

Value to the Nation of the U.S. Army Corps of Engineers Civil Works Programs

*Estimates of National Economic Development
(NED) Benefits and Revenues to the U.S. Treasury
for 2010*

2013-R-09



The logo for the Institute for Water Resources (IVWR) features the letters 'IVWR' in a bold, serif font. A stylized, curved line arches over the letters, resembling a water droplet or a wave.

Institute for Water Resources

This report estimates the value to the nation produced by several of the U.S. Army Corps of Engineers (USACE) Civil Works programs. The value of these programs is expressed in terms of each program's contributions to National Economic Development (NED) benefits and revenues to the U.S. Treasury.

Contributions to NED benefits are increases in the net value of the national output of goods and services, expressed in monetary units. Treasury revenues are the increases in revenues in the form of increased tax payments and direct payments for vendible outputs (such as hydropower) plus the decreases in expenditures in the form of decreased tax expenditures and assistance payments that accrue to the U.S. Treasury as a result of the USACE Civil Works programs.

The audience of this report extends to interested parties, both internal and external to USACE.

INSTITUTE FOR WATER RESOURCES
US ARMY CORPS OF ENGINEERS

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December 2013



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U.S. Army Engineer Institute for Water Resources

The Institute for Water Resources (IWR) is a U.S. Army Corps of Engineers (USACE) Field Operating Activity located within the Washington DC National Capital Region (NCR), in Alexandria, Virginia and with satellite centers in New Orleans, LA; Davis, CA; Denver, CO; and Pittsburg, PA. IWR was created in 1969 to analyze and anticipate changing water resources management conditions, and to develop planning methods and analytical tools to address economic, social, institutional, and environmental needs in water resources planning and policy. Since its inception, IWR has been a leader in the development of strategies and tools for planning and executing the USACE water resources planning and water management programs.

IWR strives to improve the performance of the USACE water resources program by examining water resources problems and offering practical solutions through a wide variety of technology transfer mechanisms. In addition to hosting and leading USACE participation in national forums, these include the production of white papers, reports, workshops, training courses, guidance and manuals of practice; the development of new planning, socio-economic, and risk-based decision-support methodologies, improved hydrologic engineering methods and software tools; and the management of national waterborne commerce statistics and other Civil Works information systems. IWR serves as the USACE expertise center for integrated water resources planning and management; hydrologic engineering; collaborative planning and environmental conflict resolution; and waterborne commerce data and marine transportation systems.

The Institute's Hydrologic Engineering Center (HEC), located in Davis, CA specializes in the development, documentation, training, and application of hydrologic engineering and hydrologic models. IWR's Navigation and Civil Works Decision Support Center (NDC) and its Waterborne Commerce Statistical Center (WCSC) in New Orleans, LA, is the Corps data collection organization for waterborne commerce, vessel characteristics, port facilities, dredging information, and information on navigation locks. IWR's Risk Management center is a center of expertise whose mission is to manage and assess risks for dams and levee systems across USACE, to support dam and levee safety activities throughout USACE, and to develop policies, methods, tools, and systems to enhance those activities.

Other enterprise centers at the Institute's NCR office include the International Center for Integrated Water Resources Management (ICIWaRM), under the auspices of UNESCO, which is a distributed, intergovernmental center established in partnership with various Universities and non-Government organizations; and the Conflict Resolution and Public Participation Center of Expertise, which includes a focus on both the processes associated with conflict resolution and the integration of public participation techniques with decision support and technical modeling. The Institute plays a prominent role within a number of the USACE technical Communities of Practice (CoP), including the Economics CoP. The Corps Chief Economist is resident at the Institute, along with a critical mass of economists, sociologists and geographers specializing in water and natural resources investment decision support analysis and multi-criteria tradeoff techniques.

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Section 1:

Introduction

1.1 Purpose

This report estimates the value to the nation produced by several of the U.S. Army Corps of Engineers (USACE) Civil Works programs. The value of these programs is expressed in terms of each program's contributions to National Economic Development (NED) benefits and revenues to the U.S. Treasury. Contributions to NED benefits are increases in the value of the national output of goods and services, expressed in monetary units. Treasury revenues are the increases in revenues in the form of increased tax payments and direct payments for vendible outputs (such as hydropower) plus the decreases in expenditures in the form of decreased tax expenditures and assistance payments that accrue to the U.S. Treasury as a result of the USACE Civil Works programs. The audience of this report extends to interested parties, both internal and external to USACE.

This analysis uses readily available data to estimate Fiscal Year (FY) 2010 NED benefits and U.S. treasury revenues associated with the various USACE Civil Works programs. The analysis compares the NED benefits and generated revenues to the budget for each of the Civil Works programs in FY10. This process requires significant professional judgment and data interpretation, and these estimates should be considered in that light. It should also be noted that although these estimates are presented as point estimates, they include a high-degree of uncertainty. This simply means that the values presented are estimated from sample data and the point value represents a best estimate for an unknown actual value.

Also provided as companion documents to this report are a spreadsheet model ("VTN_Data.xlsx") for calculating and updating the benefit estimates presented in this report, and a user guide ("User Guide for ROI Spreadsheet Estimator") for the spreadsheet model, and an appendix that provides a breakdown of the national estimates by USACE division ("Value to The Nation (FY 2010) Appendix: Divisional Benefits and Revenues").

1.2 Caveats

This effort has focused on measuring value to the nation as NED benefits and U.S. Treasury revenue estimates. The USACE Civil Works mission also provides value to the nation by contributing to other areas such as national defense, environmental stewardship, ecosystem restoration, enhanced safety, emergency management, and other Administration goals such as doubling exports by 2015. Because the value of these programs and contributing areas are not typically measured in monetary terms by USACE, the costs and benefits associated with these programs are not included in this report. This report focuses on the following USACE Civil Works programs: Flood Risk Management, Navigation (Inland and Coastal), Water Supply, Hydropower, and Recreation.

As possible, this report uses market prices to estimate values. In cases where prices were not available, values were estimated using the best available information. Given the available data, there is uncertainty among all values. Added, data from the same year was generally utilized in the calculations. In reality, investments likely have some lag in realizing benefits and, therefore, it is

possible that these values are capturing prior year investments or not capturing current year investments. These values represent our best estimation. All tonnage values reported are measured as short tons. **Table 1** shows the value estimates used to estimate NED benefits by business program.

Table 1: Value Estimates by Civil Works Program

Program	NED Benefit Estimate
Flood Risk Management	Flood Damages Prevented
Coastal Navigation	Transportation Cost Savings
Inland Navigation	Transportation Cost Savings
Water Supply	Average Price of Water in the U.S. x Yield from Contracted Storage
Hydropower	Average of Regional Energy Prices x Energy Generated
Recreation	Unit Day Values x Visitation

1.3 Background

USACE is the nation's lead water resources development agency. Through its annual appropriations, USACE plans, invests in, operates, and maintains its civil works infrastructure. It divides its activities into business programs: Navigation (Coastal and Inland), Flood Risk Management, Water Supply, Hydropower, Recreation, Environmental, Emergency Management, and Regulatory. The Environmental program includes aquatic ecosystem restoration, stewardship of lands, and cleanup of radiological contaminants, semi-volatile and volatile organic compounds, and heavy metals. The Regulatory program evaluates the environmental impacts of private, non-Federal water development activities and permits those activities that minimize such impacts. The Emergency Management program focuses on disaster management support and rebuilding infrastructure damaged by extreme weather events. All of these programs provide Value to the Nation, but this report focuses on those programs primarily associated with water resources infrastructure – Navigation, Flood Risk Management, Water Supply, Hydropower and Recreation.

This report focuses on measuring the value to the nation produced by USACE water resources infrastructure in terms of National Economic Development Benefits and revenue to the Treasury. National Economic Development (NED) benefits are prescribed by regulation. NED benefits are the value of goods and services gained by the nation from an investment. In a project context, net NED benefits are NED benefits less costs. Costs include investment, often denoted as first costs, plus recurring costs, often denoted as operation and maintenance. In this report, net NED benefits are defined as NED benefits less the costs of operations, maintenance, and investigations. Since the costs associated with expenses and oversight by the Assistant Secretary of the Army (ASA) serve all Corps programs, including those we did not calculate benefits for in this report, this report does not account for those costs. Cumulative investments, denoted as capital, appear in the denominator of a return calculation discussed later in this report.

This report focuses on Federal water resources infrastructure, under the USACE purview, that produces a subset of its national economic benefits: (1) Navigation infrastructure, including inland and coastal facilities that produces benefits measured as reduction of transportation costs for commodities, but also produces enhanced safety; (2) Flood risk management infrastructure that produces benefits measured by reduction monetary damages to property but also saves lives;

infrastructure benefits include hydroelectric power, recreational opportunities, and municipal and industrial (M&I) water supply storage. This report does not attempt to measure environmental benefits of ecosystem restoration, environmental cleanup, regulatory activities, and emergency management work. In addition, this report does not include monetary damages prevented from hurricane storm surges, but only precipitation or indirect inland flooding. Benefits from safety and lives saved are not measured in this report; however, other USACE publications, such as Value to the Nation brochures, further discuss these benefits in non-monetary terms.

This report is an update of two earlier analyses and reports. The first analysis and report was completed in 1997, when USACE's Institute for Water Resources (IWR) prepared a report entitled, *Value of the Corps of Engineers Civil Works Programs to the Nation* (IWR Paper 97-P-1). The overall purpose of that study was to analyze the rate of return produced by USACE Civil Works programs in 1993 and 1994 (the latest period at that time for which complete data was available). The second analysis and report was completed in January 2003 by Planning and Management Consultants, Ltd. under contract to IWR. The analysis was documented in a report titled, *Update of NED Benefits Estimates for Selected Corps Programs*. The 2003 report (based on 1999 data) employed the same methodology used in the 1997 effort. The current report does not include a side-by-side comparison of past and present NED benefits because the data and methodology in the various reports are not consistent..

In a corresponding capital stock report, titled "Estimating USACE Capital Stock, 1928 to 2011", it was found that the value of USACE capital stock is declining. Therefore, it is important to note that the values of NED benefits presented in this report may have been higher if the condition of USACE infrastructure was improved.

1.4 Summary of Results

Table 2 provides a summary, by USACE program, of the annual NED benefits to the nation,¹ net NED benefits to the nation, and the impacts to the U.S. Treasury of project outputs² and related economic activities. In this report, Net NED benefits are calculated as NED benefits less the costs of operations, maintenance, and investigations. Cumulative investments, denoted as capital appear, in the denominator of the return to capital calculation discussed later in this report.

Estimates are based on available data and analyses from a variety of sources. These sources are cited in the discussion of each Civil Works program in Section 2 of this report. Monetary values reflect Fiscal Year 2010 dollars and are considered to be order of magnitude numbers.

¹For information on NED analysis, see www.corpsNEDmanuals.us or the *Principles and Guidelines*. In a project context, net NED includes investment costs as well as operation and maintenance costs.

² Project outputs are flood damages prevented, the transportation savings, the recreation benefits, the water supply benefits, and the hydropower benefits that result from the Corps infrastructure.

Table 2: NED Benefits and U.S. Treasury Revenue Summary

Program	NED Benefits (Billions of Dollars)	Net NED Benefits³ (Billions of Dollars)	U.S. Treasury Revenues (Billions of Dollars)
Flood Risk Management	\$23.10	\$22.46	\$7.31
Coastal Navigation	\$8.73	\$7.88	\$3.28
Inland Navigation	\$7.60	\$6.98	\$1.86
Water Supply	\$6.52	\$6.52	\$0.10
Hydropower	\$2.15	\$1.95	\$1.11
Recreation	\$3.31	\$3.03	\$1.13
Leases and Sales			\$0.04
Total Annual NED	\$51.41	\$48.82	\$14.83

1.5 Organization of Report

Following this section, Section 2 provides FY 2010 estimates of the average annual NED benefits for the following six USACE programs that provide NED benefits: Flood Risk Management, Inland Navigation, Coastal Navigation, Water Supply, Hydropower, and Recreation. Section 3 uses these benefit estimates in conjunction with various other data elements and analytical tools to estimate impacts of USACE program areas on revenues to the U.S. Treasury. Finally, Section 4 concludes the report with a summary of findings.

³ In this report, net NED benefits are defined as NED benefits less the costs of operations, maintenance, and project investigations. Since the costs associated with oversight by the Assistant Secretary of the Army (ASA) and USACE Headquarters (Other Expenses) serve all Corps programs - including those for which we did not calculate benefits for - this report does not account for those costs in our calculation of net NED benefits.

Section 2:

Description of Civil Works Program NED Benefits and Estimation Methods

This section provides FY 2010 (October 1, 2009 to September 30, 2010) estimates of NED benefits for six of the USACE programs that generate NED benefits or outputs. As stated earlier, contributions to NED (NED benefits) are increases in the net value of the national output of goods and services, expressed in monetary units. The methods, procedures, and data sources are discussed in the following paragraphs. All monetary NED benefit values are expressed in 2010 dollars.

2.1 Flood Risk Management

One of the most prominent USACE's Civil Works programs is the Flood Risk Management (FRM) program. The types of infrastructure that fall under this category of investment include levees, storage reservoirs, and other types of floodplain management structural measures. Some of these projects may have multiple purposes. For example, reservoirs that help prevent flooding may also provide storage for water supply and produce hydropower. USACE annually tracks FRM programmatic benefits in its *Annual Flood Damage Report* to Congress. Each *Annual Flood Damage Report* includes assessments of flood damages, acres inundated, property damages, loss of life, and damages prevented by previously completed flood risk management projects (not including reductions in damages from coastal storm surge impacts). The estimates of FRM benefits used in this report are taken from the data supporting the *Annual Flood Damage Report Fiscal Year 2010*. The FRM benefits are an estimate of the monetary value of damages that floods would have caused in the absence of USACE investments that were put in place to prevent those damages. The FY 2010 FRM benefits are estimated to be approximately \$23.10 billion. It should be noted that each FRM benefit estimate is based on the weather conditions for the given year (years with many storms likely show greater benefits than non-stormy years since damages *prevented* are measured as benefits).

Flood Risk Management Benefits = \$23.10 Billion

2.2 Navigation

Based on the USACE budget, the largest category of USACE infrastructure investment is in the Navigation program. Activities in this Civil Works program area include the planning, design, maintenance, and construction of new navigation channel works, locks and dams. This infrastructure is subdivided into inland and coastal navigation infrastructure. Inland infrastructure refers to activities related to channels located within the coastal boundaries of the US. Inland navigation infrastructure may include locks, dams, and related infrastructure. Inland navigation is mainly associated with cargo movements within the U.S. to or from the coastal ports, such as Mississippi River to New Orleans. It also facilitates significant traffic that does not interact with coastal facilities, such as coal movements on the Ohio River basin. Conversely, coastal navigation infrastructure refers

to improved (widened, deepened) channels that are directly connected to the ocean with foreign inbound/outbound cargo. A strong majority of coastal navigation infrastructure features deep-draft ports, which are greater than 14 feet of draft. Coastal deep-draft navigation infrastructure typically pertains to coastal ports and harbors engaged in international trade. In most cases, it is also associated with the distribution of internationally traded goods to multiple US coastal ports and harbors, such as Miami and New York. The map below shows some (not all) of the US ports, highlighting the internal ports in yellow and the coastal deep-draft ports in light blue.



Source: USACE Institute for Water Resources

The primary NED benefit of USACE navigation infrastructure is the reduction in the cost required to transport commodities compared to the next best alternative or the without-project conditions. In the case of inland navigation, the next best alternative is considered rail transportation. In the case of coastal navigation, the without-project condition was used as the basis for measuring benefits.

$$\text{Navigation Benefits} = \text{Transportation cost savings per ton shipped} \times \text{tons shipped}$$

The total tonnage shipped through the inland and coastal navigation systems in FY 2010, as estimated using data from USACE Waterborne Commerce Statistics Center, is approximately 2.2 billion tons.⁴ The estimate for inland (or internal) tonnage is approximately 554 million tons.⁵ Coastal tonnage for

⁴ Amy Tujague, Special Requests Project Manager, USACE Waterborne Commerce Statistics Center, e-mail message to author, December 23, 2011.

⁵ Amy Tujague, Special Requests Project Manager, USACE Waterborne Commerce Statistics Center, e-mail message to author, December 23, 2011.

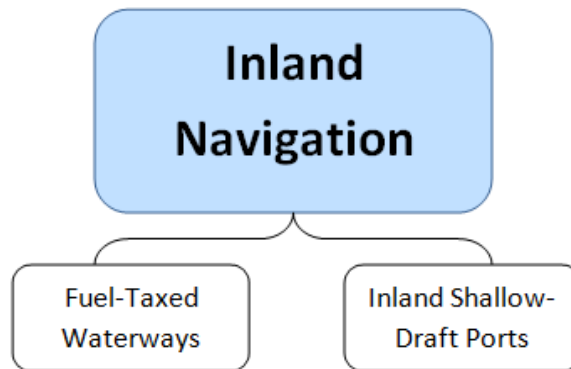
FY 2010 is estimated as the FY 2010 coastwise tonnage plus approximately 97% of total FY 2010 foreign tonnage. Table 3 provides the tonnage estimates used in this report. (Note: Lakewise values correspond with transportation within the Great Lakes or from the Great Lakes to inland. Internal values refer to traffic within the US). Unlike past reports, this analysis improved the coastal deep-draft methodology, as will be explained in detail on the next page.

Table 3: FY 2010 Tonnage Estimates

Tonnage Estimates for U.S. Waterborne Traffic in FY 2010 (in millions)		
Total Tonnage		
2,212		
Domestic Total		Foreign Total
796		1,416
Coastwise	Lakewise	Internal
1,538	120	554

Although this is an FY 2010 analysis, not all of the data are strictly 2010 data. In the case of estimates for the Coastal Deep-Draft Navigation program, the values used to generate estimated benefits of coastal ports were based on an average of data extending from calendar year 2004 through 2010 in order to correct for high volatility of cargo throughput from year to year. This is also roughly the length of a business cycle. Future analyses should consider the volatility or business cycles of other USACE business programs. The data used in this analysis are considered to be the best available and most truly representative values available.

2.2.1 Inland Navigation



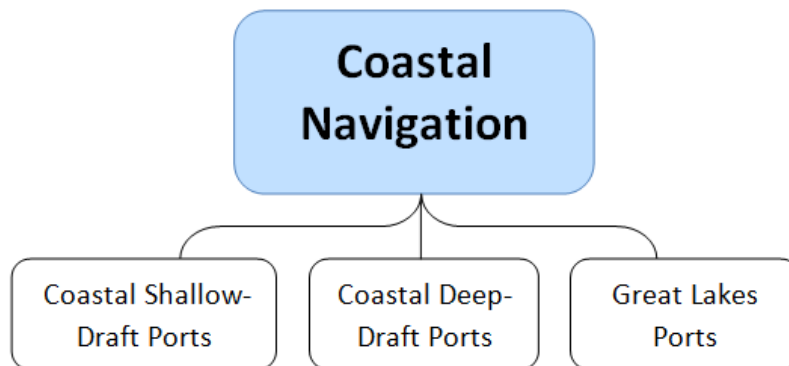
Inland navigation is typically comprised of two sub-groups: fuel-taxed ports and inland shallow-draft ports. Together, these two subgroups account for approximately 554 million tons of cargo that is transported via the inland waterway system. Transportation cost savings per ton for the Inland Navigation program are derived as the difference between unit transportation costs associated with barge movements and per unit costs associated with the most-likely alternative transport model. In this case, rail was the basis of the most-likely alternative transportation cost. During review,

reviewers noted that this methodology could be further improved if a without-project condition basis was used; however, the data to implement this methodology was not available.

A national average savings per ton estimate was obtained from the U.S. Army Corps of Engineers Planning Center of Expertise for Inland Navigation, using the methodology illustrated in the report titled *Waterway and Overland Transportation Costs Updated to October 2011 Price Levels for Use in Inland Navigation Studies*⁶ and published on January 31, 2012. Staff at the Planning Center of Expertise for Inland Navigation provided an average savings per ton value of \$13.72, which represents a system average for inland ports in 2010 (using October 2010 price level). This value does not include data from Great Lakes, as most Great Lakes ports are considered to be coastal ports. The average savings per ton of \$13.72 is the best available information on the topic. Multiplying \$13.72 by the FY 2010 tons shipped estimate yields an FY 2010 inland navigation benefit estimate of \$7.60 billion. The inland tonnage includes all domestic traffic. For example, domestic traffic from New Orleans and travelling up the Mississippi River to another inland port would be included.

$$\begin{aligned} \text{Inland Navigation Benefits} &= \text{Transportation cost savings per ton shipped} \times \text{tons shipped} \\ \$7.60 \text{ Billion} &= \$13.72 \text{ (dollars per ton)} \times 554 \text{ Million (tons)} \end{aligned}$$

2.2.2 Coastal Navigation



For the purposes of this report, coastal navigation was divided into three subgroups: coastal shallow-draft ports, coastal deep-draft ports, and Great Lakes ports. All are directly connected to the ocean. Coastal shallow-draft ports are characterized as being maintained at a depth of 14 feet or less, whereas coastal deep-draft ports are maintained at a depth greater than 14 feet. The Great Lakes ports are made up mostly of deep-draft ports and are defined as waterborne traffic that takes place between US ports on the Great Lakes system. Not including the Great Lakes ports, coastal deep-draft ports are responsible for approximately 99% of all tonnage throughput of the Coastal Navigation program. This suggests that coastal shallow-draft ports are responsible for approximately 1% of all coastal tonnage. Due to issues and limitations regarding available data, this report does not account for benefits of coastal shallow-draft navigation, which would include reductions in transportation costs, fishery, recreation opportunities, and shelters of refuge among other values.

⁶ *Waterway and Overland Transportation Costs Updated to October 2011 Price Levels for Use in Inland Navigation Studies* illustrates only the methodology used to obtain the transportation savings per ton value in this paper; It does not provide the actual value.

USACE maintains hundreds of coastal deep- and shallow-draft harbors and channels on the coasts of the Atlantic and Pacific Oceans, the Gulf of Mexico, and the Great Lakes. These harbors and channels primarily support international trade and the domestic distribution of internationally-traded goods along the domestic coastal ports. They range from large harbors like the Ports of New York, Los Angeles, and Long Beach to small harbors like Holland and Grand Haven in Michigan. The USACE navigation infrastructure provides significant benefits to the Nation in the form of transportation cost savings. Transportation cost savings for coastal deep-draft navigation projects are derived by multiplying transportation savings per ton shipped by the total number of tons shipped. This value measures only the transportation cost savings from foreign inbound and outbound traffic.

This report advances past analytical techniques that were used to calculate NED benefits of the Deep-Draft Navigation program. In previous years, analysts studied how relatively small incremental changes in the depths of deep-draft waterways would affect changes in the costs of transporting cargo. In reality, the differences in depth between historical conditions and USACE-altered conditions are much larger than previous analyses portrayed. This updated analysis employs recently developed models to estimate how waterborne transportation costs change based on larger changes in channel dimensions. Thus, this updated estimation method is an improvement in that it is based on more realistic assumptions.

The current analysis studies the top 43 coastal deep-draft ports (in terms of cargo volume) in the US by using the National Navigation Operation and Maintenance Performance Evaluation and Assessment System (NNOMPEAS), which is currently being built and maintained by IWR. NNOMPEAS examined ship traffic, loading patterns, cargo amounts and other factors (such as speed and fuel consumption) to determine the transportation cost of various vessels. NNOMPEAS data were used to find a regression relationship between depth and transportation costs. Assuming that each foot of additional depth beyond the original historical depth creates new opportunities for ships to load more cargo or for larger ships to enter, additional benefits were calculated for each additional increment of depth. A regression relationship between historic and current depth was estimated based on +/- five foot depth changes⁷.

This regression relationship was applied to the top 95 coastal ports (in terms of cargo tons) to compare coastal deep-draft transportation costs at today's depths with the costs that would have existed if the ports had not been modified by USACE. It should be recognized that the regression was based on depth changes of +/- five feet and the application of this relationship to much larger depth changes creates a certain amount of risk. Transportation cost savings per ton were estimated for each of the top 95 ports by interpolating the cost savings associated with the difference between today's depth and the historical depth. The estimated transportation cost savings per ton was then multiplied by the tonnage throughput for each respective port in order to estimate NED benefits for each of the top 95 ports. Together, these 95 ports represent about 99% of all coastal tonnage.

Coastal Deep-Draft Navigation Benefits (for the top 95 U.S. ports) = \$6.91 billion per year

⁷ It is important to note that many ports have been deepened much more than five feet from their base conditions; however, reliable data was not available for the benefits beyond the last incremental 5 feet of depth for each port.

The Great Lakes ports were not included in inland or coastal deep-draft navigation values already presented in this report. It is estimated that the Great Lakes system facilitated the movement of approximately 120 million tons in FY 2010. The best available estimate of savings per ton for the Great Lakes system is \$15.098, which results in an estimated NED benefit of \$1.82 billion. Together, Coastal Deep-Draft navigation and Great Lakes navigation are estimated to provide roughly \$8.73 billion in NED benefits.

$$\begin{aligned} \text{Great Lakes Navigation Benefits} &= \text{Transportation cost savings per ton shipped} \times \text{tons shipped} \\ \$1.81 \text{ Billion} &= \$15.09 \text{ (dollars per ton)} \times 120 \text{ Million (tons)} \end{aligned}$$

$$\begin{aligned} \text{Total Coastal Navigation Benefits} &= \text{Coastal Benefits} + \text{Great Lakes Benefits} \\ \$8.73 \text{ Billion} &= \$6.91 \text{ Billion} + \$1.82 \text{ Billion} \end{aligned}$$

2.3 Water Supply

Of the approximately 380 reservoir projects operated and maintained by USACE in 2010, 135 of them include a water supply purpose and combined they contain approximately 9.67 million acre-feet of storage space allocated for municipal and industrial (M&I) water supply (USACE, 2011). About 96 percent or 9.3 million acre-feet of this storage is under contract (USACE, 2011). This contracted storage has a potential yield of up to 6,358 million gallons a day (MGD). Water supply benefits were estimated by multiplying daily water supply yield by 365 days to arrive at an annual yield that was then multiplied by the average price of water in the U.S. as estimated by the NUS Consulting Group.⁹ The NUS estimate in 2008 was \$2,810 per MGD.

The 2010 USACE water supply benefit estimate is \$6.52 billion. Earlier estimates were based upon industrial data available at that time from American Water Works Association, but there is insufficient information available at this time to compare the earlier estimate to the NUS estimate being used in this analysis. The NUS estimate of the price of water is considered to be the best available estimate for the average price of water in the US, even though it includes treatment and other costs.

$$\begin{aligned} \text{Water Supply Benefits} &= \text{Yield from Contracted Storage (MGD)} \times 365 \times \text{Average Price of Water per MGD} \\ \$6.52 \text{ Billion} &= 6,358 \text{ (MGD)} \times 365 \text{ (days)} \times \$2,810 \text{ (per MGD)} \end{aligned}$$

⁸ A savings per ton estimate of \$15.09 for the Great Lakes was obtained from Table 22 of the Planning Center of Expertise for Inland Navigation report *Waterway and Overland Transportation Costs Updated to October 2011 Price Levels for Use in Inland Navigation Studies* and published on January 31, 2012. This estimate is the best available estimate for transportation savings per ton attributable to the USACE deep-draft navigation program in the Great Lakes.

⁹ Thompson Reuters, "Average U.S. Water Costs Increase by 7.3%." 2008. Available via <http://www.reuters.com/article/2008/09/24/idUS163067+24-Sep-2008+MW20080924>

2.4 Hydropower

USACE is the largest owner/operator of hydroelectric power plants in the U.S. and one of the largest in the world. The 75 USACE plants have a total installed rated capacity of 20,475 megawatts and produce nearly 68 billion kilowatt-hours (kWh) a year (USACE, 2012b). This is nearly one-third of the Nation's total hydropower output: enough energy to serve about ten million households, or roughly ten cities the size of Seattle, WA (USACE, 2009c). The NED benefits accruing to USACE hydropower investments are computed by multiplying the amount of energy generated by USACE hydropower facilities in Fiscal Year 2010 by the price per unit of energy to derive total energy sales, in dollars, tied to USACE hydropower infrastructure. The total energy generation from hydropower projects was acquired from the USACE database called Operations and Maintenance Business Information Link (OMBIL)¹⁰ and the retail market value per kilowatt-hour was computed as a weighted average of the regional generation prices as estimated by the Reliability First Corporation – West, the Midwest Reliability Council – East, the Western Electricity Coordinating Council / Northwest Power Pool Area, the SERC Reliability Corporation / Central, and the Southwest Power Pool / South (EIA, 2009).

The 2010 USACE hydropower benefit estimate is \$2.15 billion. The values used in earlier analyses were derived from Energy Information Administration EIA-826, *Monthly Electric Utility Sales and Revenue Report with State Distributions*. The SERC Reliability Council estimates (which are used in this report) are considered to be the best available data at this time, as they are closer to wholesale prices rather than retail prices, which better reflects the “product” that the Corps actually provides.

$$\text{Hydropower Benefits} = \text{Generation (kilowatts)} \times \text{Price (per kilowatt)}$$

$$\$2.15 \text{ Billion} = 66,202,120,000 \times \$0.0325$$

The benefit estimates may be considered conservative inasmuch as hydropower facilities are used to meet peak demands. On-peak power prices would be expected to be greater than the average retail market value per kWh used here. However, prices for on-peak power are highly variable and sources of consolidated industry-wide information on average retail on-peak power prices were not found. Analysis of wholesale prices for power on the California Power Exchange during 1999 suggests that on-peak wholesale prices were two to four times greater than average wholesale prices for power. So, there is some uncertainty among this value.

2.5 Recreation

Visitors to USACE lakes find many ways to enjoy themselves. In a recent year, the top ten recreation activities were: 1) rigorous walking, 2) driving for pleasure, 3) swimming, 4) picnicking, 5) fishing, 6) bicycling, 7) viewing wildlife, 8) camping, 9) visiting cultural sites, and 10) hunting (USACE, 2008b). Visitors are also attracted to special events, including fishing tournaments, sailing regattas, arts and crafts festivals, and scouting activities. Individuals with special needs can also depend upon USACE

¹⁰ The Operations and Maintenance Business Information Link (OMBIL) is a web-based business information gateway that allows Corps employees easy access to information about the Operations and Maintenance program. The OMBIL system is used to maintain and track O&M business information and to view summaries related to O&M activities, output, resources, and performance.

facilities and programs for their outdoor recreation. Many trails, piers, and campsites are universally accessible, and assisted hunting and fishing events are offered.¹¹

Recreation benefits can be divided into two categories. The first category is benefits derived from day visits to facilities. The second category is benefits from camping or overnight visits. In both cases, the annual benefits are estimated as the number of visits in each category multiplied by the value of an individual visit.

USACE annually publishes an Economics Guidance Memorandum (EGM) that provides instructions and background information on Unit Day values that each USACE district can use to calculate values for the recreation experiences at each specific project under its jurisdiction that generates recreation outputs.¹² Using the formula below as well as the aforementioned Economics Guidance Memorandum (EGM) 10-03, the recreation benefits for Fiscal Year 2010 were calculated for each project and summed, resulting in an estimate of \$3.3 billion for the annual National Economic Development (NED) recreation benefits provided by all USACE projects nationwide. The current estimate relies on the latest USACE data and Rec-Best software. Rec-BEST is considered the best available estimating approach and is based on the Unit Day Value approach. Unit day values are computed for each recreation area (2500 of them) each year based on the five criteria specified in the annual EGM and then applied to recreation days for that area.

$$\text{Recreation Benefits} = \text{Number of Recreation Days} \times \text{Value per Day (Unit Day Value)}$$

$$\text{Recreation Benefits} = \$3.31 \text{ Billion}$$

2.6 Programs Not Covered in National Economic Development Estimates

USACE has other business programs whose benefits are not measured in this report. These business programs are Regulatory, Emergency Management, and Environmental. The Environmental Program includes Aquatic Ecosystem Restoration, Environmental Stewardship, and Formerly Utilized Sites Remedial Actions Program (FUSRAP). Since the benefits of these programs are measured in this report, the associated costs of these programs are not included in the calculations to find net NED benefits of Corps programs. Further information about the value of some of these programs is available in the Value to the Nation brochures, which can be found online at <http://www.corpsresults.us>.

USACE aquatic ecosystem restoration projects are designed to restore degraded ecosystem structure, function, and dynamic processes to a more natural condition. Individual projects may vary greatly in scale; several USACE ecosystem restoration projects are large-scale projects like restoring the Everglades and the Chesapeake Bay. From Fiscal Year 2006 through Fiscal Year 2008, USACE

¹¹ See the Value to the Nation brochures at <http://www.corpsresults.us> for additional information.

¹² The Corps Economic Guidance Memoranda can be found at the Planning Toolbox (www.CorpsPlanning.us) or specifically at <http://planning.usace.army.mil/toolbox/library.cfm?Option=Listing&Type=EGM&Search=Policy&Sort=Default>

ecosystem restoration projects restored, created, or protected about 20,200 acres of habitat (USACE, 2008a).

Under its Environmental Stewardship program, USACE protects, preserves, and restores significant ecological resources at Civil Works projects across the Nation. Environmental Stewardship includes both passive and proactive management to sustain healthy ecosystems and biodiversity and conserve natural resources. USACE lands and waters are left in a condition equal to or exceeding the condition when USACE acquired the resource, helping to guarantee that important natural and cultural resources remain available to serve the needs of current and future generations. Species conservation is another important component of the Environmental Stewardship program. Of the nearly 12 million acres of USACE-managed land and water, 4.3 million acres provide significant waterfowl use or potential for use. USACE projects currently aid in the recovery of over 53 special status species (USACE, 2008a).

FUSRAP is a program that began in 1974 to identify, investigate, and clean up or control sites that were part of the Nation's early atomic energy and weapons program. USACE has provided supervision of the program since 1997. Objectives of FUSRAP include evaluating sites and determining whether cleanup and/or control is needed, protecting human health and the environment through site cleanup and/or control, disposing of or stabilizing contamination in an acceptable manner, and performing cleanup work in a safe and efficient manner consistent with appropriate Federal laws and regulations and state and local environmental land use requirements.

With authority granted through the Clean Water Act and its subsequent amendments, USACE oversees the deposition of dredged and fill materials into the Nation's waterways. All wetlands fall under the jurisdiction of the Regulatory business program, which processes fill permits to avoid and minimize impacts to wetlands. Through its regulatory permitting process, in Fiscal Year 2010, USACE avoided impacts to more than 28,000 acres of wetland and ensured mitigation of 43,000 acres.¹³ The Regulatory business program also has economic benefits that are not included in this report. For example, the program efficiently and effectively balances the push for private development with the need to protect wetlands and other aquatic resources. Through these efforts, USACE ensures the continued viability of wetland-dependent species vital to the fishing and shell fishing industry, which generates \$15 billion in revenue each year (USACE, 2008c). Regulatory permits also reduce the risk of erosion and flooding, thereby preventing future economic losses.

The USACE Emergency Management business program is an integral part of the Nation's disaster response effort. Although not included in this report, this program also produces real benefits. In the event of a disaster, USACE Emergency Managers can draw upon in-house expertise in a wide range of disciplines to assist in solving disaster-related issues. With annual expenditures of approximately \$14 million, USACE is able to respond to locations nationwide within 18 hours after the occurrence of a disaster and often preposition ahead of imminent weather events, such as hurricanes. This rapid response capability allows USACE to quickly establish a presence on the ground for search and rescue operations and for the transition to recovery and rebuilding.

¹³ *Annual Report Fiscal Year 2010 of the Secretary of the Army on Civil Works Activities.*
<<http://cdm16021.contentdm.oclc.org/utis/getfile/collection/p16021coll6/id/32/filename/33.pdf>> .

2.7 Summary of Annual NED Benefits of USACE Programs

The Fiscal Year 2010 NED benefits attributable to USACE infrastructure are summarized in **Table 4** below.

Table 4: NED Benefits Summary

Program	NED Benefits (Billions of 2010 Dollars)
Flood Risk Management	\$23.10
Coastal Navigation	\$8.73
Inland Navigation	\$7.60
Water Supply	\$6.52
Hydropower	\$2.15
Recreation	\$3.31
Total Annual NED Benefits	\$51.41

Section 3:

Estimated Federal Revenue Impacts of USACE Programs

This Section estimates financial impacts that USACE programs have on revenues and expenditures of the U.S. Treasury.

$$\text{Treasury Revenues} = \text{Increased Tax Payments} + \text{Direct Payments from Vendible Outputs} + \text{Decreased Expenditures from Assistance Payments}$$

As stated earlier, Treasury revenues are the increases in Treasury revenues in the form of increase tax payments and direct payments to the Treasury for vendible outputs plus the decreases in expenditures in the form of decreased tax expenditures and assistance payments that accrue to the U.S. Treasury as a result of the USACE Civil Works program. The basic approach begins with the NED benefits estimated in Section 2 for each program and then estimates the impacts on Federal revenues. However, there are other subtle calculations included that are explained. The estimates provided in this section are approximations meant to capture order of magnitude and key revenue and tax components rather than precise estimations.

The sections that follow describe the financial impact calculations for each USACE program area. Calculations are provided for 2010 and are expressed in 2010 real dollars. These calculations use Internal Revenue Service (IRS) data from a variety of publications. IRS publications can be found on the IRS website at www.irs.gov. For more detailed information on the specific IRS data used, specific publications used for each data item, and how this data was used to estimate U.S. Treasury revenue impacts, see the Excel spreadsheet model that accompanies this document (“VTN_Data.xlsx”).

3.1 Flood Risk Management

Returns to the U.S. Treasury from the Flood Risk Management program are accrued from savings from casualty loss tax deductions not taken on residential properties and commercial properties, and from savings from disaster assistance payments not made. IRS data was used in conjunction with the USACE Fiscal Year 2010 flood damages prevented estimate discussed in Section 2 above and other USACE provided flood damage parameters.

$$\begin{aligned} \text{Non-Business Casualty Losses Avoided} &= (\text{Non-business damages deducted}) \times (\text{Average Effective Tax Rate} \\ &\quad \text{for itemizers}) \\ \$.33 \text{ Billion} &= \$1.73 \text{ Billion} \times .19 \end{aligned}$$

$$\begin{aligned} \text{Business Casualty Loss Avoided} &= (\text{Flood damages prevented}) \times (\text{Percent sustained by business}) \times (\text{Average} \\ &\quad \text{Effective Tax Rate}) \\ \$1.67 \text{ Billion} &= \$23.1 \text{ Billion} \times .21 \times .34 \end{aligned}$$

$$\begin{aligned} \text{Disaster Assistance Payments Avoided} &= (\text{Flood damages prevented}) \times (\text{Disaster assistance per dollar of damage}) \\ \$5.31 \text{ Billion} &= \$23.1 \text{ Billion} \times \$0.23 \end{aligned}$$

3.2 Navigation

Revenue returns to the U.S. Treasury from the Navigation Program are estimated separately below for returns related to inland navigation and returns related to coastal deep-draft navigation.

3.2.1 Inland Navigation

There are two separate revenue impacts on the U.S. Treasury for the Inland Navigation program. One impact results from the taxes collected on the increased income retained by shippers and consumers because of transportation costs savings due to the existence of the Nation's inland waterway system. An average individual and business tax rate is applied to these savings to arrive at a first-order estimate of increased Federal revenues.

$$\begin{aligned} \text{Increased revenues due to cost savings} &= (\text{Annual NED transportation savings}) \times (\text{Average individual and business tax rate}) \\ \$1.79 \text{ Billion} &= (\$7.60 \text{ Billion}) \times (23.6\%) \end{aligned}$$

One dedicated revenue source for the Inland Navigation program is the Inland Waterways Trust Fund, which is funded by a tax on fuel. The tax is \$0.20 per gallon of fuel used by tows on the Inland Waterways system. The Fiscal Year 2010 tax revenues collected and deposited into the Inland Waterways Trust Fund were \$73,948,000 (U.S. Treasury, 2010). It is important to note that this was an anomaly, as it was the lowest year for tax revenues since 1992. It is speculated that the economic recession during FY 2010 played a large role in this atypical value.

$$\text{Inland Waterways Trust Fund tax revenues} = \$74 \text{ Million}$$

These two impacts taken together form the total revenue impacts of USACE Inland Navigation capital stock. The estimated revenue impact for Fiscal Year 2010 is approximately \$1.86 billion.

$$\begin{aligned} \text{Total Inland Navigation Revenues to the U.S. Treasury} &= (\text{Increased revenues due to cost savings}) + (\text{Inland Waterways Trust Fund tax revenues}) \\ \$1.86 \text{ Billion} &= \$1.79 \text{ Billion} + \$0.07 \text{ Billion} \end{aligned}$$

3.2.2 Coastal Navigation

Federal revenue impacts of USACE coastal projects are estimated below. Similar to the case of inland navigation, transportation cost savings are assumed to represent income to shippers who are then taxed on that income. In addition to that revenue impact, additional taxes are currently collected for the Harbor Maintenance Trust Fund (U.S. Treasury, 2010).

Increased revenues due to cost savings = (Annual NED transportation savings) * (Average individual and business tax rate)

$$\$2.06 \text{ Billion} = (\$6.91 \text{ Billion} + \$1.8 \text{ Billion}) * (23.6\%)$$

One dedicated revenue source for the Coastal Navigation program (both Deep-Draft and Great Lakes) is the Harbor Maintenance Trust Fund, which is funded by the Harbor Maintenance Tax. The Harbor Maintenance Tax is a Federal ad valorem tax imposed on shippers based on the value of the goods imported through ports. The tax is placed in the Harbor Maintenance Trust Fund to be used for operation and maintenance including dredging of eligible Federal navigational channels. The tax is 0.125 percent of the value of the commerce being imported. The Fiscal Year 2010 tax revenues collected and deposited into the Harbor Maintenance Trust Fund were approximately \$1.22 Billion.

Harbor Maintenance Trust Fund tax revenues = \$1.22 Billion

These two impacts taken together form the total revenue impacts of USACE Coastal Navigation capital stock. The estimated revenue impact for Fiscal Year 2010 is approximately \$2.85 billion.

Total Coastal Navigation Revenues to the U.S. Treasury = (Increased revenues due to cost savings) + (Harbor Maintenance Trust Fund tax revenues)

$$\$3.28 \text{ Billion} = \$2.06 \text{ Billion} + \$1.22 \text{ Billion}$$

3.3 Water Supply

All revenues received from the sponsors for purchase of municipal and industrial (M&I) water supply contracts are deposited into the U.S. Treasury. This requirement dates back to, at least, Section 6 of the 1944 Flood Control Act (33 U.S.C. § 708) (58 Stat. 890). Revenues are comprised of the repayment of investment costs, all of the various types of interest, and the assigned portion of the yearly operation, maintenance, repair, replacement and rehabilitation (O&M) costs. Collection expenses are subtracted from revenues to arrive at net revenues to the U.S. Treasury. The source for 2010 revenues and collection cost data is the Corps of Engineers Financial Management System (CEFMS). The value is \$0.1 billion, or about \$100 million.

Net revenues to the U.S. Treasury = Revenues Collected – Cost of Collection

$$\$0.1 \text{ Billion} = \$0.1014 \text{ Billion} - \$0.0013 \text{ Billion}$$

3.4 Hydropower

The return to the U.S. Treasury for the USACE Hydropower program is the sum of revenues that the Power Marketing Authorities (PMAs) receive from the sale of USACE-provided hydropower. The information used to estimate the revenues that the four PMAs (Southeastern Power Administration (SEPA), Southwestern Power Administration (SWPA), Bonneville Power Administration (BPA), and Western Power Administration (WPA)) return to the U.S. Treasury was obtained from USACE National Hydropower Business Manager¹⁴.

$$\begin{aligned} \text{Total to U.S. Treasury} &= \text{SEPA Revenues} + \text{SWPA Revenues} + \text{BPA Revenues} + \text{WPA Revenues} \\ \$1.11 \text{ Billion} &= \$0.1189 \text{ Billion} + \$0.1104 \text{ Billion} + \$0.8640 \text{ Billion} - \$0.0163 \text{ Billion} \end{aligned}$$

3.5 Recreation

To determine the return to the U.S. Treasury provided by the Recreation program, the average individual income tax rate was multiplied by the total income resulting from visits to USACE recreation facilities.

The IWR Regional Economic Systems (RECONS) was used to estimate the jobs and income resulting from visitor spending to USACE recreation facilities. RECONS was designed to provide a simple, yet accurate, way of applying appropriate multipliers to spending and visitation data. The Recreation module of RECONS was originally developed at Michigan State University in collaborations with National Park Service and US Forest Service. The research team at the USACE IWR and ERDC later worked with MSU to modify the model for USACE applications. RECONS uses four data streams to estimate income effects of recreation visits to USACE projects: recreation spending, visitor use estimates, capture rates and economic multipliers.

The visitation data used in the model was derived from OMBIL and the USACE Visitation Estimation and Reporting System (VERS) database with 2010 data, while the spending profiles were estimated from a national visitor spending survey that was conducted from 1999 to 2000 and price indexed to 2010 dollars using Consumer Price Index by sectors. Capture rates and economic multipliers were estimated using the Impact Analysis for Planning (IMPLAN) system. IMPLAN is a microcomputer based input-output (I-O) modeling system that is currently maintained by the Minnesota IMPLAN Group Inc.

Regional IMPLAN models were developed for each USACE project, district, and division, plus a national model and 43 state models to estimate the total economic effects at various geographic levels. Spending averages were computed and multiplied by visitation statistics to estimate total annual visitor spending. Generalized spending profiles were developed for two sets of visitor segments: (1) campers, other overnight visitors and day users, and (2) boaters and non-boaters. These profiles were applied to recreation use data gathered from the visitation use survey and from OMBIL and VERS to estimate total spending by each segment for each of the 420 USACE recreation projects. Following the process described above, the model estimated that the 2010 increase in national income as a result of

¹⁴Kamau Sadiki, Chief of USACE Hydropower Program. 1Dec 2011, E-mail correspondence.

recreation visits to USACE projects was \$4,560,036,944. The increase in income is then multiplied by the 2009 average individual and business tax rate of approximately 23.6 percent to yield an increase in revenue to the U.S. Treasury of \$1.0 billion.

$$\begin{aligned} \text{Increase in U.S. Treasury Revenues} &= \text{Income generated} \times \text{Average individual and business tax rate} \\ \$1.07 \text{ Billion} &= \$4.56 \text{ Billion} \times 23.6\% \end{aligned}$$

$$\text{Total Increase in U.S. Treasury Revenues from Recreation} = \$1.07 \text{ Billion} + \$51 \text{ million in fees} = \$1.13 \text{ Billion}$$

In addition to these income-generated revenues to the U.S. Treasury, USACE also collects fees for using its recreation facilities such as fees for camping and day use, fees for annual passes to use its recreational facilities, and other special use fees. These fees are approximately \$51 million annually and were added to the \$1.07 billion in income-generated U.S. Treasury revenues for a total increase in U.S. Treasury revenues attributable to the USACE recreation program of \$1.13 billion.

3.6 Leases and Sales

USACE collects revenues from the sale of agricultural and fish and wildlife leases, from permits, and from the sale of crops, timber, and sand and gravel. These collections generate about \$42 million in annual revenues to the U.S. Treasury.

$$\text{Annual Revenues from Leases and Sales} = \$42 \text{ Million or } \$0.042 \text{ Billion}$$

3.7 Summary of Overall U.S. Treasury Impacts of USACE Programs

Fiscal Year 2010 U.S. Treasury revenues attributable to USACE infrastructure are summarized in **Table 5** below.

Table 5: U. S. Treasury Revenues Summary

Revenue Category by Program		Revenues (Billions of 2010 Dollars)
Flood Risk Management		
	Non Business Casualty Losses Avoided	\$0.33
	Business Casualty Loss Avoided	\$1.67
	Disaster Assistance Payments Avoided	\$5.31
Flood Risk Management Total		\$7.31
Navigation		
Inland Navigation		
	Increase in revenue due to cost savings	\$1.79
	Inland Waterway Trust Fund revenues	\$0.07
Coastal Deep-Draft Navigation		
	Increase in revenue due to cost savings	\$2.06
	Harbor Maintenance Trust Fund revenues	\$1.22
Navigation Total		\$5.14
Water Supply		\$0.10
Hydropower		\$1.11
Recreation		\$1.13
Leases and Sales		\$0.04
Total Revenues to the U.S. Treasury		\$14.83

Section 4: Summary

Each year, USACE carries out its water resources mission through Civil Works appropriations provided by the Congress. In FY 2010, Civil Works appropriations totaled approximately \$5.45 billion. **Table 6** shows the FY2010 USACE total budget, USACE annual expenses, NED benefits, net NED benefits, and US Treasury revenues categorized by USACE Civil Works program. The USACE total budget represents the total amount of money allocated to each USACE program, while USACE annual expenses represent the Corps' costs of doing business. More specifically, USACE annual expenses reflect all values appropriated to USACE Civil Works programs by the Congress, not including the money spent on construction. Therefore, values for USACE annual expenses displayed in **Table 6** include the costs of operations, maintenance, and project investigations. USACE annual expenses – for the purposes of this report – do not include costs associated with the USACE Regulatory program, the Formerly Utilized Sites Remedial Action Plan (FUSRAP), oversight by the office of the Assistant Secretary of the Army (ASA), other expenses that generally serve all USACE programs (including those whose benefits are not measured in this report), and other USACE Civil Works programs (namely Aquatic Ecosystem Restoration, Environmental Stewardship, and Emergency Management). After subtracting the estimated cost of doing business (the USACE annual expenses) from the total benefits provided (total NED benefits), it is estimated that the USACE Civil Works program provides a total net NED benefit of approximately \$48.82 billion. In addition, the USACE Civil Works program provided about \$14.83 billion in returns to the US Treasury. In summary, in FY2010, for each dollar spent on the USACE Civil Works program, approximately \$9 in economic benefits to the nation were generated and \$2.70 in US Treasury revenues were generated. The rate of return for the USACE Civil Works program is estimated to be 26%¹⁵.

Table 6: Budget, NED Benefits and U.S. Treasury Revenue Summary

Program	2010 USACE Budget	2010 USACE Annual Expenses	NED Benefits	Net NED Benefits	U.S. Treasury Revenues
Flood Risk Management	\$1.628	\$0.640	\$23.10	\$22.46	\$7.31
Coastal Navigation	\$0.971	\$0.852	\$8.73	\$7.88	\$3.28
Inland Navigation	\$0.796	\$0.612	\$7.60	\$6.98	\$1.86
Water Supply	\$0.004	\$0.004	\$6.52	\$6.52	\$0.10
Hydropower	\$0.230	\$0.200	\$2.15	\$1.95	\$1.11
Recreation	\$0.283	\$0.283	\$3.31	\$3.03	\$1.13
Other Programs	\$0.890				\$0.04
Miscellaneous	\$0.648				
Totals	\$5.450	\$2.591	\$51.41	\$48.82	\$14.83

Note: All values in Table 6 are given in billions of dollars

¹⁵ The rate of return was calculated by dividing total net NED benefits by the estimated value of USACE capital stock in FY 2010, which was \$192,931,001,530 (approximately \$189,214,426,460 in 2010 dollars).

Section 5:

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Appendix A

USACE Division Benefits and Revenues

May 2013

In the report *Value to the Nation of the US Army Corps of Engineers Civil Works Programs*, estimates of NED benefits and revenues to the US Treasury are provided on a national level. This appendix is a supplement to that document and provides insight into the breakdown of those values by USACE Division. Tables 1, 2 and 3 illustrate the divisional estimates of benefits, revenues, and divisional share of benefits, respectively. These estimates are explained in the text provided by this document.

Table 1: NED BENEFITS (\$ millions)						
Division	Flood Risk Management	Hydropower	Water Supply	Recreation	Inland Navigation	Coastal Navigation
LRD	\$1,144	\$208	\$424	\$744	\$3,142	\$1,451
MVD	\$3,840	\$27	\$298	\$460	\$3,008	\$1,251
NAD	\$846	-	\$119	\$102	\$22	\$1,964
NWD	\$4,785	\$1,304	\$652	\$463	\$185	\$446
POD	\$1	-	\$0	\$2	\$0	\$105
SAD	\$326	\$288	\$145	\$511	\$163	\$687
SPD	\$1,816	-	\$348	\$144	\$3	\$995
SWD	\$10,337	\$324	\$4,535	\$891	\$1,070	\$1,832
National Total	\$23,096	\$2,152	\$6,521	\$3,316	\$7,597	\$8,731

Table 2: REVENUES (\$ millions)						
Division	Flood Risk Management	Hydropower	Water Supply	Recreation	Inland Navigation	Coastal Navigation
LRD	\$362	\$107	\$7	\$252	\$771	\$545
MVD	\$1,215	\$14	\$5	\$156	\$738	\$470
NAD	\$268	-	\$2	\$35	\$5	\$738
NWD	\$1,514	\$673	\$10	\$157	\$45	\$167
POD	\$0	-	\$0	\$1	\$0	\$40
SAD	\$103	\$149	\$2	\$174	\$41	\$250
SPD	\$575	-	\$5	\$49	\$1	\$374
SWD	\$3,271	\$167	\$70	\$303	\$263	\$688
National Total	\$7,308	\$1,110	\$100	\$1,126	\$1,865	\$3,280

Table 3: DIVISION SHARE OF BENEFITS (%)						
Division	Flood Risk Management	Hydropower	Water Supply	Recreation	Inland Navigation	Coastal Navigation
LRD	4.95%	9.65%	6.50%	22.43%	41.35%	16.61%
MVD	16.63%	1.26%	4.57%	13.86%	39.59%	14.33%
NAD	3.67%	-	1.82%	3.07%	0.29%	22.50%
NWD	20.72%	60.62%	10.00%	13.95%	2.44%	5.11%
POD	0.00%	-	0.00%	0.05%	0.00%	1.21%
SAD	1.41%	13.40%	2.23%	15.42%	2.20%	7.87%
SPD	7.86%	-	5.33%	4.34%	0.04%	11.40%
SWD	44.76%	15.08%	69.55%	26.88%	14.08%	20.98%

Flood Risk Management

NED benefits of the Flood Risk Management program are calculated as the monetary value of flood damages prevented by USACE investments. These values are available for each USACE district in The Corps' Annual Flood Damage Reduction Report. In order to calculate NED benefits for each division, the district estimates of flood damages prevented were summed for each division. Similarly, a national total for USACE Flood Risk Management NED benefits is equivalent to the sum of all districts' NED benefits. Divisional shares of total NED benefits were used to distribute the national revenue generated from the Flood Risk Management program to each division. The total national revenue from the Flood Risk Management program is equivalent to the returns to the U.S. Treasury from the Flood Risk Management program. The returns to the Treasury are accrued from savings from casualty loss tax deductions not taken on residential properties and commercial properties, and from savings from disaster assistance payments not made.

An example of divisional NED benefits calculations for the Great Lakes Division (LRD):

In the Great Lakes Division during FY 2010, Flood Risk Management program contributed \$1.14 billion in NED benefits. This is about 5% of the national total NED benefits for the Flood Risk Management program, which were about \$23.096. Because the Great Lakes Division contributed 4.95% of the total NED benefits of the program, we estimate the revenue generated by Flood Risk Management in the Great Lakes Division by taking 5% of the total revenue generated by the Flood Risk Management business line, which was \$7.308 billion. Although NED benefits for each business line are calculated and distributed in different ways, the national revenue generated by each division with respect to each business line is calculated the same way. Division revenue estimates are always calculated as a percentage of national revenue based on the division's share of total NED benefits.

Hydropower

Hydropower NED benefits are considered as the total energy sales of USACE hydropower facilities. (This is based on the assumption that the energy would not be produced in the absence of these USACE facilities). The total value of NED benefits of the Hydropower program is calculated as the product of energy generated by USACE hydropower facilities in FY 2010 and the price per unit of energy. Values of hydropower generation are provided by OMBIL at the district level, so each division value was computed by summing the values of energy generated by USACE hydropower facilities within the districts that comprise each division. Prices per unit of energy are available at the district level using data from the US Energy Information Administration. Total Hydropower NED benefits are estimated to be \$2.152 billion for FY 2010. Divisional shares of total NED benefits were used to distribute the national revenue generated from the Hydropower program to each division. The total national revenue from the Hydropower program is equivalent to the sum of revenues that the Power Marketing Authorities (PMAs) receive from the sale of USACE-provided hydropower.

Water Supply

NED benefits of the Water Supply program are estimated as the product of the annual yield of water supply contracted storage and the average price of water in the US. Contracted storage refers to the acre-feet of space in USACE reservoirs for which a storage agreement is in place with local entities who have agreed to pay in order to have that storage allocated to them. Although Water Supply

contracted storage values are available at the district level, the water supply yield from contracted storage is not available at this level. Therefore, divisional NED benefits are calculated by distributing total USACE Water Supply NED benefits to divisions based on each division's share of total contracted storage. Total NED benefits of the Water Supply program are estimated to be \$6.521 billion. The revenue generated from the Water Supply program is distributed to each division based on the each division's share of total Water Supply NED benefits. The national revenue of the Water Supply program (totaling about \$100 million in FY 2010) is comprised of the repayment of investment costs, all of the various types of interest collected on contracted storage, and the assigned portion of the yearly O&M costs (minus collection expenses).

Recreation

NED benefits of the Recreation program are estimated for districts, divisions, and USACE as a whole outside of the spreadsheet model. This estimate is described in detail in the report *Estimating the Value to the Nation Produced by the US Army Corps of Engineers Civil Works Program: Estimates of National Economic Development Benefits (NED) and Revenues to the US Treasury for 2010*. Recreation NED benefits are a function of number of total visits (both day and overnight visits) and the value of those visits. The national estimate of total NED benefits for the Recreation program is \$3.316 billion. Recreation revenues generated to the US Treasury by each division are calculated as the divisional share of total NED benefits multiplied by the total revenue generated nationally by the Recreation program. The total national revenue for this program in FY 2010 was \$1.126 billion, which reflects the average individual income tax rate multiplied by the total income resulting from visits to USACE recreation facilities.

Navigation

Navigation benefits accrue from inland waterways and coastal port facilities. Due to the nature of the Inland Navigation program, much of the division and district level data includes double counting (mainly because tons that are transported in one district are also likely to be transported in other districts as they move along a waterway). The process used to accommodate these issues is described in detail in the report *Estimating National Benefits of the USACE Civil Works Program: User Guide for the Return on Investment Spreadsheet Estimator Model*. In short, a national quantity of inland tonnage (based on commodity tonnage) that did not include double counted tonnages was distributed to each division based on its percentage of total tons shipped. NED benefits for the Navigation program (including both Inland and Coastal Navigation) are estimated as the product of transportation cost savings and total tons shipped.

For the Inland Navigation program, NED benefits were able to be calculated for each division by multiplying the estimate for total tons shipped through each division by the national estimate for savings per ton shipped, which is estimated to be approximately \$13.72. Following the same logic as was used for other USACE programs, national revenue generated by the Inland Navigation program (estimated to be \$1.865 billion) was distributed to each division based on each division's share of total NED benefits.

For the Coastal Navigation program, the process of obtaining divisional estimates was slightly different since there are two components of the Coastal Navigation program (coastal deep-draft and Great Lakes). This The total NED benefit of the Coastal Navigation program represents the NED benefit

of the Coastal Deep-Draft program (\$6.914 billion) and the NED benefit of the Great Lakes Navigation program (\$1.817 billion). This total NED benefit of the Coastal Navigation program is estimated to be \$8.731 billion. Following the same logic as was used for other USACE programs, national revenue generated by the Coastal Navigation program (estimated to be \$3.280 billion) was distributed to each division based on each division's share of total NED benefits.

INSTITUTE FOR WATER RESOURCES
US ARMY CORPS OF ENGINEERS

Appendix B

Supporting Materials

May 2013

Top 95 Coastal Deep-Draft Ports

Waterway	Port Name	Domestic Tonnage	Foreign Tonnage	Total Tonnage
505	Albany, NY	5,721,480	1,088,537	6,810,017
4730	Anacortes, WA	6,668,158	1,787,289	8,455,447
4820	Anchorage, AK	2,212,429	557,871	2,770,300
700	Baltimore, MD	9,462,226	30,166,961	39,629,187
4458	Barbers Point, Oahu, HI	1,620,451	7,550,103	9,170,554
2252	Baton Rouge, LA	34,768,822	20,768,165	55,536,987
2395	Beaumont, TX	25,176,606	51,781,986	76,958,592
2002	Biloxi, MS	3,140,787	0	3,140,787
149	Boston, MA	6,138,578	12,952,800	19,091,378
311	Bridgeport, CT	3,254,551	1,280,925	4,535,476
2420	Brownsville, TX	2,135,268	2,481,224	4,616,492
780	Brunswick, GA	20,236	2,417,564	2,437,800
551	Camden-Gloucester, NJ	2,167,252	3,201,866	5,369,118
773	Charleston, SC	2,885,976	15,100,019	17,985,995
297	Chester, PA	280,854	1,154,412	1,435,266
4660	Coos Bay, OR	150,059	1,436,345	1,586,404
2423	Corpus Christi, TX	18,840,615	54,822,817	73,663,432
4725	Everett, WA	910,298	469,519	1,379,817
189	Fall River, MA	1,924,404	592,655	2,517,059
784	Fernandina Beach, FL	144,359	589,771	734,130
2408	Freeport, TX	4,347,395	22,328,447	26,675,842
2417	Galveston, TX	5,934,427	8,014,469	13,948,896
4702	Grays Harbor, WA	270,604	1,409,387	1,679,991
2083	Gulfport, MS	60,597	2,019,100	2,079,697
4400	Hilo, HI	1,109,081	26,322	1,135,403
4420	Honolulu, HI	7,773,385	1,130,083	8,903,468
738	Hopewell, VA	624,249	384,521	1,008,770
2012	Houston, TX	67,572,638	159,560,593	227,133,231
2017	Jacksonville, FL	7,400,936	11,716,887	19,117,823
4410	Kahului, Maui, HI	2,019,887	94,218	2,114,105
4626	Kalama, WA	489,260	11,765,737	12,254,997
4405	Kawaihae Harbor, HI	1,021,617	28,175	1,049,792
4978	Kivilina, AK	1,453,591	1,496,530	2,950,121
2254	Lake Charles, LA	21,614,336	33,000,559	54,614,895
4110	Long Beach, CA	12,869,965	62,564,823	75,434,788
4622	Longview, WA	1,279,808	5,542,907	6,822,715
4120	Los Angeles, CA	6,443,068	55,943,535	62,386,603
5251	Marcus Hook, PA	9,530,805	12,409,654	21,940,459

Top 95 Coastal Deep-Draft Ports (continued)

Waterway	Port Name	Domestic Tonnage	Foreign Tonnage	Total Tonnage
2410	Matagorda Port Lv Pt Com, TX	2,154,222	6,724,969	8,879,191
2164	Miami, FL	293,534	6,666,191	6,959,725
764	Morehead City, NC	1,690,602	1,807,064	3,497,666
2087	Morgan City, La, Port of	1,979,417	6,827	1,986,244
4430	Nawiliwili, Kauai, HI	866,420	10,475	876,895
299	New Castle, DE	1,444,451	164,213	1,608,664
1507	New Haven, CT	7,221,889	2,765,396	9,987,285
2251	New Orleans, LA	38,331,450	34,079,280	72,410,730
398	New York, NY and NJ	55,483,848	83,714,367	139,198,215
736	Newport News, VA	4,280,717	16,558,510	20,839,227
4831	Nikishka, AK	3,351,033	1,500,490	4,851,523
5735	Norfolk Harbor, VA	6,180,239	35,389,134	41,569,373
4345	Oakland, CA	2,265,063	16,344,665	18,609,728
4933	Old Harbor, AK	336	0	336
2162	Palm Beach, FL	894,971	1,479,280	2,374,251
2016	Panama City, FL	1,399,202	1,491,678	2,890,880
2004	Pascagoula, MS	10,677,578	26,598,231	37,275,809
5252	Paulsboro, NJ	7,238,991	10,260,065	17,499,056
298	Penn Manor, PA	79,975	2,120,105	2,200,080
2007	Pensacola, FL	669,904	178,248	848,152
552	Philadelphia, PA	12,565,092	21,471,002	34,036,094
2255	Plaquemines, LA, Port of	36,927,933	18,908,754	55,836,687
2151	Ponce, PR	2,108	1,840,773	1,842,881
4708	Port Angeles, WA	480,995	238,897	719,892
2416	Port Arthur, TX	10,766,872	19,464,914	30,231,786
2160	Port Canaveral, FL	636,136	1,874,022	2,510,158
2163	Port Everglades, FL	10,156,174	10,077,023	20,233,197
4150	Port Hueneme, CA	19,000	1,362,561	1,381,561
522	Port Jefferson, NY	1,099,254	22,221	1,121,475
2023	Port Manatee, FL	320,464	2,967,707	3,288,171
128	Portland, ME	1,628,500	16,529,730	18,158,230
4644	Portland, OR	8,178,736	17,770,571	25,949,307
135	Portsmouth, NH	553,927	2,410,004	2,963,931
191	Providence, RI	2,833,204	4,282,268	7,115,472
4340	Redwood City, CA	50,547	993,955	1,044,502
4350	Richmond, CA	11,412,369	12,765,152	24,177,521
737	Richmond, VA	795,392	62,416	857,808
4100	San Diego, CA	322,608	1,002,275	1,324,883

Top 95 Coastal Deep-Draft Ports (continued)

Waterway	Port Name	Domestic Tonnage	Foreign Tonnage	Total Tonnage
4335	San Francisco, CA	285,836	619,958	905,794
2136	San Juan, PR	6,604,262	4,791,237	11,395,499
776	Savannah, GA	1,789,004	32,892,652	34,681,656
112	Searsport, ME	403,630	1,583,129	1,986,759
4722	Seattle, WA	5,094,265	22,097,410	27,191,675
4930	Seward, AK	10,661	948,720	959,381
4270	Stockton, CA	32,978	1,780,881	1,813,859
4720	Tacoma, WA	5,354,244	17,044,956	22,399,200
2021	Tampa, FL	23,005,959	11,196,120	34,202,079
2404	Texas City, TX	16,515,074	40,075,782	56,590,856
4947	Unalaska Island, AK	429,856	624,560	1,054,416
4816	Valdez, AK	31,902,056	0	31,902,056
4636	Vancouver, WA	2,019,272	6,371,213	8,390,485
2411	Victoria, TX	2,792,180	0	2,792,180
554	Wilmington, DE	1,448,879	3,375,984	4,824,863
766	Wilmington, NC	2,617,086	4,811,074	7,428,160
2348	Huntington - Tristate	61,521,942	0	61,521,942

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