel Comment response template to USACE	11/17/2010
	USACE provides draft Evaluator responses and clarifying questions	11/22/2010
	Battelle provides the Panel the draft Evaluator responses and clarifying questions	11/29/2010
	Panel provides Battelle with draft comments on draft Evaluator responses (i.e., draft BackCheck responses)	12/2/2010
	Teleconference with Battelle and Panel to discuss draft BackCheck responses	12/3/2010
	Teleconference between Battelle, IEPR Panel, and USACE to discuss IEPR Final Panel Comments, draft Evaluator responses, and clarifying questions	12/6/2010
	USACE inputs final Evaluator responses in DrChecks	12/13/2010
	Battelle provides Evaluator responses to Panel	12/14/2010
	Panel members provide Battelle with final BackCheck responses	12/20/2010
	Battelle inputs the Panel's BackCheck responses in DrChecks	12/22/2010
	*Battelle submits pdf printout of DrChecks project file and closes out DrChecks	12/23/2010

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the Olmsted Locks and Dam PACR are credible and whether the conclusions are valid. The panel members are asked to determine whether the technical work is adequate, competently performed, properly documented, satisfies established quality requirements, and yields scientifically credible conclusions. The IEPR Panel is being asked to provide feedback on the economics and cost-engineering analyses. The panel members are not being asked whether they would have conducted the work in a similar manner.

GENERAL CHARGE GUIDANCE

Please answer the scientific and technical questions listed below and conduct a broad overview of the Olmsted Locks and Dam PACR. Please focus on your areas of expertise and technical knowledge. Even though there are some sections with no questions associated with them, that does not mean that you cannot comment on them. Please feel free to make any relevant and appropriate comment on any of the sections and appendices you were asked to review.

In addition, please note the following guidance. Note that the IEPR Panel will be asked to provide an overall statement related to 1 and 2 below per USACE guidance (EC 1165-2-209; Appendix D).

1. Assess the adequacy and acceptability of the economics and cost-engineering methods, models, and analysis used.
2. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation for construction, authorization, or funding.
3. Identify, explain, and comment on assumptions that underlie economic and cost-engineering analyses.
4. Evaluate whether the interpretations of analysis and conclusions are reasonable.
5. Please focus the review on scientific information, including factual inputs, data, the use and soundness of models, analyses, assumptions, and other scientific and engineering matters that inform decision makers.

Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please **do not** comment on or make recommendations on policy issues and decision-making. Comments should be provided based on your professional judgment, **not** the legality of the document.

1. If desired, panel members can contact one other. However, panel members **should not** contact anyone who is or was involved in the project, prepared the subject documents, or was part of the USACE Independent Technical Review.
2. Please contact the Battelle deputy project manager (Lauren Baker-Hart, bakerhartl@battelle.org) or project manager (Karen Johnson-Young, johnson-youngk@battelle.org) for requests or additional information.

3. In case of media contact, notify the Battelle project manager immediately.
4. Your name will appear as one of the panel members in the peer review. Your comments will be included in the Final IEPR Report, but will remain anonymous.

Please submit your comments in electronic form to Lauren Baker-Hart, bakerhartl@battelle.org, no later than October 21, 2010, 10 pm EDT.

Independent External Peer Review
Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report
(Olmsted Locks and Dam PACR)

Final Charge Questions

GENERAL QUESTIONS

1. Are the assumptions that underlie the economic and cost engineering analyses sound?
2. Please comment on the adequacy and acceptability of the economic and cost models and analyses used, as well as any assumptions made.
3. Are the interpretations of analysis and conclusions based on the analysis reasonable?

SECTION 1 – Description of Authorized Project

1.1 Relocations

No questions.

1.2 Reservoirs

No questions.

1.3 Dam

No questions

1.4 Locks

No questions.

1.5 Fish & Wildlife Facilities

No questions.

1.6 Roads, Railroads & Bridges

No questions.

1.7 Channels & Canals

No questions.

1.8 Bank Stabilization

No questions.

1.9 Cultural Resource Preservation

No questions.

1.10 Buildings, Grounds & Utilities

No questions.

1.11 Permanent Operating Equipment

No questions.

1.12 Construction Management

No questions.

1.13 Operation & Maintenance

No questions.

SECTION 2 – AUTHORIZATION

No questions.

SECTION 3 – FUNDING SINCE AUTHORIZATION

No questions.

SECTION 4 – CHANGES IN SCOPE OF AUTHORIZED PROJECT

No questions – section is blank

SECTION 5 – CHANGES IN PROJECT PURPOSE

No questions – section is blank

SECTION 6 – CHANGES IN LOCAL COOPERATION REQUIREMENTS

No questions – section is blank

SECTION 7 – CHANGE IN LOCATION OF PROJECT

No questions – section is blank

SECTION 8 – DESIGN CHANGES

8.1 Design Changes after Feasibility Report Plan (Authorization)

No questions.

8.2 Contingencies

4. In your opinion, considering the complexity of the project and the remaining schedule, are the proposed contingencies adequate?

5. Please comment on the adequacy of the risk assessment in determining the dam construction contingencies.

6. Please discuss the extent to which the Total Project Construction Cost Contingency Analysis is adequately described and justified.

SECTION 9 – CHANGES IN TOTAL PROJECT FIRST COSTS

7. Please discuss the extent to which the Total Project Cost Estimate adequately addresses all of the costs and is sufficient to complete the project.

9.1 Lands

No questions.

9.2 Cultural Resource Preservation

No questions.

9.3 Planning Engineering and Design

No questions.

9.4 Construction Management

No questions.

9.5 Operation & Maintenance

No questions.

9.6 Other Changes in First Costs

9.6.1 Increases due to Inflation

8. Please comment on the increases due to inflation.

9. Does the Civil Works Construction Cost Index System (CWCCIS) adequately address the cost increase due to inflation?

9.6.2.12 Future Construction Modifications

10. Does the estimate include sufficient contingencies for the future construction contracts? If not, what should be included?

9.6.6 Inefficient Funding

11. Are the impacts of inefficient funding adequately described? If not, what should be included?

9.7 Remaining project Costs

No questions.

SECTION 10 – CHANGES IN PROJECT BENEFITS

12. Please discuss the technical adequacy and credibility of the timeframe as well as the evaluated river rates.

10.1 Analysis History

Without Project Condition Average Annual Transportation Costs

13. Are the assumptions made regarding the future without project condition (Locks and Dams 52 and 53) reasonable and adequately justified? (reference Appendix A)

10.2 Analysis Models

14. Is the method used to account for system reliability with the Ohio River Navigation Investment Model (ORNIM) an accurate one? (reference Appendix A)

10.3 Input Assumption Updates

15. Is the selection of the Clear Skies alternative scenario for traffic demand forecasting a reasonable one? (reference Appendix A)

16. Are the reductions in without project capacity from the 1990 benefit update, owing to use of the Waterways Analysis Model, sufficiently justified? (reference Appendix A)

10.4 Benefit Update Comparison
Transportation Rate Savings

17. Please comment on the clarity of the alternative cost and benefit estimates presented.

18. Address the inclusion of fuel tax revenues in the recommended plan National Economic Development (NED) benefit. (reference Appendix A)

SECTION 11- BENEFIT-COST RATIO

11.1 Construction Cost Interest During Construction

19. Please review interest during construction and amortization calculations.

11.2 Benefit – Cost Ratio (Benefit to Remaining Cost Ration)

No questions.

11.3 Total Benefit – Cost Ratio (Benefit to Total Cost Ratio)

20. Please comment on whether or not you are in agreement with how the benefits and costs (transportation and construction costs) were derived. Were all factors considered?

21. Are the tonnage estimates and forecasts thorough, reasonable, based on well-founded assumptions, and related to economic factors?

22. Address the extent to which the methods for performing benefit cost analysis, including use of discount rates, is adequately described and justified.

23. Does the sensitivity analysis adequately capture the economic uncertainty of the project?

SECTION 12- CHANGES IN COST ALLOCATION

No questions.

SECTION 13- CHANGES IN COST APPORTIONMENT

No questions.

SECTION 14- ENVIRONMENTAL CONSIDERATIONS IN RECOMMENDED CHANGES

No questions.

SECTION 15- PUBLIC INVOLVEMENT

No questions.

SECTION 16- HISTORY OF PROJECT

No questions.

SECTION 17- CONCLUSION

24. Comment on the adequacy and conclusions of the review regarding the potential impact during construction.

25. Please comment on the extent to which significant project construction costs have been adequately identified and described.

SECTION 18- RECOMMENDATION

26. The recommendation of this report is to reauthorize the Olmsted Locks and Dam project at $2,067,000,000; comment on this conclusion.

APPENDIX A – ECONOMICS UPDATE

27. Should other factors have been included in the analysis?

28. Please review any significant alterations in assumptions or methodology between the 2007 economic update presented in this appendix and the 1990 Benefit Update. Are these reasonable and sufficiently explained and justified?

29. Are lock capacity, traffic/tonnage forecast, transportation rate, and cost/closure assumptions reasonable and sufficiently justified?

30. Please review the use of the Waterways Analysis Model as detailed in Appendix A.

31. Please comment on the technical adequacy and credibility of the projected net benefits.

32. Are there additional key assumptions that should be considered for the "without project" conditions?

33. Discuss the extent to which the no action/without project condition is clearly defined.

APPENDIX B – MODIFICATIONS DURING CONSTRUCTION

No questions.

Appendix C – Section 902 Maximum Project Cost Computation

No questions.

APPENDIX D – OLMSTED L&D FY08 PROGRAM YEAR PB-3

No questions.

APPENDIX E – CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW

No questions.

Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report IEPR

USACE Evaluator Reponses to the IEPR Final Panel Comments

Comment 1:
The contingency cost should expand existing line items to account for cash flow issues that may arise over the next 5 years.
Basis for Comment:
The Post Authorization Change Report (PACR) contains information on the construction cash flow (yearly work allowance) that the project has received over the last 15 years; this ranges from $30,000,000 to $110,000,000 and has fluctuated markedly as administration budgetary restrictions and focus areas change over time. The Crystal Ball software used by Walla Walla District to develop the Cost Risk Model has the capability of using the actual cash-flow distribution directly to create a customized variable distribution to forecast possible future trends. Using this option would more accurately model possible cost consequences from poor cash flow in the future. If the cash flow is reduced year to year, the overall schedule is lengthened resulting in additional costs in design, construction management, labor, supplies, and possibly interest during construction. Lastly, future federal budgets may be constrained significantly due to large structural budget deficits that currently exist (CBO, 2010). Matching funds from the Inland Waterways Trust Fund (IWTF) also may be similarly constrained. According to the IWTF 2010 fact sheet: "From its inception, the IWTF contained a surplus, with collections exceeding expenditures. In FY2009, for the first time, the Fund contained less than was needed. Collections are expected to be below need for the foreseeable future."
Significance – Medium:
The unknown contingency line items could increase the PACR cost estimate.
Recommendation(s) for Resolution:
1. Develop additional contingency scenarios with the risk model to determine if the contingency cost could be larger than currently forecast if the cash flow is less than assumed. 2. Use the past historical cash flow (work allowance) to define cash flow itself as a variable distribution in the primary new risk model scenario. Alternatively, reduce cash flow by 25% from currently assumed values. 3. Expand the discussion of funding inefficiencies to include a potential shortage in matching funds from the Inland Waterways Trust Fund.

USACE Draft Evaluator Response (#1)- Concur or Non-Concur
Concur.. The PACR will be amended with additional explanation of the dam cost risk analysis, as well as expanded discussion of cash flow and consideration of funding scenarios. 1. Adopt. In the earlier years the Olmsted Project did not get all the funds it needed. The emphasis was to keep all the Navigation projects moving ahead. It became apparent to the IWUB that this method of funding all projects instead of focusing on finishing projects before you start another was not making the best use of their funds. Recently the IWUB & the COE have made the Olmsted project the number 1 project to complete. Thus it will be funded ahead of all other navigation projects. This is evident by the funding received in recent budgets: FY06 $90M, FY07 $110M, FY08 $102M, FY09 $109M & FY10 $101M. 2. Adopt. At the suggestion of the Panel LRL has gone back and analyzed the cash flow and possible impacts. We assumed that since Olmsted L&D is in the FY-11 President Budget, the House bill & the Senate version at $136M that it's a good budget amount for FY-11 and no reduction would be made in FY-11. The PACR as written is based on the following annual funding: FY-12 $150M, FY-13 $156M, FY-14 $136M, FY-15 $124M, FY-16 $43M, FY-17 $46M & FY-18 $45M. The average Appropriation for the period from FY-06 thru FY10 is $102.4M, ranging from a low of $90M to a high of $109M. A 25% cut to FY12-14 equates to $110.5M this is a year's worth of work. The result of LRL's analysis is the dam construction contract would not be able to complete by FY-16 if there is a 25% cut or reduction in the $103M range and thus an additional year would have to be added and a cost increase ($30-$40M) would be incurred. The analysis does show that if there were small cuts in FY12-14 that the dam could still be completed in FY16 by delaying future contracts. As the cuts get larger more work would slip later in FY16 causing greater impacts to being operational in 2016. For example if the wicket lifter were be delayed and not completed in the first quarter of FY-16 the project wouldn't be operational, operational buildings could be delayed and Operations would have to work out of L&D 53, & various shop equipment could be deferred with minimal impacts to maintenance.

The analysis indicates that if the funding shown in the PACR in FY-12-14 were cut 25% that the schedule & cost would be impacted. Though not likely, due to Olmsted being the number 1 priority of the IWUB, but if such a drastic cut were encountered this increase could be covered by the 902 limit calculation using the 20% allowance over the authorization plus escalation. Based on the proposed new authorization amount the project could overrun the approximate $2B by $400M and not have a problem. A one year extension and a $30-40M cost increase would easily fall within the new 902 limit.

3. Adopt. CECW-IP (Mark Mugler & Mary Ann Schmid) have analyzed the income to the Trust fund knowing the Olmsted project needs thru FY-18 and concluded that there will be adequate income to the Trust Fund to support the current funding required to keep Olmsted on schedule.

Comment 2:

The lock closure days assumptions and estimated lock closure costs used in calculating project benefits are not well supported in the report.

Basis for Comment:

The PACR bases the lock closure estimates on engineering judgment with little to no discussion of underlying data (PACR, page 49). The Panel assumes that the needed information is contained within periodic inspection reports and annual inspection reports regarding the existing lock and dams developed by the U.S. Army Corps of Engineers (USACE) over the last 20 years. This information would better justify the underlying lock closure projections and project benefit assumptions by providing necessary supporting data. Since the actual lock closure assumptions are formulated based upon the supporting data, a firm understanding linking the assumptions to the data is critical.

The PACR does not provide a discussion of how the repair construction costs for the existing Locks and Dam 52 and 53 were determined. There is no indication in the PACR whether these costs were solely based on engineering judgment tied to historic periodic inspections and annual inspections or if additional cost information (e.g., from other sources) was used to develop cost estimates used in the analysis.

Significance – Medium:

Assumptions on lock closures drive the overall benefit calculations because the time savings in using the locks is a function of the number of closures.

Recommendation(s) for Resolution:

1. Provide supporting data regarding lock closure estimates. The addition of excerpts from periodic/annual inspection reports or rehabilitation summaries in the main report would be very valuable supporting data.
2. Include full supporting data as an appendix to the PACR or as an attachment to Appendix A.
3. Provide a cross reference in Section 8.4 of Appendix A to the cost closure matrices in Attachment 1.

USACE Draft Evaluator Response (#2)- Concur or Non-Concur

Concur.

1. Adopt. The periodic/annual inspection reports and rehabilitation summaries were considered to be too voluminous to enclose in the PACR. A summary prepared by Engineering Division will be included in the revised PACR. Excerpt from the engineering summary follows:

   The information was developed by reviewing historical records associated with

the Corps of Engineers' Lock Performance Monitoring System (LPMS) data, Operations repair reports and field notes and historical notices to navigation. In general, the Operations repair reports coupled with historical navigation notices generally provided the most reliable set of historical data to draw from when developing the cost and closure information.

2. Adopt. The engineering summary document will be added to Appendix A Attachment 1.
3. Adopt.

Comment 3:
The PACR does not include an update on historical tonnages and traffic projections by commodity or sensitivity tests, nor does it consider the impact of potential environmental constraints on coal tonnage projections.
Basis for Comment:
The historical tonnages displayed in the report are only up to the year 2005. Historical tonnages are available for lock and dam 52 and 53 by month, on an Excel spreadsheet supplied by the Nashville District during the Panel review, for years 2006 through 2009 and should be added to update the PACR. This information would provide a better foundation to support the waterborne traffic projections. Projected waterborne tonnages are available by commodity from the Ohio River System forecasts published in April 2003. These projected tonnages were updated for the PACR and combined together as one total traffic tonnage. The projections should be shown by commodity in order to more fully understand the importance of each commodity relative to the total tonnage. While the uncertainty of the coal projections is the primary concern regarding future tonnage projections, it is important to report the tonnages by commodity to demonstrate that the variations in coal projections will not impact the projections of the other commodities, with the exception of sorbent materials. A no-growth sensitivity test was included in the PACR that held all traffic constant at the 2010 projection level of traffic. This sensitivity test does not address potential uncertainties related to the possible future environmental issues and concerns related to coal such as carbon dioxide emissions. Potential future coal-related environmental uncertainties should be identified and sensitivity analyses conducted to more fully capture the uncertainty of the coal projections and the impact on project justification.
Significance – Medium:

Reporting projections by commodity groups, updating existing tonnages, and focusing on additional coal sensitivity analysis will improve the understanding, completeness, and credibility of the economic analysis in the PACR report and more fully support the economic justification.
Recommendations for Resolution:
1. Update the recent historic traffic and include the historic traffic and traffic forecasts by commodity for Locks and Dam 52 and 53 in Appendix A. 2. Revise Appendix A to include a reporting of separate projections for coal. 3. Revise Appendix A to include a sensitivity analysis of future coal-related environmental uncertainties.

USACE Draft Evaluator Response (#3)- Concur or Non-Concur
Concur. The PACR will be revised to include more recent traffic displays, as well as more detailed displays of the commodity traffic forecasts and explanation of the low growth/no growth scenarios.. 1. Adopt. The recent historic tonnages for locks 52 and 53 as well as projected tonnages by commodity will be added to Appendix A. 2. Adopt. Separate projections for coal will be added to Appendix A. 3. Adopt. Because of recent traffic experience on the lower Ohio, analyses in the Olmsted PACR are based largely on the Clear Skies Scenario, which, at the time the forecasts were developed, was the most restrictive of the alternative forecasts in terms of waterborne coal traffic generally and traffic through Locks 52 and 53 specifically. Under this scenario, nationwide sulfur dioxide emissions are restricted to 4.5 million tons by 2010 and 3.0 million tons by 2018, compared to actual emissions of 12.0 million tons in 1999. Nitrogen oxide emissions are reduced from an actual level of 7.1 million tons in 1999 to levels of 2.1 million tons in 2008 and 1.7 million tons in 2018. Mercury emissions, which is a key driver in this scenario, are restricted to 26 tons in 2010 and 15 tons in 2018, versus actual emissions of 48.6 tons in 1999. Clear Skies, in contrast to other multi-emissions proposals, contained no restrictions on carbon dioxide emissions. The Clear Skies Initiative was never enacted into law, however, an EPA regulation entitled the Clean Air Interstate Rule (CAIR), described as the Clear Skies Initiative by regulation, was implemented by EPA in 2003. The more recent update of the ORS forecasts included three alternative forecasts of steam coal traffic designated High Case, Base Case, and Low Case. The High Case forecast assumes a high level economic growth; a continuation of the sulfur

dioxide and nitrogen oxide emissions restrictions contained in CAIR; implementation of the so-called Regional Greenhouse Gas Initiative (RGGI) for CO2 emissions; and relatively low growth in nuclear power additions. The Base Case forecast assumes mid-level economic growth; a continuation of CAIR requirements for sulfur dioxide and nitrogen oxide emissions; implementation of RGGI for CO2 emissions; and mid-level nuclear plant development. The Low Case forecast assumes a relatively low level of economic growth; sulfur dioxide and nitrogen oxide emissions restrictions somewhat stricter than CAIR; implementation of the Waxman-Markey bill (HR 2454) imposing strict nationwide limitations on CO2 emissions; and relatively high levels of nuclear plant development. All of the forecast alternatives assume usage of the Maximum Available Control Technology (MACT) for control of mercury emissions.

Figures 1 and 2 show the traffic forecasts for Locks 52 and 53. The Clear Skies scenario is shown along with the Low Case, Base Case and High Case scenarios from the updated ORS traffic forecasts. Also shown is a flat forecast that was used for a sensitivity test in the Olmsted PACR. Except for the early years, the updated Low Case scenario is actually somewhat lower than the Clear Skies scenario over most of the forecast horizon at both projects. This is attributable, in large part, to the effects of strict, national-level restrictions on CO2 emissions contained in the Low Case scenario. However, the flat forecast, which is actually Clear Skies flattened after 2010, is lower than both Clear Skies and the Low Case scenario. The sensitivity test using the flat forecast indicates that the Olmsted project remains justified. This would appear to indicate that additional sensitivity tests are unnecessary.

FIGURE 1

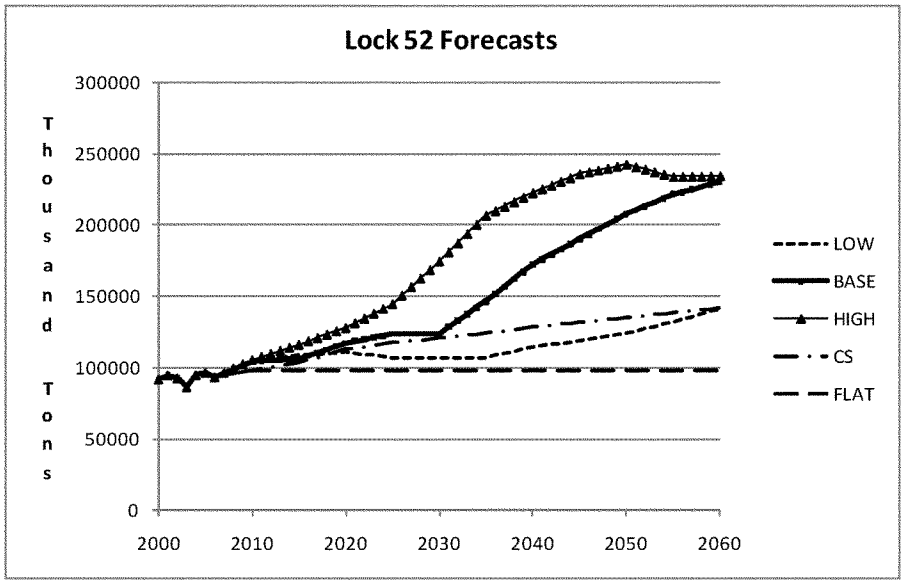
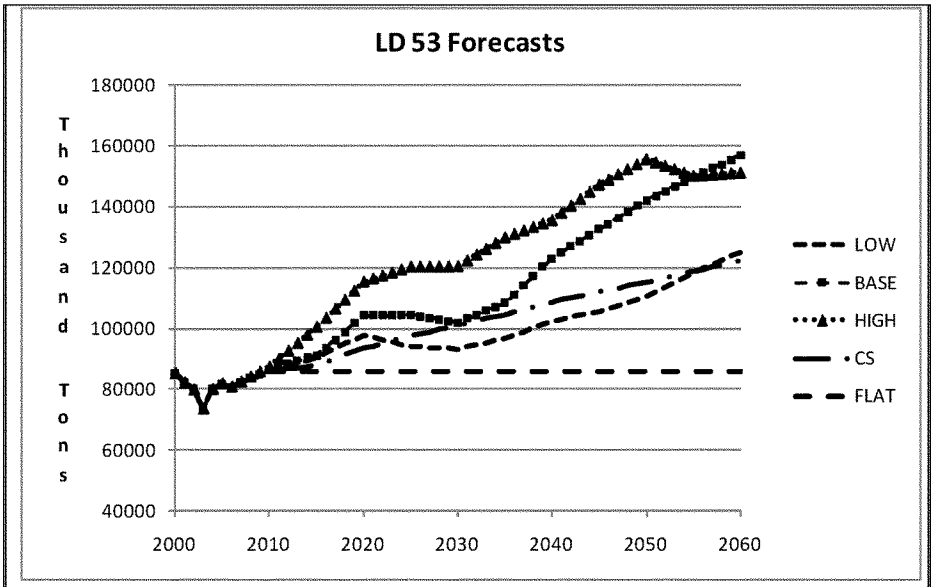


FIGURE 2



Comment 4:
The transportation rate analysis in Appendix A does not clearly describe the rate analysis methodology and derivation of project benefits.
Basis for Comment:
Rate data for the PACR were supplied by the Tennessee Valley Authority (TVA). A comparison of waterborne and land-based transportation rate data is essential in calculating the rate differential and the ultimate transportation savings of an inland navigation project. By adding a discussion of the TVA rate analysis methodology and an explanation of why the TVA rates are appropriate for use in the PACR analysis, the report would document USACE's consideration of the rates and the conclusion that the TVA rates were the best available for this analysis. The PACR should also provide further explanation of the Ohio River Navigation Investment Model (ORNIM) and how it relates to the derivation of the rate savings and transportation benefits. The resulting expanded discussion of the rate analysis methodology and the application of the rates in calculating the transportation savings would provide increased documentation and understanding and add credibility to the report. The PACR identifies commodity rates; however, a total rate is shown for all

commodities. The Panel assumed that the total rate is a result of the summation of individual commodity rates weighted by tonnage for each commodity. By providing a sample calculation to include the tonnage by commodity, the rate analysis evaluation would be better documented, supported, and understood.

Significance – Medium:

A more comprehensive discussion of the rate analysis methodology and benefit derivation will provide valuable documentation, increase the credibility, and provide an improved understanding of the total rate savings per ton and transportation savings estimates.

Recommendations for Resolution:

1. Expand the rate analysis methodology discussion (Appendix A) to include an explanation of why the rates are appropriate for this study and provide a sample calculation of the total rate.

2. Expand the discussion of the ORNIM in Appendix A, including how the ORNIM relates to the application of the rate savings and ultimate transportation benefit estimation.

USACE Draft Evaluator Response (#4)- Concur or Non-Concur

Concur. The PACR will be revised to include additional discussion of the transportation rate analysis.

1. Adopt. Appendix A, Section 5 dealing with transportation rates and their derivation will be revised as follows:

5.0 TRANSPORTATION RATES

5.1 GENERAL

Transportation rate specialists at the Tennessee Valley Authority (TVA) have been providing the Corps (USACE) transportation rates for use in navigation feasibility studies for over 30 years. The rate analysis is compliant with USACE Principles and Guidelines (P&G) to facilitate the calculation of National Economic Development (NED) benefits attributable to Ohio River navigation. Toward this objective, the analysis provides a full range of transportation rates and supplemental costs for a sampling of waterborne commodity movements which, in total or in part, were routed on the Ohio River Navigation System.

Freight rates for each sample movement are calculated based on the actual water-inclusive routing, as well as for a competing all-land alternative. All

computations reflect those rates and fees which were in effect in the third quarter 2007. Results are documented on a movement-by-movement basis, including a separate worksheet for each observation (see Sample Rate Sheet below). These dis-aggregated data are also integrated into individual spreadsheets for each of the eight commodity groupings. A full description of TVA's methods of rate research and construction, and supporting assumptions is provided below.

Sample Rate Sheet

TRANSPORTATION RATE ANALYSIS

Commodity			
WCSC		Tonnage	
River Origin		River Dest	
Origin Port Code		Dest Port Code	
Origin WW Mile		Dest WW Mile	
Off-River Orig		Off-River Dest	

Water Route	**Mode**	**Miles**	**Time**	C
(1) Loading at Origin				
(2) Charge to Transfer Point				
(3) Transfer Charge				
(4) Charge to River				
(5) Handling at River Origin				
(6) Line Haul Charge				
(7) Handling at River Destination				
(8) Charge to Exit River				
(9) Unloading at Destination				
(10) Other				
(11) Total				

Land Route	**Mode**	**Miles**	**Time**	C
(1) Loading at Origin				
(2) Charge to Transfer Point				
(3) Transfer Charge				
(4) Line Haul Charge				
(5) Transfer Charge				
(6) Final Leg to Destination				
(7) Unloading at Destination				
(8) Other				
(9) Total				

SUMMARY

	Cost
(1) Water Route	$0.00
(2) Land Route	$0.00

Because many of the sample movements have off-river origins and/or destinations, a full accounting of all transportation costs for waterborne movements also requires the calculation of railroad and/or motor carrier rates for movement to or from the nearest appropriate port facility. Additionally, all calculations reflect the loading and unloading costs at origin and destination, all transfer costs to or from barge, and any probable storage costs.

With the exception of over-dimension shipments and intra-pool sand dredging, rail or truck rates are calculated for all movements. For over dimension truck and intra-pool dredged materials, the land rate was estimated as compared to a specific modeled rate using identifiable data inputs. Additionally, pipeline or conveyor alternatives are calculated for applicable commodities when both the origin and destination are pipeline or conveyor served. As in the case of the barge-inclusive routings, many all-land routes require the use of more than one transport mode. Therefore, when appropriate, calculations include all requisite transfer charges.

To accurately reflect NED benefits, it is necessary to develop rates which portray the normal market conditions which are anticipated over the project life. For this reason, every attempt was made to purge the data of anomalous or transitory influences. As a part of all shipper surveys and interviews, respondents were directed to ignore temporary market disruptions and provide information reflective of "normal" operating conditions. As a result of the commodity mix represented within the sample, we detected no need to adjust for seasonal fluctuations. Annual contract barge rates with a fuel escalation feature and five year average spot market grain rates provide an annual average barge rate that is comparable to the multi-year contract rail rates that remove seasonality. The result is consistent rate treatment for each mode.

In the Ohio River FY 2006 Rate Study, three notable situations emerged with respect to long-term cost efficiencies for the rail mode of transportation. First, prior rail mergers in 1996 through 2005 time periods have been completed. The result of these mergers is a decrease in the variable cost of the surviving carrier and a decrease in absolute rates to reflect the surviving carriers' historic rate levels. Second, the Class 1 rail carries continue to deploy larger capacity rail cars and to install heavier gauge rail track capacity. Lading weights in excess of 120 tons for coal and grains frequently occur, reducing unit costs by fifteen to twenty percent compared to the traditional 100 ton capacity rail cars. Third, the decline in volume in the export coal market has forced rail carriers to reduce coal pricing to selected export locations to maintain the viability of railroad owned transfer docks and terminals.

Based on information collected from shippers, receivers, carriers, river terminal operators, stevedores, federal agencies, and private trade associations, TVA was able to identify probable origins and destinations for the majority of those movements that originated or terminated at off-river locations. In the absence of specific shipper/receiver information, it is assumed that the river origin and destination are the respective originating and terminating points for both river and alternative modes of transportation. In every case, an attempt was made to gather information from all shipping ports. However, in some instances,

logistical data were not available from these ports. In other cases, port representatives declined to provide the requested information.

For movements that originate or terminate at a river port location, it was assumed that rail service could also be utilized by the shipper or receiver if that port is rail served. Exceptions to this assumption are noted on individual worksheets. When the shipper or receiver is served by truck only, a railroad team track or transfer facility at the station nearest the off-river shipper or receiver is used for the land alternative. Only those shippers who ship more than 150,000 tons annually and who are adjacent to rail tracks would be assumed to undertake the significant capital expenditures necessary to acquire direct rail service. Mileage allowances made by carriers to shippers for the use of private equipment are also ignored as are rebates to shippers.

For the long run, in all cases, it is assumed that the alternative modes of transportation would have the physical capacity to accommodate the additional tonnage represented by each commodity movement (This is provided for in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G)). Commodity specific judgments and assumptions include:

Coal (Group 1)

A number of assumptions are made for land haul rates on the movements of coal to utility destinations that are not rail served. Volumes to these utility destinations are, in many cases, substantial, so that long-haul truck transportation cannot be considered a viable option. In the absence of water transportation, receiving utilities would have to carefully evaluate those available options which might insure their ability to continue to receive large volumes of coal. These considerations might include the replacement cost of transfer and handling facilities, the construction cost of switch or main line rail track, the cost of new or improved highway access, the economies of buying or leasing rail equipment, and the possibility of shifting origins to assure adequate coal supply. For their part, we may assume that rail carriers would be willing to construct additional track capacity if volumes are sufficient. However, these construction costs would most likely be passed on to the shipper via higher rates.

To accommodate those instances in which sample barge movements are to non-rail served utilities, we have incorporated the following judgments and assumptions.

If the receiving utility is not rail served, rates are applied to the nearest railhead, and trucking costs from the railhead to the destination are applied. If the shipping point is not rail served, a motor carrier charge is applied from the mine origin to the nearest railhead. It is assumed that transfer facilities would be available at both origin and destination for transfer between rail and truck.

If the receiving utility is rail served for supplies only, but not coal, the rail car unloading cost of the utility is inflated to accommodate a rail track expansion to the coal stockpile.

In some instances, movements involve a truck haul from multiple

origins to a concentration or preparation point for loading to rail. In these instances, where shipments originate at several mines within the same general area, a representative rail origin is selected as the transfer location.

Aggregates (Group 3)

Land haul rates on limestone and sand and gravel reflect the modes necessary to transport the shipments from actual origins to actual destinations. If origins or destinations are not rail served, a trucking charge is applied from the nearest rail station. For those movements where both rail and truck transportation are an option, truck hauls are limited to a distance of 100 miles. This, on occasion results in slightly higher rates. However it was deemed impractical, in the absence of water transportation, to transport large volumes of these commodities for long distances by truck. Limiting factors of truck transport include lower cargo carrying capacity, the inability to round-trip more than three times per day, and the absence of loaded back-haul opportunities.

With regard to waterway improvement materials, we assume that land movements would require a truck haul at the destination for delivery to river bank work locations. These truck movements would likely average five miles each. It should be noted that a significant amount of channel improvement and bank stabilization work is conducted off shore or at locations without highway access, making land transportation impractical.

Grain (Group 4)

The computation of rates for grain is based upon the survey responses of the shippers and receivers. Specifically, if a country elevator gathers grain then ships it to the river terminal, we assume a 20 mile truck haul from the farmer's field to the country elevator. If the grain moves for export, a unit train movement is assumed, and land rates are computed from a unit train capacity elevator to a Gulf port location. For domestic shipments, the computation of rail rates is based on the track capacity of the country elevator or domestic receiver. We assume that the grain shipper would maximize the use of his facilities and utilize gathering rates to reach the track capacity of the receiver.

The rail rating of feed ingredients follows assumptions similar to those used for the rating of grain - namely rates constrained by track capacity. Rail and barge transit programs for meals (soybean, cottonseed, oilseed and fish) were not considered.

5.2 METHODS AND PROCEDURES

As a result of pricing flexibility and differential rates allowed by surface transportation deregulation, it is sometimes difficult to determine the exact rate charged by a carrier on shipments moving under contract. Barge rates are a matter of negotiation between shipper and barge line operator, and these rates are not published in tariff form. Each carrier's rates are based on individual costs and specific market conditions, so that these rates will vary considerably between regions, across time, and from one barge line to another.

Contract rates are also common in pipeline, rail and motor carrier

transportation and, like barge rates, may be maintained in complete confidentiality. In other cases (particularly grain), tariff rates are still applied. However, there is rarely any dependable means for determining whether a contract rate or a tariff rate should be used to price a particular movement. A further complication is the use of rebates and allowances as an incentive by carriers to shippers to induce higher traffic volumes.

5.2.1 Barge Rates

With the exception of grain and feed ingredients and average trade publication spot market rate quotes, unobservable barge rates are calculated through the application of a computerized barge costing model developed by the Tennessee Valley Authority. The TVA model has been refined to include 2007 fixed and variable cost information obtained directly from the towing industry and from 2006 data published within the Corps' annual *Estimated Towboat and Barge Line-Haul Cost of Operating on the Mississippi River System (This is an update of data and equations using a 2000 report methodology).* Additionally, 2006 data from the Waterborne Commerce Statistical Center trip reports and 2006 data from the Lock Performance Monitoring System are incorporated into TVA BCM costing parameters.

The TVA model contains three costing modules: a one-way general towing service module, a round-trip dedicated towing service module, and a round-trip general towing service module. The one-way module calculates rates by simulating the use of general towing conditions between origin and destination, including the potential for a loaded return. The dedicated towing service module calculates costs based on a loaded outbound movement and the return movement of empty barges to the origin dock. The round-trip general towing service module is similar to the one-way, except that it provides for the return of empty barges to the point of origin. This module does not calculate costs for towboat standby time during the terminal process but does include barge ownership costs (maintenance, replacement cost, supplies, insurance, and administration) for both the terminal and fleeting functions. It does not require that the empty barges be returned with the use of the same towboat. Depending on the module in use inputs may include towboat class, barge type shipment tonnage, the interchange of barges between two or more carriers, switching or fleeting costs at interchange points or river junctions, and barge ownership costs accruing at origin and destination terminals, fuel taxes, barge investment costs, time contingency factors, return on investment, and applicable interest rates.

Barge rates on dry commodities are calculated with the use of the general towing service round-trip costing module. Inputs, based on information from carriers and the Corps' Performance Monitoring System (PMS) database were programmed into the module to simulate average towboat size (horsepower) and corresponding tow size (barges) for each segment of the Inland Waterway System. Other inputs include barge types, waterway speeds, horsepower ratios and empty return ratios.

An example of a typical shipment cost in this analysis would be a dry bulk

commodity (iron ore intermediates or cement clinker) originating on the Mobile River at Mobile, Alabama and terminating on the Ohio River at Cincinnati, Ohio. Based on the modeling process, this shipment would be assumed to move in an four barge tow from Mobile to the Mississippi River at New Orleans, a twenty four barge tow from New Orleans to Cairo, and a fifteen barge tow from Cairo to Cincinnati. At each interchange point, appropriate fleeting charges would be calculated. Empty return (back haul) factors would also be included for each segment of the movement.

With the exception of movements involving Northbound and tributary rivers, barge rates for grain and feed ingredients are estimated on the basis of a percentage of base rates formerly published in Waterway Freight Bureau Tariff 7.[1] For movements with origins in the Ohio River Basin, the five year average percent of base for the Lower Ohio, Mid Ohio, Upper Mississippi, Illinois, and Missouri Rivers is used. For movements on the Tennessee, Gulf Inter Coastal Waterway, an arbitrary charge is added to the New Orleans base rate. Rates for those movements that traversed the Tennessee -Tom Bigbee Waterway are calculated through the use of the TVA general towing service round-trip costing module.[2]

Barge rates for asphalt, heavy fuel oils, and light petroleum products are calculated through the use of the dedicated service round-trip costing module. Twenty hours standby time is allocated at origin and destination for towboat terminal functions. Finally, rates for sodium hydroxide, vegetable oils, lubricating oils, liquid chemicals, and molasses are calculated through the use of the general service round-trip costing module. As a result of comparable barge sizes, these commodities normally move in the same tow with dry commodities.

Barge rates calculated by the use of the TVA model reflect charges that would be assessed in an average annual period of typical demand for waterway service. It should be noted that the model does not explicitly consider market factors such as intra or inter modal competitive influences, favorable back haul conditions created by the traffic patterns of specific shippers, or the supply and demand factors which affect the availability of barge equipment. These and other factors can influence rate levels negotiated by waterway users. The model does, however, calculate rates based on the overall industry's fully allocated fixed and variable cost factors, including a reasonable rate of return on assets. It is TVA's judgment that the rates are representative of the industry and provide a reasonable basis for the calculation of NED benefits.

The spot market hopper barge rates were derived from the River Transport News published by the Criton Corporation of Silver Springs, Maryland. The average spot market rate for the second and third quarters of 2007 was utilized.

5.2.2 Railroad Rates

In 2007, rail shippers received rate relief from the Surface Transportation

[1] The expression of barge rates for agricultural commodities as a percentage of waterway Freight Bureau Tariff 7 is consistent with industry standards.

[2] There is no basis for rates via the Tenn-Tom in the Waterway Freight Bureau Tariff.

Board (STB) in the calculation of fuel surcharges. The result of the STB decision was a new calculation method for surcharges based upon mileage with the Class 1 rail carriers adopted the ALK mileage software program to estimate mileage. A further complication in rail rate calculation was the failure of Global Insight, Inc. to correct and update the Reebie Rail Costing Model that they purchased in 2004 when Global Insight acquired Reebie & Associates.

To resolve the above analytical issues, TVA developed a rail rate estimating technique using the attributes of rail shipping exhibited in the STB Waybill Sample. This technique was first employed in the Upper Mississippi and Illinois Rivers 2006 Transportation Rates Project for USACE.

The TVA rail rate estimating method has six steps. First, TVA field or telephone interviews the dock operator to establish the off river origin and/or destination, the mode and carrier of transport to or from the dock, rail track capacity at the dock, and river dock handling capability. Second, a rail route is constructed from either the off river origin or the dock origin. Third, the STB Waybill Sample for 2006 was sorted by seven digit STCC number (or five digit if insufficient observations) by carrier, by state (or all states if insufficient observations), by single car-multi car-small unit train-large unit train, and by distance (less than 500 miles or greater than 500 miles). Fourth, the average revenue per mile was calculated along with the standard deviation. Fifth, a derived revenue masking factor, an index from 2006 to third quarter 2007 (non fuel 3.5%), and a fuel surcharge ($0.28 per mile) were applied. Last, carrier mileage was multiplied by the adjusted revenue per mile, and the result was divided by the average weight per car to produce an estimate of the rail rate per short ton for the land move.

5.2.3 Motor Carrier Rates

Truck rates for off-river movements were obtained from the shipper and dock surveys conducted by TVA for the USACE. In addition, TVA maintains transportation trade publications that report various regional trucking rates and costs. The truck rate methods TVA uses consist of a rate per loaded mile for moves over 100 miles or a shuttle truck rate per hour for moves under 100 miles. The truckload weight is provided by the individual state highway axel load and bridge formula for truckload and permitted load limits.

5.2.4 Handling Charges

Handling charges between modes of transportation are estimated on the basis of information obtained from shippers, receivers, stevedores, and terminal operators. Handling charges for the transfer of commodities from or to ocean-going vessels are on the basis of information obtained from ocean ports or stevedoring companies. For import or export movements that involved mid-stream transfer operations, handling costs to or from land modes at a competing port with rail access are applied.

Except as noted within individual worksheets, it is assumed that movements of bulk products (for example, grain or fertilizer) would be handled through elevators or storage facilities. It was also assumed that liquid

commodities transferred between modes would require tank storage. Additional costs are incurred at both river and inland locations if shipments remain in storage past the free-time period allocated by the facilities involved. Storage charges are usually assessed on a monthly basis.

5.2.5 Loading and Unloading Costs

Because loading and unloading costs are not usually documented by shippers and receivers, they are particularly difficult to obtain.[3] Moreover, these costs can vary considerably across firms. In an attempt to provide the best possible estimates of these costs, we use available shipper and receiver information in combination with data from Corps studies performed by other researchers, as well as previous TVA studies. These data are revised to reflect 2007 conditions then averaged as required. In those cases where varying sources produced disparate estimates, we relied on shipper and receiver estimates.

5.2.6 Methodological Standards

The methodological standards described above reflect essentially the same processes TVA has applied in developing transportation rates for other recent (or ongoing) Corps studies. Specifically, the outlined methodology was used in the 1996 and 2000 Ohio River Studies and the 1996 and 2006 Upper Mississippi Navigation Feasibility Study and was applied in the Missouri River Master Manual Review process, the Soo Locks Study and Port Allen Cutoff assessment. Thus, inter-project comparison is facilitated by this uniform approach. More importantly, recent methodological improvements enable TVA to produce transportation rate/cost materials which are, simultaneously, more complete and more reliable than the transportation data TVA has produced for similar studies in the past. Each rate study for each District of the USACE is integrated into a series of data bases for quick accessibility and data manipulation.

5.3 TRANSPORTATION RATE SAVINGS

The economic update in this study uses 2007 transportation rates based on work done by TVA. The table below summarizes the average transportation rate savings by commodity group used in the May 2008 Olmsted PACR and compares them to the transportation rate savings used in the 1987 feasibility study. Overall, the rate data show similar savings in current dollar terms (1987 and 2007)[5]. The apparent decline in nominal rate savings is largely attributable to efficiency gains in rail transportation resulting from railroad de-regulation since the Staggers Act of 1987.

[3] Loading and unloading costs are often considered a part of through-put or production costs.

Average Transportation Rate Savings

Commodity Group	Olmsted Feas Study (1987 $)	Olmsted PACR (2007$)
1 Coal and Coke	$6.13	$6.54
2 Petrol Products	$16.25	$10.40
3 Sand and Stone	$12.68	$8.30
4 Grains	$14.98	$11.50
5 Chemicals	$15.77	$24.53
6 Ores and Minerals	$16.26	$25.55
7 Iron and Steel	$17.29	$18.16
8 All Other	$22.82	$12.57
Total All Commodities	$9.67	$8.22

A total rate savings of $8.22 per ton results from a tonnage weighted average of all the sample movements. Coal has the greatest impact on total average savings because it is the dominant commodity on the ORS accounting for over 55 percent of system tonnage.

5. Commodity group rate savings are calculated as tonnage weighted averages of the individual commodity movements comprising the group.

2. Adopt. Appendix A, sections 3.1 and 3.2 will be re-numbered to sections 3.2 and 3.3 and a new section 3.1 (below) will be added.

3.1 Calculation of Transportation Consumer Surplus

The primary guidance for this methodology framework is described in P&G and "... relies on the marginal analysis of benefits and costs for the formulation, evaluation, and selection of alternative plans that provide incremental changes in the net value of desired goods and services."[4] The conceptual basis for the "... basic economic benefit of a navigation project is the reduction in the value of resources required to transport commodities."[5] This benefit can also be described as a consumer surplus gain, where the surplus represents the difference between the price shippers paid and the price they would be willing-to-pay to transport

[4] *National Economic Development Procedures Manual Overview, IWR Report 09-R-2, U.S. Army Corps of Engineers, June 2009, page 9.*
[5] *"Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies", U.S. Water Resources Council, March 10, 1983, page 49.*

commodities. Specifically, this surplus can be termed transportation consumer surplus. Then to measure the gain (i.e. the incremental benefit or reduction in transportation costs) both the TCM/EQ and the WSDM module of ORNIM compares the transportation consumer surplus between a base (the without-project condition) and the alternative (a with-project condition, or in this case the recommended plan). In short, the without-project and with-project transportation consumer surplus estimates are used to estimate reductions in transportation costs.

To measure the transportation consumer surplus for a movement the barge transportation willingness-to-pay must be known for that movement. As a proxy for barge transportation willingness-to-pay the least-cost all-overland rate, or land rate, is used (rate data is discussed in Section 5.0). The difference between a movement's land rate and its water rate (which often also includes land transportation legs) is the movement's barge transportation consumer surplus and is typically referred to as the movement's transportation rate-savings. Summing the transportation rate-savings for all movements in the system develops the system's transportation rate-savings. The without-project and with-project system transportation rate-savings are then used to estimate the reductions in system transportation costs by subtracting the with-project system transportation rate-savings from the without-project system transportation rate-savings."

Comment 5:
The cost risk analysis and contingency determination does not include remaining work or consider experience with the dam construction methods, changes in dam construction assumptions, or changes in the economic climate that have occurred in the nearly four years since it was completed.
Basis for Comment:
With the cost growth that has occurred on this project due to a variety of issues, some foreseen and some unforeseen, the contingency analysis should be revised to ensure that another PACR is not needed before the project is completed. The 2007 cost risk analysis was primarily performed to determine the level of contingency for the remaining work on the dam construction. However, a cost risk analysis was not conducted for the future work items. The cost risk analysis is a significant component of the current construction cost; however, it was not included as an appendix to the PACR. The PACR does not give the reader a sense of the detailed cost risk analysis that was undertaken for the project. The remaining dam and future work costs and the associated contingencies are not well presented. The PACR does not provide the remaining dam construction costs associated with the contingency until Table 7 in Section 9, nor does the report present a schedule other than future funding allocations in Table 7. Contingency is presented as a single line item in Table 7 rather than being allocated by feature account. This makes it difficult to determine the level of contingency being applied for the various work items. The 2007 cost risk analysis was thorough and considered issues that could impact the project related to the construction of the dam. The cost risk analysis resulted in a contingency of nearly 38% on the remaining dam work. However, nearly four years have passed since the cost risk analysis was initially prepared and in the intervening years the dam construction has progressed and the economic climate has changed. Items identified as risks in 2007 may no longer be project uncertainties (e.g., Item No. 1 - Sand Wave) and new risks may have been identified as construction has progressed (e.g., Item No. 61 – Spare Parts cited in the USACE presentation). Previous concerns relating to the dam construction techniques (e.g., Item No. 27 – Grout Mat Laying System) may now be diminished because of several years' worth of work experience. The economic downturn may have resulted in lower materials costs or resulted in a decrease in the shortage of skilled labor. Continuation of funding shortfalls may have resulted in additional project delays. Also, the cost-reimbursable contract vehicle itself may warrant higher contingencies on certain items based upon recent project experience with dam construction. It is important to revisit the cost risk analysis to ensure that the construction realities are adequately reflected in the contingencies and the 902 Cost Limit. Considering the issues encountered on the project, including schedule delays due to design changes and an inadequate funding stream, the stated 5% contingency on remaining work may be low. It does not appear that the remaining work, valued at nearly

$80 million before escalation, was subjected to a cost risk analysis to determine appropriate contingencies. While the future work is not as complex as the dam itself and may indeed have a low contingency, it may not be appropriate to apply a general 5% contingency to all categories.
Significance – Medium:
It is important to update the cost risk analysis to ensure that the PACR reflects the current project status and that the contingencies are adequately reflected in the 902 Cost Limit.
Recommendation(s) for Resolution:
1. Provide the cost risk analysis as an appendix to the PACR. 2. Expand the explanation of the development of the cost risk analysis and determination of contingencies in Section 8.2 of the PACR. 3. Provide a tabulation of the costs and contingencies to explain the project cost breakdown and the applicable contingencies by feature account. 4. Review and revise the contingency scenarios in the risk model to determine if the contingency cost needs to be increased or decreased from that currently forecast. Include new scenarios as needed. 5. Provide an explanation of how costs were escalated according to the remaining project schedule. 6. Conduct a cost risk analysis for future work to determine an appropriate contingency for individual feature accounts.
USACE Draft Evaluator Response (#5)- Concur or Non-Concur
Concur. The PACR will be revised with additional explanation of the dam cost risk analysis. 1. Adopt. The Walla Walla cost risk analysis and/ the details of the dam risk report prepared by LRL & the contractor will be included as appendices. 2. Adopt. An explanation of the development of the cost risk analysis and determination of the contingencies will be included in the PACR. 3. Adopt. Appendix D contains PB-3 which shows the contingencies as a lump sum. The backup to the PB-3 is a PB-2(a) which has the contingencies broken down by feature. The PB-2(a) will be added to Appendix D or presented as a table in the report. 4. Adopt. The dam construction contract is cost reimbursable and due to the nature of this contract risk analysis is for this contract is reviewed regularly. The risk report is used in the contractors estimate to complete (best case, worse case & most likely). The PACR included $912M for contract & $228M in dam contingencies for a total of $1.140B. The FY12 president budget PB2(a) shows $1.065B for contract and $97M for dam contingency for a total of $1.162B. At this time the contractor best $1.089B, worst case $1.167B & most likely $1.099B.

It's been nearly three years since the PACR was prepared, the most recent dam risk analysis can be included in an appendix. Some risk items have been eliminated, mitigated or new ones added based on the progress on the dam. Currently the most likely estimate to complete is within the PACR limit.

5. Adopt. To bring the cost estimate from 1,991,000,000 to 2,067,000,000, inflation of 676,000,000 was calculated by using OMB Construction and Hired Labor Inflation Factors as published in Table 1 in the Army Programs, CORPS OF ENGINEERS CIVIL WORKS DIRECT PROGRAM, PROGRAM DEVELOPMENT GUIDANCE, FISCAL YEAR 2009, EC 11-2-187, dated 11 May 2007. These factors were applied to the all contracts not yet awarded and to all hired labor from FY 09 through FY 18. This statement will be added to Section 9.

6. Adopt. No net effect on cost. A simplified cost risk analysis approach (consistent with UFC 3-700-02a) applied to all remaining work (revised since the PACR was prepared) yields a contingency increase for all future work ($3,238 K) that is more than offset by savings realized by completed or deleted work ($4,932 K). At the time the PACR was prepared future work included Demo 52/53, prototype demo, U/S Mooring cells, final road paving, Buildings & Grounds (including a Storage Building), bulkhead claim, cultural resources, river dikes and Permanent Operating Equipment (including a 3,0000 HP towboat). Since then prototype demo has been deleted from the project, the bulkhead claim was settled, the Storage Building has been built and the 3,000 HP towboat was delivered. Demo 52/53 ($13M) and river dikes ($27M) are in river activities and thus have higher risk than the other remaining activities. Design development for demolition of LD52 & LD53 has not progressed past the Feasibility stage and river conditions may affect this activity (river conditions can be mitigated by scheduling flexibility) making its risk relatively high (25% Contingency). A final design exists for river dikes, river conditions shouldn't affect placement of the stone, and stone quantities can be reduced to mitigate the cost effects of this risk, thus its risk factor is relatively low (10% Contingency). Final designs exist for final road paving and the remaining Buildings and Grounds facilities, making risks for these facilities relatively low (10% Contingency). Cultural Resources planning has progressed past the Feasibility Stage, but a Memorandum of Understanding has not been finalized (25% Contingency). The cost for remaining Permanent Operating Equipment includes contingencies appropriate for the levels of design prepared by the Marine Design Center.

Comment 6:
The without project future condition is not properly specified and authorized changes since the 1990 update are not clearly described.
Basis for Comment:
Paragraph 2.1 of the Economics Appendix states that "The without project condition used in the 1990 Benefit Update was essentially the same as that outlined in the November 1985 feasibility report, except for authorized changes that had occurred to the waterway system in the intervening years." It is not clear what authorized changes are referred to in paragraph 2.1 of the Economics Appendix. Since "…impact assessment is the basis for plan evaluation, comparison and selection, clear definition and full documentation of the without-project condition are essential" (Page 2-3 of ER 1105-2-100). The without project condition assumes a "fix-as-fail" scenario. It is not clear that this assumption is consistent with ER 1105-2-100. The without project condition should assume normal operation and maintenance practices (Page 3-6 of ER 1105-2-100). Additionally, the without project condition should reflect rational economic behavior (Page 126 of the "Planning Manual").
Significance – Medium:
The assumption that the without project condition is based on the Federal government not efficiently funding Ohio River navigation operation and maintenance may overstate project benefits.
Recommendation(s) for Resolution:
1. Compute the remaining benefits-remaining cost ratio assuming a least-cost without project future and include in the report. 2. Include, as part of the without project condition description, a list and description of the authorized changes referred to in paragraph 2.1 of the Economics Appendix.
USACE Draft Evaluator Response (#6)- Concur or Non-Concur
Concur. The PACR will be revised to include additional description of the without project condition. 1. Not adopt. It should first be noted that the "fix-as-fail" (FAF) scenario does assume normal (i.e. current) operations and maintenance practices. The report's without-project condition (WOPC) is not "least cost", however, it is the most-likely future condition and it does reflect rational economic behavior given current, and

expected future, budget constraints (funds are prioritized to operations and critical maintenance). Advanced maintenance, while least cost in the long-run, is not the most-likely future condition. Section 2.2 will be re-written as follows to hopefully make this argument for the FAF WOPC clearer:

"*For the 2007 Olmsted Economics Update, the without project assumptions are for the most part the same as those used in the Benefit Update, except for: 1) authorized changes that had occurred to the waterway system in the intervening years*[6]*; and 2) the assumption that the increasing probability of structural failure will be addressed through major rehabilitation of all four lock chambers at LD52 and LD53. No major rehabilitation is currently in the planning stages that would allow for accomplishment of major rehabilitations in the 2010-2018 timeframe as assumed in the 1990 Benefit Update. Recent experience with major rehabilitations as well as oral guidance from Corps of Engineers leadership prompted revision of the without project condition for this analysis.*

Planning guidance specifies that in defining the without project condition that Corps analysts should identify the condition most likely to prevail in the absence of a new project. In recent years major lock rehabilitations have been approved by the Corps, but not funded due to more pressing federal budget priorities. Rehabilitation costs below a specified threshold (currently $14 million) are 100% Federally funded and paid from the O&M account, while rehabilitation costs above this threshold are 50/50 cost shared with the IWTF. Work below this threshold has not occurred as the O&M budget it prioritized to operations and critical maintenance. Big ticket advanced maintenance items in O&M is not a reasonable assumption. The expectation now is that major lock rehabilitations will continue to be difficult to implement, regardless of any underlying economic justification, and that major component replacement will only occur after failure conditions exist. Similarly, replacement-in-kind (referred to as the Chamber Replacement alternative) was judged to be an unlikely without project alternative.

In light of these factors, the without project condition for the lower Ohio river projects at LD52 and LD53 was re-cast as one of essentially fix-as-fails (FAF) or reactive maintenance. It should be noted, that FAF does assume current normal operations and maintenance practices. FAF does not assume advanced maintenance practices, even if considered economically justified. In short, the without project condition is not necessarily a least-cost without project future, however, it does reflect a realistic without project future from which to incrementally analyze advanced maintenance and other investment opportunities."

Note that the footnote stating "It should be noted that a benefit cost analysis was conducted to verify that this alterative did not outperform the recommended plan.

[6] New locks within the Ohio River Basin authorized as of the 2007 analysis were assumed to be in service by year 2018. Namely Olmsted Locks and Dam (replacing L/Ds 52 and 53), Kentucky Locks and Dam, Marmet Locks and Dam, and the Lower Monongahela.

Results of this analysis are presented in Section 8.0 of the update." has been removed. There is no such discussion in this update or in the 1990 update.

2. Adopt. Appendix A, page 1, sentence "The without project condition used in the 1990 Benefit Update was essentially the same as that outlined in the November 1985 feasibility report, except for authorized changes that had occurred to the waterway system in the intervening years." will be supplemented with the following footnote:
"*New locks within the Ohio River Basin authorized as of the 1990 analysis were assumed to be in service by year 2006. Namely Byrd Locks and Dam (expanding Gallipolis Locks and Dam), Winfield Locks and Dam, Grays Landing (replacing Monongahela Locks and Dam 7), and Point Marian (expanding Monongahela Locks and Dams 8).*"

Comment 7:
The PACR does not include a report section that identifies, describes, and analyzes areas of risk and uncertainty for the project.
Basis for Comment:
The Principles and Guidelines (P&G) requires a risk-based approach to project analysis. The P&G requires that "planners shall identify areas of risk and uncertainty in their analysis and describe them clearly, so that decisions can be made with knowledge of the degree of reliability of the estimated benefits and costs and of the effectiveness of alternative plans." (Page 1-3 of ER 1105-2-100). The Panel recognizes that several risk related areas were identified and analyzed in the PACR. Specifically, the Panel noted that the cost contingencies were determined using a risk-based approach, project benefits were computed using a "no growth" assumption, and alternative coal forecasts were considered in the analysis. However, a specific and more comprehensive "Risk and Uncertainty" section could be included in the report that identifies, describes, and analyzes these and other areas of risk and uncertainty for the project in order to be more responsive to the intent of P&G and provide a clearer understanding of the degree of reliability of the estimated benefits and costs.
Significance – Medium:
A section on areas of risk and uncertainty for the whole project would aid the reader in more clearly understanding the reliability of the analysis.
Recommendation(s) for Resolution:

1. Include a risk and uncertainty section in the PACR that discusses and analyzes all areas of risk and uncertainty associated with the project. Key areas to emphasize include engineering risks, environmental risks, institutional risks, and economic risks. (Page 1-3 of ER 1105-2-100)
2. At a minimum, incorporate the following variables required by ER 1105-2-100 (Page E-28): a) commodity forecasts, b) alternative mode costs, c) reliability of existing and proposed structures, and d) system delays associated with capacity constraints.
3. Include the following variables: a) cost and schedule risk, b) lock closure assumptions, and c) any other areas of risk and uncertainty identified by the Project Delivery Team.

USACE Draft Evaluator Response (#7)- Concur or Non-Concur

Concur. The PACR will be revised with a summary section to discuss the areas of risk and uncertainty relevant to cost engineering and economics.

1. Adopt.
2. Adopt.
3. Adopt.

Comment 8:

National Economic Development (NED) costs may not accurately reflect project implementation costs.

Basis for Comment:

National Economic Development (NED) costs should reflect the opportunity costs of direct or indirect resources consumed by project implementation. "In order to capture the opportunity costs of proposed plans, NED costs include three types of costs: implementation costs, other direct costs and associated costs" (Page 2-11 of ER 1105-2-100). Reducing project costs to reflect foregone costs results in the cost estimate no longer reflecting implementation costs.

The benefit-cost ratio has been calculated two different ways in the PACR. First, treating without-project condition costs foregone as a negative cost and, second, treating without-project condition costs foregone as a benefit. The discussion favors the calculation of costs foregone as a negative cost and only includes the calculation of costs foregone as benefits for informational purposes because it is required by Budget Engineering Circular (EC) guidance (Page 58 PACR). If costs foregone are treated as negative costs then NED costs may not reflect implementation costs.

Significance – Low:

In order to satisfy the requirements of ER 1105-2-100, the method for calculating NED costs should reflect implementation costs.

Recommendation(s) for Resolution:

1. Revise the report to state that costs foregone have been calculated as a benefit in accordance with the latest budget EC and that because costs foregone were calculated as a negative cost in the 1990 update that calculation is included for informational purposes.

USACE Draft Evaluator Response (#8)- Concur or Non-Concur

Concur.

1. Adopt. The PACR and Appendix A Section 10.0 introduction will be re-written as follows:
   "Project formulation and selection of a recommended plan is done by calculation and comparison of the alternative's net benefit (costs minus benefits); or more specifically the alternative's incremental net benefit over the base or without-project condition. Despite this, a benefit-to-cost ratio (BCR) is an often referenced performance metric of a cost benefit analysis. For this metric, the analysis period benefit and cost cash flows are discounted, amortized, and divided; the BCR is defined as the average annual equivalent benefits divided by average annual equivalent costs.

   The BCR has traditionally only been used as a summary statistic demonstrating the economic viability of the alternative (i.e. BCR $\geq$ 1.0). Traditionally in the Ohio River Division (ORD), and now in the Great Lakes and Ohio River Division

which replaced ORD, this BCR has been calculated as an incremental benefit to incremental cost ratio. This means that the without-project condition costs foregone are subtracted from the recommended plan construction cost to reflect an actual incremental cost of the investment over the base condition. This ratio is dependent upon the discount and amortization rate, and upon which specific cash flows are considered benefits and which specific cash flows are considered costs. Depending upon the specific cash flows, an incremental benefit to incremental cost ratio will typically be higher than a straight benefit to cost ratio where costs foregone are counted as a benefit (rather than a negative cost). "

Summary of Revised USACE Responses to 2010 Independent External Peer Review

November 2011

Summary of Revised USACE Responses to 2010 Independent External Peer Review
November 2011

An Independent External Peer Review was completed by Battelle Memorial Institute in December of 2010, and the USACE provided responses to these comments. In late 2011, a revised cost estimate was completed by the Huntington District and certified by the Cost Engineering Directory of Expertise in Walla-Walla, and additional work has also been done in the interim period that pertains to the comments made in the original 2010 IEPR. A second IEPR was performed in November of 2011 on the updated cost estimate. This document does not address the comments made during the 2011 review, but rather provides updated responses to the initial 2010 IEPR comments, reflecting the work that has been done since the completion of that review.

1. The contingency cost should expand existing line items to account for cash flow issues that may arise over the next 5 years.

USACE Response: Adopted
Action Taken: The cost estimate, scope and schedule as of July 2011 were reviewed by a panel comprised of experts from LRD and Walla-Walla. A revised cost estimate for the remaining work was developed using a variety of estimating methodologies, based upon historical data to-date for means, methods, productivities and costs expended to-date. This revised cost estimate, dated November 2011, included a complete probabilistic Cost and Schedule Risk Analysis (CSRA) used in the development of contingencies. Contingencies were developed at an 80 percent confidence level using the risk analysis processes as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The risk factors used in the development of the revised cost estimate contingencies included funding inefficiency.

The revised cost estimate was certified by the Walla-Walla Cost Engineering Directory of Expertise for Civil Works (Cost Engineering Dx). This cost engineering analysis, including documentation of the development of contingencies and the Cost Engineering Dx certification are included as an appendix (Appendix F) to the PACR.

2. The lock closure days assumptions and estimated lock closure costs used in calculating project benefits are not well supported in the report.

USACE Response: Adopted
Action Taken: The periodic/annual inspection reports and rehabilitation summaries were considered to be too voluminous to enclose in the PACR. A summary prepared by Engineering Division was included in the revised PACR as an attachment to Appendix A. An excerpt from the engineering summary follows:

The information was developed by reviewing historical records associated with the Corps of Engineers' Lock Performance Monitoring System (LPMS) data, Operations repair reports and field notes and historical notices to navigation. In general, the Operations repair reports coupled with historical navigation notices generally provided the most reliable set of historical data to draw from when developing the cost and closure information.

3. The PACR does not include an update on historical tonnages and traffic projections by commodity or sensitivity tests, nor does it consider the impact of potential environmental constraints on coal tonnage projections.

USACE Response: Adopted
Action Taken: Appendix A of the PACR was revised to include more recent traffic displays, as well as more detailed displays of the commodity traffic forecasts, explanation of the low growth/no growth scenarios, and separate traffic projections for coal.

In addition, a sensitivity analysis comparing the Clear Skies forecasts used in the analysis to more recent High, Base, and Low Case scenarios, as well as a flat/no growth forecast. The High Case forecast assumes a high level economic growth; a continuation of the sulfur dioxide and nitrogen oxide emissions restrictions contained in CAIR; implementation of the so-called Regional Greenhouse Gas Initiative (RGGI) for CO2 emissions; and relatively low growth in nuclear power additions. The Base Case forecast assumes mid-level economic growth; a continuation of CAIR requirements for sulfur dioxide and nitrogen oxide emissions; implementation of RGGI for CO2 emissions; and mid-level nuclear plant development. The Low Case forecast assumes a relatively low level of economic growth; sulfur dioxide and nitrogen oxide emissions restrictions somewhat stricter than CAIR; implementation of the Waxman-Markey bill (HR 2454) imposing strict nationwide limitations on CO2 emissions; and relatively high levels of nuclear plant development. All of the forecast alternatives assume usage of the Maximum Available Control Technology (MACT) for control of mercury emissions. A benefit-cost ratio was computed using the lowest alternative forecast, the flat forecast, indicating that the project remains justified at a BCR of 7.4 to 1.

4. The transportation rate analysis in Appendix A does not clearly describe the rate analysis methodology and derivation of project benefits.

USACE Response: Adopted
Action Taken: Section 5 of Appendix A, discussing transportation rates and their derivation, was rewritten to more clearly describe the analysis. Additionally, a new section (Section 3.1) was added to Appendix A discussing the calculation of transportation consumer surplus, transportation rate savings, and project benefits.

5. The cost risk analysis and contingency determination does not include remaining work or consider experience with the dam construction methods, changes in dam construction assumptions, or changes in the economic climate that have occurred in the nearly four years since it was completed.

USACE Response: Adopted
Action Taken: A new Cost and Schedule Risk Analysis (CSRA) was performed dated November 2011 by Corps cost engineers and certified by the Cost Engineering Dx in Walla-Walla. This new CSRA, used in the determination of contingencies, included up-to-date data, and accounted for uncertainty due to the cost-plus procurement/innovative construction, and other risk factors identified by the CSRA team. The out year contracts were estimated and the CSRA included these contracts in the analysis.

The Cost and Schedule Risk Analysis is documented in Appendix G of the PACR.

6. The without project future condition is not properly specified and authorized changes since the 1990 update are not clearly described.

USACE Response: Adopted
Action Taken: Section 2.1 of the Economics Appendix (Appendix A) was supplemented with additional description of the authorized changes since the 1990 update. In addition, Section 2.2 was rewritten to better state the justification for using the fix-as-fails scenario as the most likely without project condition. The fix-as-fails scenario is not "least cost", however, it is the most-likely future condition and it does reflect rational economic behavior given current, and expected future, budget constraints (funds are prioritized to operations and critical maintenance). The advanced maintenance scenario assumed in the 1990 Benefit Update, while least cost in the long-run, is not the most-likely future condition.

7. The PACR does not include a report section that identifies, describes, and analyzes areas of risk and uncertainty for the project.

USACE Response: Adopted
Action Taken: Risk and uncertainty analyses were performed on the remaining costs (for the development of contingency) as a part of the revised cost estimate completed by LRH and certified by the Cost Engineering Dx in Walla-Walla, and for the economic analysis (including traffic demand forecast uncertainty).

A section (Section 8.2) was added to the PACR summarizing how risk and uncertainty were accounted for throughout the analysis, with references to the more detailed risk and uncertainty discussions in the Economics Appendix (Appendix A) and in the Cost Estimate Appendix (Appendix F).

8. National Economic Development (NED) costs may not accurately reflect project implementation costs.

USACE Response: Adopted

Action Taken: The benefit-cost ratio section (Section 10) in the Economics Appendix (Appendix A) was revised to state that costs foregone were considered as a benefit, per the most recent Budget Engineering Circular, rather than a negative cost, with the incremental benefit to cost ratio (costs foregone subtracted from construction costs) included as a reference as this was how BCRs were reported in the 1990 Benefit Update. Benefit to cost ratios displayed in the main body of the PACR reflect the Budget EC method. Additional narrative explaining the difference was added to Section 10 of Appendix A.

Battelle
The Business of Innovation

November 4, 2011

Matthew Lowe, P.E.
U.S. Army Corps of Engineers
600 Dr. Martin Luther King Jr. Place
Louisville, KY 40202-2230

CONTRACT NO. W912HQ-10-D-0002
IWR TASK ORDER: 0020
SUBMITTAL OF DELIVERABLE: Final IEPR Report – Olmsted Cost Update IEPR

Dear Mr. Lowe:

This letter accompanies the submission of the Final IEPR Report for the Independent External Peer Review of Locks and Dam 52 and 53 Replacement Project Updated Cost Estimate Peer Review project. This deliverable is being submitted electronically in pdf format.

Please call me at (561) 656-6304 or Lauren Baker-Hart, Project Manager, at (781) 952-5363 if you have any questions regarding this submittal.

Sincerely,

Karen Johnson-Young

Karen Johnson-Young
Program Manager
encl.

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Battelle
The Business of Innovation

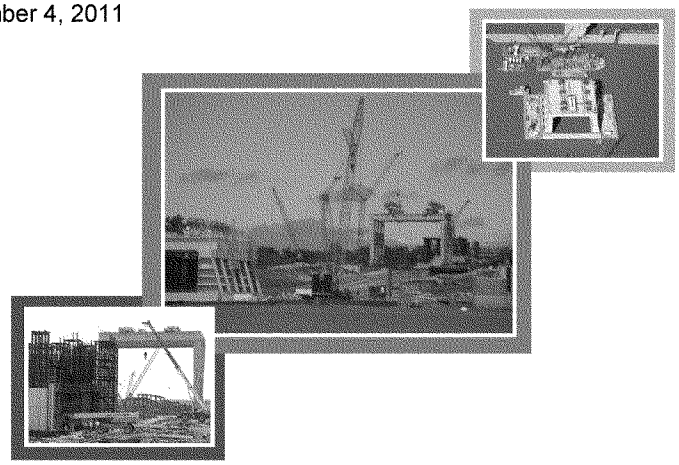
Final Independent External Peer Review Report
Olmsted Locks and Dam 52 and 53 Replacement Project
Updated Cost Estimate Peer Review

Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Inland Navigation Planning Center of Expertise
Louisville District

Contract No. W912HQ-10-D-0002
Task Order: 0020

November 4, 2011



Final Independent External Peer Review Report
Olmsted Locks and Dam 52 and 53 Replacement Project
Updated Cost Estimate Peer Review

by

Battelle
505 King Avenue
Columbus, OH 43201

for

Department of the Army
U.S. Army Corps of Engineers
Inland Navigation Planning Center of Expertise
Louisville District

November 4, 2011

Contract Number W912HQ-10-D-0002
Task Order: 0020

FINAL
INDEPENDENT EXTERNAL PEER REVIEW REPORT
for the
Olmsted Locks and Dam 52 and 53 Replacement Project
Updated Cost Estimate Peer Review

EXECUTIVE SUMMARY

Project Background and Purpose

The U.S. Army Corps of Engineers' (USACE) Olmsted Locks and Dam project provides for a structure near Ohio River Mile 964.4 that would replace the existing Locks and Dam 52 and 53. The structure will consist of twin 110-foot by 1,200-foot locks adjacent to the Illinois bank, 5 tainter gates, a 1,400-foot navigable pass, and a fixed weir extending to the Kentucky bank. The first construction contract was awarded on November 19, 1992, to construct the access road and resident engineer's office. Since then, several contracts have been awarded. The major contracts that have been awarded and completed include the locks cofferdam, the locks, the approach walls, and the operations and maintenance bulkheads contracts. The contract (cost reimbursable) for the construction of the dam was awarded January 28, 2004, and work is ongoing. Other contracts to be awarded in the future include the buildings and grounds (including site restoration), demolition of Locks and Dam 52 and 53, river dikes, upstream mooring cells, paving, and equipment contracts.

The Olmsted Locks and Dam Project had an original authorized cost of $775 million (no escalation) in the Water Resources Development Act (WRDA) of 1988. Recent design changes, contract modifications, and other unanticipated increases in project costs have led USACE to seek a Post Authorization Change Report (PACR) to increase the project's authorized amount to a level necessary for successful project completion.

In support of the PACR, Battelle was engaged to perform an Independent External Peer Review (IEPR) and submitted the Olmsted Locks and Dam 52 and 53 Replacement Project PACR (Olmsted Locks and Dam PACR) Final IEPR Report on November 15, 2010 (Battelle, 2010). The Olmsted Locks and Dam PACR Final IEPR Report identified Final Panel Comments related to concerns/issues pertaining to cost, schedule, and risk (hereinafter: original Final Panel Comments). Since that period, USACE further addressed/updated the cost estimate in an effort to improve confidence of a Total Project Cost (TPC) prior to the 2013 budget submission.

Based on the original Final Panel Comments and feedback from USACE Headquarters, USACE has further developed project cost, schedule, and risks that will then undergo a quality control (QC) review. The resulting product, the *Olmsted Locks and Dam Baseline Cost Estimate for the Post-Authorization Change Report* (Olmsted Baseline Cost Report), was subject to a cost Agency Technical Review (ATR) managed by the Cost Engineering Directory of Expertise for Civil Works and the cost estimate was certified at the conclusion of the ATR process.

Independent External Peer Review Process

USACE is conducting an IEPR of the Olmsted Locks and Dam 52 and 53 Replacement Project Updated Cost Estimate Peer Review (hereinafter: Olmsted Cost Update). As a 501(c)(3) non-profit science and technology organization, Battelle is independent, is free from conflicts of interest (COIs), and meets the requirements for an Outside Eligible Organization (OEO) per guidance described in USACE (2010). Battelle has experience in establishing and administering peer review panels for USACE and was engaged to coordinate the IEPR of the Olmsted Cost Update. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2010), USACE (2007), and OMB (2004). This final report describes the IEPR process, describes the panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel (the Panel).

The Olmsted Cost Update IEPR required the use of the two cost engineering panel members from the Olmsted Locks and Dam PACR IEPR (i.e., original IEPR) to complete the review of the Olmsted Baseline Cost Report. The cost engineering panel members for the Olmsted Cost Update IEPR were rescreened to ensure that no COIs had arisen since the original IEPR. Although the Panel was disclosed to USACE, Battelle made the final decision on selecting the Panel.

The Panel received electronic versions of the Olmsted Baseline Cost Report documents, totaling more than 6,500 pages, along with a charge that solicited comments on specific sections of the documents to be reviewed. The charge was prepared by USACE according to guidance provided in USACE (2010) and OMB (2004). Charge questions were provided by USACE and included in the draft and final Work Plans.

The USACE Project Delivery Team briefed the Panel and Battelle at an in-person briefing held at the Huntington District Office on October 19, 2011. In addition to this meeting, a teleconference with USACE, the Panel, and Battelle was held halfway through the review period to provide the Panel an opportunity to ask questions of USACE and clarify uncertainties. The Panel produced approximately 22 individual comments and 6 preliminary Final Panel Comments in response to the 11 charge questions.

IEPR panel members reviewed the Olmsted Baseline Cost Report documents individually. The panel members then met via teleconference with Battelle to review key technical comments, discuss charge questions for which there were conflicting responses, and reach agreement on the Final Panel Comments to be provided to USACE. Each Final Panel Comment was documented using a four-part format consisting of: (1) a comment statement; (2) the basis for the comment; (3) the significance of the comment (high, medium, or low); and (4) recommendations on how to resolve the comment. Overall, six Final Panel Comments were identified and documented. Of these, four were identified as having high significance, one had medium significance, and one had low significance.

IEPR Results and Panel's Understanding of Project Changes since Original IEPR

The panel members agreed among one another on their assessment of the adequacy and acceptability of the cost engineering methods, models, and analyses used (USACE, 2010; p. D-4) in the Olmsted Baseline Cost Report documents. Table ES-1 lists the Final Panel Comment statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A of this report. The following summary presents the IEPR results and the Panel's understanding of the Olmsted project changes since the original IEPR was conducted in 2010.

The Panel found the Olmsted Baseline Cost Report to be a comprehensive analysis and summary of the costs incurred to date and the anticipated future costs for the project. The high level of effort put forth by USACE to develop the Olmsted Baseline Cost Report and PACR is evident in the quality of the final deliverables. As indicated by USACE during the in-person meeting, USACE has employed its best technical experts as well as the latest technology and cost estimating methodologies to develop the updated Total Project Cost Summary (TPCS). This effort has resulted in a TPCS that is up to date, reasonable, and technically defensible.

During the October 19, 2011 in-person briefing, USACE indicated that they spent considerable time and resources in studying the ongoing dam construction, as this component is the single most expensive item of the project. A joint USACE-consultant team validated the incurred project costs and productivity levels from the completed portion of the Dam Contract. URS, the dam construction contractor, provided a detailed rebaseline cost estimate for the remaining Dam Contract completion effort. A detailed analysis of URS's estimate to complete the Dam Contract construction was conducted by Hill International, a consultant under contract to USACE. Hill International concluded that the URS estimate was within an acceptable range by estimating standards. The Cost and Schedule Risk Analysis (CSRA) for the Dam Contract was revisited and revised using the previous construction experience as a guide for future progress. In addition to the Dam Contract, USACE completed a bottom-up cost estimate for all other remaining project components to be constructed in future "out-years". The out-year contracts include a range of smaller project components such as the resident office construction, demolition of existing unused locks, and access road repaving.

The Panel understands that for typical USACE projects, all project elements would include independent government estimates (IGE); however, this project is atypical. The Dam Contract was awarded as a cost-reimbursable contract due to the unique nature of the "in-the-wet" construction methodology. As the project has progressed, the original 1986 cost estimate was superseded. As part of the updated cost estimate, USACE chose to validate URS costs for the dam rather than prepare an updated independent cost estimate for the dam. The Panel understands that the uniqueness of the project generally precluded preparation of a bottom-up cost estimate on the remaining Dam Contract costs. Overall, the Panel believes that the TPCS does adequately account for the costs to complete the project. However, the Panel does have concerns regarding elements of the TPCS. The three primary concerns outlined by the Panel are detailed herein.

USACE compiled a detailed CSRA contingency analysis for Dam Contract and out-year contracts. The Dam Contract contingency was estimated to be about 18% of the remaining base construction cost. The current contingency of 18% for the dam would be very reasonable for most projects at this stage of construction, but the Panel does not feel this is sufficient, given the overall project history and the fact that cost projections have repeatedly failed to capture the real cost of the dam construction. Consideration should be given to employing a higher contingency for the dam for the final TPCS.

The baseline cost estimate assumes $150 million per year of program funding for the majority of the upcoming contract years. Based upon the history of funding for this project and the potential for real funding limitations in the future given the current economic and political climate, this level of funding may be overestimated. A reduction in the actual funding stream in the future would result in further project schedule delays and additional cost growth. USACE should consider that less program funding may be available in the future.

The Civil Works Construction Cost Index System (CWCCIS) to estimate cost escalation through the completion of construction activities may not adequately account for future inflation. Future inflation was assumed to be 1.8% per year per OMB policy; however, this project is projected to continue through 2024. During that time, it is likely that the inflation rate will be higher than 1.8%, perhaps approaching the long-term mean of about 3% per year. USACE should consider using a higher inflation rate over the remaining life of the project for determination of the TPCS.

Table ES-1. Overview of Six Final Panel Comments Identified by the Olmsted Cost Update IEPR Panel

No.	Final Panel Comment
	Significance – High
1	The use of the Civil Works Construction Cost Index System (CWCCIS) to estimate cost escalation through the completion of construction activities may not adequately account for future inflation.
2	The project funding assumptions were not developed using a worst-case scenario and therefore may overestimate available funding.
3	The estimated contingency for the remaining dam construction costs is low, and may not account for possible delays associated with the construction of a uniquely engineered structure.
4	The Planning, Engineering and Design (PED)/Engineering During Construction (EDC)/Supervision and Administration (S&A) costs for the remaining dam construction contract and out-year construction contracts are inconsistent, and TPCs cannot be accurately determined.

Table ES–1. Overview of Six Final Panel Comments Identified by the Olmsted Cost Update IEPR Panel, continued.

No.	Final Panel Comment
	Significance – Medium
5	The cost adjustments made to the URS rebaseline estimate shown in Table 6 of the main Olmsted Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report, Olmsted Locks and Dam, October 2011 report are not thoroughly discussed, and do not provide complete documentation of the cost validation process.
	Significance – Low
6	The use of a calendar year (CY) format in the Primavera P6 schedule may have resulted in minor discrepancies among the selected mid-points used for cost escalation.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
1. INTRODUCTION 9
2. PURPOSE OF THE IEPR 10
3. METHODS 10
3.1 Planning and Schedule 10
3.2 Identification and Selection of IEPR Panel Members 12
3.3 Preparation of the Charge and Conduct of the IEPR 14
3.4 Review of Individual Comments 15
3.5 IEPR Panel Teleconference 16
3.6 Preparation of Final Panel Comments 16
4. PANEL DESCRIPTION 17
5. SUMMARY OF FINAL PANEL COMMENTS 19
6. REFERENCES 22

Appendix A. Final Panel Comments on the Olmsted Cost Update IEPR
Appendix B. Final Charge to the Independent External Peer Review Panel on the Olmsted Cost Update IEPR

LIST OF TABLES

Table ES-1. Overview of Six Final Panel Comments Identified by the Olmsted Cost Update IEPR Panel iv
Table 1. Olmsted Cost Update IEPR Schedule 11
Table 2. Olmsted Cost Update IEPR Review Documents 15
Table 3. Olmsted Cost Update IEPR Panel: Technical Criteria and Areas of Expertise 18
Table 4. Overview of Six Final Panel Comments Identified by the Olmsted Cost Update IEPR Panel 21

LIST OF ACRONYMS

ATR	Agency Technical Review
C&D	Chesapeake and Delaware
COI	Conflict of Interest
CSRA	Cost and Schedule Risk Analysis
CWCCIS	Civil Works Construction Cost Index System
CWWBS	Civil Works Work Breakdown Structure
CY	Calendar Year
DrChecks	Design Review and Checking System
EDC	Engineering During Construction
EIA	Energy Information Administration
ENR	Engineering News Record
ERDC	Engineer Research and Development Center
FY	Fiscal Year
IEPR	Independent External Peer Review
IGE	Independent Government Estimate
IMTS	Inland Marine Transportation Systems
IWTF	Inland Waterways Trust Fund
MCACES	Microcomputer Aided Cost Engineering System
MII	MCACES, 2nd Generation
OEO	Outside Eligible Organization
OMB	Office of Management and Budget
PACR	Post Authorization Change Report
PED	Planning, Engineering and Design
POP	Period of Performance
QC	Quality Control
RLB	Rider Levett Bucknall
S&A	Supervision and Administration
TPC	Total Project Cost
TPCS	Total Project Cost Summary
USACE	United States Army Corps of Engineers
WRDA	Water Resources Development Act

1. INTRODUCTION

The U.S. Army Corps of Engineers' (USACE) Olmsted Locks and Dam project provides for a structure near Ohio River Mile 964.4 that would replace the existing Locks and Dam 52 and 53. The structure will consist of twin 110-foot by 1,200-foot locks adjacent to the Illinois bank, 5 tainter gates, a 1,400-foot navigable pass, and a fixed weir extending to the Kentucky bank. The first construction contract was awarded on November 19, 1992, to construct the access road and resident engineer's office. Since then, several contracts have been awarded. The major contracts that have been awarded and completed include the locks cofferdam, the locks, the approach walls, and the operations and maintenance bulkheads contracts. The contract (cost reimbursable) for the construction of the dam was awarded January 28, 2004, and work is ongoing. Other contracts to be awarded in the future include the buildings and grounds (including site restoration), demolition of Locks & Dam 52 and 53, river dikes, upstream mooring cells, paving, and equipment contracts.

The Olmsted Locks and Dam Project had an original authorized cost of $775 million (without escalation) in the Water Resources Development Act (WRDA) of 1988. Recent design changes, contract modifications, and other unanticipated increases in project costs have led USACE to seek a Post Authorization Change Report (PACR) to increase the project's authorized amount to a level necessary for successful project completion.

In support of the PACR, Battelle was engaged to perform an Independent External Peer Review (IEPR) and submitted the Olmsted Locks and Dam 52 and 53 Replacement Project PACR (i.e., original IEPR) Final IEPR Report on November 15, 2010. This Final IEPR Report identified Final Panel Comments related to concerns/issues pertaining to cost, schedule, and risk (hereinafter: original Final Panel Comments). Since that period, USACE has elected to further address/update the cost estimate in an effort to improve confidence of a Total Project Cost (TPC) prior to the 2013 budget submission.

Based on the original Final Panel Comments and feedback from USACE Headquarters, USACE has further developed project cost, schedule, and risks that will then undergo a quality control (QC) review. The resulting product, the *Olmsted Locks and Dam Baseline Cost Estimate for the Post-Authorization Change Report* (Olmsted Baseline Cost Report), was subject to a cost Agency Technical Review (ATR) managed by the Cost Engineering Directory of Expertise for Civil Works and the cost estimate was certified at the conclusion of the ATR process.

The objective of the work described herein was to conduct an IEPR of the Olmsted Cost Update in accordance with procedures described in the Department of the Army, USACE Engineer Circular *Civil Works Review Policy* (EC No. 1165-2-209) (USACE, 2010), USACE CECW-CP memorandum *Peer Review Process* (USACE, 2007), and Office of Management and Budget (OMB) bulletin *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

This final report details the IEPR process, describes the IEPR panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel on the cost engineering analyses contained in the Olmsted Baseline Cost Report. The full text of the Final Panel Comments is presented in Appendix A.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the ATR, as described in USACE (2010) and USACE (2007).

In general, the purpose of peer review is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. IEPR provides an independent assessment of the economic, engineering, and environmental analysis of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to make a good decision regarding implementation of alternatives and recommendations.

In this case, the IEPR of the Olmsted Cost Update was conducted and managed using contract support from Battelle, which is an Outside Eligible Organization (OEO) (as defined by EC No. 1165-2-209) under Section 501(c)(3) of the U.S. Internal Revenue Code with experience conducting IEPRs for USACE.

3. METHODS

This section describes the method followed in selecting the members for the IEPR Panel (the Panel) and in planning and conducting the IEPR. The IEPR was conducted following procedures described by USACE (2010) and in accordance with USACE (2007) and OMB (2004) guidance. Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

3.1 Planning and Schedule

At the beginning of the Period of Performance (POP), Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, discuss the IEPR process, and address any questions regarding the scope (e.g., clarify expertise areas needed for panel members). Any revisions to the schedule were submitted as part of the final Work Plan. A revised final Work Plan was subsequently submitted to reflect additional changes to the overall project schedule (Table 1) and the list of review and reference documents (Table 2).

Table 1 defines the schedule followed in executing the IEPR. Due dates for milestones and deliverables are based on the award/effective date of September 22, 2011, and a draft document receipt date of October 24, 2011. Note that the work items listed in Task 6 occur after the submission of this report. Battelle will enter the six Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software

system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle.

Table 1. Olmsted Cost Update IEPR Schedule

Task	Action	Due Date
1	Award/Effective Date	9/22/2011
	Battelle submits draft Work Plan[a]	9/30/2011
	USACE provides comments on draft Work Plan	10/4/2011
	Battelle submits final Work Plan[a]	10/7/2011
	Battelle submits revised final Work Plan	11/3/2011
2	Battelle requests input from USACE on the COI questionnaire	9/27/2011
	USACE provides comments on COI questionnaire	9/28/2011
	Battelle submits list of selected panel members	9/30/2011
	USACE provides comments on selected panel members' COI	10/3/2011
	Battelle completes subcontracts for panel members	10/11/2011
3	USACE/Battelle hold kick-off meeting	10/3/2011
	Battelle/Panel hold kick-off meeting	10/14/2011
	Battelle/Panel attend on-site project briefing (Huntington District)	10/19/2011
4	USACE supplies draft cost documentation/files	10/19/2011
	USACE supplies draft Baseline Cost Estimate Report	10/24/2011
	Battelle convenes mid-review teleconference for Panel to ask clarifying questions of USACE	10/26/2011
	USACE supplies Final Baseline Cost Estimate Report	10/28/2011
	Panel members complete their individual reviews	10/31/2011
	Battelle provides Panel merged individual comments and talking points for Panel Review Teleconference	10/31/2011
	Panel members provide preliminary Final Panel Comments to Battelle	11/1/2011
	Battelle supplies working draft Final Panel Comments to USACE	11/4/2011
5	Battelle submits Final IEPR Report to USACE[a]	11/4/2011
6[b]	Battelle convenes teleconference with USACE to review the Comment Response Process	TBD
	USACE provides draft Evaluator Responses to Battelle	11/7/2011
	Battelle convenes teleconference with Panel and USACE to discuss Final Panel Comments and draft responses	11/8/2011
	USACE inputs final Evaluator Responses in DrChecks	11/9/2011
	Battelle inputs the Panel's BackCheck Responses in DrChecks	11/11/2011
	Battelle submits pdf printout of DrChecks project file[a]	11/11/2011
	Project Closeout: includes time to close out subcontracts with panel members[c].	11/23/2011

[a] Deliverable.
[b] Task 6 occurs after the submission of this report.
[c] A no-cost extension to modify the POP will be necessary to extend the POP 52 days (i.e., through January 31, 2012) after the last deliverable is submitted in order to conduct project closeout activities.

3.2 Identification and Selection of IEPR Panel Members

The Olmsted Cost Update IEPR required the participation of the two cost engineering panel members from the original IEPR to complete the review of the updated cost review documents. No other primary or back-up panel members were identified for the Olmsted Cost Update IEPR project. Information about the candidate panel members, including brief biographical information, highest level of education attained, and years of experience, was provided to USACE for feedback. Battelle made the final selection of panel members according to the selection criteria described in the Work Plan.

The cost engineering panel members for the Olmsted Cost Update IEPR were rescreened to ensure that no COIs had arisen since the original IEPR for the following potential exclusion criteria or COIs.[1] These COI questions were intended to serve as a means of disclosure and to better characterize a candidate's employment history and background. Providing a positive response to a COI screening question did not automatically preclude a candidate from serving on the Panel. For example, participation in previous USACE technical peer review committees and other technical review panel experience was included as a COI screening question. A positive response to this question could be considered a benefit.

- Involvement by you or your firm[2] in the Olmsted Locks and Dam 52 and 53 Replacement Project Updated Cost Estimate Peer Review and technical appendices.
- Involvement by you or your firm[2] in any work on the Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report (Olmsted Locks and Dam PACR), or related projects.
- Involvement by you or your firm[2] in flood control, navigation, or ecosystem restoration projects in Ballard County (KY), Pulaski County (IL), or in the vicinity of Ohio River Mile 964, including:
    - Smithland Locks and Dam
    - Olmsted Dam Design & Construction
    - Olmsted Locks and Dam Project- Locks Cofferdam
    - Olmsted Locks and Dam Project - Locks
    - Olmsted Locks and Dam Project - Approach Walls
    - Olmsted Locks and Dam Project - Operating & Maintenance Bulkheads.
- Involvement with paid or unpaid expert testimony related to the Olmsted Locks and Dam PACR.

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[1] Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See OMB (2004, p. 18), "....when a scientist is awarded a government research grant through an investigator-initiated, peer-reviewed competition, there generally should be no question as to that scientist's ability to offer independent scientific advice to the agency on other projects. This contrasts, for example, to a situation in which a scientist has a consulting or contractual arrangement with the agency or office sponsoring a peer review. Likewise, when the agency and a researcher work together (e.g., through a cooperative agreement) to design or implement a study, there is less independence from the agency. Furthermore, if a scientist has repeatedly served as a reviewer for the same agency, some may question whether that scientist is sufficiently independent from the agency to be employed as a peer reviewer on agency-sponsored projects."

[2] Includes any joint ventures in which your firm is involved and if your firm serves as a prime or as a subcontractor to a prime. Please clarify which relationship exists.

- Current or previous employment or affiliation with members of the cooperating agencies or local sponsors (for pay or *pro bono*), including:
  - Kentucky Department of Fish and Wildlife Resources
  - City of Olmsted, IL
  - City of Paducah, KY
  - City of Cairo, IL
  - Illinois State Historic Preservation Agency
  - Kentucky State Historic Preservation Office
  - Inland Waterways Trust Fund.
- Past, current, or future interests or involvements (financial or otherwise) by you, your spouse, or your children related to Ballard County (KY), Pulaski County (IL), or in the Ohio River System in the vicinity of River Mile 964.
- Participation in relevant prior Federal studies relevant to this project and/or Locks and Dam 52 and 53 Replacement Project (Olmsted Lock and Dam) PACR, including the project cost estimating performed by Hill International.
- Current personal involvement in other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, Engineer Research and Development Center [ERDC], etc.), and position/role. Please highlight and discuss in detail any projects that are specifically with the Louisville District.
- Current firm[2] involvement in other USACE projects, specifically those projects/contracts that are with the Louisville District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role.
- Previous employment by the USACE as a direct employee or contractor (either as an individual or through your firm[2]) within the last 10 years, notably if those projects/contracts are with the Louisville District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Other USACE affiliation (e.g., scientist employed by USACE).
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning coastal protection projects, and include the client/agency and duration of review (approximate dates).
- Pending, current, or future financial interests in the Olmsted Locks and Dam PACR, or related contracts/awards from USACE, including:
  - Smithland Locks and Dam
  - Olmsted Dam Design & Construction
  - Olmsted Locks and Dam Project- Locks Cofferdam
  - Olmsted Locks and Dam Project - Locks
  - Olmsted Locks and Dam Project - Approach Walls
  - Olmsted Locks and Dam Project - Operating & Maintenance Bulkheads

- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years came from USACE contracts.
- Any publicly documented statement, affidavit, or opinion on USACE coastal projects.
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to related to Olmsted Locks and Dam PACR.
- Participation in relevant prior Federal studies relevant to this project and/or Olmsted Locks and Dam PACR, including:
    - The Lower Ohio River Feasibility Study
    - Smithland Locks and Dam
    - Olmsted Dam Design & Construction
- Participation in prior non-Federal studies relevant to this project and/or Olmsted Locks and Dam PACR.
- Is there any past, present, or future activity, relationship or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project? If so, please describe.

Other considerations:

- Participation in previous USACE technical review panels
- Other technical review panel experience

The two final reviewers were affiliated with either academic institutions or consulting companies. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. USACE was given the list of candidate panel members, but Battelle made the final selections of the Panel. Section 4 of this report provides names and biographical information on the panel members.

Prior to beginning their review and within 3 days of their subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication procedures, and other pertinent information for the Panel.

3.3 Preparation of the Charge and Conduct of the IEPR

Charge questions were provided by USACE and included in the draft and final Work Plans. In addition to a list of 11 charge questions/discussion points, the final charge included general guidance for the Panel on the conduct of the peer review (provided in Appendix B of this final report).

Battelle held a kick-off meeting via teleconference where the details of the IEPR process and project schedule were presented to the Panel. Before the meeting, the IEPR Panel received an electronic version of the final charge. In addition, USACE conducted an in-person briefing to discuss the Olmsted Cost Update IEPR at the Huntington District Office on October 19, 2011.

The documents and files in Table 2 were provided for review October 24, 2011 through October 28, 2011; the other documents were provided for reference or supplemental information only.

- USACE guidance *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010
- CECW-CP Memorandum dated March 30, 2007
- OMB's *Final Information Quality Bulletin for Peer Review* released December 16, 2004

Table 2. Olmsted Cost Update IEPR Review Documents

Document Title[1]	Review (R) or Reference (RF)	Page Count
Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report	R	70
Appendix A - Total Project Cost Summary	R	20
Appendix B - MII Reports	R	11
Appendix C - Dam Base Cost Estimate Adjustments	R	98
Appendix D - Primavera P6® Schedule	R	23
Appendix E - Agency Technical Review Documentation	R	60
Appendix F - Quality Control Documentation	RF	118
Appendix G - Prior Expenditures	R	10
Appendix H - Team Resumes	RF	91
Appendix I - Cost & Schedule Risk Analysis	R	191
Appendix J - Out-Year Contract Back Up	R and RF	60
Appendix K - Hill Olmsted Cost and Schedule Review Report with Backup	R and RF	2268
Appendix L - URS Corporation 2011 Rebaseline Estimate Summary& Details	R and RF	2271
Appendix M - Backup to URS 2011 Rebaseline Estimate	RF	777
Construction schedule and supporting docs	R and RF	22

[1] Draft versions of these documents were received on October 24, 2011. The final versions were received on October 28, 2011.

About halfway through the review of the Olmsted Baseline Cost Report documents, a teleconference was held with USACE, the Panel, and Battelle so that USACE could answer any questions the Panel had concerning either the review documents or the project.

3.4 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle. At the end of the review period, the Panel produced approximately 22 individual comments and 6 preliminary Final Panel Comments in response to the charge questions/discussion points. Battelle reviewed the comments to identify overall recurring themes, areas of potential conflict, and other overall impressions. As a result of the review, Battelle summarized the 22 comments into a preliminary list of 11 overall comments and discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

3.5 IEPR Panel Teleconference

Battelle facilitated a 2-hour teleconference with the Panel so that the panel members could exchange technical information. The main goal of the teleconference was to identify which issues and preliminary Final Panel Comments should be carried forward as Final Panel Comments in the Final IEPR Report and decide which panel member would serve as the lead author for the development of each Final Panel Comment. This information exchange ensured that the Final IEPR Report would accurately represent the Panel's assessment of the project, including any conflicting opinions. The Panel engaged in a thorough discussion of the overall positive and negative comments, added any missing issues of high-level importance to the findings, and merged any related individual comments. In addition, Battelle confirmed each Final Panel Comment's level of significance to the Panel.

The Panel also discussed responses to five charge questions where there appeared to be disagreement among panel members. The conflicting comments were resolved based on the professional judgment of the Panel, and all sets of comments were determined not to be conflicting. Each comment was either incorporated into a Final Panel Comment, determined to be consistent with other Final Panel Comments already developed, or determined to be a non-significant issue.

At the end of these discussions, the Panel identified six comments and discussion points that should be brought forward as Final Panel Comments.

3.6 Preparation of Final Panel Comments

Following the teleconference, Battelle prepared a summary memorandum for the Panel documenting each Final Panel Comment (organized by level of significance). The memorandum provided the following detailed guidance on the approach and format to be used to develop the Final Panel Comments for the Olmsted Cost Update:

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged individual comments table, a summary detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.
- Directive to the Lead: Each lead was encouraged to communicate directly with other IEPR panel member as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.
- Format for Final Panel Comments: Each Final Panel Comment was presented as part of a four-part structure:
  1. Comment Statement (succinct summary statement of concern)
  2. Basis for Comment (details regarding the concern)

3. Significance (high, medium, low; see description below)
4. Recommendation(s) for Resolution (see description below).

- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
  1. High: Describes a fundamental problem with the project that could affect the recommendation, success, or justification of the project. Comments rated as high indicate that the Panel analyzed or assessed the methods, models, and/or analyses and determined that there is a "showstopper" issue.
  2. Medium: Affects the completeness of the report in describing the project, but will not affect the recommendation or justification of the project. Comments rated as medium indicate that the Panel does not have sufficient information to analyze or assess the methods, models, or analyses.
  3. Low: Affects the understanding or accuracy of the project as described in the report, but will not affect the recommendation or justification of the project. Comments rated as low indicate that the Panel identified information (tables, figures, equations, discussions) that was mislabeled or incorrect or data or report sections that were not clearly described or presented.
- Guidance for Developing Recommendations: The recommendation section was to include specific actions that USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

At the end of this process, six Final Panel Comments were prepared and assembled. Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy. There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in Appendix A of this report.

4. PANEL DESCRIPTION

The Olmsted Cost Update IEPR utilized the two cost engineering panel members from the original IEPR to complete the review of the updated cost review documents. No other primary or back-up panel members were identified for the Olmsted Cost Update IEPR project. Battelle prepared a presentation with the primary cost engineering panel members (who were rescreened for availability and COIs), and provided it to USACE for feedback. Battelle made the final selection of panel members.

An overview of the credentials of the final two primary members of the Panel and their qualifications in relation to the technical evaluation criteria is presented in Table 3. More detailed biographical information regarding each panel member and his area of technical expertise is presented in the text that follows the table.

Table 3. Olmsted Cost Update IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criteria	Brown	Schlebusch
Cost Engineering		
10 years of experience	X	X
Registered professional engineer, certified cost consultant/certified cost engineer, or certified estimating professional	X	X
Demonstrated experience in reviewing Federal water resource economic documents justifying construction efforts	X	X
Demonstrated experience in developing estimated construction costs and construction methods related to large Civil Works navigation projects	X	X
Familiarity with applicable USACE regulations, including knowledge of the Microcomputer Aided Cost Engineering System (MCACES) 2nd Generation (MII) estimating software package, the Civil Works Work Breakdown Structure (CWWBS), and critical path project scheduling.	X	X
M.S. or higher in cost engineering	X	X

Christopher Brown, P.E., Ph.D.
Role: This panel member was chosen primarily for his cost engineering experience and expertise.
Affiliation: University of North Florida

Dr. Christopher Brown is a professor at the University of North Florida teaching civil engineering, fluid mechanics, hydraulics, and engineering geology. He earned his Ph.D. in civil engineering in 2005 from the University of Florida and is a licensed professional engineer in Florida and Pennsylvania. He has over 20 years of experience working on public works projects for USACE (1991-2006) and as a private consultant focusing on geotechnical engineering, water resources planning, and civil engineering projects. He is experienced in developing estimated construction costs and construction methods related to large Civil Works navigation projects involving canals, ocean harbors, inland navigation, dredged material disposal, waterborne construction, and subsurface barrier walls. Large Civil Works projects supported include the Chesapeake and Delaware (C&D) Canal Deepening Project in Maryland and Delaware and the Delaware Main Channel Deepening Project in Pennsylvania and New Jersey. Dr. Brown is familiar with all applicable USACE regulations that require an extensive knowledge of cost engineering applications. He is familiar with Microcomputer Aided Cost Engineering System (MCACES I) model estimates and understands the assumptions and outputs associated with it. He has worked on a team developing the replacement of bridge sections along the Tamiami Trail in south Florida, a complex project costing over $100 million and involving multiple contracts over a 3-year period. He is familiar with the basic Civil Works Work Breakdown Structure (CWWBS) and has utilized it on studies such as the Liquid Natural Gas tank foundation improvement in Martin County in 2009 as a part of a five-part feasibility-level cost study. He has also utilized the CWWBS to develop feasibility-level cost estimates for the rehabilitation of embankments, outlet structures, and structures for the Iluka Mine, Green Cove, Florida.
Dr. Brown is familiar with Critical Path Method (CPM) scheduling, utilizing various software tools including Microsoft Project, Timeline, and self-programming inside Microsoft Excel. He developed PERT charts for the Iluka Mine project and has used Gantt charts for numerous

projects, including the New Jersey Coast Guard helicopter landing facility rehabilitation and replacement project.

Marc Schlebusch, P.E.
Role: This panel member was chosen primarily for his cost engineering experience and expertise.
Affiliation: CDM, Inc.

Marc Schlebusch is a cost engineer for CDM, Inc., specializing in cost estimates, construction schedules, and project controls for complex projects. He earned his M.S. in environmental engineering from the University of Iowa in 1997, has received formal training in MCACES, 2nd generation (MII), and is a licensed professional engineer in Kansas and Missouri. He has more than 10 years of demonstrated experience in civil cost engineering analysis, design, cost estimation, construction, and operations and maintenance. He is familiar with large, high-visibility, complex, Civil Works projects, having provided cost estimating support for such projects as the Louisiana Coastal Area Ecosystem Restoration and the Covent/Blind River Diversion Project, Louisiana, and the Central City Project in Ft. Worth, Texas. Mr. Schlebusch is experienced with the development of estimated construction costs and construction methods related to large Civil Works navigation projects, including the Baptiste Collette Bayou Navigation Channel Deepening, Plaquemines Parish, Louisiana, an 8-mile channel enlargement project (estimated cost of $123 million); and the Central City Project in Ft. Worth, Texas, involving the relocation of a channel and installation of new dam structures (estimated cost of $681 million). He is familiar with all applicable USACE regulations that require an extensive knowledge of cost engineering applications. He has extensive experience preparing MCACES MII cost estimates for USACE projects with values from $1 million to more than $100 million, including feasibility-, design-, and construction-level estimates for bypass channel/flood control, ecosystem restoration, floodwall demolition and construction, and hazardous site remediation. He is experienced in the CWWBS and has completed cost estimates requiring its use. Specific projects utilizing both MII and CWWBS include the Ft. Worth Central City Project and the St. James Parish Convent/Blind River Diversion Project mentioned above. Mr. Schlebusch is experienced in the use of CPP, and has prepared preliminary construction schedules for numerous projects including the Central City Project and Hurricane Protection Projects, Jefferson Parish, Louisiana.

5. SUMMARY OF FINAL PANEL COMMENTS

The following summary presents the IEPR results and the Panel's understanding of the Olmsted project changes since the original IEPR was conducted in 2010. The panel members agreed among one another on their assessment of the adequacy and acceptability of the cost engineering methods, models, and analyses used (USACE, 2010; p. D-4) in the Olmsted Baseline Cost Report IEPR document. Table 4 lists the six Final Panel Comment statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A of this report.

The Panel found the Olmsted Baseline Cost Report to be a comprehensive analysis and summary of the costs incurred to date and the anticipated future costs for the project. The high level of

effort put forth by USACE to develop the Olmsted Baseline Cost Report and PACR is evident in the quality of the final deliverables. As indicated by USACE during the in-person meeting, USACE has employed its best technical experts as well as the latest technology and cost estimating methodologies to develop the updated Total Project Cost Summary (TPCS). This effort has resulted in a TPCS that is up to date, reasonable, and technically defensible.

During the October 19, 2011 in-person briefing, USACE indicated that they spent considerable time and resources in studying the ongoing dam construction, as this component is the single most expensive item of the project. A joint USACE-consultant team validated the incurred project costs and productivity levels from the completed portion of the Dam Contract. URS, the dam construction contractor, provided a detailed rebaseline cost estimate for the remaining Dam Contract completion effort. A detailed analysis of URS's estimate to complete the Dam Contract construction was conducted by Hill International, a consultant under contract to USACE. Hill International concluded that the URS estimate was within an acceptable range by estimating standards. The Cost and Schedule Risk Analysis (CSRA) for the Dam Contract was revisited and revised using the previous construction experience as a guide for future progress. In addition to the Dam Contract, USACE completed a bottom-up cost estimate for all other remaining project components to be constructed in future "out-years". The out-year contracts include a range of smaller project components such as the resident office construction, demolition of existing unused locks, and access road repaving.

The Panel understands that for typical USACE projects, all project elements would include independent government estimates (IGE); however, this project is atypical. The Dam Contract was awarded as a cost-reimbursable contract due to the unique nature of the "in-the-wet" construction methodology. As the project has progressed, the original 1986 cost estimate was superseded. As part of the updated cost estimate, USACE chose to validate URS costs for the dam rather than prepare an updated independent cost estimate for the dam. The Panel understands that the uniqueness of the project generally precluded preparation of a bottom-up cost estimate on the remaining Dam Contract costs. Overall, the Panel believes that the TPCS does adequately account for the costs to complete the project. However, the Panel does have concerns regarding elements of the TPCS. The three primary concerns outlined by the Panel are detailed herein.

USACE compiled a detailed CSRA contingency analysis for Dam Contract and out-year contracts. The Dam Contract contingency was estimated to be about 18% of the remaining base construction cost. The current contingency of 18% for the dam would be very reasonable for most projects at this stage of construction, but the Panel does not feel this is sufficient, given the overall project history and the fact that cost projections have repeatedly failed to capture the real cost of the dam construction. Consideration should be given to employing a higher contingency for the dam for the final TPCS.

The baseline cost estimate assumes $150 million per year of program funding for the majority of the upcoming contract years. Based upon the history of funding for this project and the potential for real funding limitations in the future given the current economic and political climate, this level of funding may be overestimated. A reduction in the actual funding stream in the future

would result in further project schedule delays and additional cost growth. USACE should consider that less program funding may be available in the future.

The Civil Works Construction Cost Index System (CWCCIS) to estimate cost escalation through the completion of construction activities may not adequately account for future inflation. Future inflation was assumed to be 1.8% per year per OMB policy; however, this project is projected to continue through 2024. During that time, it is likely that the inflation rate will be higher than 1.8%, perhaps approaching the long-term mean of about 3% per year. USACE should consider using a higher inflation rate over the remaining life of the project for determination of the TPCS.

Table 4. Overview of Six Final Panel Comments Identified by the Olmsted Cost Update IEPR Panel

No.	Final Panel Comment
	Significance – High
1	The use of the Civil Works Construction Cost Index System (CWCCIS) to estimate cost escalation through the completion of construction activities may not adequately account for future inflation.
2	The project funding assumptions were not developed using a worst-case scenario and therefore may overestimate available funding.
3	The estimated contingency for the remaining dam construction costs is low, and may not account for possible delays associated with the construction of a uniquely engineered structure.
4	The Planning, Engineering and Design (PED)/Engineering During Construction (EDC)/Supervision and Administration (S&A) costs for the remaining dam construction contract and out-year construction contracts are inconsistent, and TPCs cannot be accurately determined.
	Significance – Medium
5	The cost adjustments made to the URS rebaseline estimate shown in Table 6 of the main Olmsted Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report, Olmsted Locks and Dam, October 2011 report are not thoroughly discussed, and do not provide complete documentation of the cost validation process.
	Significance – Low
6	The use of a calendar year (CY) format in the Primavera P6 schedule may have resulted in minor discrepancies among the selected mid-points used for cost escalation.

6. REFERENCES

Battelle (2010). Final Independent External Peer Review Report Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report. November 15.

EIA (2011). International Energy Outlook 2011, Energy Information Administration, U.S. Department of Energy, DOE/EIA Report # 0484 (2011). http://205.254.135.24/forecasts/ieo/index.cfm.

ENR (2011). Historical Indices. Engineering News Record. http://enr.construction.com/economics/historical_indices/. October 2011.

IMTS (2010). Inland Marine Transportation Systems Capital Projects Business Model, Final Report. Inland Marine Transportation Systems (IMTS) Capital Investment Strategy Team. April 13.

IWTF (2011). Inland Waterways Trust Fund Status Report. Inland Waterways Trust (IWTF). April 1.

OMB (2004). Final Information Quality Bulletin for Peer Review. Executive Office of the President, Office of Management and Budget, Washington, D.C. Memorandum M-05-03. December 16.

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Turner (2011). Turner Building Cost Index – 2011 Third Quarter Forecast. Turner Construction. 2011

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USACE (2010). Water Resources Policies and Authorities: Civil Works Review Policy. Department of the Army, US Army Corps of Engineers, Washington, D.C. Engineer Circular (EC) No. 1165-2-209. January 31.

USACE (2011). Civil Works Construction Cost Index System. EM 1110-2-1304. September 30.

APPENDIX A

Final Panel Comments

on the

Olmsted Cost Update IEPR

Final Panel Comment 1
The use of the Civil Works Construction Cost Index System (CWCCIS) to estimate cost escalation through the completion of construction activities may not adequately account for future inflation.
Basis for Comment:
The CWCCIS uses Office of Management and Budget (OMB) inflation factors to forecast escalation for years in which no data are available. The CWCCIS currently is forecasting approximately 1.8% escalation year to year after fiscal year (FY) 2012. Escalation was considered in the Cost and Schedule Risk Analysis (CSRA), Appendix I - Risk Register under risk number DAM-036. Under current economic conditions, this escalation rate may be adequate for immediate future escalation. However, when compared to historical averages, this is relatively low. The recent economic downturn has resulted in negative or comparably low inflation indices, and there is variation depending on which cost index is reviewed, but looking at inflation rate over 20 years, the average annual inflation rate is approximately 3%. Some indices, like those from the Engineering News Record (ENR), have shown recent inflation rates close to this (ENR, 2011). For example: ENR Construction Cost Index from calendar year (CY) 2009 to CY2010 showed an increase of 2.7% and from CY2010 to CY2011 showed an increase of 2.8%. The CWCCIS over the same time frame has increases of 3% and 4.1%, respectively. The Rider Levett Bucknall (RLB) National Construction Cost Index had smaller gains of 0.9% and 1.4%, respectively (RLB, 2011); however, the RLB index considers primarily bid price inflation. And the Turner Building Cost Index over the same period showed a decrease of -4% and then an increase of 1.9%, respectively (Turner, 2011). Based on the ENR Skilled Labor Index History, labor costs have increased on average approximately 3.4% per year. Through the recent economic downturn, labor cost increases have remained higher than material cost increases. The ENR Skilled Labor Index from CY2009 to CY2010 showed an increase of 3.5% and from 2010 to 2011 showed an increase of 2.5%. In addition, in the CSRA, risk number DAM-036 suggests a 4% per year labor agreement cost increase. Generally, material prices have been very volatile and are dependent on global economic demand. Concrete and steel prices may currently be stable or decreasing because global demand is depressed as a result of the economic downturn. For example, fuel costs could grow at significantly higher rates than 1.8%. The Energy Information Administration 2011 Energy Outlook includes a high oil price scenario that has the price of a barrel of oil at $146 in 2015 and at $169 in 2020 (EIA, 2011). If this scenario were realized, the cost of diesel fuel for the Olmsted project would be much higher than estimated. Should economic conditions improve, which is possible considering the time frame until completion, it is likely that inflation could be higher than the current CWCCIS approximation. Current USACE guidance mandates the use of Table 1 of the Program Development Guidance for Fiscal Year 2011 (USACE, 2009); however, the CWCCIS (USACE, 2011) also states on page 2-1 that "while the historic projections are reliable to update project costs, forecasting beyond two years may be unreliable."

Significance – High
Actual costs due to inflation could be significantly higher than those currently projected.
Recommendations for Resolution:
1. Review inflation rates assumed in the CWCCIS with respect to historic construction cost indices and inflation on similar projects. Revise inflation rates based on review. 2. Consider the assumptions made by URS for escalation in the Dam Contract and apply a similar methodology/rate to the Total Project Cost Summary (TPCS) for the remainder of the Dam Contract.

Literature Cited:

EIA (2011). International Energy Outlook 2011, Energy Information Administration, U.S. Department of Energy, DOE/EIA Report # 0484 (2011). http://205.254.135.24/forecasts/ieo/index.cfm.

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USACE (2009). Corps of Engineers Civil Works Direct Program, Program Development Guidance – Fiscal Year 2011, Table 1. EC 11-2-194. April 1.

Final Panel Comment 2
The project funding assumptions were not developed using a worst-case scenario and therefore may overestimate available funding.
Basis for Comment:
The Olmsted Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report (PACR), Olmsted Locks and Dam, October 2011 report (main report) states on page 35 that "… it was apparent that the dam construction duration is cost driven rather than activity driven." The funding stream scenario used in the analysis is $150 million per year through FY2021, then a $100 million per year for FY2022 to FY2024. The CSRA risk register number DAM-021 has a worst case scenario of $150 million per year for FY2012 and FY2013 which is then reduced to $130 million per year for the remainder of the dam contract and $75 million per year for out-year contracts. Final Panel Comment number 1 from the Final Independent External Peer Review Report Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report related to the adequacy of funding from the Inland Waterways Trust Fund (IWTF) in meeting future project needs. Even if all available funds from the IWTF are made available solely to the Olmsted Locks and Dam project, the assumption of $150 million a year in funding may not be realistic. The FY2010 ending balance of the IWTF was $58.5 million (IWTF, 2011). The FY2010 revenues were $73.9 million, down from $76 million in FY2009. There has generally been a decreasing trend in revenue for the IWTF (IMTS, 2010). In addition, because the total IWTF has been severely reduced, the interest on remaining funds generated year to year has decreased more substantially. Depending on economic conditions, the IWTF may be depleted to the point where it cannot maintain the 50% cost share for funding of $150 million per year through FY2021. The use of a $150 million per year funding stream for the majority of the upcoming contract years may not be realistic, based on the history of funding for this project and the potential for real funding limitations in the future given the current economic and political climate. Contingency for the remaining dam contract and out-year contracts may increase under the worst-case funding scenario. The main report, page 47, states that fixed site overhead costs are approximately $50 million per year. These costs are incurred regardless of how much construction is accomplished in a given year. Program funding at levels less than expected would have a real impact on project schedule because less construction would then be accomplished. Less construction accomplished delays the project schedule and increases costs. The report does cite an estimation of project savings under a better-than-expected funding scenario. However, the report would benefit from additional text describing the funding streams in more detail and the implications of lower-than-ideal funding, including number of additional years and costs potentially incurred based on the worst-case scenario.

Significance – High
If program funding is less than assumed, the overall project schedule will be delayed, resulting in increased costs.
Recommendations for Resolution:
1. Base schedule and cost estimate on an expected funding limit of $130 million per year through FY2021 and $75 million for the out-year contracts (worst-case scenario under CSRA risk register number DAM-021). 2. Include additional text in the report regarding the implications of lower-than-ideal funding, including number of additional years and costs potentially incurred based on the worst-case scenario. 3. Include a discussion of the two funding streams, IWTF and Treasury, for the Olmsted project and their possible limitations.

Literature Cited:

Battelle (2010). Final Independent External Peer Review Report Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report. November 15.

IMTS (2010). Inland Marine Transportation Systems Capital Projects Business Model, Final Report. Inland Marine Transportation Systems (IMTS) Capital Investment Strategy Team. April 13.

IWTF (2011). Inland Waterways Trust Fund Status Report. Inland Waterways Trust (IWTF). April 1.

Final Panel Comment 3
The estimated contingency for the remaining dam construction costs is low, and may not account for possible delays associated with the construction of a uniquely engineered structure.
Basis for Comment:
The "Rebaseline Estimate and Schedule Review" (hereinafter called the Hill International Report) performed by Hill International for USACE and described in Appendix K contains great detail regarding their evaluation of the dam construction issues and cost growth. The Hill International Report recommendations are then included in the risk analysis study. One task that has not been completed to date, though, is a comparison of URS annual budget estimate updates. These have increased continually during construction, including a most recent estimate increase of 31% from February 2009 to July 2011 as referenced in the main report and in Appendix L. This indicates that there still is considerable risk of further cost growth in the dam portion of the project. The current contingency of 18% would be very reasonable for most projects at this stage of construction, but it is not sufficient for this project given the overall project history and the fact that cost projections have repeatedly failed to capture the real cost of the dam construction. A key reason that the cost projections have not been accurate to date is that the work is so unique for the dam that the overall "worst-case" conditions are not described adequately due to lack of experience and knowledge with construction techniques being used. Perhaps what is assumed to be the worst case in the risk analysis is really the expected value, making it difficult to foresee further costs that could be incurred. The risk analysis also portends possible future issues. Figure 18 in the main report depicts the S-curve or cumulative probability plot detailing the expected contingency cost levels for the dam construction. The 80% confidence level provides an estimate of $200 million, whereas the 100% confidence level is about $400 million. This difference may indicate that the top-end risks are not adequately understood yet due to the unique nature of the dam construction methodology. Although the 80% confidence interval is used by USACE for most project risk studies, a higher contingency confidence interval may be warranted for this project due to the non-standard project issues highlighted here. In addition, using a higher confidence interval, say 90% rather than 80%, may provide a more expedient way to incorporate further cost estimate buffers to account for a number of other project uncertainties (e.g., inflation rate, actual funding stream, construction challenges) under one umbrella. Using a higher confidence interval also may address the observed tendency to underestimate overall dam construction costs for the project.
Significance –High
The TPC may be underestimated, potentially leading to future project delays and further PACR updates.

Recommendations for Resolution:
1. Use a higher confidence interval for the dam construction contingency rather than the standard 80% value. 2. Consider the use of the 90% confidence interval to increase the contingency costs by about $40 million; this could be justified given the past project history.

Final Panel Comment 4
The Planning, Engineering and Design (PED)/Engineering During Construction (EDC)/Supervision and Administration (S&A) costs for the remaining dam construction contract and out-year construction contracts are inconsistent, and TPCs cannot be accurately determined.
Basis for Comment:
The EDC for the dam is estimated at $1.75 million per year which is approximately 2% of the dam construction estimate. EDC for out-year contracts is assumed to be 5% of construction estimates. Given that the dam is a much more complex and expensive cost item, it seems reasonable that the EDC percentage could be higher while out-year values are lower. Similarly, the S&A estimate for the dam is about 5 to 5.5% of construction cost while the out-year value is assumed to be 7.5%. USACE might consider investing higher S&A in the dam and less in the out-year contracts given that the dam is a large majority of the future project costs. This approach would also be consistent with higher oversight for Civil Works "mega-projects" as recommended by USACE Headquarters. For comparison purposes, total PED, EDC, and S&A for the prior project expenditures accounted for approximately 14.5% of the construction cost, according to Table 4. Table 9 lists PED/EDC/S&A proposed values for out-year contracts that range from 27.5% to 37.5% of the construction cost for each listed element of work. Overall, the sum of these items appears to be unreasonably high. The S&A costs are estimated at 7.5% of the construction costs. This cost may be reasonable, but the other costs, including PED and EDC, appear overestimated. For example, for military construction, rates for sum of PED/EDC/S&A are usually capped at 12% to 15% of the construction cost; similar rates for private-sector projects are usually even lower. USACE has employed a large and diverse team of estimators to compile the various updated cost estimates. Engineering judgment is used when assigning values for PED, EDC, and S&A; with such a large number of estimators, the "judgments" may all be entirely different.
Significance – High
The TPC estimate may be underestimated or overestimated due to inconsistencies in design and construction oversight costs.
Recommendations for Resolution:
1. Re-evaluate the PED, EDC, and S&A costs for the remaining dam construction contract and the out-year contracts. 2. Convene a panel of the top three most experienced cost estimators to adjust the final PED/EDC/S&A percentages assigned to all contracts, keeping in mind the actual past expense as a guide.

Final Panel Comment 5
The cost adjustments made to the URS rebaseline estimate shown in Table 6 of the main Olmsted Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report, Olmsted Locks and Dam, October 2011 report are not thoroughly discussed, and do not provide complete documentation of the cost validation process.
Basis for Comment:
Table 6 of the main report lists the various adjustments, additions, and deletions included in the USACE analysis, but there is very little explanation for most of these items. Some of this information is contained in the Hill International Report in Appendix K, but it would be better if it were also in the main report. A short narrative describing each table item would be useful. The narrative could include the following: • An explanation of the work item in terms of construction activities involved or assumptions made. • An explanation of the difference identified by Hill and how it was uncovered. • An explanation of the significance of the item. • A discussion of how the adjustment was applied to the cost estimate. This methodology appears to be very useful in validating URS costs. It may also prove useful in the future as part of enhanced project controls.
Significance – Medium
It is important to fully document the government cost validation process for the dam construction contract since a bottom-up independent government estimate has not been prepared.
Recommendation for Resolution:
1. Include more detailed narrative discussions of each item listed in Table 6 and provide further explanation on how each was applied in the final TPC estimate.

Final Panel Comment 6

The use of a calendar year (CY) format in the Primavera P6 schedule may have resulted in minor discrepancies among the selected mid-points used for cost escalation.

Basis for Comment:

Based on a review of the detailed P6 schedule, it appears that there are minor discrepancies in the selected mid-points. Some of these changes may have a beneficial impact on the overall cost, meaning that the amount of escalation would decrease.

The discrepancy in the mid-points for escalation may be attributed to the Primavera P6 schedule provided for the draft schedule in Appendix D of the baseline cost estimate report being in calendar year format and not government fiscal year (FY) format (Figure 1; line below the year is represented by a "Q" indicating calendar year quarter). The final schedule had a change in the date line replacing the line represented by "Q" with that of the government FY start (Figure 2); however, a review of the midpoints assumed for escalation in the TPCS did not change between the draft and final reports provided. An example of the difference in date format between the two versions is included below.

Figure 1. Draft Primavera P6 Schedule (Appendix D)

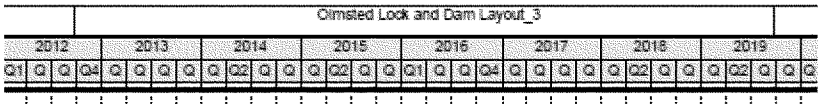
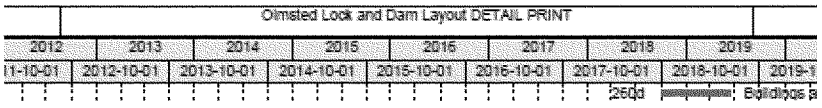


Figure 2. Final Primavera P6 Schedule (Appendix D)



Significance – Low

Changes in the midpoint of construction assumptions will have minor impacts to the TPC.

Recommendation for Resolution:

1. Review midpoints of construction with respect to the project schedule and revise the midpoints in the TPCS.

APPENDIX B

Final Charge to the Independent External Peer Review Panel
as
Submitted to USACE on October 7, 2011

on the

Olmsted Cost Update IEPR

APPENDIX B
Charge Questions and Guidance to the Peer Reviewers
for the
Independent External Peer Review of the Olmsted Locks and Dams 52 and 53 Replacement Project Updated Cost Estimate Peer Review

BACKGROUND

The U.S. Army Corps of Engineers' (USACE) Olmsted Locks and Dam (L&D) Project provides for a structure near Ohio River Mile 964.4 that would replace the existing Locks and Dams 52 and 53. The structure will consist of twin 110 foot by 1200 foot locks adjacent to the Illinois bank, five tainter gates, a 1400 foot navigable pass, and a fixed weir extending to the Kentucky bank. The first construction contract was awarded on 19 November 1992 to construct the Access road and Residents Engineer's Office. Since then, several contracts have been awarded. The major contracts that have been awarded and completed include the Locks Cofferdam, the Locks, the Approach Walls, and the Operations and Maintenance Bulkheads contracts. The contract (cost reimbursable) for the construction of the Dam was awarded 28 January 2004 and work is ongoing. Other contracts to be awarded in the future include the Buildings and Grounds (including Site Restoration), Demolition of Locks & Dams 52 and 53, River Dikes, Upstream Mooring Cells, Paving, and Equipment contracts.

The Olmsted Locks and Dam Project had an original authorized cost of $775M (no escalation) in WRDA 1988. Recent design changes, contract modifications, and other unanticipated increases in project costs have led USACE to seek a PACR to increase the project's authorized amount to a level necessary for successful project completion.

In support of the PACR, Battelle was previously engaged in performing an Independent External Peer Review (IEPR), which was submitted in a November 15, 2010 report, "Final Independent External Peer Review Report." That report offered several comments from the peer reviewers that raised cost, schedule, and risk concerns/issues. Since that period, USACE has elected to further address/update the cost estimate in an effort to improve confidence of a Total Project Cost (TPC) prior to the 2013 budget submission.

Based on the previous comments, USACE has elected to further develop project cost, schedule, and risks that will then undergo a quality control (QC) review. The resulting product will also undergo a cost Agency Technical Review (ATR) managed by the Cost Engineering Directory of Expertise for Civil Work. The goal is to have the certified cost estimate at the conclusion of this process, anticipated no later than October 28, 2011.

OBJECTIVES

The objective of this work is to conduct an IEPR of the Olmsted Locks and Dams 52 and 53 Replacement Project Updated Cost Estimate Peer Review (hereinafter: Olmsted Cost Update IEPR) in accordance with the Department of the Army, USACE, Water Resources Policies and Authorities' *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010, and the Office

of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates the clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

The purpose of the IEPR is to assess the "adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (EC 1165-2-209; p. D-4) for the Olmsted Cost Update documents. The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR panel members) with extensive experience in cost engineering as well as experience applying their subject matter expertise to flood risk management.

The Panel will be "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-209, Appendix D, review panels should identify, recommend, and comment upon assumptions that underlie the analyses as well as evaluate the soundness of any models used in preparing this estimate. The reviewers should be able to evaluate whether the interpretations of analyses and conclusions are technically sound and reasonable, provide effective review in terms of both usefulness of results and of credibility, and have the flexibility to bring important issues to the attention of decision makers. The reviewers may offer opinions as to whether there are sufficient technical analyses upon which to base the ability to implement the project. The independent reviewers will address factual inputs, data, the use cost models, analyses, assumptions, and other scientific and engineering tools/methodologies to inform decision-making.

DOCUMENTS PROVIDED

The following is a list of documents and reference materials that will be provided for the review.

- The Locks and Dams 52 and 53 Replacement Project (Olmsted Lock and Dam) Revised Baseline Cost Report, which will include: MII, Risk Report, TPC Report and supporting information.

Documents for Reference

- USACE guidance Civil Works Review Policy (EC 1165-2-209) dated January 31, 2010
- CECW-CP Memorandum dated March 31, 2007
- Office of Management and Budget's Final Information Quality Bulletin for Peer Review released December 16, 2004.

SCHEDULE

This draft schedule is based on the October 21, 2011 receipt of the final review documents. The schedule will be revised upon receipt of final review documents. Dates that are important to the panel members are shown in **bold**. Asterisk denotes Battelle deliverable to USACE.

Task	Action	Due Date
Conduct Peer Review	**Battelle/Panel hold kick-off meeting**	**10/14/2011**
	USACE/Battelle/Panel hold kick-off meeting	**10/14/2011**
	Battelle sends review documents to IEPR Panel	**10/21/2011**
	Battelle/Panel Conduct Site Visit	**10/18/2011-10/19/2011**
	Battelle convenes mid-review teleconference for Panel to ask clarifying questions of USACE	10/25/2011
	Panel members complete their individual reviews and provide response to charge questions and Preliminary Final Panel Comments	**10/27/2011**
Prepare Final Panel Comments and Final IEPR Report	Battelle provides Panel merged individual comments, talking points, and comments on Preliminary FPCs for Panel Review Teleconference	10/28/2011
	Battelle convenes Panel Review Teleconference	**10/28/2011**
	Panel members submit Final Panel Comments in final format to Battelle	**11/1/2011**
	Battelle submits Final Panel Comments in word format to USACE	11/1/2011
	Battelle provides Final IEPR Report to Panel for review	11/2/2011
	Panel provides comments on Final IEPR Report	11/2/2011
	*Battelle submits Final IEPR Report to USACE	11/3/2011
Comment/ Response Process	Battelle convenes teleconference with Panel to review the Comment Response Process (if necessary)	11/1/2011
	USACE provides draft Evaluator Responses to Battelle	11/7/2011
	Battelle provides the Panel the draft Evaluator Responses	11/7/2011
	Panel members provide Battelle with draft comments on draft Evaluator Responses (i.e., draft BackCheck Responses)	**11/8/2011**
	Battelle convenes teleconference with Panel to discuss draft BackCheck Responses	**11/8/2011**
	Battelle convenes teleconference with Panel and USACE to discuss Final Panel Comments, and draft responses	**11/8/2011**
	USACE inputs final Evaluator Responses in DrChecks	11/9/2011
	Battelle provides Evaluator Responses to Panel	11/9/2011
	Panel members provide Battelle with final BackCheck Responses	**11/10/2011**
	Battelle inputs the Panel's BackCheck Responses in DrChecks	11/11/2011
	*Battelle submits pdf printout of DrChecks project file	11/11/2011

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the Olmsted Locks and Dam 2011 updated cost estimate are credible and whether the conclusions are valid. The reviewers are asked to determine whether the technical work is adequate, competently performed, properly documented, satisfies established quality requirements, and yields scientifically credible conclusions. The panel is being asked to provide feedback on the cost-engineering analyses. The reviewers are not being asked whether they would have conducted the work in a similar manner.

GENERAL CHARGE GUIDANCE

Please answer the scientific and technical questions listed below and conduct a broad overview of the Olmsted Locks and Dam revised baseline cost report. Please focus on your areas of expertise and technical knowledge. In addition, please note the following guidance. Note that the panel will be asked to provide an overall statement related to 1 and 2 below per USACE guidance (EC 1165-2-209; Appendix D).

1. Your response to the charge questions should not be limited to a "yes" or "no." Please provide complete answers to fully explain your response.
2. Assess the adequacy and acceptability of the cost-engineering methods, models, and analysis used.
3. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation for re-authorization.
4. Identify, explain, and comment on assumptions that underlie cost-engineering analyses.
5. Evaluate whether the interpretations of analysis and conclusions are reasonable.

Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please **do not** comment on or make recommendations on policy issues and decision making. Comments should be provided based on your professional judgment, **not** the legality of the document.

1. If desired, panel members can contact one another. However, panel members **should not** contact anyone who is or was involved in the project, prepared the subject documents, or was part of the USACE Independent Technical Review.
2. Please contact the Battelle Project Manager (Project Manager, bakerhartl@battelle.org) or Program Manager (Karen Johnson-Young (johnsonyoungk@battelle.org) for requests or additional information.
3. In case of media contact, notify the Battelle Program Manager, Karen Johnson-Young (johnsonyoungk@battelle.org) immediately.
4. Your name will appear as one of the panel members in the peer review. Your comments will be included in the Final IEPR Report, but will remain anonymous.

Please submit your comments in electronic form to Project Manager, bakerhartl@battelle.org, no later than October 27, 2011, COB ET.

Independent External Peer Review
of the
Olmsted Locks and Dams 52 and 53 Replacement Project
Updated Cost Estimate Peer Review

Charge Questions As Supplied By USACE

1. Are the assumptions that underlie the 2011 cost-engineering analyses sound?

2. Please comment on the adequacy and acceptability of the cost models and analyses used, as well as any assumptions made.

3. Are the interpretations of analysis and conclusions based on the analysis reasonable?

4. Are the contingency cost expanded to existing line items to account for cash flow issues that may arise over the next 5 years?

5. Do cost risk analysis and contingency determinations include remaining work or consider experience with the dam construction methods or changes in dam construction assumptions?

6. In your opinion, considering the complexity of the project and the remaining schedule, are the proposed contingencies adequate or overstated?

7. Please comment on the adequacy of the risk assessment in determining the dam construction contingencies.

8. Please discuss the extent to which the Total Project Construction Cost Contingency Analysis is adequately described and justified.

9. Please discuss the extent to which the Total Project Cost Estimate adequately addresses all the cost and is sufficient to complete the project.

10. Please comment on the increases due to inflation. Does the CWCCIS adequately address the cost increase due to inflation?

11. Does the estimate include sufficient contingencies for the future construction contracts?

Final Compiled Comments and Responses
on the
Olmsted Locks and Dam 52 and 53
Replacement Project
Updated Cost Estimate IEPR

Final Comment-Response Record

Final Panel Comment 1
The use of the Civil Works Construction Cost Index System (CWCCIS) to estimate cost escalation through the completion of construction activities may not adequately account for future inflation.
Basis for Comment:
The CWCCIS uses Office of Management and Budget (OMB) inflation factors to forecast escalation for years in which no data are available. The CWCCIS currently is forecasting approximately 1.8% escalation year to year after fiscal year (FY) 2012. Escalation was considered in the Cost and Schedule Risk Analysis (CSRA), Appendix I - Risk Register under risk number DAM-036.jj Under current economic conditions, this escalation rate may be adequate for immediate future escalation. However, when compared to historical averages, this is relatively low. The recent economic downturn has resulted in negative or comparably low inflation indices, and there is variation depending on which cost index is reviewed, but looking at inflation rate over 20 years, the average annual inflation rate is approximately 3%. Some indices, like those from the Engineering News Record (ENR), have shown recent inflation rates close to this (ENR, 2011). For example: ENR Construction Cost Index from calendar year (CY) 2009 to CY2010 showed an increase of 2.7% and from CY2010 to CY2011 showed an increase of 2.8%. The CWCCIS over the same time frame has increases of 3% and 4.1%, respectively. The Rider Levett Bucknall (RLB) National Construction Cost Index had smaller gains of 0.9% and 1.4%, respectively (RLB, 2011); however, the RLB index considers primarily bid price inflation. And the Turner Building Cost Index over the same period showed a decrease of -4% and then an increase of 1.9%, respectively (Turner, 2011). Based on the ENR Skilled Labor Index History, labor costs have increased on average approximately 3.4% per year. Through the recent economic downturn, labor cost increases have remained higher than material cost increases. The ENR Skilled Labor Index from CY2009 to CY2010 showed an increase of 3.5% and from 2010 to 2011 showed an increase of 2.5%. In addition, in the CSRA, risk number DAM-036 suggests a 4% per year labor agreement cost increase. Generally, material prices have been very volatile and are dependent on global economic demand. Concrete and steel prices may currently be stable or decreasing because global demand is depressed as a result of the economic downturn. For example, fuel costs could grow at significantly higher rates than 1.8%. The Energy Information Administration 2011 Energy Outlook includes a high oil price scenario that has the price of a barrel of oil at $146 in 2015 and at $169 in 2020 (EIA, 2011). If this scenario were realized, the cost of diesel fuel for the Olmsted project would be much higher than estimated. Should economic conditions improve, which is possible considering the time frame until completion, it is likely that inflation could be higher than the current CWCCIS approximation. Current USACE guidance mandates the use of Table 1 of the Program Development Guidance for Fiscal Year 2011 (USACE, 2009); however, the CWCCIS (USACE, 2011) also states on page 2-1 that "while the historic projections are reliable to

Panel Comment Under Review

update project costs, forecasting beyond two years may be unreliable."

Significance – High

Actual costs due to inflation could be significantly higher than those currently projected.

Recommendations for Resolution:

1. Review inflation rates assumed in the CWCCIS with respect to historic construction cost indices and inflation on similar projects. Revise inflation rates based on review.
2. Consider the assumptions made by URS for escalation in the Dam Contract and apply a similar methodology/rate to the Total Project Cost Summary (TPCS) for the remainder of the Dam Contract.

USACE Final Evaluator Response to FPC 1

Non-concur

1. Adopt-in-Part - Inflation is captured and presented in accordance to current policy and regulations. USACE will not revise the inflation rates but per discussion with IEPR team on 11/8/11, will update the report to further explain methodology used and how escalation risks were accounted for in the CSRA and contingencies added to the base cost. The future rates in the CWCCIS table are not accurate models for predicating future inflation and fully funded costs. The CWCCIS table is actually a composite table with prior to publication date rates being actual computed inflation values and future rates as set by OMB. These rates are mandated for use and generally are low for future years. (The future rates for CWCCIS should match the annual program EC Table 1 and Table 2 rates for future years.) Current USACE cost engineering guidance and direction requires utilization of CWCCIS escalation factors for estimating future escalation per ER 1110-2-1302 and ETL 1110-2-573. Under WRDA 1986 and the provisions of section 902, this project if reauthorized will receive the ACTUAL inflation allowance as captured by CWCCIS past rates. These past rates are considered to be accurate. In the examination of risk with regards to inflation, the potential for CWCCIS to not capture the actual local inflation is what is studied and added to the contingency value. From studying past inflation rates we think that there most likely will be 3-4% average inflation over the remainder of this contract and that it will be captured by the updates to the CWCCIS Tables as the project progresses subsequently raising the 902 limit of the project each year.

2. Adopt-in-Part - Methodology utilized to capture inflation is in accordance with current policy and regulation. USACE will not revise the inflation rates using the recommended methodology per discussion with IEPR team on 11/8/11, but will update report to further explain methodology used.

Final Panel BackCheck Response FPC1

Concur with Comment.

1. and 2. The Panel notes that verbiage regarding a sensitivity analysis on escalation was included in the revised report in the executive summary. The Panel requests that the discussion from the bullet for Dam-036 and OYC-001 on Page ix regarding the sensitivity analysis conducted on escalation also be included in similar bullets on Page 49, Page 50, and Page 52.

Final Comment Response Record

Final Panel Comment 2
The project funding assumptions were not developed using a worst-case scenario and therefore may overestimate available funding.
Basis for Comment:
The Olmsted Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report (PACR), Olmsted Locks and Dam, October 2011 report (main report) states on page 35 that "… it was apparent that the dam construction duration is cost driven rather than activity driven." The funding stream scenario used in the analysis is $150 million per year through FY2021, then a $100 million per year for FY2022 to FY2024. The CSRA risk register number DAM-021 has a worst case scenario of $150 million per year for FY2012 and FY2013 which is then reduced to $130 million per year for the remainder of the dam contract and $75 million per year for out-year contracts. Final Panel Comment number 1 from the Final Independent External Peer Review Report Olmsted Locks and Dam 52 and 53 Replacement Project Post Authorization Change Report related to the adequacy of funding from the Inland Waterways Trust Fund (IWTF) in meeting future project needs. Even if all available funds from the IWTF are made available solely to the Olmsted Locks and Dam project, the assumption of $150 million a year in funding may not be realistic. The FY2010 ending balance of the IWTF was $58.5 million (IWTF, 2011). The FY2010 revenues were $73.9 million, down from $76 million in FY2009. There has generally been a decreasing trend in revenue for the IWTF (IMTS, 2010). In addition, because the total IWTF has been severely reduced, the interest on remaining funds generated year to year has decreased more substantially. Depending on economic conditions, the IWTF may be depleted to the point where it cannot maintain the 50% cost share for funding of $150 million per year through FY2021. The use of a $150 million per year funding stream for the majority of the upcoming contract years may not be realistic, based on the history of funding for this project and the potential for real funding limitations in the future given the current economic and political climate. Contingency for the remaining dam contract and out-year contracts may increase under the worst-case funding scenario. The main report, page 47, states that fixed site overhead costs are approximately $50 million per year. These costs are incurred regardless of how much construction is accomplished in a given year. Program funding at levels less than expected would have a real impact on project schedule because less construction would then be accomplished. Less construction accomplished delays the project schedule and increases costs. The report does cite an estimation of project savings under a better-than-expected funding scenario. However, the report would benefit from additional text describing the funding streams in more detail and the implications of lower-than-ideal funding, including number of additional years and costs potentially incurred based on the worst-case scenario.

Final Comment-Response Record

Significance – High
If program funding is less than assumed, the overall project schedule will be delayed, resulting in increased costs.
Recommendations for Resolution:
1. Base schedule and cost estimate on an expected funding limit of $130 million per year through FY2021 and $75 million for the out-year contracts (worst-case scenario under CSRA risk register number DAM-021). 2. Include additional text in the report regarding the implications of lower-than-ideal funding, including number of additional years and costs potentially incurred based on the worst-case scenario. 3. Include a discussion of the two funding streams, IWTF and Treasury, for the Olmsted project and their possible limitations.
USACE Final Evaluator Response to FPC 2
Non-concurred Olmsted is already due to receive $150M for FY12 and FY13. Through discussions with USACE-HQ, LRL Program Office, and the IWTR User's Board, the assumed most-likely scenario was that the $150M per year funding stream could be maintained for the dam contract. A funding stream of $130 per year was assumed to be worst-case to account for the potential for some funding to go to other navigation projects in the latter years. USACE cost engineering guidance and best practices require the most-likely cost to complete the project to be developed. In this case, the most-likely funding stream is $150M per year. The funding stream impacts are discussed in Risk Item # DAM-021 in the executive summary as well as other sections of the report; further details are included in Appendix I – Cost and Schedule Risk Analysis. This risk item is categorized as high for both cost and schedule. The best case scenario assumes a 1-year reduction in schedule and overhead costs (-$48M) if additional funding did become available; adversely, the worst-case scenario assumes an additional 2-years for construction and overhead costs (+$175M). Verbiage has been added to report to account for the order-of-magnitude related to costs associated with this risk item for both an unconstrained funding stream and the $130M per year funding stream as stated below: DAM-021 - Funding differs from $150M per year: The current estimate and schedule are based on a $150M per year construction cap. Uncertainty exists actual funding levels may vary up or down. Increased funding, sooner in the project schedule would result in reduced escalation over time and potential reduction to contractor's onsite duration and associated extended site overheads. On the other hand, less funding would tend to increase escalation and add contractor's onsite duration and extended site overheads. An unconstrained funding scenario could cut up to three years from the project schedule resulting in significant cost savings of approximately $250M (~$170M first-cost plus ~$80 escalation); approximately $215M per year would be needed for this scenario. Conversely, a reduced funding stream down to $130M per year would result in additional schedule impacts and adversely affect overall project costs (~$175M cost increase including additional overheads and escalation).

Final Comment-Response Record

Response to Recommendations: 1. Adopt in Part – USACE will not adopt the specific recommendation of basing the cost estimate on the worst case funding scenarios for the project, per discussion with IEPR team on 11/8/11. USACE will update the report to include verbiage explaining why the $150M/year most-likely funding stream was used and how we accounted for the risk of a lower funding stream in the CSRA and associated contingency dollars. 2. Adopt – USACE will update the report to include verbiage explaining why the $150M/year most-likely funding stream was used and how we accounted for the risk of a lower funding stream in the CSRA and associated contingency dollars. 3. Adopt in Part – USACE will update the report to include a discussion of the two funding streams and their limitations.
Final Panel BackCheck Response FPC2
Concur with Comment. 1. and 2. Panel notes that verbiage has been in the included the final report discussing the cost and schedule impacts under the worst-case funding stream. 3. Please include the discussion regarding the development of the most-likely funding scenario from Page vii on Page 37. While this discussion does provide a general origin for the $150 million per year funding assumption for the remaining dam contract, the Panel requests that the report discuss the two funding sources in more detail. It should be noted in the report the assumption that all the funds in the IWTF be diverted to the Olmsted project to meet the 50% cost share for the majority of the remaining project; this appears to be a fundamental assumption in the funding forecasts.

Final Comment-Response Record

Final Panel Comment 3
The estimated contingency for the remaining dam construction costs is low, and may not account for possible delays associated with the construction of a uniquely engineered structure.
Basis for Comment:
The "Rebaseline Estimate and Schedule Review" (hereinafter called the Hill International Report) performed by Hill International for USACE and described in Appendix K contains great detail regarding their evaluation of the dam construction issues and cost growth. The Hill International Report recommendations are then included in the risk analysis study. One task that has not been completed to date, though, is a comparison of URS annual budget estimate updates. These have increased continually during construction, including a most recent estimate increase of 31% from February 2009 to July 2011 as referenced in the main report and in Appendix L. This indicates that there still is considerable risk of further cost growth in the dam portion of the project. The current contingency of 18% would be very reasonable for most projects at this stage of construction, but it is not sufficient for this project given the overall project history and the fact that cost projections have repeatedly failed to capture the real cost of the dam construction. A key reason that the cost projections have not been accurate to date is that the work is so unique for the dam that the overall "worst-case" conditions are not described adequately due to lack of experience and knowledge with construction techniques being used. Perhaps what is assumed to be the worst case in the risk analysis is really the expected value, making it difficult to foresee further costs that could be incurred. The risk analysis also portends possible future issues. Figure 18 in the main report depicts the S-curve or cumulative probability plot detailing the expected contingency cost levels for the dam construction. The 80% confidence level provides an estimate of $200 million, whereas the 100% confidence level is about $400 million. This difference may indicate that the top-end risks are not adequately understood yet due to the unique nature of the dam construction methodology. Although the 80% confidence interval is used by USACE for most project risk studies, a higher contingency confidence interval may be warranted for this project due to the non-standard project issues highlighted here. In addition, using a higher confidence interval, say 90% rather than 80%, may provide a more expedient way to incorporate further cost estimate buffers to account for a number of other project uncertainties (e.g., inflation rate, actual funding stream, construction challenges) under one umbrella. Using a higher confidence interval also may address the observed tendency to underestimate overall dam construction costs for the project.
Significance –High
The TPC may be underestimated, potentially leading to future project delays and further PACR updates.

Final Comment-Response Record

Recommendations for Resolution:
1. Use a higher confidence interval for the dam construction contingency rather than the standard 80% value. 2. Consider the use of the 90% confidence interval to increase the contingency costs by about $40 million; this could be justified given the past project history.
USACE Final Evaluator Response to FPC 3
Non-concur The 80% confidence contingency amount presented for the dam contract is $200M (18%). The IEPR recommendation of 90% confidence contingency amount would be $240M (22%). The USACE business model recommends standard 80% confidence levels for budgetary requests. This level of confidence reflects the organization's management approach to acceptable risk exposure. Per USACE Cost And Schedule Risk Analysis Guidance dated 17 May 2009 published by the Directory of Expertise for Civil Works Cost Engineering: "The PM and management are left to decide what confidence level they prefer to present to Congress for authorization. Historically, Congress and the Assistant Secretary of the Army are accustomed to a contingency value with an 80 percent confidence of successful execution and completion." Further, Section 902 of the Water Resources Development Act (WRDA) of 1986 defines the maximum amount that a project may cost (often referred to as the 902 Limit). ER 1105-2-100 Appendix G states: "The maximum project cost limit imposed by Section 902 is a numerical value specified by law which must be computed in a legal manner (ER 1105-2-100 Appendix G)." "The maximum project cost includes the authorized cost (adjusted for inflation), the current cost of any studies, modifications, and action authorized by WRDA '86 or any later law, and 20 percent of the authorized cost (without adjustment for inflation). The cost of modifications required by law is to be kept separate and added to other allowable costs. These three components equal the maximum project cost allowed by section 902." Note: Appendix G also prescribes the calculation for allowed inflation based on the CWCCIS method, the same method applied in the TPCS. This greatly reduces the future escalation risk to the budget management, however some risk remains that the CWCCIS method does not adequately address the actual inflation (see Risk Item # DAM-036). It is important to note some of the basis for the historical cost growth to date. Also to be considered is the learning curve that has been realized since the early estimates. Prior items of uncertainty and "unknowns" are now functioning elements such as the precast yard, lifting systems, and the track experience of nearly two construction seasons of precast shell placements. At this stage of the project the means and methods of construction have been demonstrated, invoiced, and set to be refined. Much of this cost

Final Comment-Response Record

growth from the February 2009 to July 2011 estimates were due to the incorporation of known production rates (further variation of production rates is in Risk Item# DAM-001). Another key revision was the project estimate taking ownership of some of the key risk items into the base estimate. In other words, buying into risks/uncertainties and making the base estimate more conservative, and therefore warranting a lesser contingency to achieve the same confidence level.

For the FY12 PACR Cost Estimate, the dam contingency amount was developed utilizing a risk-based approach to identify root cause events and conditions that could impact the project cost and schedule. This process involved soliciting feedback from the entire project management, design, and construction management team who do have a great deal of experience and knowledge of the existing construction techniques at the Olmsted Project. These key areas of "known" uncertainty in design and constructability are included in the base estimate and/or as specific risk items. Further, the team recognizes that there is still "unknown" uncertainty in the remaining construction that is quantified in Risk Item# DAM-035.

Further, contingency amount resulting from the 18% applied to the dam equates to $200M. This contingency amount in itself encompasses the Total Project Cost of "most" large USACE civil works projects. The recommendation for a 90% confidence is too risk averse and is inconsistent with budget requests for other projects that the USACE has presented to the Congress and the Assistant Secretary of the Army.

Response to Recommendations

1. Not Adopt - USACE will not incorporate this IEPR recommendation to use the 90% confidence level and associated contingencies per discussion on 11/8/11. The 80% confidence contingency amount presented for the dam contract is $200M (18%). The IEPR recommendation of 90% confidence contingency amount would be $240M (22%). The USACE business model recommends standard 80% confidence levels for budgetary requests. This level of confidence reflects the organization's management approach to acceptable risk exposure. Per USACE Cost And Schedule Risk Analysis Guidance dated 17 May 2009 published by the Directory of Expertise for Civil Works Cost Engineering: "The PM and management are left to decide what confidence level they prefer to present to Congress for authorization. Historically, Congress and the Assistant Secretary of the Army are accustomed to a contingency value with an 80 percent confidence of successful execution and completion."

2. Not Adopt - Same response for recommendation #1

Final Panel BackCheck Response FPC3

Concur with comment.

The USACE may opt to use a higher confidence interval rather than 80% as noted by USACE Cost And Schedule Risk Analysis Guidance dated 17 May 2009 published by the Directory of Expertise for Civil Works Cost Engineering:

"The PM and management are left to decide what confidence level they prefer to present to

Final Comment-Response Record

Congress for authorization." Given, the past problems estimating the actual costs for the dam component of the project, the use of 90% confidence interval should be seriously considered. This value would increase the dam contingency by 20%. With the appropriate explanation, the Congress and the Assistant Secretary of the Army for Civil Works would understand why such a confidence interval was necessary for this project.

Final Comment-Response Record

Final Panel Comment 4
The Planning, Engineering and Design (PED)/Engineering During Construction (EDC)/Supervision and Administration (S&A) costs for the remaining dam construction contract and out-year construction contracts are inconsistent, and TPCs cannot be accurately determined.
Basis for Comment:
The EDC for the dam is estimated at $1.75 million per year which is approximately 2% of the dam construction estimate. EDC for out-year contracts is assumed to be 5% of construction estimates. Given that the dam is a much more complex and expensive cost item, it seems reasonable that the EDC percentage could be higher while out-year values are lower. Similarly, the S&A estimate for the dam is about 5 to 5.5% of construction cost while the out-year value is assumed to be 7.5%. USACE might consider investing higher S&A in the dam and less in the out-year contracts given that the dam is a large majority of the future project costs. This approach would also be consistent with higher oversight for Civil Works "mega-projects" as recommended by USACE Headquarters. For comparison purposes, total PED, EDC, and S&A for the prior project expenditures accounted for approximately 14.5% of the construction cost, according to Table 4. Table 9 lists PED/EDC/S&A proposed values for out-year contracts that range from 27.5% to 37.5% of the construction cost for each listed element of work. Overall, the sum of these items appears to be unreasonably high. The S&A costs are estimated at 7.5% of the construction costs. This cost may be reasonable, but the other costs, including PED and EDC, appear overestimated. For example, for military construction, rates for sum of PED/EDC/S&A are usually capped at 12% to 15% of the construction cost; similar rates for private-sector projects are usually even lower. USACE has employed a large and diverse team of estimators to compile the various updated cost estimates. Engineering judgment is used when assigning values for PED, EDC, and S&A; with such a large number of estimators, the "judgments" may all be entirely different.
Significance – High
The TPC estimate may be underestimated or overestimated due to inconsistencies in design and construction oversight costs.
Recommendations for Resolution:
1. Re-evaluate the PED, EDC, and S&A costs for the remaining dam construction contract and the out-year contracts. 2. Convene a panel of the top three most experienced cost estimators to adjust the final PED/EDC/S&A percentages assigned to all contracts, keeping in mind the actual past expense as a guide.

Final Comment-Response Record

USACE Final Evaluator Response to FPC 4
Non-concur. EDC and S&A for the remaining dam contract were based on the historical average expended over the last five years. The E&D for the dam contract is conservative since 90% of the design has been completed. The S&A is based on the historical average over the last five years. Total E&D for Out-Year Contracts is $14.44M which is approximately 13.3% of construction costs. Total S&A for OYCs is $8.04M which is approximately 6.7% of construction costs. Although these costs appear to be high, it is not unreasonably high. When factoring in the percent of design development, duration of activities, and yearly costs for each OYC, these costs could be incurred especially if there is earlier design involvement to prepare for this future work. PED costs vary for each OYC based on the amount of design completed and are also dependent on the size of the job and duration of each activity. EDC was assumed to be a 5% of construction costs regardless of size. S&A was assumed to be 7.5% of construction costs and is the historical percentage that USACE is adheres to and is measured against. Response to Recommendations: 1. Adopt in Part – USACE will not re-evaluate PED, EDC, and S&A costs per discussion with IEPR team on 11/8/11. USACE will update the report to add explanation justifying the use of actual historical rates for these costs. 2. Adopt in Part – USACE will not convene a panel to adjust PED/EDC/S&A percentages per discussion with IEPR team on 11/8/11. USACE will update the report to add explanation justifying the use of actual historical rates for these costs.

Final C

Out-Year Contract	Design Development
Buildings & Grounds	90%
Dredging	10%
Final County Road Paving	100%
Lock & Dam 52 - Land Demolition	10%
Lock & Dam 52 - Marine Demolition	10%
Lock & Dam 53 - Land Demolition & Historic Restoration	10%
Lock & Dam 53 - Marine Demolition	10%
Lock Rehab/O&M Startup	5%
Operations Equipment and Machinery	90%
Project Closeout & Site Restoration	5%
RE Office Conversion to Ops Building	10%
River Dikes	25%
Salvage/Excess of Government Owned Equipment	5%
U/S Mooring Cells	95%
Wicket Lifter Barge	90%

Feature Account	Project First Cost FY12 Price Level	Total Project Cost (Fully Funded)
Dam Contract	1,291.89 M	1,406.14 M
Remaining	1,291.89 M	1,406.14 M
Construction	**1,209.02 M**	**1,307.68 M**
04 - DAMS	**1,209.02 M**	**1,307.68 M**
Non-Construction	**82.88 M**	**98.46 M**
01 - LANDS & DAMAGES	**0.03 M**	**0.03 M**
30 - PLANNING, ENGINEERING & DESIGN	**20.71 M**	**24.61 M**
31 - CONSTRUCTION MANAGEMENT	**62.13 M**	**73.82 M**
Out Year Contracts	268.18 M	329.33 M
Remaining	268.18 M	329.33 M
Construction	**216.78 M**	**259.90 M**
04 - DAMS	**35.95 M**	**43.72 M**
05 - LOCKS	**70.98 M**	**84.45 M**
06 - FISH & WILDLIFE FACILITIES	**5.25 M**	**5.75 M**
08 - ROADS, RAILROADS, & BRIDGES	**1.01 M**	**1.26 M**
09 - CHANNELS & CANALS	**60.31 M**	**73.61 M**
18 - CULTURAL RESOURCE PRESERVATION	**3.61 M**	**4.41 M**
19 - BUILDINGS, GROUNDS, & UTILITIES	**14.94 M**	**17.12 M**
20 - PERMANENT OPERATING EQUIPMENT	**24.71 M**	**29.59 M**
Non-Construction	**51.41 M**	**69.43 M**
30 - PLANNING, ENGINEERING & DESIGN	**28.92 M**	**39.70 M**
31 - CONSTRUCTION MANAGEMENT	**14.44 M**	**21.04 M**
50 - CONSTRUCTION FACILITIES	**8.04 M**	**8.70 M**
PRIOR	1,358.10 M	1,358.10 M
Spent	1,358.10 M	1,358.10 M
Grand Total	**2,918.18 M**	**3,093.57 M**

Final Panel BackCheck Response FPC4
Concur with comment. Costs for PED and EDC for the out-year contracts are substantially inconsistent. For the River Dikes project, the PED and EDC costs are the same ($2,520,109). For Marine Demolition project, the PED cost is twice the EDC cost. For RE Office conversion to Ops Building project, the PED cost is five times the EDC cost. From the Panel's experience, EDC costs are usually some percentage of the original PED total unless USACE is expecting to complete 100% redesign during EDC. A reasonable EDC value would likely be 20% to 40% of PED costs. The Panel understands that the PED and EDC costs were developed using assumed percentages of construction costs, however, the proposed dollar value to complete each effort should be reasonable and consistent. In those instances where the EDC value is the same or nearly the same as the corresponding PED cost, the implication is that the same or about the same level of engineering is required during construction as was required to develop the contract documents in the first place.

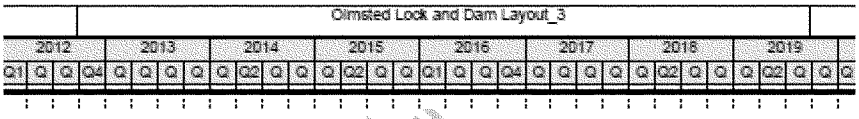
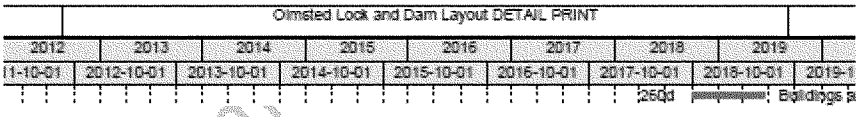
Final Comment-Respo

Final Panel Comment 5
The cost adjustments made to the URS rebaseline estimate shown in Table 6 of the main Olmsted Final Baseline Cost Estimate (FY12) for the Post-Authorization Change Report, Olmsted Locks and Dam, October 2011 report are not thoroughly discussed, and do not provide complete documentation of the cost validation process.
Basis for Comment:
Table 6 of the main report lists the various adjustments, additions, and deletions included in the USACE analysis, but there is very little explanation for most of these items. Some of this information is contained in the Hill International Report in Appendix K, but it would be better if it were also in the main report. A short narrative describing each table item would be useful. The narrative could include the following: • An explanation of the work item in terms of construction activities involved or assumptions made. • An explanation of the difference identified by Hill and how it was uncovered. • An explanation of the significance of the item. • A discussion of how the adjustment was applied to the cost estimate. This methodology appears to be very useful in validating URS costs. It may also prove useful in the future as part of enhanced project controls.
Significance – Medium
It is important to fully document the government cost validation process for the dam construction contract since a bottom-up independent government estimate has not been prepared.
Recommendation for Resolution:
1. Include more detailed narrative discussions of each item listed in Table 6 and provide further explanation on how each was applied in the final TPC estimate.
USACE Final Evaluator Response to FPC 5
Concur Response to Recommendation: 1. Adopt - A bulleted list of the major cost adjustments have been added to the report. A more detailed version of Table 6 will be added in the Appendix as well providing further explanation of adjustments. • Extended FOOH Due to Longer Construction Schedule. Added $206,356,956 to account for extended FOOH from 1-DEC-15 until the end of the existing dam contract (approximately 6 years). Total cost added: $206.4M. • Spent Dollars from 28-FEB-11 to 30-SEP-11 by Work Package. The 2011 URS Corporation Rebaseline Estimate included costs from 28-FEB-11 to 30-NOV-15

Final Comment-Response Record

while the spent dollars for the project were up to 30-SEP-11. This amount was deducted from the estimate to avoid double-counting these costs. Total cost deduction: $66.8M. • Escalation. Escalation was removed from the estimate since it will be accounted for in the TPCS (Total Project Cost Summary) sheet which will capture escalation. Total cost deduction: $56.4M. • Home Office G&A. Due to the addition/deletion of costs, HOOH had to be adjusted to account for these adjustments (7.37% of select items). Total cost added: $18.5M. • Management Reserve. Management reserve (contingency) was removed from the estimate since it will be accounted for in the CSRA (Cost and Schedule Risk Analysis). Total cost deduction: $15M. • Standby tug for river operations. Per the contract requirements (Document 00800 page 49, Spec 1.62), a tug is needed 24-7 to assist river traffic for safe passage through the NAV pass section of the dam during construction. Total cost added: $14.8M. • Variation of pile length on uncompleted sections. This was an adjustment made for revising pile lengths for the navigable pass from 42' to 54'. The 2011 URS Corporation Rebaseline Estimate assumes navigable pass piles are equal length to the tainter gate piles. USACE believes that once test piles are driven, the "most likely" case is that the navigable pass piles will be 33% longer than tainter gate piles. Total cost added: $11.3M.
Final Panel BackCheck Response FPC 5
Concur.

Final Comment-Response Record

Final Panel Comment 6
The use of a calendar year (CY) format in the Primavera P6 schedule may have resulted in minor discrepancies among the selected mid-points used for cost escalation.
Basis for Comment:
Based on a review of the detailed P6 schedule, it appears that there are minor discrepancies in the selected mid-points. Some of these changes may have a beneficial impact on the overall cost, meaning that the amount of escalation would decrease. The discrepancy in the mid-points for escalation may be attributed to the Primavera P6 schedule provided for the draft schedule in Appendix D of the baseline cost estimate report being in calendar year format and not government fiscal year (FY) format (Figure 1; line below the year is represented by a "Q" indicating calendar year quarter). The final schedule had a change in the date line replacing the line represented by "Q" with that of the government FY start (Figure 2); however, a review of the midpoints assumed for escalation in the TPCS did not change between the draft and final reports provided. An example of the difference in date format between the two versions is included below. Figure 1. Draft Primavera P6 Schedule (Appendix D)  Figure 2. Final Primavera P6 Schedule (Appendix D) 
Significance – Low
Changes in the midpoint of construction assumptions will have minor impacts to the TPC.
Recommendation for Resolution:
1. Review midpoints of construction with respect to the project schedule and revise the midpoints in the TPCS.
USACE Final Evaluator Response to FPC 6
Concur Response to Recommendation: 1. Adopt - The mid-points of select Out-Year Contracts will be reviewed by USACE and adjusted as necessary

Final Comment-Response Record

Final Panel BackCheck Response FPC 6
Concur.

Final Comment-Response Record