

**DELAWARE RIVER MAIN CHANNEL DEEPENING PROJECT  
(PENNSYLVANIA, NEW JERSEY, AND DELAWARE)**

**ECONOMIC UPDATE FOR FY 2011 BUDGET**



**U.S. Army Corps of Engineers, Philadelphia District  
North Atlantic Division  
DECEMBER 2009**

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## Executive Summary

This economic update has been developed as part of the budgeting process for the FY 2011 Federal Budget, and conducted in accord with EC-11-2-194 (1 Apr 09). The document presents a limited reevaluation of the benefits and costs for the Delaware River Main Channel Deepening Project. The last approved documents are the Supplement to the Comprehensive Economic Reanalysis Report, February 2004, which included an External Independent Technical Review. This was subsequently followed by an Economic Update in April 2008 that verified trends utilizing published commodity data that post-dated the 2004 report.

This purpose of this document is to incorporate new information pertaining to costs and benefits for the proposed deepening of the Delaware River to 45 feet. The 2009 price level and FY 2010 Federal discount rate of 4 3/8% have been applied as parameters in the analysis. NEPA compliance status and the project sponsor, the Philadelphia Regional Port Authority, are also discussed.

The authorized project consists of a navigation channel extending from deep water in the Delaware Bay to Philadelphia Harbor, Pennsylvania and to Beckett Street Terminal, Camden New Jersey, a distance of about 102.5 miles. The plan provides for modifying the existing Delaware River Federal Navigation Channel (Delaware River, Philadelphia to the Sea and Delaware River in the Vicinity of Camden) from 40 to 45 feet below Mean Low Water (MLW).

The estimate for the Federal portion of the project assumes using pipeline, clamshell and hopper dredges. The total initial construction dredging quantity is 15,961,000 cubic yards. Cost estimates take into account environmental windows that may be encountered during dredging or placement of dredged material.

Cost estimates were updated for disposal area preparation. The disposal area work consists of site clearing, raising dikes and constructing sluices. Construction schedules, disposal areas use schedule and all quantities for initial and maintenance dredging cost estimates, including disposal area development were updated in estimating the cost of the project.

Due to the amount of material to be dredged, disposal area capacity considerations and locations, construction is scheduled to take five years. Total initial construction costs for deepening the federal navigation channel, at the 2009 price level, are \$265,627,000.

Current Project Refinements, dredging quantities, disposal plan: There is sufficient capacity at existing Federal upland disposal sites to construct the 45' project in Reaches A/AA, B, C, and D and then maintain it for an additional 50 years. In Reach E, the dredged material from the construction of the 45' project can be utilized for beneficial use projects at Kelly Island and Broadkill Beach. Sufficient capacity exists at the Buoy 10 site to handle maintenance dredging quantities generated in Reach E.

The present worth analysis of project costs determined that average annual costs are equal to \$22,281,000.

The project benefits quantified included the reduced costs of transportation realized through operational efficiencies (reduced lightering and lightloading), and the use of larger more efficient vessels, both resulting from navigation improvements at the harbor. The design vessel for the channel will not change with the proposed deepening. The largest vessels in the Delaware River fleet are tankers that lighter in the lower bay at the naturally deep Big Stone Beach Anchorage.

These tankers enter the bay currently with a maximum 55 foot sailing draft. With the deepened channel, these tankers will need to lighter less tonnage at the anchorage in order to reduce their sailing drafts prior to navigating upriver. For the other commodities, the charter market will allow a change in the vessel size from the 40 foot to 45 foot design draft class to more efficiently take advantage of a deepened channel. Reduced transportation costs result in reduced production and distribution costs and thereby increase the net value of the national output of goods and services. With the current construction schedule, no pre-base year benefits are claimed. Economic benefits are annualized for the 50-year study period. All project benefits are computed in the Fiscal Year 2009 Price Level and discounted at the Federal Fiscal Year 2010 discount rate of 4-3/8%. Average annual benefits are estimated to be \$30,091,000. The benefit-cost ratio (BCR) is 1.35, with net benefits per year of \$7,810,000.

The plan using only existing Federal sites has a higher BCR and net benefits compared to the alternative plan (which includes non-federal disposal sites). The alternative plan has a BCR of 1.27 and net benefits of \$6,336,000. As a result of this comparison, the plan using only existing Federal disposal sites is determined to be the least-cost plan.

The current project construction cost estimate is within the Section 902 allowance. Section 902 of WRDA 1986 allows for project cost increases up to 20 percent, apart from the price level adjustment of the authorized project costs, due to modifications which do not materially alter the scope or function of a project. This criterion applies to real terms, not nominal terms such as inflation.

The Corps ITR Technical Review has been incorporated: for the project benefits the ITR was conducted by New England District and New York District, and for the project costs the ITR was conducted by New York District. Comments were satisfactorily addressed and the report was revised to reflect this resolution of comments.

Environmental Review: Based on the information presented in this Environmental Review and comments received in response to the Public Notices (CENAP-PL-E-09-01 and CENAP-PL-E-09-02 dated 17 December 2008 and 31 December 2008, respectively), it is concluded that any changes in the project conditions would have a de minimis impact on the conclusions reached since the SEIS and ROD, and no significant adverse environmental impacts are expected to occur as a result of the proposed action. Because the potential impacts identified have been determined to be minor, localized and temporary, the preparation of a new SEIS is not warranted. The Corps is committed to continue to work closely with Federal and State resource agencies during project construction to monitor and collect additional environmental data, and to apply adaptive management and best management practices as appropriate.

Appendices A and B present more detailed discussions of the disposal plan and benefit analysis.

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## **INTRODUCTION**

This economic update has been developed as part of the budgeting process for the FY 2011 Federal Budget, and conducted in accord with EC-11-2-194 (1 Apr 09) paragraph 11.b.(3): For a continuing construction project, “The economic update will involve no major new analysis. It will be limited to reviewing and updating previous assumptions and limited surveying, sampling, and application of other techniques to develop a reasonable estimate of project benefits.” The prior economic update for the project was completed last year, in April 2008. The document presents a limited reevaluation of the benefits and costs for the Delaware River Main Channel Deepening Project. The last approved documents are 1) the Supplement to the Comprehensive Economic Reanalysis Report, February 2004, which included an External Independent Technical Review Team, comprised of economic experts from academia and private industry, and was subsequently followed by 2) an Economic Update in April 2008 that verified trends utilizing published commodity data that post-dated the 2004 report.

### **Background**

The history and background of economic studies for the Delaware River Main Channel Deepening are described below chronologically.

### **Feasibility Report**

The Delaware River Comprehensive Navigation Study Main Channel Deepening Interim Feasibility Report and Environmental Impact Statement were completed in February 1992. The Division Engineer's Public Notice for that report was issued in February 1992. Thereafter, the report was reviewed by the Washington Level Review Center (WLRC), and the Board of Engineers for Rivers and Harbors (BERH). In June 1992, the WLRC concurred with the findings and recommendations of the reporting officers. Subsequently, the project was reviewed by the Office of Management and Budget. A Record of Decision (ROD) for the Final Environmental Impact Statement was completed in December 1992. Public Law 102-580, Section 101(6) of the Water Resources Development Act of 1992, authorized the recommended project for construction and was modified by Section 308 of the Water Resources Development Act of 1999 Public Law 106-53, and further modified by Section 306 of the Water Resources Development Act of 2000, Public Law 106-541.

### **Preconstruction, Engineering and Design**

In 1992, the Preconstruction, Engineering, and Design (PED) study was initiated. The objective of this study was to refine the recommended plan, respond to concerns raised by the WLRC review of the 1992 Interim Feasibility Report and to perform additional supplementary environmental analyses as recorded in the December 1992 Record of Decision for the Final Environmental Impact Statement. The Project Management Plan called for preparation of a Design Memorandum (DM) and an appropriate NEPA document.

With the completion of the DM and Supplemental Environmental Impact Statement as part of the PED study, the project design features for the proposed deepening to 45 feet of the Delaware River Main Channel were finalized.

In May 1996, the results of the PED study were documented in a DM which was approved by the District, as per guidance contained in CECW-EP Memorandum dated 31 May 1995, Subject: Engineering, Design and Dam Safety Guidance. In addition, a Draft Supplemental

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Environmental Impact Statement (SEIS) was prepared in December 1996 and made available to the public and agencies. The Final SEIS was filed with the U.S. Environmental Protection Agency in July 1997. The July 1997 Final SEIS re-affirmed the environmental impacts that were presented in the 1992 Interim Feasibility Report and Final Environmental Impact Statement. A Record of Decision (ROD) for the Final SEIS was completed in December 1998.

### **Limited Reevaluation Report 1998**

A Limited Reevaluation Report (LRR) was completed in February 1998 to serve as the decision document for budgetary purposes.

### **Comprehensive Economic Reanalysis Report, 2002**

The U.S. General Accounting Office (GAO), since renamed the General Accountability Office, in a June 2002 report on the Delaware River Main Channel Deepening (GAO-02-604), recommended that a comprehensive reanalysis be conducted to address uncertainties that GAO identified in the project's economic analysis in the Limited Reevaluation Report (LRR). The Assistant Secretary of the Army (Civil Works) (ASA (CW)) and the Corps of Engineers Washington, D.C. Headquarters agreed with GAO on the need for the comprehensive reanalysis as well as had a review conducted by an external independent party to ensure that the reanalysis accurately represented expected benefits and costs for the proposed project. The Director of Civil Works approved the report on 18 December 2002 and provided the report to ASA (CW). Subsequently, ASA (CW) transmitted the report to GAO on the same date.

The project benefits included the reduced costs of transportation that will be realized through operational efficiencies (from reduced crude oil lightering and cargo lightloading) and the use of larger, more efficient vessels from the proposed navigation improvement. Reduced transportation costs result in reduced production and distribution costs and thereby increase the net value of the national output of goods and services. The quantification of benefits involved computing and comparing total transportation costs for the 40 and 45 foot channel depths for each pertinent vessel class, by trade route, commodity, and by terminal. Benefits were estimated for liquid bulk (crude oil and petroleum product imports), dry bulk (including blast furnace slag and slab steel), and containerized cargo. The Comprehensive Reanalysis Report in December 2002 concluded that the channel deepening of the Delaware River to a 45 foot depth was justified with a benefit-cost ratio of 1.18. Smaller projections of commodity growth were applied in this report compared to the LRR.

### **Supplement to Comprehensive Economic Reanalysis Report, 2004**

Following the Comprehensive Economic Reanalysis completed in December 2002, the principal lightering company that offloaded crude oil from tankers in the lower Delaware Bay, since purchased by another lightering company, provided comments on the crude oil benefit methodology and results.

In order to address the lightering company comments, a refinement of the crude oil transportation cost savings benefits was accomplished. The supplemental analysis also included a review and revision as appropriate of the other benefiting commodities. Project costs were not revised from the 2002 report, except for the incorporation of an addition to project costs to meet compliance with the General Conformity Rule of the Clean Air Act. The Director of Civil Works approved this report on 12 March 2004, following extensive review by an External Independent

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Review Panel. This panel constituted a grouping of experts in navigation and economics, with representation from both academia and private industry. This supplement to the Comprehensive Economic Analysis Report verified justification for the deepening of the Delaware River channel to a depth of 45 feet with a benefit-cost ratio of 1.15.

### **Economic Update, April 2008**

The April 2008 economic update of the 2004 Supplement to the Comprehensive Economic Reanalysis Report concluded that the project remained economically justified at the FY 08 discount rate (4 7/8%) and price level for the authorized plan as well as for two sensitivity analyses. The authorized plan had a BCR=1.25, with net benefits of \$6,014,000 per year.

### **PURPOSE AND SCOPE**

This purpose of this document, as part of the budgeting process for the FY 2011 Federal Budget, pertains to costs and benefits for the proposed deepening of the Delaware River to 45 feet. The 2009 price level and FY 2010 Federal discount rate of 4 3/8% have been applied as parameters in the analysis. NEPA compliance status and the project sponsor, the Philadelphia Regional Port Authority, are also discussed.



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## **DESCRIPTION OF THE PROJECT**

### **Authorized Project**

### **Study Area**

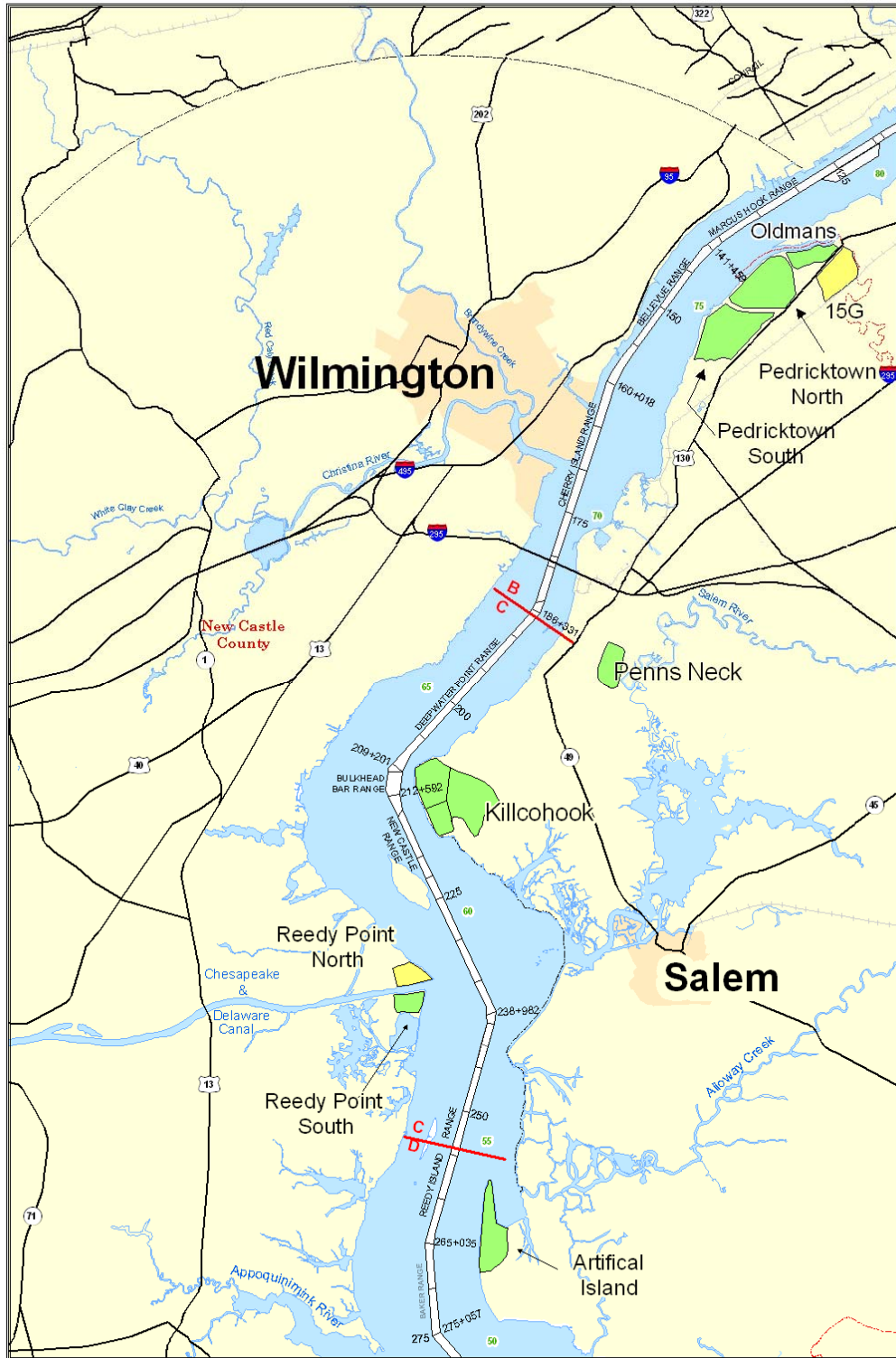
The study area is located along the northeastern coast of the United States. The Delaware River Port System is located in the center of the Eastern industrial corridor of the United States. The port complex is served by a highly efficient rail and highway network that brings some of the greatest centers of commerce within easy reach. The proposed 45-foot channel-deepening project is located within the Delaware River and Bay and the borders of the Commonwealth of Pennsylvania, and the States of New Jersey and Delaware. It extends over 100 river miles of the Delaware River and Bay, from Philadelphia, Pennsylvania to the mouth of Delaware Bay, following the alignment of the existing 40-foot Federal projects.

### **Summary Description**

The authorized project consists of a navigation channel extending from deep water in the Delaware Bay to Philadelphia Harbor, Pennsylvania and to Beckett Street Terminal, Camden New Jersey, a distance of about 102.5 miles. The plan provides for modifying the existing Delaware River Federal Navigation Channel (Delaware River, Philadelphia to the Sea and Delaware River in the Vicinity of Camden) from 40 to 45 feet below Mean Low Water (MLW). Figures 1-3 present the project (proceeding from north to south), including channel reaches and disposal site locations.



Figure 1. Reaches A-A to B, Disposal Site Map



**Figure 2. Reaches B to D, Disposal Site Map**

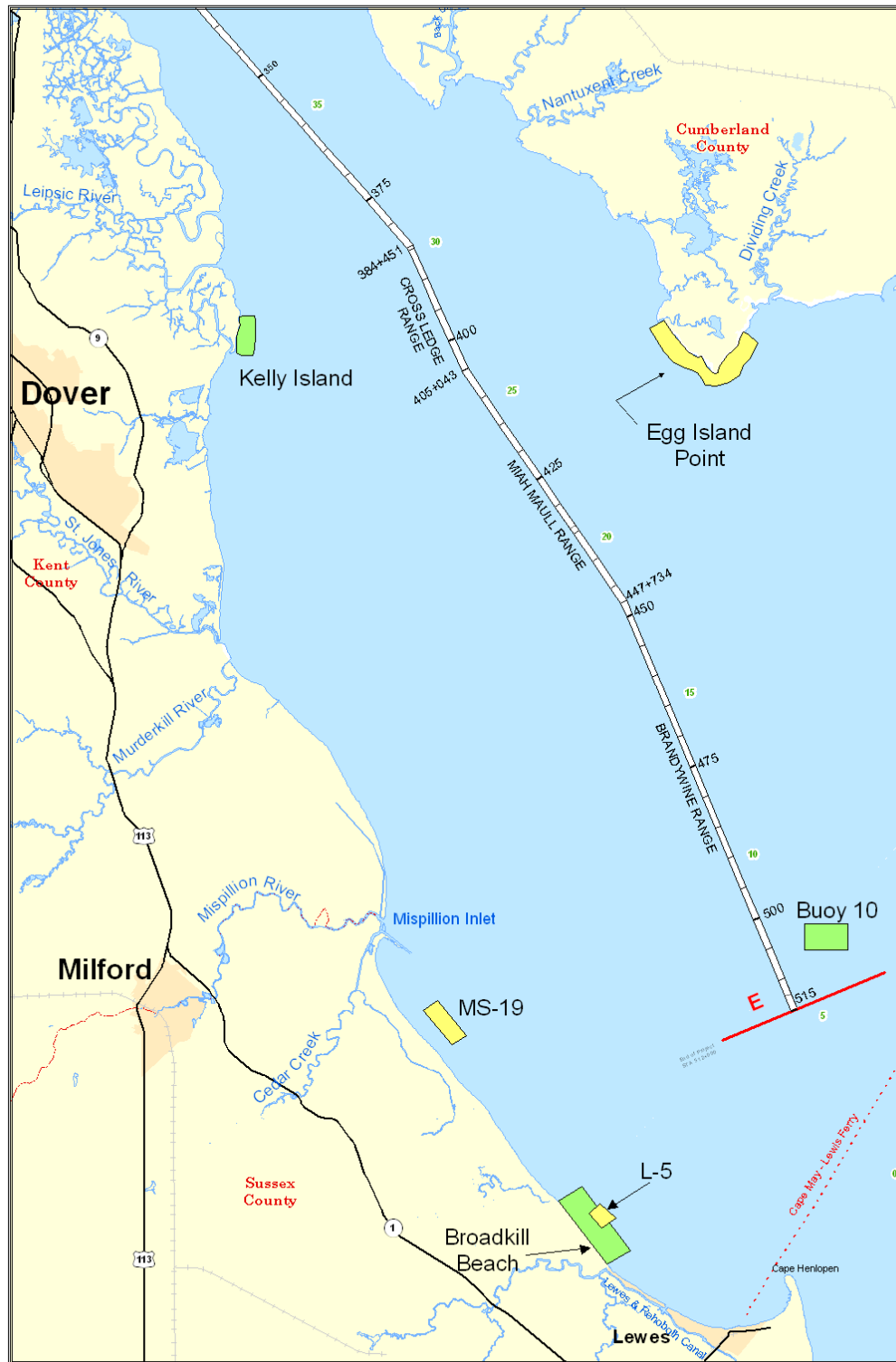


Figure 3. Reach E, Disposal Site Map

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## Current Project Refinements

There is sufficient capacity at existing Federal upland disposal sites to construct the 45 foot project in Reaches A/AA, B, C, and D and then maintain it for an additional 50 years. In Reach E, all of the dredged material from the construction of the 45 foot project can be utilized for beneficial use projects at Kelly Island and Broadkill Beach. Sufficient capacity exists at the Buoy 10 site to handle all maintenance dredging quantities generated in Reach E. Reach B is now scheduled for construction in the last year (five), a revision from Reach A/AA being scheduled in year five in prior reports. With this change, the current economic update does not claim any pre-base year benefits. There is a cost saving associated with constructing and maintaining the 45 foot project without the three new disposal sites at Raccoon Island, 15-D, and 15-G.

Eliminating new disposal sites eliminates any environmental impacts that would have been associated with the development and utilization of those sites. Due to the decrease in initial and projected maintenance quantities throughout the river, the ultimate projected elevations for all of the federal disposal areas are at or below those predicted in the feasibility phase.

The projections in the 1992 EIS and 1997 SEIS that additional disposal capacity would be needed to complete the 45 foot Project were based on estimated dredging quantities that are no longer considered accurate. Further, given the continuing downward trend in maintenance dredging quantities and the increasing opportunities for and emphasis on beneficial use of dredged material it is unlikely that there will be a critical need for additional upland disposal capacity even looking beyond the 50 year life of the 45 foot Project.

The authorized project supported by the 1997 SEIS included restoration of approximately 145 acres of intertidal habitat adjacent to Egg Island Point utilizing cubic yards of material dredged from the Delaware Bay navigation channel. However, due to the reduction in estimated quantities of dredged material, this element of the project is being deferred until such time as sufficient dredged material quantities are available to support its construction.

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## DREDGING QUANTITIES AND DISPOSAL PLAN SCHEDULE

Table 1 below lists the eight planned dredging contracts (with River Mile locations, cubic yardage quantities, and timing) for the five year construction period for the initial construction for the proposed deepening of the Delaware River main channel to 45 feet.

**TABLE 1  
DREDGING QUANTITIES AND DISPOSAL PLAN SCHEDULE**

<b>DREDGING CONTRACTS</b>	<b>River Mile</b>	<b>Estimated Quantity (CY)</b>
<b>Contract No.1</b>		
<b>Reach C-Bulkhead Bar</b>		
Killcohook	68.3	932,600
Reedy Pt South	63.9	597,800
Killcohook	60.3	972,400
<b>Contract No.2</b>		
Reach D-Reedy Pt South	55.8	396,300
<b>Contract No. 3</b>		
<b>Reach B- Rock Blasting &amp;</b>		
Rock Dredging-Fort Mifflin		77,000
<b>Contract No.4</b>		
Reach E- Broadkill Beach	15.6	1,598,700
<b>Contract No.5</b>		
Reach B-Oldmans		1,671,400
Reach B-Pedricktown North		1,050,700
Reach B-Pedricktown South	85.9	1,942,800
<b>Contract No.6</b>		
Reach E-Kelly Island-Dredge	36.4	345,800
	32.1	55,500
	30.8	

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**2,081,700**

**Contract No.7**

**Reach D-Artificial Island            51.8   1,654,800**

**Contract No.8**

**Reach AA-National Park            99.2   994,000**

**Reach A-Pedricktown North        98.8   1,666,600**

Table 2 lists the disposal area plan evolution over time.

**TABLE 2**

<b>Delaware River Deepening - Disposal Area Plans 1992 - 2009</b>					
<b>Disposal Areas (DA) Listed North to South</b>	<b>DA Located in Reach</b>	<b>DA Status in 1992 Feasibility</b>	<b>DA Status in 1997 Suppl. EIS</b>	<b>DA Status in 2002 Comp. Econ. Analys.</b>	<b>Current DA Plan - 2009</b>
National Park	A	Existing site	Existing site	Existing site	Existing site
17G	A	Proposed new DA	Proposed new DA	Eliminated - not available	
17O	A	Proposed new DA	Eliminated - cultural		
Fort Mifflin	A	Existing site	Existing site	Existing site	Existing site
Raccoon Island	B	Proposed new DA	Proposed new DA	Proposed new DA	Eliminated - not needed
15D	B	Proposed new DA	Proposed new DA	Proposed new DA	Eliminated - not available
15G	B	Proposed new DA	Proposed new DA	Proposed new DA	Eliminated - not needed
Oldmans	B	Existing site	Existing site	Existing site	Existing site
Pedricktown North	B	Existing site	Existing site	Existing site	Existing site
Pedricktown South	B	Existing site	Existing site	Existing site	Existing site
Penns Neck	B	Existing site	Existing site	Existing site	Existing site
Killcohook	C	Existing site	Existing site	Existing site	Existing site
Reedy Point North	C	Existing site	Existing site	Existing site	Eliminated - not needed
Reedy Point South	C	Existing site	Existing site	Existing site	Existing site
Artificial Island	D	Existing site	Existing site	Existing site	Existing site
Kelly Island	E		Proposed new DA	Proposed new DA	Proposed new DA
Egg Island Point	E		Proposed new DA	Proposed new DA	Deferred - not needed at present
MS19 Stockpile	E		Proposed new DA	Eliminated - environmental	
Buoy 10	E	Existing site	Existing site	Existing site	Existing site
L5 Stockpile	E		Proposed new DA	Eliminated - environmental	
Broadkill Beach	E			Proposed new DA	Proposed new DA



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There is sufficient capacity at existing Federal upland disposal sites to construct the 45 foot project in Reaches A/AA, B, C, and D and maintain the federal project channel for at least 50 years. In Reach E, all dredged material from the construction of the 45-ft project can be utilized for beneficial use projects at Kelly Island and Broadkill Beach. Sufficient capacity exists at the Buoy 10 disposal site to handle all maintenance dredging quantities generated in Reach E.

There is a cost saving associated with constructing and maintaining the 45 foot project without new disposal sites at Raccoon Island and 15G. Eliminating new disposal sites eliminates all environmental impacts associated with the development and utilization of those sites. This also eliminates real estate costs associated with new site acquisition, and site preparation costs associated with dike construction and sluicing.

Due to the decrease in initial and projected maintenance quantities, the ultimate dike heights required in 2009 are all less than or equal to those anticipated in the 1992 EIS. The current dike elevations and capacity analysis are based on updated topographic mapping and the 2007 disposal area inspection report. This has provided more accurate dike heights and disposal capacity information than was available in 1992.

Overall, constructing the 45 foot project utilizing only existing Federal disposal sites is both feasible and cost-effective. At the same time, it will eliminate all environmental and costs impacts that would have been associated with construction and utilization of new disposal sites and substantially reduce the overall environmental impact of the project.

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## PROJECT BENEFITS

### NATIONAL ECONOMIC DEVELOPMENT (NED) BENEFITS-RECOMMENDED PLAN

National Economic Development (NED) benefits were updated for this analysis following the guidelines and procedures established in the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies, February 3, 1983; the Planning Guidance Notebook, ER 1105-2-100, 22 April 2000; and the National Economic Development Procedures Manual – Deep Draft Navigation, IWR-91-R-13, dated November 1991. The February 2004 Delaware River Main Channel Deepening Comprehensive Reanalysis Supplemental Report, which augmented the December 2002 Comprehensive Reanalysis, was applied as the methodological basis for updating benefits.

The Principles and Guidelines defines NED benefits as follows:

“Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.”

The NED benefits quantified include the reduced costs of transportation realized through operational efficiencies (reduced lightering and lightloading), and the use of larger more efficient vessels, both resulting from navigation improvements at the harbor. Reduced transportation costs result in reduced production and distribution costs and thereby increase the net value of the national output of goods and services.

Benefits will result from the decrease in the cost per ton for shipping commodities into or out of the Delaware River Port System. The proposed 45 foot channel depth will improve the economic efficiency of ships moving through the Delaware River ports, resulting in a reduction in total vessel trips. No induced tonnage (i.e., commodity shifts from other ports) will take place with the proposed project deepening. The largest vessels in the port fleet, crude oil tankers, currently lighter at Big Stone Anchorage in the naturally deep water of the lower Delaware Bay. These vessels will continue to carry the same tonnage from the foreign origin ports but will be able to operate more efficiently in the Delaware River with a deepened channel from reduced lightering. This will also result in a reduction in barge traffic needed to move the lightered crude oil upriver to the refineries. An unquantified benefit is the value of the reduction in the number of exposures to oil spill risk through the reduction in the number of lightering connections and disconnections. Also, a deeper channel depth will allow current dry bulk and container vessels to carry more cargo as well as allow a fleet shift in the charter dry bulk market. These factors will more efficiently apportion operating costs for the same amount of total tonnage and further reduce total vessel trips through the port. Benefits have been estimated for liquid bulk, dry bulk, and containerized cargo. Also, benefits are claimed for cost reductions resulting from beneficial reuse of dredged material at the authorized Broadkill Beach. No pre-base year benefits are claimed with the current construction schedule. Economic benefits are annualized for the 50-year study period. All project benefits are computed in the 2009 Price Level and are discounted at the federal Fiscal Year 2010 discount rate of 4-3/8%.

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## **QUANTIFIED NED BENEFITS**

### **Background**

Economic benefit calculations to the National Economic Development (NED) Account include only the transportation cost savings associated with vessel efficiencies and operational efficiencies, and beach renourishment at Broadkill Beach. Environmental benefits will also likely accrue due to improved safety and beneficial ecosystem uses of dredged material at Kelly Island and Egg Island Point, but have not been quantified in the project analysis.

As background, a summary of economic benefit information from the last approved decision document, the February 2004 Supplement to the Comprehensive Economic Reanalysis, resulted in average annual benefits of \$24,249,000. This prior analysis was based upon a 5 5/8% discount rate (FY 04 Discount Rate) at a May 2002 price level.

### **Waterborne Commerce**

To provide an overall understanding of economic activity and health of the economy related to this project, total waterborne commerce serves as a baseline.

### **Fleet Composition**

Historic data shows that the large majority of the tons of foreign commerce transported to the Delaware River consist of crude oil delivered on tankers, followed, in descending order, by bulk, combination, containerized cargo, and other vessels.

### **Crude Oil Benefits**

NED benefits for crude oil imports are the reduced cost of transportation realized through operational efficiencies (reduced lightering) and more efficient loading of tankers that will result from navigation improvements at the harbor. Large crude oil vessels that currently lighter in the naturally deep water of the lower Delaware Bay will continue to carry equivalent tonnage into the system, but will be able to travel to the dock more fully laden in a deepened channel, thereby reducing the need for lightering. Reduced lightering costs result in reduced production and distribution costs and thereby increase the net value of the national output of goods and services.

For crude oil, some facilities are expected to reconfigure their non-lightering fleet segments to allow some of the vessels to load deeper under the with project condition.

As was expected in the 2004 decision document, crude oil tonnage has continued to remain stable. This finding is in accord with the relative fixed capacity at the area refineries. There is sufficient tank capacity to handle any deliveries anticipated by tankers under the with project condition. Technological advancements will allow for very modest growth in refinery capacity (and, thus, related crude oil imports) in future years. The minor fluctuations in historic tonnage shown above track this expected stable level of tonnage per year for this benefit category that was applied as the baseline in the February 2004 report analysis, as the fluctuations reflect the normal maintenance practices in refinery operations.

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The benefits for this commodity category are supported by the historic tonnage information. The benefit magnitude for this category is affirmed, with the update of the average annual benefit estimate at \$15,101,600.

## **Container Benefits**

The Packer Avenue Terminal (PAMT) is the specific container facility in the study area that will benefit from the deepened channel. The terminal is located at the intersection of Delaware Avenue and Packer Avenue, adjacent to, and just south of the Walt Whitman Bridge in Philadelphia. There are no air draft limitations presented by the three bridges, the Delaware Memorial, the Commodore Barry, and the Walt Whitman that span the Delaware River along the project's length. The terminal facility is approximately a 106-acre terminal with six berths (3,800 linear feet of berthing space) with over 400,000 square feet of dry, cooler, and freezer warehouse space, a northern container gate, a south-end breakbulk and general cargo gate, administration offices, a vehicle maintenance and repair shop and several other terminal related buildings and operations. The terminal handles goods including containers, steel, meat, and fruit; has a 40-foot current berth depth commensurate with the existing Delaware River navigation channel; and rail service connections with CP Rail, CSX and Norfolk Southern; and 385 plugs to handle reefer container boxes. PAMT has four Kocks Cranes, one Paceco Crane, and two Hyundai Cranes which provide heavy lift direct access to truck, rail, and vessel. The facility is directly accessible to Interstate Highways I-95 and I-76. PAMT has also acquired national status as a Strategic Military Seaport in the Northeast Corridor. This designation, by the Defense Department's Military Traffic Management Command, requires the ability of the operator at the facility to load military equipment onto vessels with a minimum of advance notice. In addition, PAMT is an activated Foreign-Trade Zone.

The benefit magnitude for this category is affirmed by the historic tonnage that post-dates the 2004 report and augmented by the PRPA projections. The baseline tonnage from the 2004 report has been applied in this update. Average annual containership benefits in this update are estimated at \$7,785,400.

## **Slag Benefits**

Blast furnace slag (or clinker), used in the production of cement, is imported to the Camden Marine Terminal at Beckett Street. The existing fleet exhibits design drafts ranging from 42 feet to 46 feet and sailing drafts averaging 40 feet (with the current without project condition channel). This current fleet is expected to remain the same under the without project condition. Under the with project condition, however, the fleet is expected, through use of the charter market, to shift to larger vessels that can take advantage of the deeper channel depth.

Slag imports would shift to larger bulk vessels with design drafts in excess of 45 feet under with project conditions. Bulk vessels are contracted from the charter market and there are no barriers to fleet replacement. Therefore, an 80,000 DWT foreign flag bulk vessel drafting 46 feet was selected to represent the with project condition fleet, in order to accommodate each year's total tonnage.

The benefit magnitude for this category is affirmed, with the updated average annual benefit estimate of \$2,296,400.

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## **Steel Slab Benefits**

Steel slabs are imported through Packer Avenue Terminal on a variety of vessels with design drafts ranging from 34 feet to 45 feet and sailing drafts ranging from 33 feet to 40 feet. This existing fleet is expected to remain the same under the without project condition, with the use of similarly sized vessels to handle future commodity growth. Under with project conditions, the operator of Packer Avenue Terminal has indicated that it is likely that there will be a shift to larger vessels that could take full advantage of a 45-foot channel. These dry bulk vessels will be contracted from the charter market; therefore there are not any sunk investment costs that would mitigate against a fleet shift. The 2004 benefit analysis in the approved decision document had a projection of future average growth rate of only 1% per year for steel slabs.

The actual tonnage post-dating the February 2004 report exceeds the tonnage applied in the 2004 benefit analysis. The benefit magnitude for this category is affirmed. The updated average annual benefit estimate is \$4,658,200.

## **Petroleum Product Benefits**

A potential beneficiary handles refined petroleum products (#6 fuel oil, diesel, and home heating oil predominantly). This operational practice is expected to continue under both the with project and without project conditions. A fleet of larger vessels would be employed to take advantage of the deeper 45-foot channel under the with project condition.

The 2004 benefit analysis from the decision document applied a future average growth rate of 0.2% per year for the petroleum products.

The benefit magnitude for this category is affirmed. The updated average annual benefit estimate is \$435,900.

## **Benefits from Beneficial Use Cost Savings at Broadkill Beach**

Benefits would be realized due to cost savings resulting from jointly developing the Delaware River and Broadkill Beach projects rather than developing them independently. The Delaware River Main Channel Deepening Project has the capability to provide dredged material for beach nourishment for Broadkill Beach. In doing so, the Delaware River project is assigned the NED cost savings (i.e., NED benefits) from beneficial use of the disposal of material. The following approach was used in estimating potential NED cost savings. With the least cost option established in the 2004 report, \$12,435,000 million (2009 price level) in avoided borrow area sand source costs foregone for the Broadkill Beach authorized project is a benefit for the material provided by the Delaware River project. On an average annual basis, this is equal to \$616,600 in benefits (multiplying this cost savings by the Capital Recovery Factor, at the 4 3/8% discount rate, for the 50 year period of analysis).

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## AVERAGE ANNUAL BENEFITS

This analysis has estimated benefits that would result from deepening the Delaware River Main Channel from its current authorized and maintained project depth of 40 feet below MLW to the depth of 45 feet below MLW.

A four-step approach was used to update benefits. First, as a baseline, during the 2004 report analysis, the benefits, at a 2002 price level, had been computed at both the 5 7/8% and 5 5/8% discount rates. Using the relationships established for this 1/4% point change, adjustments in this current update were calculated at the 4 3/8% discount rate for each of the benefiting commodities. Second, the price level index factor from 2002 to 2009 was applied. Third, the change for the Broadkill Beach category due to the discount rate and price level changes was incorporated into the benefits. Fourth, in the current construction schedule, Reach B is scheduled for the final year (five), so no pre-base year benefits are claimed. In the prior 2004 Supplement to the Comprehensive Reanalysis, with Reaches A/AA being planned to be constructed in year five, 2.6% of total benefits were pre-base year benefits.

The average annual NED benefits of the 45-foot deepening plan are presented in 2009 Price Levels and at the FY 2010 federal discount rate of 4-3/8 percent. Table 3 displays average annual benefits by individual category, with the total equal to \$30,091,000.

**Table 3**  
**Average Annual Benefits by Category**

<b>Benefit Type</b>	<b>Average Annual Benefits</b>
<b>Transportation Cost Savings</b>	
Crude Oil	\$15,101,600
Petroleum Products	\$435,900
Containerized Cargo	\$7,785,400
Slag	\$2,296,400
Steel Slabs	\$4,658,200
<b>Subtotal Transportation Cost Savings</b>	<b>\$30,277,600</b>
<b>Beneficial Use Cost Savings at Broadkill Beach</b>	\$616,600
<b>Pre-Base Year Benefits Not Claimed</b>	<b>(803,200)</b>
<b>Total Project Benefits</b>	<b>\$30,091,000</b>

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## **BENEFIT SENSITIVITY (APPLYING IMPACT OF INCREASE IN CORPS' DEEP-DRAFT VESSEL OPERATING COSTS)**

Benefits have been revised in this scenario applying the weighted impact on the changes in the Corps' vessel operating costs for the benefiting commodities from 1) the FY 2002 vessel operating cost summary table to the FY 2008 set of tables developed for individual vessel types, and then 2) further adjusting for the price level increase from April 2008 to FY 2009 as defined in EM 1110-2-134. The net result of this benefit sensitivity is displayed in Table 4. Benefits are 7.3% higher than for the plan displayed in Table 3.

**Table 4**  
**Average Annual Benefits**  
**Sensitivity Analysis**

<b>Benefit Type</b>	<b>Average Annual Benefits</b>
<b>Transportation Cost Savings</b>	
Crude Oil	\$15,479,300
Petroleum Products	\$464,400
Containerized Cargo	\$8,988,700
Slag	\$2,535,100
Steel Slabs	\$5,057,300
<b>Subtotal Transportation Cost Savings</b>	<b>\$32,524,800</b>
<b>Beneficial Use Cost Savings at Broadkill Beach</b>	<b>\$616,600</b>
<b>Pre-Base Year Benefits Not Claimed</b>	<b>(861,700)</b>
<b>Total Project Benefits</b>	<b>\$32,279,700</b>



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## **PROJECT COSTS**

### **NATIONAL ECONOMIC DEVELOPMENT (NED) COSTS**

This section presents the current estimate (2009 Price Levels) of NED costs for the Delaware River Main Channel Deepening Project using the existing Federal disposal sites only.

#### **Initial Construction Costs**

The estimate for the Federal portion of the project assumes using pipeline, clamshell and hopper dredges. The total initial construction dredging quantity is 15,961,000 cubic yards. Cost estimates take into account environmental windows that may be encountered during dredging or placement of dredged material.

Cost estimates were updated for disposal area preparation. The disposal area work consists of site clearing, raising dikes and constructing sluices. Construction schedules, disposal areas use schedule and all quantities for initial and maintenance dredging cost estimates, including disposal area development were updated in estimating the cost of the project.

Due to the amount of material to be dredged, disposal area capacity considerations and locations, construction is scheduled to take five years. Total initial construction costs for deepening the federal navigation channel are \$265,627,000.

#### **Real Estate Costs (Lands, Easements, Rights-of-Way, Relocations)**

There are no costs for this category because only the existing federal upland disposal sites are being utilized for construction (and the placement sites have no alternative uses).

#### **Navigation Aid Costs**

Costs were updated to \$406,100 for the U.S. Coast Guard to relocate and install aids to navigation.

#### **Air Quality Impacts (General Conformity- Clean Air Act)**

The February 2004 Supplement to the Comprehensive Reanalysis report demonstrated that several viable options exist to allow the channel deepening project to achieve general conformity compliance for carbon monoxide and nitrogen dioxide, with the recommended option having an updated cost of \$15,892,000. A new General Conformity Analysis and Mitigation Report is currently undergoing public and agency review. The draft General Conformity Analysis concludes that the purchasing of perpetual multi-year emission reduction credits is the most cost efficient way to attain conformity. The cost of purchasing credits is significantly lower than the mitigation plan contained in the 2004 analysis, however the \$15,892,000 previously estimated is retained in the cost estimate in this update as an upper cost limit until the new General Conformity Analysis is completed.

#### **Associated Costs (LSF)**

Associated costs are defined in the Planning Guidance Notebook, ER 1105-2-100, Appendix D. Economic and Social Considerations, D-3. NED Cost Evaluation Procedures, subparagraph f. Evaluation Procedure: Associated Costs.

“Associated costs are the costs of measures needed over and above project measures to achieve the benefits claimed during the period of analysis . . . . Base associated costs on the current market prices of goods and services required for the installation of measures needed over and above project measures . . . . (2) It is preferred that associated costs be explicitly treated as NED project related costs, and appear as costs in benefit-cost ratios.” Associated costs for the Delaware River project consist of: a) any required initial construction and dredging costs necessary to achieve benefits from a deepened Federal channel, and b) any increase in the annual operations and maintenance costs of non-federal benefiting entities, in excess of those needed to maintain their facilities for the existing 40 foot project. Associated costs were updated for the benefiting facilities and are included in the NED project cost estimate, at \$32,752,000.

## Summary of Initial Costs

Table 5 below displays the initial project costs for the cost categories. All costs are at a 2009 price level.

**Table 5: Project First Costs  
(2009 Price Level)**

<b>Account</b>	<b>Item</b>	<b>Cost (Excluding PED)</b>
01	Lands, Easements-Rights of Way	\$0
02	Relocations	\$0
12	Navigation, Ports and Harbors	\$210,697,400
12a	Navigation Aids	\$406,100
18	Air Mitigation	15,892,000
30	Engineering and Design (including Pre-PPA)	\$25,143,500
	Preconstruction Engineering and Design-Sunk	\$0
31	Construction Management	\$13,488,500
	<b>Subtotal Project First Cost</b>	<b>\$265,627,500</b>
	Associated First Cost (LSF)	\$32,752,000
	<b>Total Project First Cost</b>	<b>\$298,379,500</b>

## Operation and Maintenance Costs

### Federal Project

Estimates were updated for maintenance costs of the Federal portions of the project. These costs were updated to a 2009 price level. Average annual maintenance dredging costs are equal to \$5,482,000 and average annual maintenance costs for navigation aids are \$117,000.

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## Associated Costs (LSF)

Associated costs for operations and maintenance include any increase in the annual operations and maintenance costs of non-federal benefiting entities, in excess of those needed to maintain their facilities for the existing 40 foot project. The incremental maintenance costs for maintaining the 45-foot depth at the berthing area (s) (i.e., the difference between the maintenance costs of the 45 and 40 foot depths) is included in the update. Incremental average annual maintenance dredging costs are equal to \$199,000.

**INTEREST DURING CONSTRUCTION (IDC)** is an economic cost of the project and is therefore included in the NED cost estimate. ER 1105-2-100, paragraph 2-4.k.(3), defines Interest During Construction:

“Other direct costs are the costs of resources directly required for a project or a plan but for which no implementation outlays are made. Examples of these costs are interest during construction...”

The Planning Guidance Notebook, ER 1105-2-100, Appendix D. Economic and Social Considerations, D-3. NED Cost Evaluation Procedures, subparagraph D. (10) states:

“Interest During Construction. This represents the opportunity cost of capital incurred during the construction period. The cost of a project to be amortized is the investment incurred up to the beginning of the period of analysis. The investment cost at that time is the sum of construction and other initial cost plus interest during construction. Cost incurred during the construction period should be increased by adding compound interest at the applicable project discount rate from the date the expenditures are incurred to the beginning of the period of analysis. “

Interest during Construction (IDC) has been calculated for the opportunity costs for the incurrence of costs, applying the costs to be incurred on an annual basis over the five-year construction period, with the interest then compounded forward to the base year, and is equal to \$32,752,000. Interest during construction was also calculated for associated costs at \$1,650,000.

## AVERAGE ANNUAL COSTS

Average annual costs (AACs) have been determined applying the 2009 price level and the federal FY 2010 discount rate of 4-3/8 percent. Average annual costs of \$22,281,000 are summarized in Table 6 below.

**Table 6: Average Annual Costs**

<b>Cost Item</b>	<b>Cost (Excluding PED)</b>
Financial First Costs	\$265,627,000
Interest During Construction (Financial First Costs)	\$32,434,000
Associated First Costs (LSF)	\$32,752,000
Interest During Construction (Associated Cost)	\$1,650,000
Total Economic First Costs	\$332,464,000
Average Annual Economic First Costs	\$16,483,000
Annual Operations and Maintenance – Project	\$5,482,000

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Annual Operations and Maintenance – Associated	\$199,000
Annual Operations and Maintenance – Navigation Aids	\$117,000
<b>Total Average Annual Costs</b>	<b>\$22,281,000</b>

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## SUMMARY OF BENEFITS AND COSTS

Table 7 below presents a summary of benefits and costs for the plan update, expressed at a 2009 price level and FY 2010 Federal discount rate, compared to the benefits and costs previously presented in the Delaware River Main Channel Deepening Comprehensive Reanalysis February 2004 Supplemental Report. The Supplemental Report data is at a May 2002 price level and the FY 2004 federal discount rate of 5 5/8%.

**Table 7**  
**Average Annual Benefits and Costs Comparison**

	Average Annual Results 2004 Report	Average Annual Results 2009 Update
Crude Oil	\$11,778,000	\$15,101,000
Petroleum Products	\$352,000	\$436,000
Containerized Cargo	\$6,124,000	\$7,785,000
Blast Furnace Slag	\$1,807,000	\$2,296,000
Steel Slabs	\$3,605,000	\$4,658,000
Subtotal Transportation Cost Savings	\$23,665,000	\$30,278,000
Beneficial Use Savings at Broadkill Beach	\$583,000	\$617,000
Pre-Base Year Benefits Not Claimed (in 2009 Update)	N/A	(\$803,200)
<b>Total Project Benefits</b>	<b>\$24,249,000</b>	<b>\$30,091,000</b>
<b>Total Project Costs</b>	<b>\$21,025,000</b>	<b>\$22,281,000</b>
Benefit-Cost Ratio	1.15	1.35
Average Annual Net Benefits	\$3,223,000	\$7,810,000

## BENEFIT-COST RATIO FOR PLAN OF IMPROVEMENT

For the plan of improvement, all project costs and benefits are computed at a 2009 price level and are discounted at the current federal FY 2010 discount rate of 4-3/8%. The project life is 50

years. In accordance with ER 1105-2-100, expended PED costs are considered sunk. The current benefit-cost ratio is 1.35 with net benefits annually of \$7,810,000.

## NET BENEFIT PLAN COMPARISON

To determine that the plan that maximizes net benefits has been identified, the plan’s average annual costs have been compared to the average annual costs for an alternative disposal plan that would include the utilization of two non-federal disposal area (D/A) sites. Average annual benefits are the same for both plans.

For comparison, average annual costs have been determined for the alternative plan (which includes two non-federal disposal area sites), applying the 2009 price level and the federal FY 2010 discount rate of 4-3/8 percent. Average annual costs of \$23,755,000 are itemized in Table 8 below.

**Table 8: Cost Summary for Plan with Non-Federal D/A Sites**

Cost Item	Cost (Excluding PED)
Financial First Costs	\$268,390,000
Interest During Construction (Financial First Costs)	\$28,628,000
Associated First Costs	\$32,752,000
Interest During Construction (Associated Cost)	\$1,650,000
Total Economic First Costs	\$331,420,000
Average Annual Economic First Costs	\$16,431,000
Annual Operations and Maintenance – Project	\$7,008,000
Annual Operations and Maintenance – Associated	\$199,000
Annual Operations and Maintenance – Navigation Aids	\$117,000
<b>Total Average Annual Costs</b>	<b>\$23,755,000</b>

Table 9 below presents a summary of benefits and costs for the alternative plan which includes non-federal disposal areas.

**Table 9**

### BCR for Alternative Plan with Non-Federal D/A Sites

AVERAGE ANNUAL RESULTS	
<b>AVERAGE ANNUAL PROJECT BENEFITS</b>	<b>\$30,091,000</b>

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<b>AVERAGE ANNUAL PROJECT COSTS</b>	<b>\$23,755,000</b>
<b>BCR</b>	<b>1.27</b>
<b>AVERAGE ANNUAL NET BENEFITS</b>	<b>\$6,336,000</b>

**CONCLUSION:** The plan using only existing Federal disposal sites has a BCR of 1.35, with net benefits of \$7,810,000, as compared to the alternative plan's (which includes non-federal disposal sites) BCR of 1.27 and net benefits of \$6,336,000.

**SENSITIVITY: BENEFIT-COST RATIO INCORPORATING SENSITIVITY BENEFIT SCENARIO (APPLYING IMPACT OF INCREASE IN CORPUS OF ENGINEERS DEEP-DRAFT VESSEL OPERATING COSTS)**

Table 10 below presents a summary of benefits and costs for the benefit sensitivity scenario.

**Table 10**  
**Average Annual Benefits and Costs-Benefit Sensitivity Analysis**

	Average Annual Results
<b>Transportation Cost Savings</b>	
Crude Oil	\$15,479,300
Petroleum Products	\$464,400
Containerized Cargo	\$8,988,700
Blast Furnace Slag	\$2,535,100
Steel Slabs	\$5,057,300
<b>Subtotal Transportation Cost Savings</b>	<b>\$32,524,800</b>
Beneficial Use Cost Savings at Broadkill Beach	\$616,600
<b>Total Project Benefits (No Pre-Base Year Claimed)</b>	<b>\$32,279,700</b>
<b>Total Project Costs (Rounded)</b>	<b>\$22,281,000</b>
<b>Benefit-Cost Ratio</b>	<b>1.45</b>
<b>Average Annual Net Benefits</b>	<b>\$9,998,700</b>

For the benefit sensitivity analysis, all benefits and costs are computed at the 2009 price level and are discounted at the federal FY 2010 discount rate of 4-3/8%. The project life is 50 years. There are no pre-base year benefits claimed. In accordance with ER 1105-2-100, expended PED costs are considered sunk, therefore the benefit-cost ratio is 1.45 with net benefits annually of \$9,998,700.

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## **ENVIRONMENTAL REVIEW**

### **Summary of Conclusions and Findings**

The purpose of the 2009 Environmental Assessment was to evaluate the impacts of refinement changes to the Congressionally authorized project for the Delaware River Main Stem and Channel Deepening Project, which are the result of detailed preconstruction, engineering and design studies, as well as changes to the existing conditions in the project area from those described in the 1992 Environmental Impact Statement (EIS), 1997 Supplemental Environmental Impact Statement (SEIS), and 1998 Record of Decision (ROD) for the project, and to consolidate in one document the results of post-SEIS monitoring and data collection efforts.

### **Refinement Changes to the Authorized Project:**

a. Due to reduction of dredged material quantities the project will be constructed using only existing Federal dredged material disposal sites. Four new dredged material disposal sites identified in the SEIS (15D, 15G, 17G, and Raccoon Island) are no longer needed and have been eliminated, which reduces impacts due to disposal;

b. The current plan also includes placement of sand dredged in the Delaware Bay directly on Broadkill Beach rather than offshore sand stockpiling as stated in the SEIS. This change was in response to concerns raised by resource agencies regarding the impacts of sand stockpiling and is consistent with the 1998 ROD;

c. Deferment of Egg Island Point restoration. The authorized project supported by the 1997 SEIS included restoration of approximately 145 acres of intertidal habitat adjacent to Egg Island Point utilizing approximately 2,600,000 cubic yards of material dredged from the Delaware Bay navigation channel. However, due to the reduction in estimated quantities of dredged material, this element of the project is being deferred until, and if, such time as sufficient dredged material quantities will be available to support its construction.

### **Changes to the Affected Environment since the 1997 SEIS**

a. Athos oil spill. The January 2009 Draft Damage Assessment and Restoration Plan and Environmental Assessment for the November 26, 2004 M/T Athos I Oil Spill (NOAA, 2009) concluded that the Athos Oil Spill only temporarily (14 months) contributed to an increase in toxicity of sediments in the Delaware River. Similarly, sediment sampling conducted by the Corps in 2005 (Versar, 2005b) also indicates that there has been no change in sediment quality. Therefore, it has been determined that the Athos Oil Spill will have no significant adverse effect on construction or maintenance of the deepening project.

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b. Shortnose Sturgeon. Additional environmental concerns not addressed in the EIS, the SEIS, or the 2001 Biological Opinion from the National Marine Fisheries Service regarding distribution of the Federally listed shortnose sturgeon: Based on recent surveys (Versar, 2005a), a significant expansion in the number and distribution of the shortnose sturgeon in the Delaware River appears likely. Consequently, there is potential for shortnose sturgeon to be in the vicinity of the Marcus Hook rock blasting area. The Corps has determined that with implementation of appropriate monitoring measures and with the restriction that work is limited to the period between December 1 and March 15, there will not be an adverse affect on the shortnose sturgeon or its habitat.

Evaluations of impacts on resources addressed previously in the Environmental Impact Statement and Supplemental Environmental Impact Statement are not discussed in the Environmental Review and are incorporated by reference. Where appropriate, potential areas of concern have been re-evaluated and updated.

Based on the information presented in this Environmental Assessment and comments received in response to the Public Notices (CENAP-PL-E-09-01 and CENAP-PL-E-09-02 dated 17 December 2008 and 31 December 2008, respectively), it is concluded that any changes in the project conditions would have a de minimis impact on the conclusions reached since the SEIS and ROD, and no significant adverse environmental impacts are expected to occur as a result of the proposed action. Because the potential impacts identified have been determined to be minor, localized and temporary, the preparation of a new SEIS is not warranted. The Corps is committed to continue to work closely with Federal and State resource agencies during project construction to monitor and collect additional environmental data, and to apply adaptive management and best management practices as appropriate.



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## **SECTION 902 OF WRDA 1986 ANALYSIS: MAXIMUM ALLOWABLE COST OF PROJECT**

Section 902 of WRDA 1986 allows for project cost increases up to 20 percent, apart from the price level adjustment of the authorized project costs, due to modifications which do not materially alter the scope or function of a project. As per ER 1105-2-100, the construction component of the authorized cost was updated in the Section 902 analysis to account for historical information by using the Civil Works Cost Index System (CWCCIS) in EM 1110-2-1304. Associated costs are also in accord with Section 902. As determined by the cost information, the current project construction cost estimate is within the Section 902 allowance.

The comparison at the current 2009 price level is as follows:

a. Current construction cost estimate for federal navigation channel presented in this economic update:

\$265,627,000

b. Authorizing document (1992 Feasibility Report) construction cost updated to the 2009 price level to establish Section 902 allowance:

\$640,492,000

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## **CONCLUSION**

The result presented in this economic update for the FY 2011 budget, conducted in accord with EC-11-2-194 (1 Apr 09), paragraph 11.b.(3) and Appendix D, ER 1105-2-100, concludes that the Delaware River Main Channel Deepening Project to a depth of 45 feet remains economically justified. The Corps ITR Technical Review has been incorporated: for the project benefits the ITR was conducted by New England District and New York District, and for the project costs the ITR was conducted by New York District. Comments were satisfactorily addressed and the report was revised to reflect this resolution of comments.

The plan, using only existing federal disposal sites is the least-cost, has a BCR=1.35, with net average annual benefits of \$7,810,000 per year over the 50-year project life.

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## APPENDICES

### Appendix A: Disposal Plan

#### Updated Dredged Material Disposal Plan

#### Delaware River Main Stem and Channel Deepening Project

### 1. PURPOSE AND INTRODUCTION

The purpose of this appendix is to document for the record:

- That the current dredged material disposal plan for the Delaware River Deepening, based on results of the latest surveys, concludes that only 16 million cubic yards of dredged material need to be removed to achieve the authorized 45 foot depth
- That there is sufficient capacity at the existing Federal disposal sites to accommodate the initial construction, incremental O&M for the 45-ft project, as well as ongoing O&M for the 40-ft project, for over 50 years, and
- That utilizing existing Federal sites is the least cost disposal option

This appendix documents evolution of the dredged material disposal plan for the Delaware River Main Channel Deepening project beginning with the 1992 Feasibility Study. As subsequent phases of investigation and reporting have been completed, the disposal plan has been modified to reflect changes in a number of factors such as: quantities of new work and O&M dredged material; acquisition and availability of new disposal sites (which are no longer needed); state and agency views on preferred beneficial use disposal options in the Bay; etc. The final section of this appendix presents the current dredged material disposal plan, and includes the results of an economic analysis that shows the current (2009) plan, utilizing only existing Federal disposal sites in Reaches AA through D, is the least-cost plan. This plan no longer requires the acquisition of new sites in Reaches AA/A and B. Beneficial use options at sites in Delaware Bay are included in Reach E of the current plan.

The reports that document evolution of the dredged material disposal plan for the project include:

- Final Interim Feasibility Study and Environmental Impact Statement (February 1992)
- Delaware River Main Channel Deepening Project, Supplemental Environmental Impact Statement (July 1997) and LRR (February 1998)
- Comprehensive Economic Reanalysis Reports (December 2002 and February 2004)

The disposal plan from each of these reports is summarized in the following sections of this appendix. To assist the reader in visualizing the locations mentioned in the text, [Figures A-1](#)

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through A-3 display the locations of all referenced disposal sites, from upstream (Philadelphia) to downstream (Delaware Bay). [Figure A-4](#) presents a matrix of these disposal sites and indicates when a particular disposal area was included in, or subsequently eliminated from, the disposal plan at each successive stage of study. The final column of Figure A-4 lists those sites (highlighted in green) included in the current disposal plan. Yellow highlighting indicates at what stage of investigation, and for what reason, other sites were eliminated from the disposal plan.

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## **2. PRIOR STUDIES AND REPORTS**

### **a. Final Interim Feasibility Study and Environmental Impact Statement (February 1992)**

The Philadelphia District completed the “Main Channel Deepening Final Interim Feasibility Study and Environmental Impact Statement” in February 1992. In that document, the following dredged material estimates were presented:

Initial construction (new work) dredging: 50.1 MCY

Annual O&M dredging for the 40-ft channel: 5.4 MCY/yr

Incremental maintenance dredging for 45-ft project: 756,000 CY/yr

Total annual O&M dredging for the 45-ft channel: 6.2 MCY/yr

The 1992 Feasibility Study evaluated the use of only existing upland Federal disposal areas because these sites are well distributed along the length of the main channel and had potential to minimize project costs. However, this option was eliminated given the quantity of new work and O&M dredging estimated at the time for the 45-ft channel project.

The 1992 Feasibility Study ultimately recommended the construction of new upland disposal sites (17G, 17O, Raccoon Island, 15D, and 15G) for the project in Reaches AA through C (Delaware River), along with continued use of existing Federal disposal areas. The disposal plan for Reach E (Delaware Bay) included a combination of beneficial use sites (wetland/island creation) and sand stockpiles for future use by non-Federal interests, with identification of the final recommended Reach E disposal plan deferred until the PED phase of study.

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### **b. Delaware River Main Channel Deepening Project, Supplemental Environmental Impact Statement (July 1997) and LRR (February 1998)**

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Dredged material estimates in the 1997 SEIS and 1998 LRR were:

Initial construction (new work) dredging: 33 MCY

Annual O&M dredging for the 40-ft channel: 4.9 MCY/yr

Incremental maintenance dredging for 45-ft project: 1.1 MCY/yr

Total annual O&M dredging for the 45-ft channel: 6.0 MCY/yr

Section 2 of the SEIS presented the disposal area requirements anticipated for each reach, as described in the following paragraphs.

Reach A (from the upstream project limit to and including Billingsport Range). “Approximately 153,000 CY of material are dredged from these channel ranges on an annual basis. This material is dredged for both the Delaware River, Philadelphia to the Sea project, and the Delaware River at Camden project. This material is currently placed in a single upland disposal area located at National Park, New Jersey. This site has a capacity of about 3.2 MCY to a dike height of 50 feet. With the current rate of usage, this elevation would be reached in the year 2007. Raising the dike further could add an additional 3.3 MCY of capacity, and extend the life of the site to 2027. In order to continue maintenance dredging activities for the full 50-year term of the study period, an additional disposal area will be required in the vicinity of Reach A.”

Reach B (Tinicum Range to and including Cherry Island Range). Approximately 2.4 MCY of material are dredged from Reach B on an annual basis. This material is currently placed in three dredged material disposal sites. These Federal sites are Pedricktown North and Pedricktown South, and the adjacent Oldmans site which is leased. These sites currently have a combined capacity of 21.3 MCY to a dike height of 50 feet. Replacement sites would be needed by the base year if dikes at the Federal sites are not raised and if the Oldmans lease cannot be extended beyond the current expiration date of 1996. Raising the dikes further could add an additional 36.5 MCY of capacity, and extend the life of this complex to 2030. A new site would be required by the year 2030 assuming that dike raising continues.”

Reach C (Deepwater Range to and including New Castle Range). Approximately 2.0 MCY of material are dredged from Reach C on an annual basis. This material is currently placed in two Federal sites, Penns Neck and Killcohook. These sites have a disposal capacity of 42.3 MCY to a dike height of 50 feet. Based on current usage, fill would reach that elevation in year 2014. Raising the dikes further would add an additional 48.7 MCY of capacity and extend the lives of these sites throughout the planning period. As such, there is sufficient dredged material disposal capacity in Reach

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C to conduct maintenance dredging activities for the full term of the study period, assuming dike raising continues.”

Reach D (Reedy Island Range to the lower end of Liston Range). Approximately 226,000 CY of material are dredged from Reach D on an annual basis. This material is currently placed in the Federal dredged material disposal site on Artificial Island. The Artificial Island site has a capacity of 15.8 MCY to a dike height of 50 feet. By raising the dikes further, an additional 4.9 MCY of capacity would be gained. There is sufficient dredged material disposal capacity to maintain the navigation channel in Reach D for the entire 50-year study period and beyond.

Reach E (lower end of Liston Range to natural deep water in Lower Delaware Bay). Approximately 370,000 CY of material are dredged from Reach E every five years. This material is currently placed in an overboard disposal site designated as Buoy 10. Buoy 10 is located approximately six miles northwest of Cape May Point, NJ. Sufficient capacity exists at the Buoy 10 site to continue maintenance dredging activities within Reach E for more than the 50-year study period.

Based on the capacity requirements identified above and changes in site availability that occurred subsequent to the 1992 Feasibility Study, the 1997 SEIS recommended that site 17G be added in Reach A to replace 17O, which was subject to concerns about cultural resources. In addition, the SEIS identified three new sites (15D, 15G, and Raccoon Island) to be added in Reach B. Overall, there was no change in disposal capacity of the new sites recommended in the SEIS compared to the sites recommended in the 1992 Feasibility Study.

For Reach E, the SEIS identified four beneficial use sites that would receive dredged material from the initial dredging phase of the project: Kelly Island (wetland restoration); Egg Island Point (wetland restoration); L5 (sand stockpile offshore of Broadkill Beach); and MS19 (sand stockpile offshore of Slaughter Beach).

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### **c. Comprehensive Economic Reanalysis Reports (December 2002 and February 2004)**

In December 2002 and February 2004, the District prepared Comprehensive Economic Reanalysis Reports (CERRs) for the deepening project. As part of these reports further refinements were made to the Disposal Plan based on more recent and accurate surveys, updated new work and O&M dredging quantities, updated survey datums for the project, and changes in site availability.

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The CEERs provided the following estimated dredging quantities:

Initial construction (new work) dredging: 26.0 MCY

Annual O&M dredging for the 40-ft channel: 3.5 MCY/yr

Incremental maintenance dredging for 45-ft project: 862,000 CY/yr

Total annual O&M dredging for the 45-ft channel: 4.3 MCY/yr

Site 17G, which was a component of the recommended disposal plan in the 1997 SEIS, was no longer available and was thus eliminated from further consideration. Additionally, the sand stockpile locations in Reach E (MS19 and L5) were eliminated based on environmental concerns raised during the SEIS process. Instead, sand would be placed directly onto Broadkill Beach as part of the initial 45-ft project dredging in Reach E.

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#### **d. Current Disposal Plan**

**1. Summary Findings.** The current dredged material disposal plan is based on the following estimated dredging quantities:

- Initial construction (new work) dredging: 16.0 MCY
- Annual O&M dredging for existing 40-ft channel: 3.5 MCY/yr
- Incremental annual O&M dredging for 45-ft project: 862,000 CY/yr
- Total annual O&M dredging for the 45-ft channel (sum of O&M quantities above): 4.3 MCY/yr

This current plan utilizes only existing Federal disposal areas, does not require new disposal sites, and accommodates new work and 50 years of O&M dredging for the 45-ft channel. Several factors contribute to this situation.

- Total estimated 50-year dredged material quantities associated with constructing and maintaining the 45-ft channel have declined from 375 MCY in 1992; to 321 MCY in 1997; to 242 MCY in 2002; to 232 MCY in 2009. Consequently, projections of required disposal capacity presented in the 1992 EIS and 1997 SEIS have been reduced accordingly.
- The decrease in new work dredging quantity estimates between 1992 and 2009 is the result of four principal factors.
  - Improved hydrographic survey technology that provides much higher resolution mapping of the channel

- 
- Dredging in the navigation channel by non-Federal interests to obtain upland fill material
  - Natural scour (deepening) in parts of the navigation channel
  - Revised tidal datums to reflect measured sea level rise since the 1950-period when previous tidal datums were established
  - Sites 15D, 17G, and 17O were identified as components of earlier disposal plans, but are no longer available as dredged material disposal areas. 15D has been developed as an equestrian training center. 17G was acquired by West Deptford Township and developed as “Riverwinds”, which includes residential and commercial properties, an indoor township pool, and golf course. 17O was eliminated due to significant cultural findings.
  - Eliminating the acquisition of new sites is consistent with Corps policy to avoid and/or minimize adverse impacts in planning and implementing new projects.
  - The Water Resources Development Act of 1996 eliminated the need for non-Federal sponsors to provide disposal capacity for navigation projects without regard to whether adequate capacity to meet project objectives already existed.
  - The current plan, which eliminates acquisition of new disposal sites, is the least-cost plan for placement of all dredged material associated with construction and maintenance of the 45-ft channel.

**2. 2009 Capacity Analysis of Existing Federal Disposal Sites.** In order to determine if the 45-ft project can be constructed and maintained without addition of new upland disposal sites, the following methodology was applied to each reach of the project:

- 1) Identify estimated quantity of dredged material to be dredged during initial construction plus 50 years of maintenance
- 2) Identify existing disposal site or sites to be utilized
- 3) Identify remaining capacity for each existing disposal site based on size of disposal site and projected maximum dike elevation; and
- 4) Determine adequacy of identified disposal site or sites to accommodate estimated dredged quantities after accounting for bulking and shrinkage. (Bulking represents the increased volume of unconsolidated dredged material initially placed in a confined upland disposal facility. Shrinkage represents the decreased volume of dredged material after subsequent consolidation and compaction within the disposal facility.)

[Table A-1](#) presents a comparison of the quantity of material to be placed at each disposal site as estimated in the 1992 Feasibility Report and as estimated in the current (2009) plan.

The 2009 incremental maintenance column identifies the quantity of dredged material estimated to be placed over and above the O&M requirements of the existing 40 ft project for a 50-year period of analysis. The incremental quantity estimated to be dredged over 50 years is approximately equivalent to ~12 years of maintenance under the existing 40 ft project. [Figure A-5](#) shows the historic summary of the O&M dredging quantity for the existing 40-ft project for



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Fiscal Years 1976 through 2007, and demonstrates the decreasing trend in annual O&M dredging over the past decade.

The following reach-by-reach summary shows allocation of new work and O&M dredging quantities to existing Federal disposal sites. The term “50 years maintenance” refers to the total volume of material to be dredged to maintain the 45-ft channel. It therefore includes both a component for existing (40-ft) channel maintenance and a component for incremental maintenance dredging of the 45-ft channel.

**Reach A-A/A.** New work dredging in Reach A-A/A will utilize the **National Park** and **Pedricktown North** disposal sites. All future O&M dredging in this segment of the project will be placed in National Park.

Reach A-A/A, new work dredged material: 2,606,600 CY

Reach A-A/A, 50 years maintenance: 7,200,000 CY

Current dike elevation at **National Park**: +35

Ultimate dike elevation at **National Park** to contain dredged material: +60

Capacity remaining after initial construction + 50 years maintenance: 787,200 CY

Current dike elevation at **Pedricktown North**: +42

Ultimate dike elevation at **Pedricktown North** to contain dredged material: +76

Capacity remaining after initial construction + 50 years maintenance: 2,267,900 CY

**Reach B.** New work dredging in Reach B will utilize **Pedricktown North, Pedricktown South, and Oldmans** disposal sites. Future O&M dredging in this segment of the project will also be placed in these three sites.

Reach B, new work dredged material: 4,664,900 CY

Reach B, 50 years maintenance: 104,700,000 CY

Current dike elevation at **Pedricktown North**: +42

Ultimate dike elevation at **Pedricktown North** to contain dredged material: +76

Capacity remaining after initial construction + 50 years maintenance: 2,267,900 CY

Current dike elevation at **Oldmans**: +36

Ultimate dike elevation at **Oldmans** to contain dredged material: +66

Capacity remaining after initial construction + 50 years maintenance: 4,610,400 CY

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Current dike elevation at ***Pedricktown South***: +45

Ultimate dike elevation at ***Pedricktown South*** to contain dredged material: +75

Capacity remaining after initial construction + 50 years maintenance: 3,277,900CY

**Reach C.** New work dredging in Reach C will utilize the **Killcohook** disposal site. Future O&M dredging in this segment of the project will be placed in **Killcohook** and **Penns Neck** disposal sites.

Reach C, new work dredged material: 2,502,800 CY

Reach C, 50 years maintenance: 71,350,000 CY

Current dike elevation at ***Killcohook 1***: +35

Ultimate dike elevation at ***Killcohook 1*** to contain dredged material: +65

Capacity remaining after initial construction + 50 years maintenance: 10,000,000CY

Current dike elevation at ***Killcohook 2***: +50

Ultimate dike elevation at ***Killcohook 2*** to contain dredged material: +50

Capacity remaining after initial construction + 50 years maintenance: +10,000,000 CY

Current dike elevation at ***Killcohook 3***: +46

Ultimate dike elevation at ***Killcohook 3*** to contain dredged material: +46

Capacity remaining after initial construction + 50 years maintenance: +3,000,000 CY

Current dike elevation at ***Penns Neck***: +30

Ultimate dike elevation at ***Penns Neck*** to contain dredged material: +60

Capacity remaining after initial construction + 50 years maintenance: +1,390,600 CY

**Reach D.** New work dredging in Reach D will utilize the Reedy Point South and **Artificial Island** disposal sites. Future O&M dredging in this segment of the project will be placed in Artificial Island.

Reach D, new work dredged material: 2,051,100 CY

Reach D, 50 years maintenance: 9,000,000 CY

Current dike elevation at ***Reedy Point South***: +25

Ultimate dike elevation at ***Reedy Point South*** to contain dredged material: +25

Area will only be used for initial dredging

Current dike elevation at ***Artificial Island***: +20

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Ultimate dike elevation at *Artificial Island* to contain dredged material: +50  
Capacity remaining after initial construction + 50 years maintenance: 1,800,200 CY

**Reach E.** New work dredging in Reach E will utilize the beneficial use placement sites at **Kelly Island** and **Broadkill Beach**. Future O&M dredging in this segment of the project will be placed at **Buoy 10**.

Reach E, new work dredged material: 4,080,700 CY

Reach E, 50 years maintenance: 23,600,000 CY

*Kelly Island* - dredged sand/silt required for beneficial use construction = 2,483,000 CY

*Broadkill Beach* – dredged sand required for beach nourishment = 1,597,700 CY

*Egg Island* - deferred due to reduction in dredged material quantities

### **3. Capacity Conclusions**

Sufficient capacity exists within existing Federal disposal sites in Reaches A-A through D to accommodate the initial construction dredging quantity associated with the 45-ft channel deepening project, as well as all ongoing and incremental maintenance dredging for the next 50 years. None of the dikes in existing Federal disposal sites will have to be raised higher than was projected in the 1992 Interim Feasibility Study (Authorized) plan. Further, no new sites are required in Reaches A-A through D. Beneficial use sites and the existing Buoy 10 site can accommodate all new work and future O&M dredging in Reach E.

**Table A-1. Comparison of 1992 Feasibility Disposal Plan with Current (2009) Disposal Plan**

<b>DELAWARE RIVER DEEPENING - 1992 vs 2009 - DISPOSAL AREA ANALYSIS</b>								
<b>Reach</b>	<b>Disposal Area</b>	<b>1992</b>			<b>2009</b>			
		<b>Feasibility Plan, Initial Qty, CY</b>	<b>Feasibility Plan, Total 50-Yr O&amp;M Qty, CY 1/</b>	<b>Dike Elevation for Initial Qty and 50-Yr Total O&amp;M</b>	<b>Current Initial Qty, CY</b>	<b>Incremental Maintenance Qty 45ft Project, CY 2/</b>	<b>Current Plan, Total 50-Yr O&amp;M Qty, CY 1/</b>	<b>Dike Elevation for Initial Qty and 50-Yr Total O&amp;M</b>
<b>A-A</b>	<b>National Park</b>		6,469,600	+70 Feet	994,000	300,000	7,200,000	+60 Feet
<b>A</b>	<b>17G</b>		8,690,400		Eliminated - not available			
	<b>17O</b>	7,626,000			Eliminated - not available			
	<b>Pedricktown North</b>				1,666,600			
<b>REACH A-A/A TOTAL</b>		<b>7,626,000</b>	<b>15,160,000</b>	<b>n/a</b>	<b>2,660,600</b>	<b>300,000</b>	<b>7,200,000</b>	<b>n/a</b>
<b>B</b>	<b>15G</b>		13,966,000		Eliminated - not needed			
	<b>Pedricktown North</b>		33,378,400	+76 Feet	1,050,700	4,128,000	45,408,000	+76 Feet
	<b>Oldmans</b>		9,696,000	+66 Feet	1,671,400	1,982,000	21,452,000	+66 Feet
	<b>Pedricktown South</b>		33,428,400	+78 Feet	1,942,800	3,440,000	37,840,000	+75 Feet
	<b>15D</b>	11,400,000	58,437,200		Eliminated – not available			
<b>REACH B TOTAL</b>		<b>11,400,000</b>	<b>148,906,000</b>	<b>n/a</b>	<b>4,664,900</b>	<b>9,550,000</b>	<b>104,700,000</b>	<b>n/a</b>
<b>Rock</b>	<b>Fort Mifflin</b>				77,000			

<b>C</b>	<b>Killcohook</b>		94,389,600	+84 Feet	2,502,800	5,200,000	46,700,000	+65 Feet
	<b>Penns Neck</b>		30,470,400	+70 Feet	0	4,450,000	24,650,000	+60 Feet
	<b>Raccoon Island</b>	8,020,000			Eliminated - not needed			
<b>REACH C TOTAL</b>		<b>8,020,000</b>	<b>124,860,000</b>	<b>n/a</b>	<b>2,502,800</b>	<b>9,650,000</b>	<b>71,350,000</b>	<b>n/a</b>

(Table A-1 continues on next page)

(Table A-1 continued from previous page)

Reach	Disposal Area	1992			2009			
		Feasibility Plan, Initial Qty, CY	Feasibility Plan, Total 50-Yr O&M Qty, CY 1/	Dike Elevation for Initial Qty and 50-Yr Total O&M	Current Initial Qty, CY	Incremental Maintenance Qty 45ft Project, CY 2/	Current Plan, Total 50-Yr O&M Qty, CY 1/	Dike Elevation for Initial Qty and 50-Yr Total O&M
D	Reedy Point South	4,270,000		+30 Feet	396,300			+25 feet
	Artificial Island		19,980,000	+70 Feet	1,654,800	4,600,000	9,000,000	+50 Feet
	Reedy North	4,000,000			0			
<b>REACH D TOTAL</b>		<b>8,270,000</b>	<b>19,980,000</b>	<b>n/a</b>	<b>2,051,100</b>	<b>4,600,000</b>	<b>9,000,000</b>	<b>n/a</b>
E	Kelly Island				2,483,000			
	Broadkill Beach				1,597,700			
	Egg Island Point				0			
	Buoy 10	14,870,000	15,850,000			19,000,000	23,600,000	
	L5							
	MS19							
<b>REACH E TOTAL</b>		<b>14,870,000</b>	<b>15,850,000</b>	<b>n/a</b>	<b>4,080,700</b>	<b>19,000,000</b>	<b>23,600,000</b>	<b>n/a</b>
<b>PROJECT TOTALS</b>		<b>50,186,000</b>	<b>324,756,000</b>	<b>n/a</b>	<b>16,037,100</b>	<b>43,100,000</b>	<b>215,850,000</b>	<b>n/a</b>

1/ Includes incremental maintenance between the 40 and 45 foot projects.

2/ Incremental maintenance quantity between the 40 foot and 45 foot project. These quantities are included in the total 50 year maintenance quantities.

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#### 4. Least-Cost Plan Comparison

There is a cost saving associated with constructing and maintaining the 45-ft project using only existing Federal disposal sites in Reaches AA through D, compared to the option of adding new non-Federal disposal sites at Raccoon Island and 15G.

The distribution of quantities for the two plans is shown in Table A-2. This table shows only the distribution of dredged material disposal for Reaches A and B, as the distribution for both plans is the same for Reaches A-A, C, D and E. As previously stated, Sites 17G, 17O and 15D are no longer available for the purpose of dredged material disposal. Site 17G was acquired by West Deptford Township and developed as “Riverwinds”, which includes residential and commercial properties, an indoor township pool and a championship size golf course. Site 17O was eliminated from potential use due to significant cultural findings. Site 15D has been developed as an equestrian training center.

Therefore, the plan analyzed for comparison to the Federal-only plan includes a combination of existing Federal sites and the previously identified new sites, 15G and Raccoon Island. It should be noted (see Figure A-2) that 15G is situated further from the river, landward of the Oldmans and Pedricktown Federal sites. Due to its location, 15G is more expensive to use for disposal of dredged material. Additionally, costs are reduced by utilizing only existing Federal sites due to acquisition costs for 15G, estimated at \$2,200,000, and site development costs of \$2,400,000.

Raccoon Island provides a shorter pumping distance for the initial dredging of Reach A material and the northern portion of Reach B since it is located in the upper portion of Reach B. However, for a majority of Reach B, the pumping distance to Raccoon Island is significantly longer than for the Oldmans and Pedricktown sites as they are centrally located in Reach B. However, the savings associated with this shorter pumping distance are more than offset by the initial costs of acquiring and preparing Raccoon Island as a disposal site. Specifically, the cost analysis for Raccoon Island includes acquisition costs estimated at \$4,032,000 and site development costs of approximately \$3,700,000. For both plans the project costs are comprised of initial costs and future incremental O&M costs. Initial construction cost estimates included disposal area preparations including site clearing, raising or building dikes, constructing sluices, plus installation of monitoring wells and wick drains, acquisition costs, dredging and placement.

Excluding Raccoon Island and 15G from the disposal plan eliminates the real estate costs associated with new site acquisition, and site preparation costs associated with dike construction and sluicing. It also eliminates all environmental impacts associated with the development and utilization of the sites.

In this analysis, project costs and benefits are computed at a FY 2009 price level discounted at the current Federal FY 2010 rate of 4 3/8%, over a period of analysis of 50 years. In accordance with ER 1105-2-100, expended PED costs are considered sunk.

To demonstrate that the least-cost disposal plan has been selected, costs of the current plan (no acquisition of new disposal sites) are compared to costs for the disposal plan that includes construction of new non-Federal disposal sites at Raccoon Island and Site 15G. This cost and benefit comparison is presented in Table A-3.

**Table A-2. Distribution of Dredging Quantities, Reaches A and B**

<b>Distribution of New Work Dredging Quantities - Comparison of Plans</b>				
<b>Reach</b>	<b>Current (2009) Plan</b>		<b>Plan With Non-Fed Sites</b>	
	<b>New Work Qty, CY</b>	<b>Disposal Area</b>	<b>New Work Qty</b>	<b>Disposal Area</b>
<b>A</b>	1,666,600	Pedricktown North	1,666,600	Raccoon Island
<b>B</b>	1,050,700	Pedricktown North	1,050,700	Raccoon Island
	1,671,400	Oldmans	1,671,400	15G
	1,942,800	Pedricktown South	1,088,200	Pedricktown South
			854,600	Pedricktown North
<b>B Total</b>	<b>4,664,900</b>		<b>4,664,900</b>	



**Table A-3: Cost and Benefit Summary for Disposal Plan Comparison**

<b>Benefit and Cost Comparison</b>		
<b>Item</b>	<b>Current Plan (Existing Federal Disposal Sites Only)</b>	<b>Plan With New Disposal Sites at Raccoon Island and 15G</b>
Financial First Costs	\$265,627,000	\$268,390,000
Interest During Construction (Financial First Costs)	\$32,434,000	\$28,628,000
Associated First Costs	\$32,752,000	\$32,752,000
Interest During Construction (Associated Cost)	\$1,650,000	\$1,650,000
Total Economic First Costs	\$332,464,000	\$331,420,000
Average Annual Economic First Costs	\$16,483,000	\$16,431,000
Annual Operations and Maintenance – Project	\$5,482,000	\$7,008,000
Annual Operations and Maintenance – Associated	\$199,000	\$199,000
Annual Operations and Maintenance – Navigation Aids	\$117,000	\$117,000
<b>Average Annual Costs</b>	\$22,281,000	\$23,755,000
<b>Average Annual Benefits</b>	\$30,091,000	\$30,091,000
<b>BCR</b>	1.35	1.27
<b>Net benefits</b>	\$7,810,000	\$6,336,000

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The current (2009) disposal plan has a BCR of 1.35, with net benefits of \$7,810,000, compared to the disposal plan with acquisition of new sites, with a BCR of 1.27 and net benefits of \$6,336,000. As a result of this comparison, the current plan, using only existing Federal sites, is determined to be the plan that maximizes net benefits.

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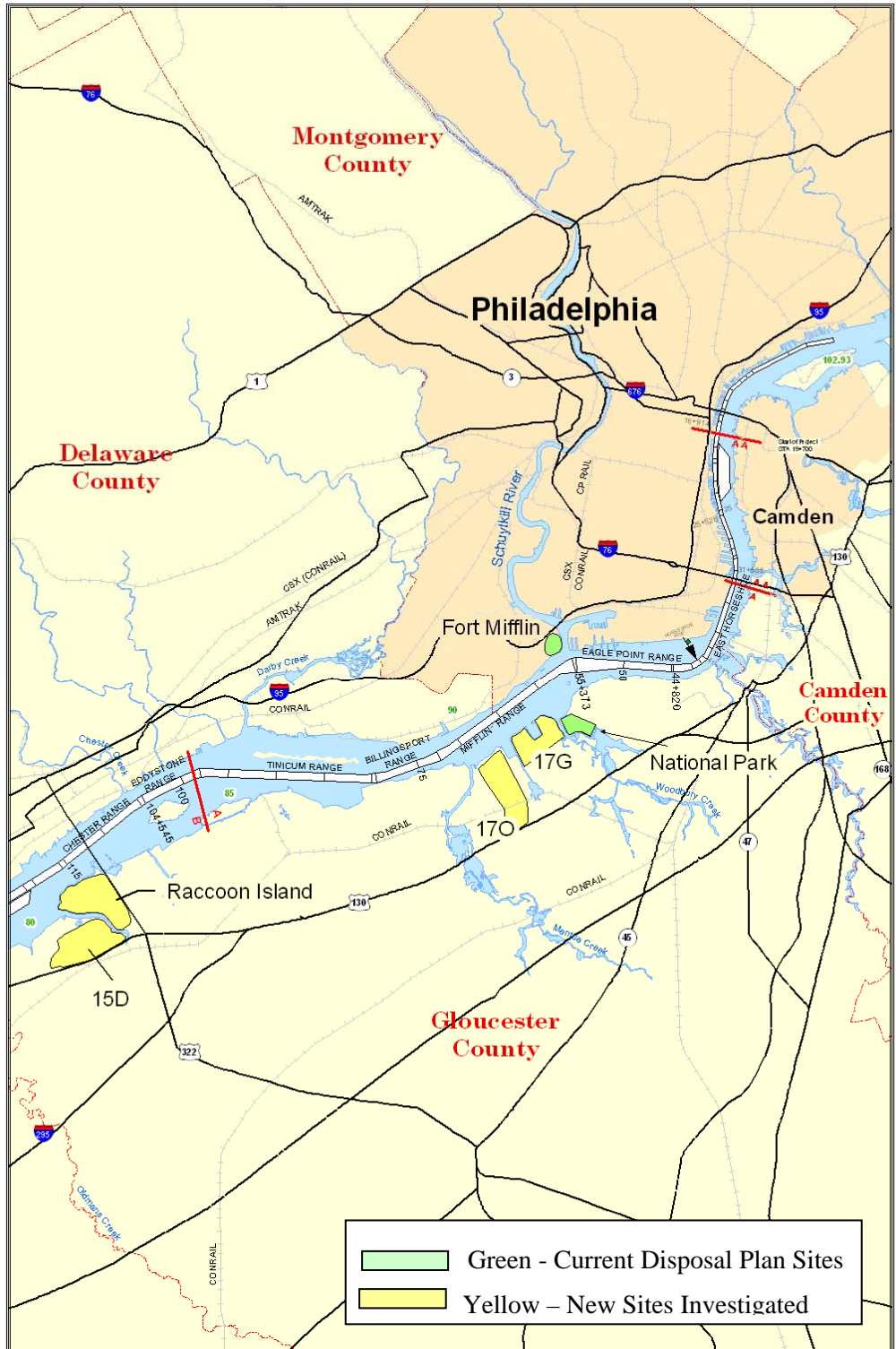
## **5. CONCLUSIONS**

There is sufficient capacity at existing Federal upland disposal sites to construct the 45-ft project in Reaches A/AA, B, C, and D and maintain the project for at least 50 years. Reach B will be constructed in the final year (five), instead of Reaches A/AA in year five as in the prior reports. In Reach E, all dredged material from the construction of the 45-ft project can be utilized for beneficial use projects at Kelly Island and Broadkill Beach. Sufficient capacity exists at the Buoy 10 disposal site to handle all maintenance dredging quantities generated in Reach E. Figures A-1 through A-3 display Disposal Site Maps. Figure A-4 displays the Disposal Site Matrix. Figure A-5 displays total O&M dredging by fiscal year for the Philadelphia to the Sea project.

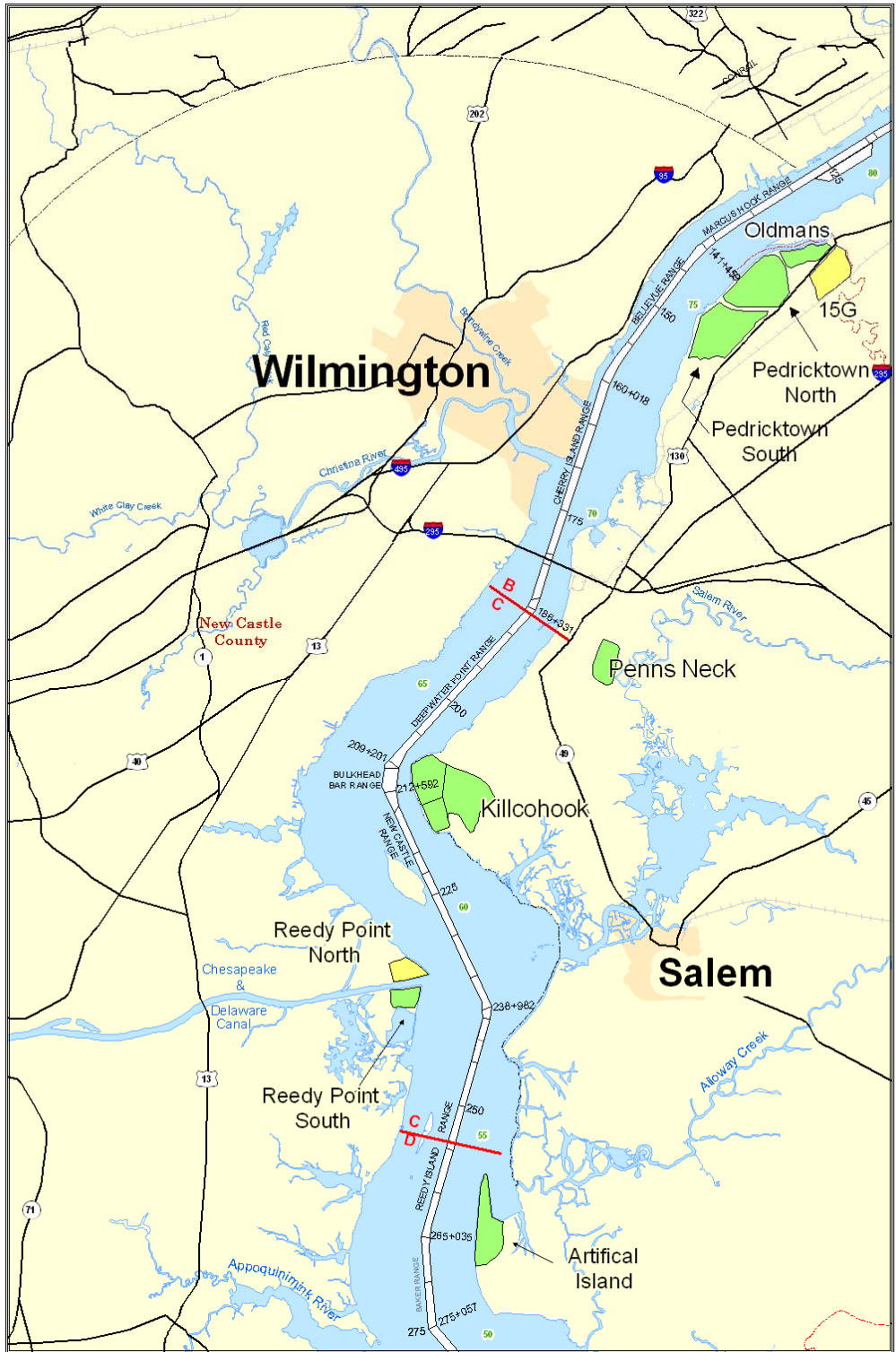
There is a cost saving associated with constructing and maintaining the 45-ft project without new disposal sites at Raccoon Island and 15G. Eliminating new disposal sites eliminates all environmental impacts associated with the development and utilization of those sites. This also eliminates real estate costs associated with new site acquisition, and site preparation costs associated with dike construction and sluicing.

Due to the decrease in initial and projected maintenance quantities, the ultimate dike heights required in 2009 are all less than or equal to those anticipated in the 1992 EIS. The current dike elevations and capacity analysis are based on updated topographic mapping and the 2007 disposal area inspection report. This has provided more accurate dike heights and disposal capacity information than was available in 1992.

Overall, constructing the 45-ft project utilizing only existing Federal disposal sites is both feasible and cost-effective. At the same time, it will eliminate all environmental and costs impacts associated with construction and utilization of new disposal sites and substantially reduce the overall environmental impact of the project.



**Figure A-1. Reaches A-A to B, Disposal Site Map**



**Figure A-2. Reaches B to D, Disposal Site Map**

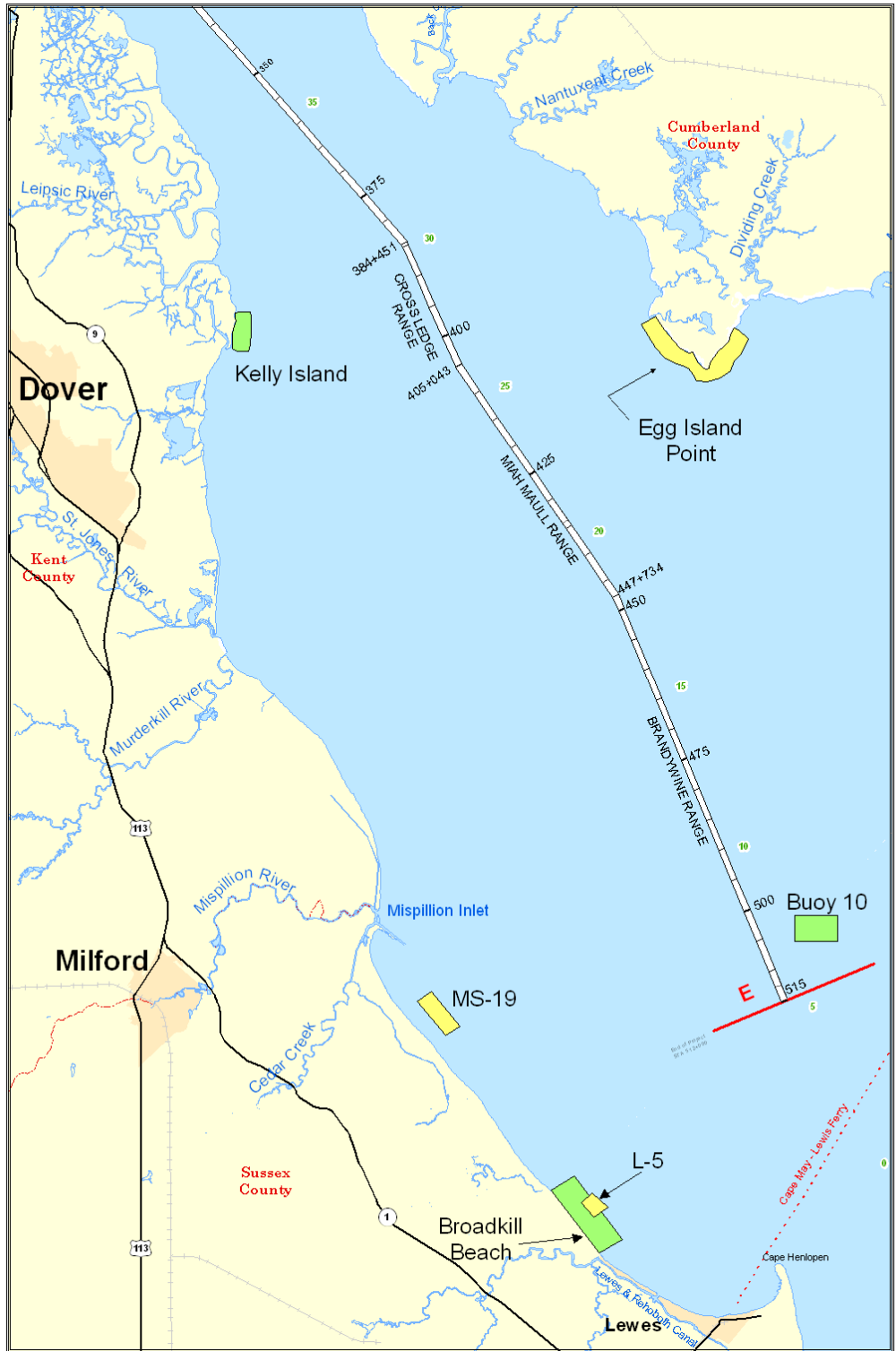
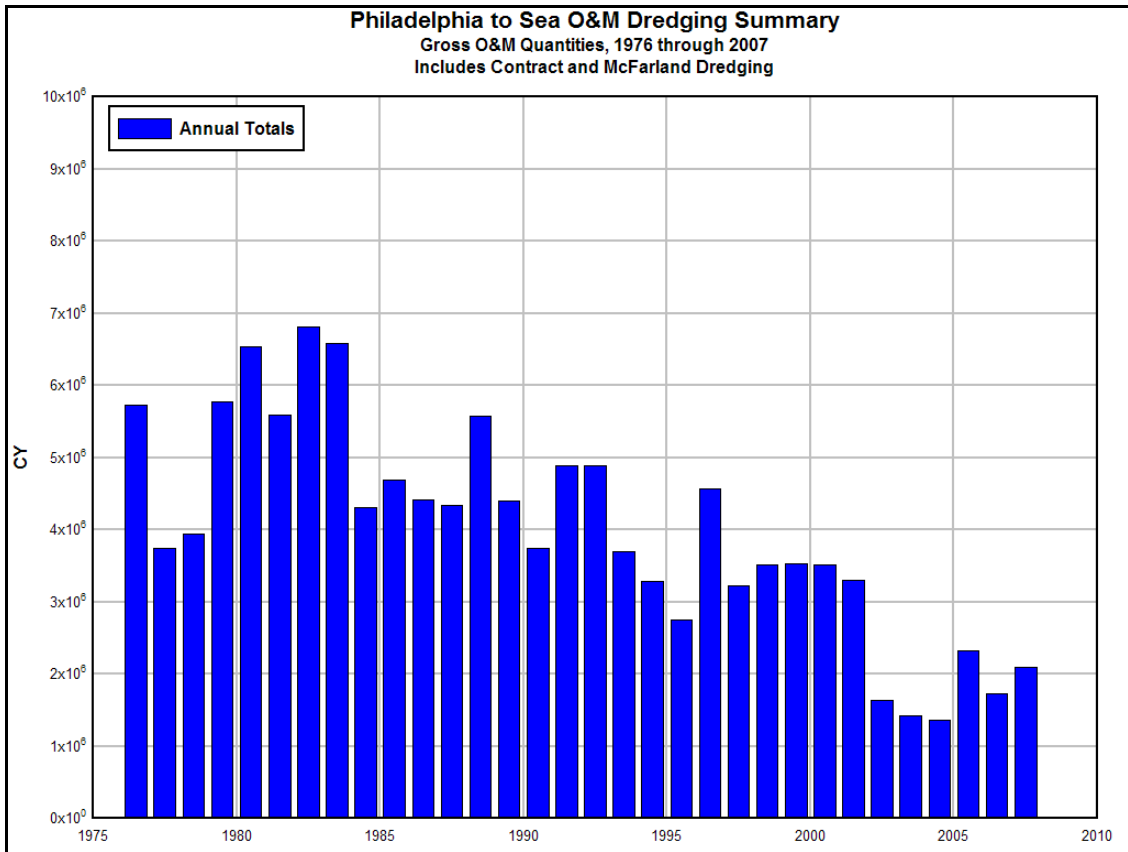


Figure A-3. Reach E, Disposal Site Map

<b>Delaware River Deepening – Disposal Area Plans 1992 - 2009</b>					
<b>Disposal Areas (DA) Listed North to South</b>	<b>DA Located in Reach</b>	<b>DA Status in 1992 Feasibility</b>	<b>DA Status in 1997 SEIS</b>	<b>DA Status in 2002 CERR</b>	<b>Current DA Status - 2009</b>
<b>National Park</b>	A	Existing site	Existing site	Existing site	Existing site
<b>17G</b>	A	New DA	New DA	Eliminated - not available	
<b>17O</b>	A	New DA	Eliminated - cultural concerns		
<b>Fort Mifflin</b>	A	Existing site	Existing site	Existing site	Existing site
<b>Raccoon Island</b>	B	New DA	New DA	New DA	Eliminated - not
<b>15D</b>	B	New DA	New DA	New DA	Eliminated - not
<b>15G</b>	B	New DA	New DA	New DA	Eliminated - not
<b>Oldmans</b>	B	Existing site	Existing site	Existing site	Existing site
<b>Pedricktown</b>	B	Existing site	Existing site	Existing site	Existing site
<b>Pedricktown South</b>	B	Existing site	Existing site	Existing site	Existing site
<b>Penns Neck</b>	B	Existing site	Existing site	Existing site	Existing site
<b>Killcohook</b>	C	Existing site	Existing site	Existing site	Existing site
<b>Reedy Point North</b>	C	Existing site	Existing site	Existing site	Eliminated - not
<b>Reedy Point South</b>	C	Existing site	Existing site	Existing site	Existing site
<b>Artificial Island</b>	D	Existing site	Existing site	Existing site	Existing site
<b>Kelly Island</b>	E		New DA	New DA	New DA
<b>Egg Island Point</b>	E		New DA	New DA	Deferred - not
<b>MS19 Stockpile</b>	E		New DA	Eliminated – environmental	
<b>Buoy 10</b>	E	Existing site	Existing site	Existing site	Existing site
<b>L5 Stockpile</b>	E		New DA	Eliminated – environmental	
<b>Broadkill Beach</b>	E			New DA	New DA

**Figure A-4. Disposal Site Matrix**



**Figure A-5. Total O&M dredging for Philadelphia to Sea project, by Fiscal Year.**

## Appendix B

### **NATIONAL ECONOMIC DEVELOPMENT (NED) BENEFITS-RECOMMENDED PLAN**

National Economic Development (NED) benefits were updated for this analysis following the guidelines and procedures established in the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies, February 3, 1983; the Planning Guidance Notebook, ER 1105-2-100, 22 April 2000; and the National Economic Development Procedures Manual – Deep Draft Navigation, IWR-91-R-13, dated November 1991. The February 2004 report was applied as the basis for updating benefits.

The Principles and Guidelines defines NED benefits as follows:

“Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.”

The NED benefits quantified include the reduced costs of transportation realized through operational efficiencies (reduced lightering and lightloading), and the use of larger more efficient bulk vessels, both resulting from navigation improvements at the harbor. Reduced transportation costs result in reduced production and distribution costs and thereby increase the net value of the national output of goods and services.

Benefits will result from the decrease in the cost per ton for shipping commodities into or out of the Delaware River Port System. The proposed 45 foot channel depth will improve the economic efficiency of ships moving through the Delaware River ports. No induced tonnage (i.e., commodity shifts from other ports or reduced transaction costs) will take place with the proposed project deepening. The largest vessels in the port fleet, crude oil tankers, currently lighter at Big Stone Anchorage in the naturally deep water of the lower Delaware Bay. These vessels will continue to carry the same tonnage from the foreign origin ports but will be able to operate more efficiently in the Delaware River with a deepened channel from reduced lightering. This will also result in a reduction in barge traffic needed to move the lightered crude oil upriver to the refineries. Also, a deeper channel depth will allow current dry bulk and container vessels to carry more cargo as well as allow a fleet shift in the charter dry bulk market. These factors will more efficiently apportion average variable costs over the tonnage and further reduce total vessel trips through the port. Benefits have been estimated for liquid bulk, dry bulk, and containerized cargo. Also, benefits are claimed for cost reductions resulting from beneficial reuse of dredged material at the authorized Broadkill Beach. No pre-base year benefits are claimed. Economic benefits are annualized for the 50-year study period. All project benefits are computed in the 2009 Price Level and are discounted at the Federal Fiscal Year 2010 discount rate of 4-3/8%.



## **Categories of Benefits**

### **Vessel Efficiencies**

In the category of transportation cost savings resulting from vessel efficiencies, benefits have been identified based on the shift to larger vessels on specific trade routes. Vessel efficiencies have been identified for container ships, liquid bulk and dry bulk vessels.

### **Vessel Operating Cost Savings**

Reductions in vessel trips will achieve reductions in operating expenses being incurred during vessel trips. A benefit sensitivity scenario has analyzed the impact of the changes in the Corps' Institute for Water Resources (IWR) Deep-Draft Vessel Operating Costs from 2002 to 2009.

### **Operational Efficiencies**

Benefits resulting from operational efficiencies have been identified for:

- Reduced liquid bulk (crude oil) lightering: Deeper channels would allow some of the liquid bulk vessels in the fleet that require lightering to be able to access the refinery facilities with reduced or no lightering.
- Reduced lightloading: Deeper channels would allow some vessels that cannot currently load to their design draft to more fully load their vessels, resulting in reduced per unit operating costs. This benefit will accrue to liquid bulk, dry bulk and container vessels. For containers, a Philadelphia port call will become possible on services currently necessitated to load or offload at New York and truck boxes to or from Philadelphia-area facilities.

### **Beneficial Use of Dredged Material at Broadkill Beach**

The Corps of Engineers has conducted studies along Delaware Bay to determine Federal involvement in providing shoreline and environmental projects for various communities. Authorization to undertake these studies was established in a resolution adopted in October 1986 by the Public Works and Transportation Committee, United States House of Representatives. Based on the results of these investigations, a Federal project was recommended at Broadkill Beach. Subsequently, a feasibility study was initiated in January 1993 for the Broadkill Beach. This study was cost shared between the Federal Government and the State of Delaware, Department of Natural Resources and Environmental Control. In September 1996, a final Feasibility Report and Environmental Impact Statement were completed for Broadkill Beach. The project calls for beach nourishment utilizing sand obtained from offshore borrow areas to provide storm damage and erosion control protection. Beach nourishment will consist of a berm and dune restoration along 13,500 linear feet of the bay front.

For the Delaware River Main Channel Deepening project, dredged material in the bay consists of a sand quality suitable for beach restoration at Broadkill Beach. This material would otherwise be placed in an existing federally owned upland confined disposal facility.

# QUANTIFIED NED BENEFITS

## Background

Economic benefit calculations to the National Economic Development (NED) Account include only the transportation cost savings associated with vessel efficiencies and operational efficiencies, and beach renourishment at Broadkill Beach. Benefits will also likely accrue due to improved safety and beneficial ecosystem uses of dredged material at Kelly Island and Egg Island Point, but have not been quantified in the project analysis.

The following sections discuss new economic information for the port that augments the overall conclusions made in the February 2004 Supplement to the Comprehensive Reanalysis report. First, the summary results of the benchmark 2004 economic analysis are listed below. Benefits are displayed by category in descending order of monetary significance. Second, total historic port activity information follows to give an overall perspective on the Delaware River port system. Third, port activity by benefiting commodity with new information that post-dates the 2004 report is provided.

As background, a summary of economic benefit information from the last approved decision document, February 2004 Supplement to the Delaware River Main Channel Deepening Comprehensive Economic Reanalysis, is shown in Table B-1. The analysis was based upon a 5 5/8% discount rate (FY 04 Discount Rate) at a May 2002 price level.

**Table B-1**  
**Average Annual Benefits by Commodity Type**  
**February 2004 Report**

Benefit Type	Average Annual Benefits
<b>Transportation Cost Savings</b>	
Crude Oil	\$11,778,000
Petroleum Products	\$352,000
Containerized Cargo	\$6,124,000
Slag	\$1,807,000
Steel Slabs	\$3,605,000
<b>Subtotal Transportation Cost Savings</b>	<b>\$23,665,000</b>
Beneficial Use Cost Savings at Broadkill Beach	\$583,000
<b>Total</b>	<b>\$24,249,000</b>

## Waterborne Commerce

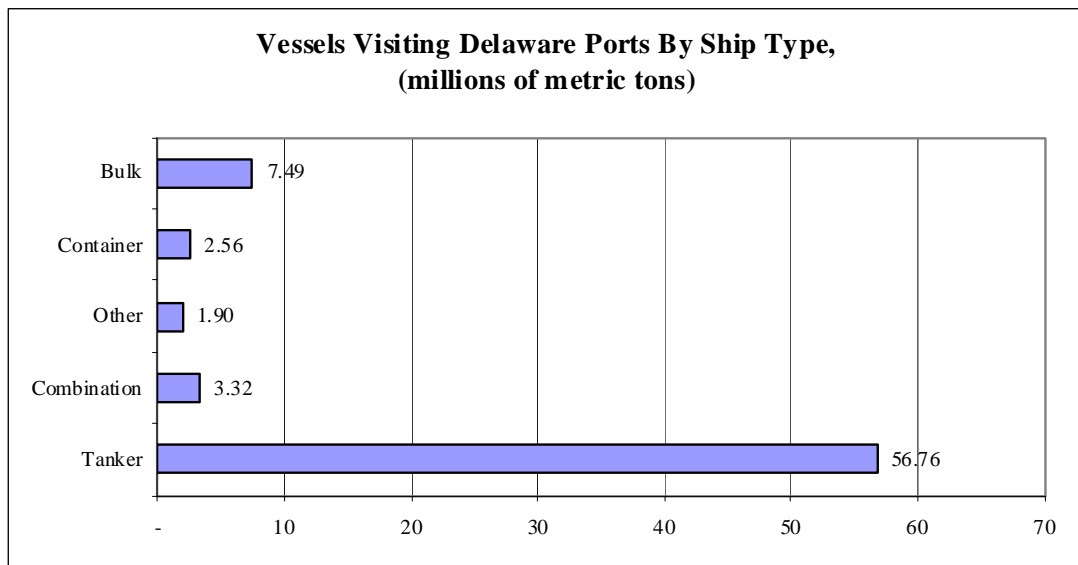
To provide an overall understanding of economic activity related to this project, the following data from 2002-2007 is provided for the Delaware River, Philadelphia to the Sea Project—Total Foreign and Domestic Commerce. These are the most recent years available from the Corps' Waterborne Commerce Statistics Center (WCSC):

2002: 124.0 MILLION TONS  
 2003: 126.8 MILLION TONS  
 2004: 131.0 MILLION TONS  
 2005: 132.3 MILLION TONS  
 2006: 132.0 MILLION TONS  
 2007: 129.7 MILLION TONS

## Fleet Composition

As depicted in Figure B-1 (from the February 2004 report), historic data shows that the large majority of the tons of foreign commerce transported to the Delaware River consists of crude oil delivered on tankers, followed, in descending order, by bulk, combination, containerized cargo, and other vessels. Tanker vessels constitute the largest portion of vessel traffic. Nearly 44 percent of total Delaware River port system tonnage was carried on vessels in excess of 100,000 design deadweight tons (DWT). Over 21 percent of total tonnage was carried on vessels in excess of 140,000 DWT.

**Figure B-1**



## Benefiting Commodities

The following sections provide updated economic data on each of the commodities included in the project's average annual benefits.

## Crude Oil Benefits

NED benefits for crude oil imports are the reduced cost of transportation realized through operational efficiencies (reduced lightering) and more efficient loading of tankers that will result from navigation improvements at the harbor. Large crude oil vessels that currently lighter in the naturally deep water of the lower Delaware Bay will continue to carry equivalent tonnage into the system, but will be able to travel to the dock more fully laden in a deepened channel, thereby reducing the need for lightering. Reduced lightering costs result in reduced production and distribution costs and thereby increase the net value of the national output of goods and services.

Contracted lightering operations in the Delaware River System are primarily conducted by a single firm that also conducts lightering operations in the Gulf of Mexico and, to a lesser extent, for several other east coast refineries. In addition, several of the refineries conduct their own offshore lightering operations for tankers bound for the Delaware River, or contract with another lightering firm to operate the refineries' lightering vessels. This analysis expects, consistent with Corps guidelines and observations of past industry practices, that the lightering industry will adjust lightering fleet capacity to future conditions, whether the depth of the Delaware River channel is at 40 or 45 feet.

When calculating the NED benefits resulting from proposed navigation improvements, it is typically assumed that any productive resources no longer required will be available for productive use elsewhere in the nation. The resource cost savings associated with these "freed" resources are considered a positive contribution to the nation's productive capacity, and an NED benefit of a navigation improvement project.

An analysis was conducted in the February 2004 report to verify that adequate alternative deployment opportunities exist for the portion of Delaware River lightering resources that will no longer be required once the main ship channel is deepened to 45 feet. Typically, in an analysis of the NED benefits of navigation improvements, the business management decisions of a firm concerning alternative employment of the resources made unnecessary by the improvements are not included in the analysis. From a national perspective, identification of the next best use of the resources saved (and the cost of those resources in their next best use) does not impact the expectation that the national need for resources will be reduced by the project. Although it is not appropriate to forecast the business management decisions of an individual firm for the purpose of estimating NED benefits, a listing of possible alternative employment decisions was developed. A lightering firm may choose to execute any one of these management decisions, or all of them, or any combination if the Delaware River channel is deepened:

Expand other operations within the Delaware River system.

Expand operations in Virginia and New York Harbor.

Reallocate vessels between the Gulf and the Delaware fleets.

Lease or sell extraneous resources.

Refit vessels for clean service.

Expand into the market for transport of other black oils.

The physical and cost characteristics of the existing Delaware River System lightering fleet is used in the analysis as the best approximation of physical and cost characteristics for the future fleet under both without and with project conditions. While it is expected that shifts will occur in the future fleet, this assumption is reasonable given that there are no significant changes predicted to occur within the system, i.e., similar tankers will be arriving with similar loads destined for the same refineries. The only expected change resulting from the project is the reduction in volume of lightering required under with-project conditions. The reduction in lightered volume will result in a reduction in the resources required to conduct lightering, freeing these resources for possible alternative uses and resulting in NED resource cost savings.

The operational characteristics of the existing fleet are also expected to represent the operational characteristics of the future fleet. Operational characteristics, such as the time it takes to load, offload, and transit the system, or observed vessel deployment protocols are expected to continue into the future under without and with-project conditions. The only expected changes in operational practices will be the reduced time to lighter, due to the reduced volumes that will need to be offloaded from tankers that will be able to transit the channel more fully laden under with project conditions.

The current fleet composition and observed utilization levels have been selected to balance the demands of customer satisfaction with the costs of vessel availability (i.e., that the existing fleet is sized efficiently for the current level of lightering that it performs). Current lightering vessel deployment provides an adequate amount of reserve lightering capacity to handle surges in demand without causing excessive delays and is considered to be an appropriate allocation of lightering resources.

Vessel utilization is determined by the volume of crude transported and the number of lightering trips, as well as weather delays, time for maintenance and repairs, and external constraints imposed by the refiners.

With-project resource cost savings are calculated as the proportional reduction in the costs of hull replacement, crew, lubes and stores, maintenance and repair, and administration; as well as the reduction in total fuel costs. The reduction in the costs of hull replacement, crew, lubes and stores, maintenance and repair, and administration is based upon the proportion of with-project vessel operating hours to without-project vessel operating hours. This approach to calculating resource savings is consistent with USACE policy, which is to use the change in vessel transportation costs – as a proxy for resource reductions – as the measure of project benefits. This approach focuses on the reduction in economic resources that would be required for conducting Delaware River lightering operations during the 50-year period of analysis, and does not attempt to predict in detail how any specific firm would conduct its future operations over the near or long term.

Lightering vessel operating costs were developed specifically for the February 2004 report. The Corps of Engineers Water Resources Support Center, Institute for Water Resources (WRSC-IWR) compiles information on deep draft and shallow draft vessel operating costs and publishes them approximately bi-annually in a series of Economic Guidance Memoranda. The published deep draft vessel operating costs were used in this analysis for all vessel categories, except lightering vessels. Because of the unique nature of the lightering vessels at the Delaware River (one U.S. flag double-hulled tanker and two large tug/barge combinations); the standard

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published vessel costs were not considered applicable for this cost component of this study. Therefore, WRSC-IWR was requested to compile vessel operating costs specifically for this lightering fleet. These vessel-specific operating costs were developed in close cooperation with the lightering company. Cost savings are based on the difference in the proportion of the resource costs of the vessel consumed in Delaware River lightering operations under with and without project conditions.

Lightering service providers can be expected to respond to changes in future lightering demand by adjusting their fleet costs to continue to efficiently meet future lightering volume requirements under both without and with-project conditions. As described previously, over the 50 year project planning period, the lightering service providers have many other fleet configuration and deployment options (some of which have been exercised in the past), including seeking other spot market or contract work, swapping one or more vessels for smaller ones from the Gulf or elsewhere, or selling a vessel to one of the refiners or some other operator. In summary, because the analytic horizon for the deepening project is 50 years there is both time and flexibility for lightering service providers to explore alternative fleet utilization and to rationalize fleet composition to adjust to the reduction in demand resulting from the deepening project. Of the tonnage carried on tankers with design drafts greater than or equal to 40 feet (which represent 60% of total foreign commerce moved through the Delaware River port system), 35% of the tonnage was carried on tankers with design drafts between 55 feet and 60 feet, and 22% of the tonnage was carried on tankers with design drafts between 50 feet and 55 feet. There are a variety of foreign ports that are the origins of crude imports to the Delaware River. In general, vessels in the larger sizes carried cargo from the further origins in Africa, the Middle East, South America, and the North Sea. Vessels in the smaller size ranges generally carried cargo from closer origins in the Caribbean Sea and Canada. Many of these closer origins are actually transshipment facilities.

For crude oil, some facilities are expected to reconfigure their non-lightering fleet segments to allow some of the vessels to load deeper under the with project condition. Interviews with terminal operators for the February 2004 report indicated that the practice of filling vessels to the maximum allowable channel draft will continue under both with and without project conditions.

#### **Crude Oil Imports (for Philadelphia to the Sea Project—Source WCSC)**

2002: 62.4 MILLION TONS

2003: 63.9 MILLION TONS

2004: 63.9 MILLION TONS

2005: 62.8 MILLION TONS

2006: 58.5 MILLION TONS

2007: 60.8 MILLION TONS

Crude oil tonnage has continued to remain stable. This finding is in accord with the relative fixed capacity at the area refineries. Technological advancements will allow for very modest growth in refinery capacity (and, thus, related crude oil imports) in future years. The 2004 benefit analysis in the approved decision document projected a future average growth rate of 0.2% per year, or a total increase in refinery capacity in the study area by year 50 of the project life of 10%. The future growth compounded component accounts for approximately 8.7% of the total

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present worth for crude oil benefits. The minor fluctuations in historic tonnage shown above track this expected stable level of tonnage per year for this benefit category that was applied as the baseline in the February 2004 report analysis, as the fluctuations reflect the normal maintenance practices in refinery operations.

The benefits for this commodity category are supported by the historic tonnage information for the above calendar years. The benefit magnitude for this category is affirmed, with the update of the average annual benefit estimate at \$15,101,600.

## **Container Benefits**

Identification of containership-based benefits in the February 2004 report was based upon observations of current actual operations, including sailing drafts, port rotations, and cargo handling practices.

The Packer Avenue Terminal (PAMT) is the specific container facility in the study area that will benefit from the deepened channel. The terminal is located at the intersection of Delaware Avenue and Packer Avenue, adjacent to, and just south of the Walt Whitman Bridge in Philadelphia. The terminal facility is approximately a 106-acre terminal with six berths (3,800 linear feet of berthing space) with over 400,000 square feet of dry, cooler, and freezer warehouse space, a northern container gate, a south-end breakbulk and general cargo gate, administration offices, a vehicle maintenance and repair shop and several other terminal related buildings and operations. The terminal handles goods including containers, steel, meat, and fruit; has a 40-foot current berth depth commensurate with the existing Delaware River navigation channel; and rail service connections with CP Rail, CSX and Norfolk Southern; and 385 plugs to handle reefer container boxes. PAMT has four Kocks Cranes, one Paceco Crane, and two Hyundai Cranes which provide heavy lift direct access to truck, rail, and vessel. The facility is directly accessible to Interstate Highways I-95 and I-76. PAMT has also acquired national status as a Strategic Military Seaport in the Northeast Corridor. This designation, by the Defense Department's Military Traffic Management Command, requires the ability of the operator at the facility to load military equipment onto vessels with a minimum of advance notice. In addition, PAMT is an activated Foreign-Trade Zone.

The detailed analysis for the February 2004 report determined that some of the container lines using PAMT will benefit from a deepened channel. Other container lines use vessels that do not require a channel in excess of 40 feet. One benefiting container line provides service from the South America to the east coast of the United States. The port rotations, schedules, and vessel characteristics for these services were developed through negotiations among the multiple slot sharing partners who ship containers on these services. The schedules and port rotations were developed to achieve as many direct service calls as possible, while maintaining weekly service to each port of call. Also, two round-the-world weekly services that deliver goods between Australia-New Zealand (ANZ) and the U.S. east coast will benefit. One service is an east bound round-the-world service that originates in Australia. The same slot sharing partners also operate a west bound round-the-world service.

Because of the high proportion of refrigerated cargo carried on the east bound ANZ vessels, these vessels tend to "weigh out" instead of "cube out", which is somewhat uncommon among more typical containerships. This means that vessels on this service are more likely to achieve

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their maximum sailing draft due to the heavy weight of the refrigerated cargo. Data provided by the Packer Avenue Terminal in the February 2004 report presented that the average weight of a twenty foot container is 17.5 tons and the average weight of a forty foot container is 25.9 tons.

One of the major commodities imported to Philadelphia by the ANZ service is Australian meat. Other commodities imported to Philadelphia on this service include Australian wine and produce, and New Zealand meat, produce, and dairy products. Historically, imported meat was frozen for shipping, but the availability of large containerships on a weekly service has resulted in an increase in the volume of chilled meat imports from Australia (chilled meat was previously transported solely via air, at much greater cost). This shift towards chilled versus frozen meat has also been identified by the carriers and the warehouse operators.

There is an extensive refrigerated warehouse/distribution center infrastructure that has developed in the Philadelphia area, which has shifted from the Port of NYNJ region. This infrastructure includes many large refrigerated warehouses and USDA inspection facilities. The major cause of the shift in location from the Port of NYNJ to the Philadelphia-metro area is that refrigerated warehousing is a very land-intensive operation. Because of the limited availability of land in the New York metropolitan area, this industry (which services a broad geographic region), has been relocating to the relatively less expensive Philadelphia-metro area.

Discussions with the marine carriers for the February 2004 report determined that under with-project conditions (45 ft MLW controlling depth at the Delaware River), Philadelphia would become the port of call prior to the Port of NYNJ and that time sensitive cargo now being trucked from the Port of NYNJ to the Philadelphia-metro area warehouses would be landed in Philadelphia. Because landside transportation costs would be eliminated under the with-project condition, this would constitute a transportation cost savings for the deepening project. Therefore, an analysis of landside transportation costs was conducted to identify the differential in transportation costs that are incurred when Philadelphia-bound refrigerated cargo is routed through the Port of NYNJ (or other potential alternative ports), rather than through the Delaware River ports.

Future without-project conditions are based on a number of assumptions. These assumptions are conservative in the areas of future vessel size and growth in commodity volume. The without-project condition is based on vessels deployed on existing services.

The future sustainability of current operations is supported by five significant factors:

- There is an extensive refrigerated warehouse/distribution center infrastructure in the Philadelphia area.
- The retail value and marketability of chilled meat and produce is very sensitive to the remaining shelf life of the product.
- The additional cost of trucking some time-sensitive goods from the Port of NYNJ to Philadelphia-based distributors would be negotiated as an increase in the average price across all of that customer's freight.
- Trucking of time-sensitive goods from other ports to Philadelphia-based distributors is a common industry practice. Warehouse operators indicated that they regularly receive time sensitive goods from other ports.



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- There are few, if any, reasonable alternatives for timely delivery of time-sensitive goods other than the current services. Although there are many carriers engaged in this trade, they share slots on a very limited number of services and vessels, and trends towards industry consolidation and slot sharing are continuing.

In order to demonstrate that the without-project condition is the least-cost, long-term solution to the challenges of without-project cargo flows, an analysis of alternative without-project condition scenarios was conducted in the February 2004 report. This analysis of alternative without-project condition scenarios was based on estimated total transportation costs for each alternative and identification of any operational constraints associated with the alternatives.

The expected without project condition is the least cost alternative. The costs used in the analysis did not include the additional capital costs that would be required for the vessels to be refitted to carry the additional reefer cargo. Therefore, the cost differentials were considered conservative estimates of the differences in costs (i.e., benefits) between the expected without-project condition and the alternative scenarios. Similar to the without-project condition assumptions, the with-project condition is based on existing vessels deployed on existing services and future growth in commodity volumes beyond the base year during the project life is not claimed in the benefit analysis.

Historic container movements through PAMT reported by the Philadelphia Regional Port Authority (PRPA):

2005: 205,000 TEUs

2006: 247,800 TEUs

2007: 246,500 TEUs

2008: 247,700 TEUs

The February 2004 benefit analysis projected future average growth rate of 3.4% per year to the base year. To be conservative, future growth in commodity volumes during the project life was not claimed in the benefit analysis. Actual container growth tonnage from 2005-2008, that post-dates that available for the February 2004 document, is equal to 6.5%, with PRPA then projecting further growth to 2011. Because of the economic downturn, the 2009 expectation of TEUs appears to be optimistic. The actual and projected tonnage data serves to confirm the reasonableness of the currently updated level of benefits (see Table B-2).

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**TABLE B-2****CONTAINER CARGO PROJECTIONS**

<b>Cargo Type</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>PRPA % Growth 05-08</b>	<b>Feb 2004 Corps % Growth</b>
Containers (TEUs)	247,800	246,500	247,700	390,700	461,000	544,000	6.5%	3.4%

Average annual containership benefits in this update are estimated at \$7,785,400.

**Slag Benefits**

Blast furnace slag (or clinker), used in the production of cement, is currently imported to the Camden Marine Terminal at Beckett Street. The existing fleet exhibits design drafts ranging from 42 feet to 46 feet and sailing drafts averaging 40 feet (with the current without project condition channel). This current fleet is expected to remain the same under the without project condition. Under the with project condition, however, the fleet is expected, through use of the charter market, to shift to larger vessels that can take advantage of the deeper channel depth.

Actual growth in historic tonnage available from WCSC is shown:

2002: 323,000 TONS

2003: 450,000 TONS

2004: 606,000 TONS

2005: 851,000 TONS

2006: 507,000 TONS

2007: 529,000 TONS

A shift to larger bulk vessels with design drafts in excess of 45 feet under with project conditions is expected. Bulk vessels are contracted from the charter market and there are no barriers to fleet replacement. Therefore, an 80,000 DWT foreign flag bulk vessel drafting 46 feet was selected to represent the with project condition fleet, in order to accommodate each year's total tonnage.

The benefit magnitude for this category is affirmed, with the updated average annual benefit estimate of \$2,296,400.

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## Steel Slab Benefits

Steel slabs are currently imported through Packer Avenue Terminal on a variety of vessels with design drafts ranging from 34 feet to 45 feet and sailing drafts ranging from 33 feet to 40 feet. This existing fleet is expected to remain the same under the without project condition, with the use of similarly sized vessels to handle future commodity growth. Under with project conditions, the operator of Packer Avenue Terminal has indicated that it is likely that there will be a shift to larger vessels that could take full advantage of a 45-foot channel. These dry bulk vessels will be contracted from the charter market; therefore there are not any sunk investment costs that would mitigate against a fleet shift. The current steel slab charter fleet contains greater variability in design draft and sailing draft than the furnace slag fleet. Two vessel sizes were chosen to comprise the with project fleet: a 60,000 DWT, 42-foot design draft bulker and an 87,000 DWT, 47-foot design draft bulker.

The 2004 benefit analysis in the approved decision document had a projection of future average growth rate of only 1% per year for steel slabs.

PRPA provided the following historic data:

2005: 999,000 Tons

2006: 1,226,000 Tons

The growth rate of tons above is significantly above the projections in the February 2004 decision document. PRPA also has a projected growth rate to 2011 for steel slabs, as shown in Table B-3 below.

**TABLE B-3**  
**PRPA FIVE-YEAR STEEL SLAB CARGO PROJECTIONS**

<b>Cargo Type</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>PRPA % Growth Per Year</b>	<b>Feb 2004 Corps % Growth</b>
Steel Slabs	1,226,000	1,318,000	1,417,000	1,523,000	1,637,000	1,760,000	7.5	1.0

The actual tonnage post-dating the February 2004 report exceeds the tonnage applied in the 2004 benefit analysis. The 2006 tonnage of 1,226,000 tons is above the 1,000,000 tons used in the February 2004 report as the base year tonnage. The benefit magnitude for this category is affirmed and has applied the baseline tonnage from the 2004 report to be conservative in the update. The updated average annual benefit estimate is \$4,658,200.

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## **Petroleum Product Benefits**

A potential beneficiary handles refined petroleum products (#6 fuel oil, diesel, and home heating oil predominantly). This operational practice is expected to continue under both the with project and without project conditions. A fleet of larger vessels would be employed to take advantage of the deeper 45-foot channel under the with project condition.

The 2004 benefit analysis from the decision document applied a future average growth rate of 0.2% per year for the petroleum products, the same as for crude oil. :

2002: 476,000 TONS

2003: 736,000 TONS

2004: 518,000 TONS

2005: 708,000 TONS

2006: 803,000 TONS

2007: 831,000 TONS

Tonnage fluctuates, but the average amount of historic tonnage for the six available years shown above is 679,000 per year. This average level of tonnage is above the 560,000 tons used in the February 2004 report as the baseline. As a consequence, the benefit magnitude for this category is affirmed and has applied the baseline tonnage from the 2004 report to be conservative in the update. The updated average annual benefit estimate is \$435,900.

## **Benefits from Beneficial Use Cost Savings at Broadkill Beach**

Benefits would be realized due to cost savings resulting from jointly developing the Delaware River and Broadkill Beach projects rather than developing them independently. The Delaware River Main Channel Deepening Project has the capability to provide dredged material for beach nourishment for Broadkill Beach. In doing so, the Delaware River project is assigned the NED cost savings (i.e., NED benefits) from beneficial use of the disposal of material. The following approach was used in estimating potential NED cost savings. With the least cost option established (in the 2004 report), \$12.435 million (2009 price level) in avoided borrow area sand source costs foregone for the authorized Broadkill Beach project is a benefit for the material provided by the Delaware River project. On an average annual basis, this is equal to \$616,600 in benefits (multiplying this cost savings by the Capital Recovery Factor, at the 4 3/8% discount rate, for the 50 year period of analysis).

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## AVERAGE ANNUAL BENEFITS

This analysis has estimated benefits that would result from deepening the Delaware River Main Channel from its current authorized and maintained project depth of 40 feet below MLW to the depth of 45 feet below MLW.

A four-step approach was used to update benefits. First, as a baseline, during the 2004 report analysis, the benefits, at a 2002 price level, had been computed at both the 5 7/8% and 5 5/8% discount rates. Using the relationships established for this 1/4% point change, adjustments in this current update were calculated at the 4 3/8% discount rate for each of the benefiting commodities. Second, the price level index factor from 2002 to 2009 was applied. Third, the change for the Broadkill Beach category due to the discount rate and price level changes was incorporated into the benefits. Fourth, in the current construction schedule, Reach B is scheduled for year five, so no pre-base year benefits are claimed. In the prior 2004 Supplement to the Comprehensive Reanalysis, with Reaches A/AA being planned to be constructed in year five, 2.6% of total benefits were pre-base year benefits.

The average annual NED benefits of the 45-foot deepening plan are presented in 2009 Price Levels at the FY 2010 federal discount rate of 4-3/8 percent. Table B-4 displays average annual benefits by individual category, with the total equal to \$30,091,000.

**Table B-4**  
**Average Annual Benefits by Category**

<b>Benefit Type</b>	<b>Average Annual Benefits</b>
<b>Transportation Cost Savings</b>	
Crude Oil	\$15,101,600
Petroleum Products	\$435,900
Containerized Cargo	\$7,785,400
Slag	\$2,296,400
Steel Slabs	\$4,658,200
<b>Subtotal Transportation Cost Savings</b>	<b>\$30,277,600</b>
<b>Beneficial Use Cost Savings at Broadkill Beach</b>	\$616,600
<b>Pre-Base Year Benefits Not Claimed</b>	<b>(803,200)</b>
<b>Total Project Benefits</b>	<b>\$30,091,000</b>

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**BENEFIT SENSITIVITY (APPLYING IMPACT OF INCREASE IN CORPS' DEEP-DRAFT VESSEL OPERATING COSTS FROM FY 2002 TO FY 2009)**

Benefits have been revised in this scenario applying the weighted impact on the changes in IWR vessel operating costs for the benefiting commodities from 1) the FY 2002 vessel operating cost summary table to the FY 2008 set of tables developed for individual vessel types, and then 2) further adjusting for the price level increase from April 2008 to FY 2009 as defined in EM 1110-2-134. The net result of this benefit sensitivity is displayed in Table B-5. Benefits are 7.3% higher than for the recommended plan displayed in Table B-4.

**Table B-5**

**Average Annual Benefits: Sensitivity**

Benefit Type	Average Annual Benefits
<b>Transportation Cost Savings</b>	
Crude Oil	\$15,479,300
Petroleum Products	\$464,400
Containerized Cargo	\$8,988,700
Slag	\$2,535,100
Steel Slabs	\$5,057,300
<b>Subtotal Transportation Cost Savings</b>	<b>\$32,524,800</b>
Beneficial Use Cost Savings at Broadkill Beach	\$616,600
Pre-Base Year Benefits Not Claimed	<b>(861,700)</b>
<b>Total Project Benefits</b>	<b>\$32,279,700</b>

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