

## REPORT SUMMARY

### Lake Worth Inlet, Palm Beach Harbor, Palm Beach County, Florida Integrated Feasibility Report and Environmental Impact Statement

Feasibility Cost Sharing Agreement:	August 2005
“National Pilot Program for Feasibility Studies” Milestones:	
Decision Point 1 (DP1)	October 21, 2011
Decision Point 2 (DP2)	April 5, 2013

## STUDY INFORMATION

**Study Authority.** House Resolution Docket 2559 dated 25 June 1998 authorized the Lake Worth Inlet study: *“Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Palm Beach Harbor, Florida, published as House Document 283, 86th Congress, 1st Session, and other pertinent reports, with a view of determining if the authorized project should be modified in any way at this time, with particular reference to widening the existing interior channel through Lake Worth Inlet.”*

**Study Sponsor.** The non-Federal sponsor is the Port of Palm Beach.

**Study Purpose and Scope.** This study represents a Feasibility Report with an integrated Environmental Impact Statement (EIS). The inlet, serving as the entrance channel to the port, has not had a Federal project in over 50 years and is inadequate both in width and depth for today’s existing vessel fleet. The major ports closest to Palm Beach Harbor are Port Everglades and Miami Harbor to the south, and Port Canaveral to the north. Although the ports share the same hinterland, the Port of Palm Beach is considered a niche port, meaning one that specializes in a particular cargo or market segment. Most notable at the Port of Palm Beach, is its equipment to handle sugar and molasses. It also specializes in an overnight cruise service to the Bahamas, a day cruise that sails twice daily, and a containership operator that services the Caribbean islands on small container vessels. Like its investment to service sugar and molasses products and associated bulker vessels, the Port of Palm Beach has further embraced its “niche port” status by investing in assets suited to its Caribbean cargo market and cruise operators. Based on existing vessel sizes, the port is operating with insufficient channel width and depth. These deficiencies cause the local harbor pilots in conjunction with the U.S Coast Guard to place restrictions on vessel transit to ensure safety. In turn, these restrictions lead to light loading, tidal delays, and maneuvering difficulties – resulting in economic inefficiencies that translate into costs to the national economy.

The purpose of this study and report is to address these issues and to determine the feasibility of improvements to the Federal navigation project, both non-structural and structural, at Lake Worth Inlet and at the Port of Palm Beach.

**Project Location/Congressional District.** Lake Worth Inlet connects Palm Beach Harbor to the Atlantic Ocean. The closest major ports to Palm Beach Harbor are Port Everglades, in Ft. Lauderdale, and Miami Harbor, approximately 40 miles and 65 miles to the south, respectively.

Canaveral Harbor is approximately 90 miles to the north. The harbor entrance (also known as Lake Worth Inlet) is an artificial cut through the barrier island and limestone formation connecting Lake Worth, a coastal lagoon, with the Atlantic Ocean. Lake Worth Inlet contains a federally authorized channel and associated features that support a deepwater port located on the Atlantic Ocean in Palm Beach County, Florida. Lake Worth Inlet is in the FL-18, FL-20, and FL-22 Congressional District. Congressional representatives Patrick Murphy, Alcee Hastings, and Lois Frankel support efforts to investigate solutions to the navigation congestion problems.

**Prior Reports and Existing Projects.** The table below (Table 1) depicts authorizations in the Lake Worth Inlet channel. Other Federal authorized projects adjacent to Lake Worth Inlet are the Lake Worth Inlet Sand Transfer Plant and the Peanut Island Environmental Enhancement Project.

**Table 1: Related Authorizations.**

DATE	WORK AUTHORIZED	DOCUMENTS
March 13, 1934 P.W.A. Program	Maintenance of improvements previously constructed by local interests.	H.Doc 185/73/2
August 30, 1935	Authorized work previously approved by the P.W.A. and restoration of jetties, removal of south point, revetment of banks, widening of channels, and enlargement of turning basin.	H.Doc. 185/73/2 and R&H Comm. Doc 42/74/1
December 10, 1935 P.W.A. Program	Deepening channels and turning basin to 20 feet.	Recommended by U.S. Army Corps of Engineers to P.W.A., October 17, 1934
March 2, 1945	Deepening channels and turning basin to 25 feet.	H.Doc 530/78/2
May 17, 1950	Extending turning basin southward 550 feet.	H. Doc 704/80/2
July 14, 1960	Deepening channels to 35 and 33 feet and enlarging turning basin.	H.Doc 283/86/1
November 17, 1986	Maintenance of locally expanded turning basin to a depth of 25 feet on north side of existing basin.	Public Law 99-662
July 11, 1992	Authorized Port of Palm Beach to deepen the northern side of existing basin from 25 feet to 33 feet.	Permit Number 199130682
December 23, 2011	FY11 Request to Construct and Maintain Additional Advance Maintenance Features, Palm Beach County, FL	Memorandum

## Existing Projects.

- a. Lake Worth Inlet Federal Project. The existing project is shown in REF-2 (foldout, located on the last page the of this report), and is currently authorized to the dimensions shown in

**Table 2: Existing Federal Project Features.**

	<b>Authorized Depth (feet)</b>	<b>Width (feet)</b>	<b>Length (miles)</b>
Entrance Channel	35	400	0.8
Inner Channel	33	300	0.3
Main (South) Turning Basin	33	1200 (diameter)	n/a
North Turning Basin	25	n/a	n/a

- b. Lake Worth Inlet Sand Transfer Plant. The Lake Worth Inlet sand transfer plant (REF-2), a Federal project and locally maintained, is located on the west end of the north jetty and is operational year-round. Its purpose is to pump 160,000 cy of sand per year from the vicinity near the settling basin through a 12 inch pipeline below the inlet to three discharge points located at 750 feet, 1250 feet, and 1750 feet along the beach south of the inlet. The quantity of sand it pumps was determined from the 1996 Chief's Report which was based on the 1996 Coast of Florida Report which indicates that the Federal Navigation Project at Lake Worth Inlet is responsible for 67% of the downdrift erosion, or 160,000 cy per year. Through Section 111, the Sand Transfer Plant is funded 100% Federal, with Operation and Maintenance carried out and funded by the project's non-federal sponsor, the Town of Palm Beach. It has been recently upgraded with a new electrical service, pump, and intake structure.
- c. Peanut Island Environmental Enhancement Project Section 1135. See REF-2. Peanut Island was created in 1918 as a result of material excavated when the Lake Worth Inlet was created. Peanut Island, originally called Inlet Island, amounted to only ten acres. In 1923 the Port of Pam Beach was using the island as a spoil site for the maintenance of the inlet and the Port shipping channel. In 1991, the Port sold the northern half of the island to the Florida Inland Navigation District (FIND) as a spoil site for the Intracoastal Waterway maintenance dredging. The primary use of the island is as a spoil site but the Port of Palm Beach and FIND have made the perimeter of the island available to the public as a park through an agreement with Palm Beach County.

The Peanut Island Environmental Enhancement Project Section 1135 was completed in 2005 with the following partners: U.S. Army Corps of Engineers, Palm Beach County, Florida Department of Environmental Protection, Florida Inland Navigation District, Port of Palm Beach, the U.S. Department of Agriculture, and the Florida Fish and Wildlife Conservation Commission. The project added environmental enhancement features on Peanut Island to include reef, lagoons and upland habitats and clearing exotic plant species. The project also

created public access features including floating docks, bridges, boardwalks and swim platforms.

**Other Studies.** Related National Environmental Policy Act (NEPA) documents are listed below:

- Feasibility Report and Environmental Assessment, Palm Beach Harbor, Florida. 1984.
- Environmental Impact Statement, Coast of Florida Erosion and Storm Effects Study Region III, Palm Beach, Broward, and Dade Counties, Florida. October 1996.
- Environmental Assessment and Finding of No Significant Impact, Maintenance Dredging, Palm Beach Harbor, Palm Beach County, Florida. October 1998.
- Environmental Assessment, Section 107 Small Navigation Project, Palm Beach Harbor-Lake Worth Access Channel Expansion, Palm Beach County, Florida. 2001.
- Environmental Assessment, Sand Transfer Plant Rehabilitation and Extended Outfall, Palm Beach Harbor- Lake Worth Inlet, Palm Beach County, Florida. May 2004.
- Revised Environmental Assessment, Sand Transfer Plant Rehabilitation and Addition of Second Discharge Point and Permanent Booster Pump, Palm Beach Harbor-Lake Worth Inlet, Palm Beach County, Florida. August 2006.
- Environmental Assessment, Palm Beach Harbor Operations and Maintenance Activities, Palm Beach Harbor-Lake Worth Inlet, Palm Beach County, Florida. January 2012.

**Federal Interest.** There is Federal interest in this project. This harbor is providing valuable services, commodities, and jobs to the community. The Port of Palm Beach is the fourth busiest container port in Florida and the eighteenth busiest in the continental United States. The port is positioned well for growth due to its access to inter-modal capabilities, as well as its acreage available for warehousing. The port has evolved into an export port (one of only 11 in the United States) and is a major nodal point for the shipment of bulk sugar, molasses, cement, utility fuels, produce, and breakbulk items. Demand for all of the major commodities is anticipated to increase through 2067. Located in the heart of south Florida's tourism enclave, the port also serves significant recreational boat traffic. In addition, the Bahamas Celebration cruise ship is based at the port. There are specific problems within the harbor, such as insufficient channel width and channel depth, which are creating transportation delays to the economy and safety concerns to the harbor pilots and community.

The Water Resources Development Act of 1986 (Public Law 99-662) as amended, specifies cost apportionment by project purpose for deep draft navigation projects. Federal participation in navigation projects is limited to sharing costs for design and construction of general navigation features (GNF) consisting of breakwaters and jetties, entrance and primary access channels, widened channels, turning basins, anchorage areas, locks, and dredged material disposal areas with retaining dikes. Non-Federal interests are responsible for and bear all costs for acquisition of necessary lands, easements, rights-of-way and relocations; terminal facilities; and dredging berthing areas and interior access channels to those berthing areas. For a commercial navigation project with project depths greater than 20 feet but not in excess of 45 feet, the non-Federal share for the construction is 25 percent. Lands, easements, rights-of-way, and relocations (LERRs) are 100 percent non-Federal costs.

This project meets these definitions for Federal interest. Project implementation will generate approximately \$3,980,000 in average annual net benefits with a benefit-to-cost ratio of 2.0.

## **STUDY OBJECTIVES**

### **Problems and Opportunities.**

The existing conditions in Palm Beach Harbor cause navigation and economic problems within Lake Worth Inlet. The problems are that vessels are restricted by light loading, tidal delays, and maneuvering difficulties due to three navigation concerns:

1. **Insufficient Depth:** Depths are limited to 33 feet in the inner entrance channel and turning basin.
2. **Insufficient Width:** The channel width decreases from 400 feet to 300 feet at a turn in the inner entrance channel, limiting the safe transit of vessels. The turning basin dimensions also limit the vessel size that can safely turn.
3. **Currents:** The proximity of the Gulf Stream current to the entrance channel and perpendicular direction to the channel make entering the entrance channel and slowing to safe speeds problematic. Additional currents occur in the Area C on ebb tide that effect the turning of vessels to stay in the channel.

Opportunities are positive conditions in the study area that may result from management measures. The opportunity at Palm Beach Harbor is more efficient navigation maneuvering (mainly to benefit bulker vessels carrying cement and concrete, tanker vessels carrying liquid petroleum, asphalt, and molasses, and the *Bahamas Celebration* cruise ship), resulting in a reduction in light loading, tidal delays, easier, and reduced frequency of operation and maintenance dredging intervals.

**Planning Objectives.** The plan formulation was based on the following project objectives, while keeping the constraints in mind:

- Reduce transportation costs caused by vessel light loading, tidal delays, or other transportation costs for commercial navigation relating to insufficient depth in the main turning basin and from the entrance channel to the inner channel, beginning in 2017.
- Reduce navigation concerns and improve vessel safety in the harbor relating to insufficient width, in areas A-1, A-2, B, C, D, F, and G, beginning in 2017.
- Maintain or improve operations and maintenance dredging intervals within the Federal channel, in conjunction with the options provided in the “FY11 Request to Construct and Maintain Additional Advance Maintenance Features, Palm Beach Harbor, Palm Beach County, Florida,” approved December 23, 2011.

With these objectives as the target, appropriate management measures were developed.

## Planning Constraints.

- Avoid or minimize potential impacts on manatees and marine grass beds.
- Avoid or minimize impacts on environmental resources including seagrass, hardbottom and softbottom resources found in the study areas A1, A2, B, C, D, F, and G.
- Avoid adverse impacts of shoreline erosion in proximity to Lake Worth Inlet.

## ALTERNATIVES

**Plan Formulation Rationale.** The Four Accounts are established in the Principles and Guidelines (P&G 1983) to facilitate the evaluation and display of effects of alternative plans. The national economic development (NED) account displays changes in the economic value of the national output of goods and services, the environmental quality (EQ) account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of ecosystem restoration plans, the regional economic development (RED) account displays changes in the distribution of regional economic activity (e.g., income and employment), and the other social effects (OSE) account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others. The NED plan must also meet the test of four additional criteria: completeness, effectiveness, efficiency, and acceptability. The criteria are used in the building of alternatives; the four accounts are used in addition to the planning objectives and constraints in evaluating alternative plans.

**Management Measures and Alternative Plans.** A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. Management measures are used to create plans and can be categorized as non-structural or structural. The following measures were identified to reduce light loading, tidal delays, and maneuvering difficulties at Lake Worth Inlet.

Of the variety of measures considered during the feasibility phase, some were found infeasible due to technical, economic, or environmental constraints, and are described below in the following sections. The remaining feasible measures were formulated into alternative plans. The measures considered are listed below:

- **No Action:** For this measure, no action would be taken to deepen or widen Lake Worth Inlet. This measure is always considered during the planning process.
- **Non-Structural (an activity)**
  - Non-Structural Measure 1 (Tug Assists): Use additional tug assists to help larger vessels and vessels with decreased maneuverability transit the existing harbor.

- Non-Structural Measure 2 (High-Tide Transiting): Time transits to use high tide to allow for the current fleet to transit the harbor under existing project conditions.
- Non-Structural Measure 3 (Light-Loading): Light-load the larger vessels to allow the current fleet (larger than the existing project's design vessel) to transit the harbor under existing project conditions.
- **Structural (construction/assembly on-site)**
  - Maintenance Feature 1: Reconfigure the newly authorized expanded settling basin, which was constructed in the fall of 2012, to more effectively catch material before it enters the entrance channel.
  - Maintenance Feature 2: Consider additional advance maintenance of highest shoaling areas in the entrance channel.
  - Channel Deepening: Analyze deepening of the entrance channel, inner channel, main turning basin, and northern turning basin in one-foot increments from a 34-foot to a 43-foot project depth.
  - Channel Widening: See the descriptions below.

**Specific Widening Measures.** Widening measures were identified in key areas (shown on REF-3) to solve specific problems and are discussed as follows:

- A-1 (South Entrance Channel Flare Widening): Widen the outer portion of the Entrance Channel from Station 0+00 to just outside of the tip of the south jetty. This area would provide more width for vessels as they enter the entrance channel when they encounter the strong Gulf Stream current as they approach the inlet from the south to north. Note that dredging is required only for the inner portion of the flare due to naturally deep water in the outer portion.
- A-2 (North Entrance Channel Flare Widening): Widen the outer portion of the Entrance Channel from Station 0+00 to just outside of the tip of the north jetty. This area would provide more width for vessels entering the entrance channel due to swells to the north of the entrance channel. Note that dredging is required only for the inner portion of the flare due to naturally deep water in the outer portion.
- B-1 (Inner Channel Widening): Widen the inner portion of the Entrance Channel from just outside of the Jetties to Cut-1 by 100 feet to the south. This would provide a larger margin of error to prepare for the sharp turn when the channel narrows to 300 feet.
- B-2 (Inner Channel Widening): Widen the inner portion of the Entrance Channel from just outside of the Jetties to Cut-1 by 100 feet to the north. This would provide a larger margin of error to prepare for the sharp turn when the channel narrows to 300 feet.

- C (Inner Channel Turn Widener): Add a turn widener along the north side of Area C. The widener would provide for a 400 foot of channel width at the widest point of the widener. This would allow a larger margin of error, due to the ebb tide, when currents move across the area in a northeasterly direction causing dangerous currents at a critical point of transition to smaller width near rock outcroppings.
- D (Peanut Island Widener): The Peanut Island Widener (Area D) would expand the radius of the Southern Turning Basin by approximately 290 feet. The *Bahamas Celebration* must make a sharp turn when backing out to avoid the shoal at the south side of Peanut Island. This turn prevents cargo vessels from berthing at Berth 6 (opposite Berths 2-3 in Slip 1) when the cruise ship is present. There are also suction effects during flood tide which affect maneuverability. This measure would allow a larger margin of error around Peanut Island, for better maneuverability and would allow cruise vessels to have a straight back departure, which would allow containerships to access berth 6 when cruise is present. This would allow for increased safety in turning near Peanut Island, due to the suction effects from currents on the flood tide. The actual dimensions of the required dredging area are approximately 290 feet by 910 feet.
- E (Northern Turning Basin Widener): The Northern Turning Basin Expansion Area (Area E) would extend the Northern Turning Basin 250 feet to the north. This would allow for a larger turning radius for cruises if the existing cruise terminal were to be expanded. The actual dimensions of the required dredging area are approximately 250 feet by 400 feet.
- F (Main Turning Basin Widener): The Southern Turning Basin widener (Area F) would provide approximately 275 feet of additional width to the Southern Turning Basin. This would allow a larger turning radius for larger vessels. The actual dimensions of the required dredging area are approximately 275 feet by 1800 feet.
- G (South Main Turning Basin Widener): The Southern Basin Expansion Area (Area G) would extend the Southern Turning Basin 1300 feet to the south. This would allow for a larger turning radius for larger vessels. The actual dimensions of the required dredging area are approximately 1300 feet by 1500 feet.

**Measures Eliminated.** Non-structural measures may be combined with structural measures to achieve project objectives, but non-structural measures cannot stand alone, since they are already being used to every extent possible in the current project. Waiting for high tide, vessel light loading, and tug assistance are non-structural measures which are already used, and are not considered further as stand-alone options; however, they are inherently complementary with all other measures carried forward.

Area E was eliminated as a measure early on in the process, as requested by the Port of Palm Beach, as they no longer were going to consider expansion of the cruise terminal to the north. (See letter dated February 13, 2008 in Pertinent Correspondence, Appendix E, Attachment 2). Area A-2 was eliminated during discussions with the pilots since it would not be used frequently, as most vessels approach the channel from the south rather than the north.

**Widening Alternatives.** USACE agreed to ship simulation conducted with the harbor pilots, instead of an incremental widening analysis, to determine minimum vessel widening needs for safety and maneuverability. This decision was made because the real experience of the pilots combined with the ship simulation would be a more effective way to determine the minimum width that would best solve problems in specific areas. Additionally, having one widening footprint would reduce combinations of plans when paired with deepening alternatives and therefore also reduce modeling time and costs.

Widening measures (with the exception of E) were refined based on dialogues with harbor pilots. The pilots shared their experience and historical accounts of harbor transits, and the refined measures were combined into a large and small plan, known as Plan 1 and Plan 2, shown below in Figure 1. In both plans, the channel and turning basin depths were the same; however, widening of those areas is less in Plan 2. Both Plans were simulated in a model at the Simulation, Training, Assessment, and Research (STAR) Center with 2 design vessels: a bulk carrier vessel (fully loaded) and a cruise ship. Plan 2 met design vessel needs for width needed to maneuver safely.

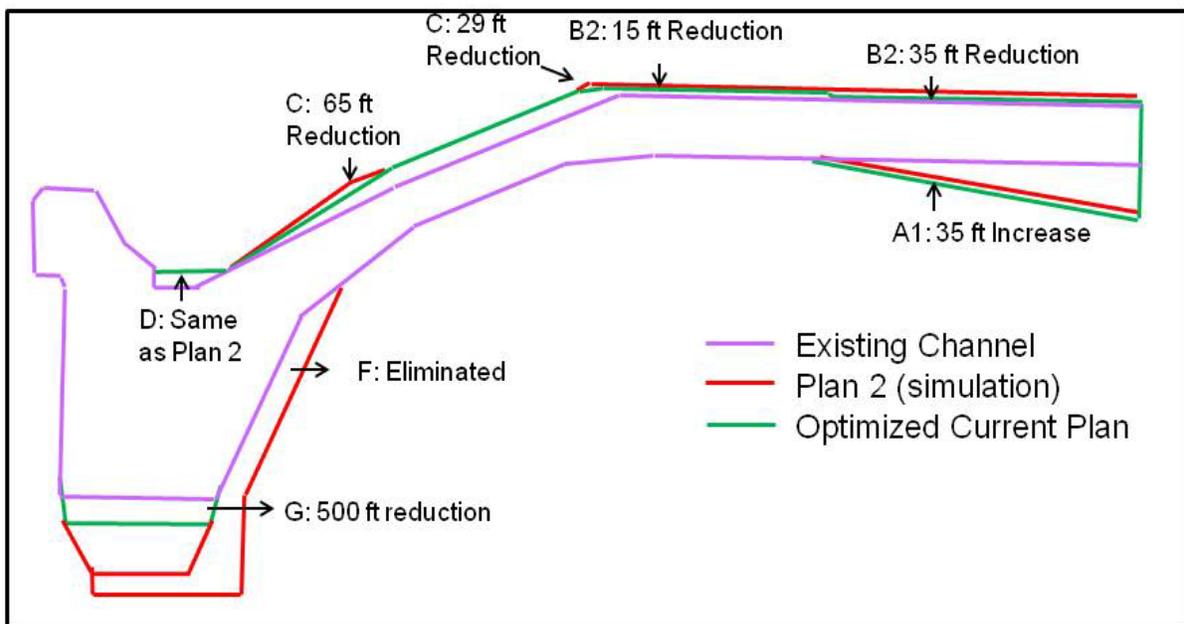
**Figure 1: Plan 1 and Plan 2.**



**Widening Optimization.** Since Plan 2 was considered to be sufficient for maneuvering the design vessels and involves less environmental impact, Plan 1 was discarded. Plan 2 was then further refined during a series of iterative meetings with the harbor pilots. Area F was rarely needed by the pilots in the ship simulation, as shown in the ship tracks, and was thus eliminated from Plan 2. Area G was reduced significantly (14 acres in Plan 2 down to 4.5 acres of seagrass impact in the recommended plan) upon further review of the ship tracks for design bulk vessels,

along with input from the Port of Palm Beach and the harbor pilots, and with consideration to the environmental resources within the area. Area B2 and A1 were slightly modified to accommodate widening while maintaining a safe distance from the north jetty. Area C was reduced in order to optimize the plan to avoid building more project than is necessary for safe and efficient navigation. Area D remained in the plan as modeled and remains an important part of the widening footprint to the port and the harbor pilots for its ability to give safer maneuverability to cruise vessels and allow access for containerships to Berth 6. Figure 2 shows the refinements that were made.

**Figure 2: Plan 2 Optimization.**



The refined Plan 2, known from this point forward as Plan 2, was carried forward as the widening footprint. The final Plan 2 footprint is shown in REF-4.

**Intermediate Array of Alternatives.** Alternatives were formed in the intermediate array which paired the widening footprint (Plan 2) with deepening. Deepening alternatives, with the widening footprint, were formulated in one-foot increments from 34 to 43-foot project depths. A widening-only plan was also evaluated at the existing 33-foot project depth.

During this phase, the USACE economic model HarborSym was used to estimate cost savings, or benefits, that would be captured as a result of more efficient vessels, as well as related savings from reduced time delays. The average annual benefits (or cost savings), were then subtracted from the average annual costs, to determine net benefits. The average annual benefits were also compared to the average annual cost to find the benefit to cost ratios. The National Economic Development plan (NED) must have the highest net benefits of all the plans, and must have a benefit to cost ratio over 1.0. The base year for planning purposes was assumed to be 2017, as a likely year when the project benefits could begin to be realized after construction is completed. The end of the period of analysis would be 50 years from the base year, or 2067. More information on the HarborSym model, assumptions, and calculations can be found in the Socio-Economic Appendix C. Model data is available upon request.

The advance maintenance plan was not included during formulation of the recommended plan; rather, it is included as an optimization and an added benefit after the recommended plan was determined.

For each of the alternatives, total required mitigation was assumed to be the same. This assumption was based on the following: widening of the channel (required footprint already established) is the feature causing impacts to adjacent seagrass and hardbottom communities. Regardless of the proposed depth of the project, acreage of impacts would remain the same between alternatives. While it is true that the ultimate top width is dependent upon the final depth, the relative width increase for each foot of deepening (approximately 3 feet of width) is very small when compared to the actual widening measures that are necessary to accommodate the design vessel (range from 40 feet to over 150 feet of width). The minimal additional top width would not have any impacts on mitigation requirements. Additionally, a conservative impact for the side slopes was assumed which went slightly beyond the impact of the final 39-foot project depth to account for the natural equilibrium of the side slopes. Therefore, regardless of the proposed depth of the project, acreage of impacts would remain the same between alternatives. Seagrass and hardbottoms typically exist at elevations of -6 feet MLLW (the natural lagoon elevation), which is in shallow areas outside of the proposed deepening alternatives. The costs for this exercise were at a rough order of magnitude (ROM) to identify large variations between each alternative. Costs at this level included ROM mitigation costs, ROM dredging with mechanical and hydraulic, and placement at the ODMDS and beach template. Jetty stabilization costs are included for project depths of 41 to 43 feet.

The north and south jetty at the entrance to Lake Worth Inlet are in close proximity to the existing project. Earlier it was discussed that the south jetty currently has an inadequate factor of safety in the existing and future-without project condition. Geotechnical analysis determined

that the south jetty would not be affected by the proposed widening footprint or any of the depths in the intermediate array. Therefore the existing, future without-project conditions and future with-project conditions are the same for the south jetty. The proximity of the alternatives to the north jetty, due to depth and respective width, became a significant factor in cost as depths were evaluated. The combination of proposed deepening and widening alternatives at certain depths has the potential to affect the stability of the existing jetty on the north side. In such a case, jetty stabilization would become a project cost. Geotechnical modeling determined that north jetty stabilization would be required at a project depth of 41 feet. This means, the cost of deepening alternatives from project depths of 41 to 43 feet would also include the cost of north jetty stabilization (a sheet pile wall installed in a linear fashion along the entire length of the jetty, and extended to the project depth). Additional details regarding jetty stability analysis and the proposed sheet pile wall can be found in Engineering Appendix A.

The intermediate array included the widening-only alternative (at existing project depth of 33 feet), and the widening footprint plus incremental depths from 34 to 43 feet. Rough order of magnitude costs for the intermediate array shown in Table 3 included jetty stabilization measures for project depths of 41 to 43 feet.

**Table 3: Intermediate Array (FY12 Price Levels, 3.75% discount rate).**

Project (Depth)	Average Annual Benefits	Average Annual Costs	Net Benefits	BCR
Widening-Only	\$4,116,905	\$2,171,796	\$1,945,109	1.90
34'+ Widening	\$6,245,097	\$2,171,903	\$4,073,194	2.88
35'+ Widening	\$6,900,701	\$2,217,688	\$4,683,014	3.11
36'+ Widening	\$7,556,306	\$2,264,137	\$5,292,169	3.34
37'+ Widening	\$8,211,911	\$2,402,193	\$5,809,718	3.42
38'+ Widening	\$8,779,066	\$2,635,478	\$6,143,587	3.33
39'+ Widening	\$9,346,221	\$2,962,377	\$6,383,844	3.15
40'+ Widening	\$9,768,940	\$3,244,471	\$6,524,469	3.01
41'+ Widening	\$10,191,659	\$3,916,886	\$6,274,773	2.60
42'+ Widening	\$10,530,963	\$4,348,164	\$6,182,798	2.42
43'+ Widening	\$10,870,267	\$4,686,761	\$6,183,506	2.32

Table 3 shows that the 40-foot depth had the highest net benefits, with the 39-foot depth having the next highest net benefits. Additionally, these two depths had net benefits within 1% of one another. Therefore, 1 foot above and 1 foot below those two depths were taken as the boundaries. The end result was that project depths of 38-41 feet became the final array of depths to be evaluated.

**Final Array of Alternatives.** In order to determine the sensitivity of the four alternatives with respect to each other, another level of detailed evaluation was performed including more refined

cost estimates and economic modeling<sup>1</sup> for the depths of 38 to 41 feet. Costs for stabilization of the north jetty were included for the 41-foot depth alternative.

Table 4 shows that the refinement in cost and economic modeling slightly broadened the range of the net benefits between the alternatives. This analysis shows that the 40-foot alternative has the highest net benefits. The 39-foot alternative is within 3% of the 40-foot alternative, but the net benefits for the 38-foot and 41-foot alternatives, respectively, are each more significantly lower than both the 39-foot and 40 foot alternatives.

ER 1105-2-100 (Appendix G, Exhibit G-1) states the following: “Identification of the NED plan is to be based on consideration of the most effective plans for providing different levels of output or service. Where two cost effective plans produce no significantly different levels of net benefits, the less costly plan is to be the NED plan, even though the level of outputs may be less.”

**Table 4: Final Array (FY12 Price Levels, 3.75% discount rate).**

<b>Project (Depth)</b>	<b>Average Annual Benefits</b>	<b>Average Annual Costs</b>	<b>Average Annual Net Benefits</b>	<b>BCR</b>
38'+Widening	\$6,416,498	\$2,982,771	\$3,433,727	2.15
39'+Widening	\$7,325,811	\$3,311,091	\$4,014,720	2.21
40'+Widening	\$7,746,616	\$3,599,861	\$4,146,755	2.15
41'+Widening	\$7,793,759	\$4,297,090	\$3,496,669	1.81

Table 4 shows that the 39-foot alternative produces just 3% lower net benefits than the 40-foot alternative, and is also the less costly plan of the two alternatives. Therefore, when the guidance referenced above from ER 1105-2-100 is applied, the 39-foot alternative becomes the National Economic Development (NED) plan. The benefit to cost (B:C) ratio is also the highest of the four alternatives, at 2.21 to 1.

**Recommended Plan.** The 39-foot depth with widening footprint is the recommended plan and is shown in REF-4.

The widening footprint includes the addition of a new channel flare on the south side of the entrance channel, a widening of the entrance channel by 40 feet and 60 feet (varies) to the north, widening the inner harbor to provide for a minimum channel width of 450 feet, a 150-foot expansion of the Southern (Main) Turning Basin to the south, and an expansion of the Southern (Main) Turning Basin on the north side to remove a notch currently encroaching into the basin.

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<sup>1</sup> In this round, the costs were estimated at a greater level of detail with more information, and the economic model for each alternative was run with more iterations, making the benefits more refined. Notes: FY12 costs were used and annualized at a discount rate of 3.75% over 50 years.

The inner channel would be deepened to a project depth of 39 feet. The plan includes an improved settling basin, improved advance maintenance plan, and sheet pile on the north jetty, for stabilization due to the close proximity of dredging to the existing jetty in that area for the improved advance maintenance plan.

The plan will generate 1.4 million cy of material which will be placed at the ODMDS. It will also generate 450,000 cy of sand which will be placed in the nearshore, south of the inlet, below the Mean High Water (MHW) line and filling landward to seaward. As a result of the improved advance maintenance plan, O&M events will change from dredging approximately 117,500 cubic yards of sand every year on average to approximately 240,000 cubic yards of sand every two years (there will be a 2,500 cubic yard per year increase in shoaling from the project). All material from O&M events is anticipated to be sand and will continue to be placed south of the inlet, on the beach or in the nearshore. Mitigation compensation for seagrasses will likely be required and is not expected to exceed 11.25 acres of beneficial dredge material placement based on conservative calculations completed by USACE using the HEA model; mitigation compensation for hardbottom will likely be required and is not expected to exceed 9.8 acres of artificial reef creation based on conservative calculations completed by USACE using the HEA model. In addition, it is possible these acreages could decline during the PED phase of the project. An array of potential mitigation sites will be carried forward through the feasibility phase, and into pre-construction, engineering and design (PED), when a final site determination for each will be made. After final refinements in modeling and cost estimating, as well as application of a risk based contingency, the total project cost is estimated at \$88.531 million (without Interest During Construction), with a benefit to cost ratio of 2.0 to 1.

**Environmental Operating Principles.** Consistent with NEPA, the USACE has reaffirmed its commitment to the environment by formalizing a set of “Environmental Operating Principles” applicable to all its decision making and programs. The U.S. Army Corps of Engineers-Environmental Operating Principles (EOPs) were considered during each step of the plan formulation process. These principles foster unity of purpose on environmental issues and ensure that environmental conservation, preservation, and restoration are considered in all USACE activities. USACE Environmental Operating Principles are addressed for this project as follows: 1) Throughout the planning process, the team strived for minimization of impacts to the surrounding environment and will mitigate for any losses within as close a proximity to the area of loss as possible to maintain the same level of quality of the environment; 2) the interdependence of the built environment, navigation environment, economics environment, and living environment remained evident and each project measure was carefully considered for all elements; 3) The project uses dredged material to restore seagrass beds in formerly dredged holes, thus keeping material within the system. While the project is required to mitigate for a certain amount of acreage, there is potential to use as much project material as allowable to fill the dredged holes more to create even more seagrasses, thus using the project to support the environment. Although quarry rock is proposed currently for hardbottom mitigation, there may still be potential to use native rock from the project to create reefs, if it meets required state standards. Beach quality sand from dredging operations will be placed on the nearshore to support the natural systems and add to human recreational opportunities; 4) Each element of human health, welfare, and viability of natural systems was thoroughly assessed throughout this report in a responsible manner; 5) Cumulative impacts to the environmental were thoroughly

assessed in this report and any impacts have been thoroughly evaluated with a fair mitigation plan; 6) The USACE collected a great deal of information throughout the preparation of this study which has been thoughtfully prepared and organized in a manner so as to facilitate a greater knowledge base about the area, its challenges, and the opportunities which can be achieved; The USACE worked with many agencies, individuals, and groups throughout this study, sharing scientific, economic and social information and exchanging ideas for the betterment of a design that will find solutions to the problem while maintaining the level of quality within the surrounding environment.

Sustainability can only be achieved by the combined efforts of Federal agencies, tribal, state and local governments, and the private sector, each doing its part, backed by the citizens of the country.

In accordance with the NEPA, an information letter was sent to interested parties on December 6, 2007. A Notice of Intent (NOI) was published in the Federal Register (Volume 72, No 239: Pages 70825-70826) December 13, 2007 to advertise the intent of USACE to write an Environmental Impact Statement. A public meeting was held January 9, 2008 at the Port of Palm Beach to discuss the proposed project. Written comments from Federal, state, and local governmental agencies, various private and non-profit organizations, and individuals are included in Pertinent Correspondence Appendix E along with the official responses from USACE.

Federal agencies invited to attend meetings and provide comments throughout the scoping and public involvement process included the USACE, U.S. Coast Guard (USCG), U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS). State agencies included the Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FFWCC), State Historic Preservation Office (SHPO), and the Florida Department of Transportation (FDOT).

The Notice of Availability (NOA) of the Draft Feasibility Report and Environmental Impact Statement (FR/EIS) was published in the Federal Register (Volume 78, No 76: Page 23558) April 19, 2013 to initiate the 45 day public review comment period. A public meeting was held May 9, 2013 at the Port of Palm Beach to present the tentatively selected plan described in the Draft FR/EIS.

#### **Agency Technical Review / Independent External Peer Review.**

**ATR:** An external Agency Technical Review (ATR) of the draft report was performed by a multi-disciplinary team consisting of technical staff from USACE Districts. The ATR team membership and the scope of ATR work were coordinated with the USACE National Deep Draft Navigation Planning Center of Expertise (DDNPCX). All comments were resolved.

In general, the ATR team found that the information presented in the report describing the plan formulation and evaluation supported the selection of the recommended plan. Certification was given in March 2013.

Final ATR was conducted as a backcheck of draft report PGM, Public, and IEPR comments and was certified on August 13, 2013.

**IEPR:** IEPR was conducted beginning on May 9, 2013 and the IEPR Panel's final BackCheck Responses were entered into the DrChecks system, and DrChecks was closed-out for this project by the IEPR Panel on July 16, 2013.

## **EXPECTED PROJECT PERFORMANCE**

**Project Costs, Equivalent Annual Costs and Benefits.** The recommended plan includes:

- the addition of a new channel flare on the south side of the Entrance Channel,
- a widening of the Entrance Channel by 40 feet and 60 feet (varies) to the north,
- widening of Inner Harbor Cuts 1 and 2 to provide for a minimum channel width of 450 feet,
- a 150-foot expansion of the Southern (Main) Turning Basin to the south, and
- an expansion of the Southern (Main) Turning Basin on the north side to remove a notch currently encroaching into the basin.
- Improved maintenance plan: settling basin, advance maintenance, and associated jetty stabilization

The channel would be deepened to a project depth of 39 feet Mean Lower Low Water (MLLW) plus an additional 2 feet of required overdepth and 1 foot of allowable overdepth. The plan includes an improved advance maintenance plan and sheet pile on the north jetty, for stabilization due to the close proximity of dredging to the jetty in that area. Advance maintenance and jetty stabilization were not included in the plan formulation screening, as they are considered to be optimizations to the recommended plan. The recommended plan produces the needed improvements to increase safety and economic efficiency (resulting in transportation cost savings), and to reduce the frequency of maintenance dredging within Lake Worth Inlet. There are no local facility costs associated with the project cost, since the Port of Palm Beach is in the process of improving the Slip 3 bulkhead and deepening Slip 3, as an existing/future without-project condition. The Recommended Plan has a benefit-to-cost ratio (BCR) of 2.0 to 1.0 with AAEQ Net Benefits of \$3,980,000. AAEQ Benefits equal \$7,940,000 and AAEQ Costs equal \$3,960,000. Table 5 outlines the project costs.

**Table 5: Cost Summary.<sup>1</sup>**

WBS Number	General Navigation Feature (GNF)	Project cost	23% Contingency (CSRA)	Total Project Cost	Federal Share	Non-federal Share
12	Mob, Demob, Mech& Pipeline (w/ seagrass mit)	\$50,863,000	\$11,698,000	\$62,561,000	\$46,920,750	\$15,640,250
6	Hardbottom Mitigation	\$10,708,000	\$2,463,000	\$13,171,000	\$9,878,250	\$3,292,750
30	PED	\$2,111,000	\$486,000	\$2,597,000	\$1,947,750	\$649,250
31	Construction Management	\$5,087,000	\$1,167,000	\$6,254,000	\$4,690,500	\$1,563,500
10	Sheetpile wall (north jetty)	\$2,135,000	\$491,000	\$2,627,000	\$1,970,250	\$656,750
6	5 yr monitoring	\$1,049,000	\$241,000	\$1,290,000	\$967,500	\$322,500
	<b>Subtotal Construction of GNF<sup>2</sup></b>	<b>\$72,000,000</b>	<b>\$16,500,000</b>	<b>\$88,531,000</b>	<b>\$66,375,000</b>	<b>\$22,125,000</b>
1	RE Admin <sup>3</sup>	\$25,000	\$7,000	\$32,000	\$19,000	\$13,000
	<b>Total Project First Cost<sup>4</sup></b>	<b>\$72,000,000</b>	<b>\$16,600,000</b>	<b>\$88,531,000</b>	<b>\$66,394,000</b>	<b>\$22,138,000</b>
12	Aids to Navigation <sup>5</sup>	\$20,000	\$5,000	\$25,000	\$25,000	
	Credit for non-federal LERR <sup>6</sup>				\$13,000	-\$13,000
	10% GNF non-federal <sup>7</sup>				-\$8,850,000	\$8,850,000
	<b>Total Cost Allocation<sup>8</sup></b>	<b>\$72,000,000</b>	<b>\$16,600,000</b>	<b>\$88,556,000</b>	<b>\$57,581,000</b>	<b>\$30,975,000</b>

<sup>1</sup>Cost is based on Project First cost (constant dollar basis) on Total Project Cost Summary spreadsheet, which includes 0.5% escalation to program year 2014 at effective price level 1 Oct 13 (Cost Appendix, page 34).

<sup>2</sup>75% Federal/25% non-federal including the cost of the improved advance maintenance plan.

<sup>3</sup>RE Admin costs. There are no actual lands and damages but per USACE regulations, RE admin costs will be placed in the 01 account. Additional RE costs will be cost shared according to the GNF. Escalation from the TPCS accounts for some numerical differences.

<sup>4</sup>These costs have been rounded.

<sup>5</sup>Navigation Aids - 100% Federal (U.S. Coast Guard cost, not USACE cost)

<sup>6</sup>LERR Adjustment credit of 01 account (non-fed) not to exceed 10% of GNF.

<sup>7</sup>Project cost sharing also includes the sponsor paying an additional 10% of the construction of GNF over a period of 30 years. The value of LERR will be credited toward the additional 10%.

**Cost Sharing.** The Water Resources Development Act of 1986 (Public Law 99-662) as amended, specifies cost apportionment by project purpose for deep draft navigation projects. Federal participation in navigation projects is limited to sharing costs for design and construction of general navigation features (GNF) consisting of breakwaters and jetties, entrance and primary access channels, widened channels, turning basins, anchorage areas, locks, and dredged material disposal areas with retaining dikes. Non-Federal interests are responsible for and bear all costs for acquisition of necessary lands, easements, rights-of-way and relocations; terminal facilities; and dredging berthing areas and interior access channels to those berthing areas.

Title I Section 101 of WRDA 1986 requires the project sponsor to bear a percentage share of harbor construction for project components that are cost shared (general navigation features, mitigation) that varies according to the range of water depths where work is to be done. That cost share is paid during construction.

For a commercial navigation project with project depths greater than 20 feet but not in excess of 45 feet, the non-Federal share at the time of the construction is 25 percent. The percentage applies as well to mitigation and other work cost shared the same as general navigation features. Lands, easements, rights-of-way, and relocations (LERRs) are 100 percent non-Federal costs. Operation and maintenance of the general navigation features with a 100 percent commercial vessel navigation project are a 100 percent Federal responsibility. The project sponsor will pay an additional amount equal to 10 percent of the total construction cost for general navigation features. This may be paid over a period not to exceed thirty years, and LERRs may be credited against it. Table 5 shows the total cost sharing summary of the NED plan. Table 6 summarizes the cost sharing percentages.

**Table 6: Cost Sharing.**

Feature	Federal Cost %1	Non-Federal Cost % 1
<b>General Nav. Features (GNF)</b>	· 90% from 0' to 20'	· 10% from 0' to 20'
	· 75% from 20' to 45'	· 25% from 20' to 45'
	· 50% 46' and deeper	· 50% 46' and deeper
Mitigation	· 75%	· 25%
GNF's costs for this project include: mobilization, all dredging costs, and all disposal area construction costs.		
<b>Navigation Aids</b>	· 100%	· 0%
<b>Operation and Maintenance</b>		
GNF	· 100% except cost share 50% costs for maint. > 45 feet	· 0% except cost share 50% for maint. > 45 feet
(1) The Non-Federal Sponsor shall pay an additional 10% of the costs of GNF over a period of 30 years, at an interest rate determined pursuant to Section 106 of WRDA 86. The value of LERR shall be credited toward the additional 10% payment.		

**Project Implementation.** The U. S. Army Corps of Engineers is responsible for budgeting for the Federal share of construction costs for all future work for Federal projects. Federal funding is subject to budgetary constraints inherent in the formation of the national civil works budget for a given fiscal year. The USACE would perform the necessary preconstruction engineering and design needed prior to construction. Cost sharing will be in accordance with WRDA 1986, as amended, subject to the availability of appropriations and concurrence with the coastal zone consistency determination.

**Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R).** The Federal Government would be responsible for operation and maintenance of the navigation improvements proposed in this report upon completion of the construction contract. The Federal Government currently maintains the existing project. The contractor would be responsible for all maintenance during the construction contract.

As a result of the improved advance maintenance plan, O&M events will change from dredging approximately 117,500 cubic yards of sand every year on average to dredging approximately

240,000 cubic yards of sand every two years (there will be a 2,500 cubic yard per year increase in shoaling from the project). All material from O&M events is anticipated to be sand and will continue to be placed south of the inlet, on the beach or in the nearshore.

Post-construction mitigation monitoring will be conducted annually for five years and will be cost shared with the non-federal sponsor, 75% Federal and 25% non-federal.

The U.S. Coast Guard (USCG) would be responsible for providing and maintaining navigation aids.

**Key Social and Environmental Factors.** Conservation measures were a major focus during the plan formulation phase for the proposed project, due to the presence of seagrass and manatees within potentially widened areas. The original widening footprint (Plan 2) was further refined during a series of iterative meetings with the harbor pilots. Area F was rarely needed by the pilots in the ship simulation, as shown in the ship tracks, and was thus eliminated from Plan 2. Area G was reduced significantly (14 acres in Plan 2 down to 4.5 acres of seagrass impact in the recommended plan) upon further review of the ship tracks for design bulk vessels, along with input from the Port of Palm Beach and the harbor pilots, and with consideration to the environmental resources within the area.

For each of the alternatives, total required mitigation was assumed to be the same for each depth. This assumption was based on the following: widening of the channel (required footprint already established as described above) is the feature causing impacts to adjacent seagrass and hardbottom communities. Regardless of the proposed depth of the project, acreage of impacts would remain the same between alternatives.

Impacts caused by the total project include losses of 4.5 acres of seagrass habitat and 4.9 acres of low relief hardbottom habitat, for which mitigation will be required where new construction dredging is proposed. Mitigation compensation of 11.25 acres for seagrass impacts is under negotiation between USACE and Federal and state agencies as the HEA model results are discussed. Final mitigation compensation amounts will be known in the pre-construction, engineering and design (PED) phase. 9.8 acres is proposed for hardbottom mitigation based on hardbottom coverage from recent surveys of the project area. For cost estimating purposes, a conservative estimate of mitigation acreages was used (11.25 acres for seagrass and 11.25 acres for hardbottom) based on conservative calculations completed by USACE using the HEA model.

An array of potential sites are under consideration for mitigation. Turtle Cove and Little Lake Worth were originally considered but were strongly opposed by local residents during the public review period and will not be considered for further evaluation within this study. For the remaining sites, not all sites will be needed, and one or more could be used depending on capacity. It is possible that some of these sites may no longer be available at the time of construction. For this reason, sites will be reassessed in more detail in the PED (pre-construction, engineering, and design) phase closer to construction.

During the colder months, high numbers of manatees aggregate at the Florida Power and Light Riviera Plant south of Area G. Deepening and widening the channels in Lake Worth Inlet is not

expected to result in any change of use by manatees. Though some foraging acreage would be lost in Areas D and G, mitigation for seagrass impacts would be completed. No changes to manatee/vessel interactions within the harbor are expected as a direct result of the expansion project. Protective measures would be taken to ensure the safety of manatees when waterborne workboats are used, including having an observer(s) aboard the dredging equipment to maintain a watch for manatees during dredging operations and during the dredge transit to and from the disposal site.

The purpose of the proposed action is to provide increased safety, efficiency, and lower costs for navigation while protecting the environment. The proposed activity would not (a) exclude persons from participation in, (b) deny persons the benefits of, or (c) subject persons to discrimination because of their race, color or national origin, nor would the proposed action adversely impact "subsistence consumption of fish and wildlife." The proposed project would benefit shipping and the general economy including minority and low income populations. Furthermore, construction activities and any additional trucking/commerce that would be due to the project is not anticipated to disproportionately affect economically disadvantaged residential areas or persons belonging to minority groups. Construction traffic and logistic traffic use commercial traffic routes immediately adjacent to the Port, including U.S. Highways and Interstate highways. Construction activities and any additional trucking/commerce that would be due to the project are not expected to disproportionately affect economically disadvantaged residential areas of persons belonging to minority groups.

**Stakeholder Perspectives and Differences.** Comments received during scoping included the following issues: impacts to seagrass, hardbottom, coral, mangrove, essential fish habitat, migratory birds, manatees, sea turtles, boating, diving, snorkeling, erosion of the shoreline, further interruption of sand flow across the inlet, storm surge, public safety, property values, quality of life, commerce, future of the Port, and the economy. The transcript of the scoping meeting is included in Pertinent Correspondence Appendix E. Comments received during scoping and associated responses can be found in Pertinent Correspondence Appendix E.

Comments received during the review period for the Draft FR/EIS can be found in Pertinent Correspondence Appendix E. A table summarizing comments received on the Draft FR/EIS and USACE responses is also included at the start of the appendix.

In summary, comments received during the Draft FR/EIS comment period included the following issues: opposition to the use of Little Lake Worth and Turtle Cove for seagrass mitigation, concerns over potential impacts to the Blue Heron Bridge dive site, concerns for construction duration and potential impacts to navigation and recreational boating, clarification of economic discussions, storm surge, and potential impacts to nearby infrastructure as a result of the proposed widening.

**Environmental Compliance.** The NEPA document for this project is an EIS. The Draft EIS was coordinated with the Draft Feasibility Report as an integrated document. All public comments were incorporated into the Final EIS. A Draft Record of Decision (ROD) has been included in the report submittal package.

**Certification of Peer, Agency, Cost and Legal Review.**

IEPR Certification	July 16, 2013
Draft ATR Certification	March 2013
Final ATR Certification	August 13, 2013
Cost Certification	August 9, 2013
Legal Review Certification	August 16, 2013