GALVESTON HARBOR CHANNEL EXTENSION—FEASIBILITY STUDY, HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS

COMMUNICATION

FROM

THE ASSISTANT UNDER SECRETARY OF THE ARMY, CIVIL WORKS, DEPARTMENT OF DEFENSE

TRANSMITTING

THE CORPS' REPORT ON GALVESTON HARBOR CHANNEL EXTENSION—FEASIBILITY STUDY, HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS, FOR FEBRUARY 2017, PURSUANT TO 33 U.S.C. 549a; PUBLIC LAW 91–611, SEC. 216; (84 STAT. 1830)



JULY 27, 2018.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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

MAY 24 2013

The Honorable Paul Ryan
Speaker of the House
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

In response to section 216 of the Flood Control Act of 1970, Public Law 91-611, the Secretary of the Army supports the authorization and construction of the Galveston Harbor Channel Extension (GHCE), Galveston Navigation Channels, Texas. The proposal is described in the report of the Chief of Engineers, dated August 8, 2017, which includes other pertinent documents. The Secretary of the Army plans to implement the project at the appropriate time, considering National priorities and the availability of funds.

This project study was conducted to analyze and formulate improvements for increasing the economic efficiency of commercial navigation on the GHCE. The recommended plan will significantly contribute to the economic efficiency of commercial navigation in the region by deepening a portion of the existing GHCE Project.

The GHCE provides for a deep-draft waterway from the Gulf of Mexico to the City of Galveston. The channel is authorized and maintained at a depth of -46 feet Mean Lower Low Water (MLLW) for 20,000 feet and -41 feet MLLW for the last 2,571 feet. Terminals at the end of the GHCE handle materials that are produced by and/or used in oil and gas production activities. Existing fleet data show that the channel is operating with insufficient depth to allow access by larger vessels that would maximize economic efficiency in transporting these materials. The recommended plan would deepen the last 2,571 feet (from station 20+000 to station 22+571) of the channel from -41 feet to -46 feet MLLW. This plan is the National Economic Development plan.

Based on the October 2017 Fiscal Year (FY 2018) price level, the estimated project first cost of constructing the GHCE is $13,652,000, which includes the total cost of construction of the General Navigation Features (GNFs) as follows: $11,696,000 for channel modification and dredged material placement; $1,544,000 for planning, engineering and design efforts; and $412,000 for construction management. In addition to these costs there are associated non-Federal costs for local service facilities of approximately $1,973,000 for dredging of berthing areas adjacent to the channel. The value of Lands, Easements, Rights-of-way and Relocations and the costs of utility relocations would normally be included in project first costs, but because the recommended plan does not anticipate the need for lands, easements, rights-of-way or relocations for this project, the project first costs are equivalent to the total cost of construction of the GNFs.

The Port of Galveston, representing the Board of Trustees of the Galveston Wharves, is the non-Federal sponsor. In accordance with the cost sharing provisions of Section 101(a)(1) of WRDA 1986, as amended (33 U.S.C. 2211(a)(1)), the Federal share of the total

construction cost of the GNFs is 75 percent, and the non-Federal share is 25 percent, or an estimated $10,239,000 and $3,386,000, respectively. Estimated associated costs of $1,973,000 will be the responsibility of the non-Federal sponsor. There are no required aids to navigation (a U.S. Coast Guard expense) for this project improvement.

Based on FY 2018 price level, a 2.75-percent discount rate, and a 50-year period of analysis, the total equivalent average annual cost of the project is estimated to be $581,000. The average annual equivalent benefits are estimated to be $1,603,000. The average net benefits are $1,022,000. The benefit-to-cost ratio for the recommended plan is 2.8. It is estimated that there will be no increase of material to be dredged each year from the new project.

An environmental assessment (EA) was prepared in accordance with the National Environmental Policy Act. The recommended plan has been identified as the environmentally preferred plan. Adverse environmental impacts have been avoided and minimized where practicable. The EA resulted in a Finding of No Significant Impact to the environment, therefore, preparation of an Environmental Impact Statement is not required. No compensatory mitigation is required.

Based on applicable laws and policy, this project study is not subject to Independent External Peer Review (IEPR) as it does not meet any of the mandatory requirements. The project has a cost estimate less than $45 million; does not represent a threat to health and safety; is not controversial; and has not had a request for IEPR from a Governor or the head of a Federal or state agency.

The Office of Management and Budget (OMB) advises that there is no objection to the submission of the report to Congress and concludes that the report recommendation is consistent with the policy and programs of the President. However, OMB also noted that the project would need to compete with other proposed investments for funding in future budgets. A copy of OMB's letter, dated March 26, 2018, is enclosed. I am providing a copy of this transmittal and the OMB letter to the Subcommittee on Water Resources and Environment of the House Committee on Transportation and Infrastructure, and the Subcommittee on Energy and Water Development of the House Committee on Appropriations. I am also providing an identical letter to the President of the Senate.

Sincerely,

R.D. James
Assistant Secretary of the Army
(Civil Works)

Enclosures

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Enclosures:

1. Report of the Chief of Engineers, August 8, 2017
2. Finding of No Significant Impact, June 6, 2018
2. OMB Clearance Letter, March 26, 2018
3. Feasibility Report and Environmental Assessment, February 2017

DEPARTMENT OF THE ARMY
CHIEF OF ENGINEERS
2600 ARMY PENTAGON
WASHINGTON, D.C. 20310-2600

AUG 0 8 2017

DAEN

SUBJECT: Galveston Harbor Channel Extension Project, Houston-Galveston Navigation Channels, Texas

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on navigation improvements for the Galveston Harbor Channel Extension project (GHCE). It is accompanied by the report of the Galveston District Engineer and the Southwestern Division Engineer. The feasibility study was conducted under the authority of Section 216 of the Flood Control Act of 1970 (33 U.S.C. 549a), which authorizes review of completed U.S. Army Corps of Engineers (Corps) navigation projects when significant changes in physical or economic conditions have occurred, and the submission of a report to Congress on the advisability of modifying the project in the overall public interest. Pre-construction engineering and design activities for this proposed project, if funded, would be continued under the authority provided by the section cited above. The existing Galveston Harbor Channel (GHC) project was authorized by Section 101(a)(30) of the Water Resources Development act (WRDA) of 1996, P.L. 104-303.

2. The reporting officers recommend authorizing a plan that will significantly contribute to the economic efficiency of commercial navigation in the region by deepening a portion of the existing GHC Project. The GHC provides for a deep-draft waterway from the Gulf of Mexico to the City of Galveston. The channel is authorized and maintained at a depth of -46 feet Mean Lower Low Water (MLLW) for 20,000 feet and -41 feet MLLW for the last 2,571 feet. Terminals at the end of the GHC handle materials that are produced by and/or used in oil and gas production activities. Existing fleet data show that the channel is operating with insufficient depth to allow access by larger vessels that would maximize economic efficiency in transporting these materials. The recommended plan:

a. Would deepen the last 2,571 feet (from station 20+000 to station 22+571) of the channel from -41 feet to -46 feet MLLW.

b. Includes dredging of approximately 727,000 cubic yards of new material to deepen the channel. The volume of maintenance dredging material is not expected to increase above maintenance volumes for the existing channel depths. Material would be placed in the existing upland confined placement area at Pelican Island. The Pelican Island placement area has sufficient capacity for 50 years of dredging operations of the GHC Project.

c. Would not have any significant adverse effects so no mitigation measures or compensation measures would be required.

d. Is the National Economic Development (NED) plan and all features are located in Galveston County, Texas.

3. The Port of Galveston, representing the Board of Trustees of the Galveston Wharves, is the Non-Federal sponsor.

4. Project costs are allocated to the commercial navigation purpose and are in October 2016 prices.

a. Project First Cost. The estimated project first cost of constructing the GHCE is $13,395,000, which includes the total cost of construction of the General Navigation Features (GNFs) as follows: $11,490,000 for channel modification and dredged material placement; $1,504,000 for planning, engineering and design efforts; and $401,000 for construction management. The value of Lands, Easements, Rights-of-way and Relocations (LERRs) and the costs of utility relocations would normally be included in project first costs, but because the recommended plan does not anticipate the need for lands, easements, rights-of-way or relocations for this project, the project first costs are equivalent to the total cost of construction of the GNFs.

b. Estimated Federal and Non-Federal Shares. In accordance with the cost sharing provisions of Section 101(a)(1) of WRDA 1986, as amended (33 U.S.C. 2211(a)(1)), the Federal share of the total construction cost of the GNFs is 75 percent, and the non-Federal share is 25 percent, or an estimated $10,046,000 and $3,349,000, respectively.

c. Additional 10 Percent Payment. In addition to payment by the Non-Federal sponsor of its share of the total cost of construction of the GNFs during construction, the Non-Federal sponsor must pay an additional 10 percent of the cost of the GNFs in cash over a period not to exceed 30 years, with interest, in accordance with Section 101(a)(2) of WRDA 1986, as amended (33 U.S.C. 2211(a)(2)). The additional 10 percent payment without interest is estimated to be $1,339,500. The value of LERRs and the costs of utility relocations, should they become necessary, will be credited toward this amount in accordance with Section 101(a)(3) of WRDA 1986, as amended (33 U.S.C. 2211(a)(3)).

d. Associated Costs. Estimated associated costs of $1,938,000 will be the responsibility of the Non-Federal sponsor for dredging of Non-Federal berthing areas adjacent to the federal channel. There are no required aids to navigation (a U.S. Coast Guard expense) for this project improvement.

e. Authorized Project Cost and Section 902 Calculation. The project first cost for the purpose of calculating the maximum cost of the project pursuant to Section 902 of WRDA 1986, as amended (33 U.S.C. 2280), includes the total cost of construction the GNFs, and should they become necessary the value of LERRs and the costs of utility relocations. Accordingly, as set forth in paragraph 4.a, above, based on October 2016

prices, the total estimated project first cost for these purposes is $13,395,000. Based on October 2016 price levels, a discount rate of 2.875 percent, and a 50- year period of economic analysis, the project average annual benefits and costs for the GHCE are estimated at $1,597,000 and $585,000, respectively, with resulting net excess benefits of $1,012,000 and a benefit-to-cost ratio of 2.7 to 1.

5. The goals and objectives included in the Campaign Plan of the Corps have been fully integrated into the GHCE study process. The recommended plan was developed in coordination and consultation with various Federal State, and local agencies using a systematic and regional approach to formulating solutions and evaluating the benefits and impacts that would result. The feasibility study evaluated navigation problems as well as opportunities for beneficial use of dredge material. Risk and uncertainty were addressed during the study by sensitivity analyses that evaluated the potential impacts of sea level change and economic assumptions as well as cost uncertainties.

6. In accordance with the Corps Engineering Circular on review of decision documents, all technical, engineering, and scientific work underwent an open, dynamic, and vigorous review process to ensure technical quality. This included an Agency Technical Review (ATR) and a Corps policy and legal review. All concerns of the ATR have been addressed and incorporated into the final report. The Corps approved an Independent External Peer Review exclusion on September 23, 2011.

7. Washington level review indicates that the project recommended by the reporting officers is technically sound, environmentally and socially acceptable, cost effective, and economically justified. The plan complies with all essential elements of the U.S. Water Resources Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* and complies with other administrative and legislative policies and guidelines. The views of interested parties, including Federal, State, and local agencies were considered. During State and Agency review one letter was received from the Department of Agriculture with no objection noted.

8. I concur in the findings, conclusions, and recommendations of the reporting officers. Accordingly, I recommend that navigation improvements for the GHC be authorized in accordance with the reporting officer's recommended plan at an estimated cost of $13,395,000, with such modifications as in the discretion of the Chief of Engineers may be advisable. My recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and State laws and policies, including Section 101 of WRDA 1986, as amended (33 U.S.C. 2211). This recommendation is subject to the Non-Federal sponsor agreeing to comply with all applicable Federal laws and policies including that the Non-Federal sponsor must agree with the following requirements prior to project implementation.

a. Provide 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of -20 feet MLLW but not in excess of -50 feet as further specified below:

DAEN
SUBJECT: Galveston Harbor Channel Extension Project, Houston-Galveston Navigation Channels, Texas

(1) Provide 25 percent of design costs allocated by the Government to commercial navigation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide, during construction, any additional funds necessary to make its total contribution for commercial navigation equal to 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of -20 feet but not in excess of -50 feet MLLW;

b. Provide all lands, easements, and rights-of way, including those necessary for the borrowing of material and placement of dredged or excavated material, and perform or assure performance of all relocations, including utility relocations, all as determined by the Government to be necessary for the construction or operation and maintenance of the GNFs;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNF's, an additional amount equal to 10 percent of the total cost of construction of GNFs, less the amount of credit afforded by the Government for the value of any LERRs and the costs of any utility relocations provided by the Non-Federal sponsor for the GNFs. If the amount of credit afforded by the Government for the value of LERRs and the costs of utility relocations provided by the Non-Federal sponsor equals or exceeds 10 percent of the total cost of construction of the GNFs, the Non-Federal sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of LERRs and the costs of utility relocations in excess of 10 percent of the total costs of construction of the GNFs;

d. Provide, operate, and maintain, at no cost to the Government, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Government;

e. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating and maintaining the GNFs;

f. Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

g. Perform, or ensure performance of, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, that may exist in, on, or under the lands,

easements, or rights-of-way that the Government determines to be necessary for the construction or operation and maintenance of the GNFs. However, for lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigation unless the Government provides the Non-Federal sponsor with prior specific written direction, in which case the Non-Federal sponsor shall perform such investigations in accordance with such written direction.

h. Assume complete financial responsibility, as between the federal government and the Non-Federal sponsor, for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, rights-of-way that the Government determines to be necessary for the construction or operation and maintenance of the project.

i. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA.

10. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to the Congress, the State of Texas, Port of Galveston, interested federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment.

Proud to be able to Chiefs finalize the Report for this Project!! Critical

TODD T. SEMONITE
Lieutenant General, USA
Commanding

FINAL
STATEMENT OF FINDINGS
AND
FINDING OF NO SIGNIFICANT IMPACT

FOR

GALVESTON HARBOR CHANNEL EXTENSION
POST-AUTHORIZATION CHANGE REPORT

GALVESTON COUNTY, TEXAS

U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
GALVESTON, TEXAS

1. Purpose. This document addresses the proposed deepening of the Galveston Harbor Channel from -41 feet mean lower low water (MLLW) to -46 feet MLLW for a distance of 2,571 feet, beginning at the Port of Galveston (POG) Pier-38 (Station 20+000) and continuing westward ending near the Pelican Island Bridge (Station 22+571). The project is located in Galveston Bay between Pelican and Galveston Islands, in Galveston, Galveston County, Texas.

The Galveston Harbor Channel portion of the Houston-Galveston Navigation Channels (HGNC) Project is authorized to a project depth of 46 feet deep (plus 3 feet of advance maintenance and 2 feet of allowable overdepth) from Station 0+000 to Station 20+000 (generally from Bolivar Roads to the vicinity of POG Pier-38), and to a project depth of only 41 feet (plus 3 feet of advance maintenance and 2 feet of allowable overdepth) from Station 20+000 to Station 22+571 (vicinity of POG Pier-38 west to vicinity of Pelican Island Bridge). The last 41-foot deep portion of the Galveston Harbor Channel limits efficient movement of deep-draft vessels transporting commodities along the waterway.

Deep draft vessels transiting the 41-foot deep portion of the Galveston Harbor Channel must arrive and depart light-loaded in order to utilize bulk facilities docks handling cement, barite ore, bio-diesel, and coal, located along the far western end of the 41-foot channel segment. Deepening the channel would allow vessel operators and shippers to fully realize the economies of scale of fully loaded vessels that are currently light-loaded inbound and outbound due to channel depth constraints. This Environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) and Council on Environmental Quality (CEQ) regulations to document findings concerning the environ- mental impacts of the proposed action.

2. Proposed Action. Proposed channel improvements consist of deepening a segment of the existing 41-foot deep by 1075-foot wide channel from -41 feet MLLW to -46 feet MLLW, along a distance of 2,571 feet. The deepening will originate near POG Pier-38 at Station 20+000, continuing westward towards Pelican Island Bridge and ending at Station 22+571.

Channel deepening will be accomplished using a cutter head, hydraulic pipeline dredge. Advanced maintenance and allowable overdepth will remain at the current requirement of 3 feet and 2 feet, respectively, such that the maximum channel depth following periodic maintenance will not exceed -50 feet MLLW. No widening is proposed; the bottom width would remain at 1,075 feet or less and the channel top-of-cut will remain in the template of the existing project.

The project will generate 609,500 cubic yards (cy) of new work material (Federal and third party), consisting of primarily firm to stiff clays of low plasticity. The dredged material will be placed in the upland confined Pelican Island Placement Area (PA).

Maintenance quantity and frequency from the proposed 46-foot channel deepening project will remain at 648,000 cy every 4 years which currently dredged from the existing 41-foot deep channel project. No ocean disposal will be performed for new work dredged material placement. Beneficial use was not considered economically feasible and will not be implemented for this project. All maintenance material will be placed in the existing upland confined Pelican Island PA consistent with current practices.

The construction period for the new work dredging and placement would be approximately four months, including one month to prepare the placement area and three months to construct the channel extension and place the material.

3. Coordination. A Notice of Availability was issued to interested parties including Federal and state agencies on September 19, 2012, which described the proposed action and announced the availability of the Draft EA. Comments on the Notice of Availability and Draft EA and the District's responses, are included in Appendix E of the Final EA.

4. Environmental Effects. Galveston District has taken every reasonable measure to evaluate the environmental, social and economic impacts of the proposed project. Based on information provided in the EA and coordination with Federal, state, and local agencies, temporary and permanent effects resulting from the proposed project have been identified and can be found in Section 4 of the Final EA. The deepening of Galveston Harbor Extension would have negligible impacts to very low quality bay bottom habitat comparable in type and magnitude to those experienced during routine maintenance that occurs for the existing channel template. No special aquatic sites, including wetlands, would be impacted. Therefore, no mitigation would be required for this project. Only minor, temporary increases in turbidity, noise and navigation traffic are anticipated. However, such effects would not be "new", but would be among the cyclical recurring impacts that occur during maintenance of the channel. All affected re- sources are expected to recover to pre-project conditions after the work is completed. The proposed project is expected to contribute beneficially to navigation efficiency and is not expected to contribute negative cumulative impacts to the area.

The District has determined that the project is consistent with the Texas Coastal Management Plan and compliant with Essential Fish Habitat (EFH). A Section 404(b)(1) Evaluation (short form) of project impacts to water quality indicates the project will not adversely affect water quality. The District has received water quality certification from the Texas Commission on Environmental Quality and requested a consistency determination from the Texas General Land Office. It is the District's conclusion that the proposed project will not have a significant impact on the environment or to the surrounding human population.

5. Determinations. The analysis of the environmental impacts of the proposed project is based on the accompanying Final EA. Factors considered in the review were impacts to sea level rise, vegetation, wildlife, aquatic resources including EFH, threatened and endangered species and piping plover critical habitat, cultural resources, socioeconomic resources, Environmental Justice, Prime and Unique Farmlands, Hazardous, Toxic, and Radioactive Wastes, air, noise, water quality, as well as alternative courses of action and cumulative impacts. The proposed project was found to be com- pliant with the Endangered Species Act, Clean Air Act, Clean Water Act, EFH, and the Texas Coastal Management Plan (TCMP).

6. Findings. Based on my analysis of the Final EA and other information pertaining to the proposed project, I find that the Galveston Channel Extension Project will not have a significant effect on the quality of the human environment. Galveston District reviewed the project for consistency with the goals and policies of the TCMP. Based on this analysis, I find that the proposed plan is consistent with the goals and policies of the TCMP. After consideration of the information presented in the Final EA, All applicable laws, executive orders, regulations, and local government plans were considered in the evaluation of the alternatives. It is my determination that the recommended plan does not constitute a major federal action that would significantly affect the human environment; therefore, preparation of an Environmental Impact Statement is not required and that the proposed project may be constructed.

6 JUN 12
(date)

Lars N. Zetterstrom
Colonel, Corps of Engineers
District Commander

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

THE DIRECTOR

March 26, 2018

The Honorable R. D. James
Assistant Secretary of the Army (Civil Works)
U.S. Army Corps of Engineers
108 Army Pentagon
Washington, D.C. 20310-0108

Dear Assistant Secretary James:

As required by Executive Order 12322, the Office of Management and Budget has reviewed an August 2017 Army Corps of Engineers (Corps) Feasibility Report (report) for the Galveston Harbor Channel Extension Project in Galveston, Texas. The report estimates a total project first cost of $13,652,000 at October 2017 prices.

According to information provided in the report, the benefit-to-cost ratio (BCR) for this project is 2.8 to 1 at a discount rate of 2.750 percent. This is the rate that the Corps is required to use for Fiscal Year 2018 under section 80 of the Water Resources Development Act of 1974 to evaluate and formulate its projects. The Corps estimates that the equivalent BCR is 1.3 to 1 at a discount rate of 7%. This is the discount rate that the Administration uses in the Budget to measure the performance of Corps construction projects whose primary purpose is to provide an economic return to the Nation.

Based on the estimates of the benefits and costs in the report, we have concluded that an authorization to construct this project would be consistent with the program and policies of the President. The Office of Management and Budget does not object to you submitting this report to the Congress. However, when you do so, please inform the Congress that should this project be authorized for construction, it would need to compete with other proposed investments in future Budgets.

Sincerely,

John Pasquantino
Deputy Associate Director
Energy, Science and Water



U.S. Army Corps
of Engineers
Galveston District

Galveston Harbor Channel Extension
Feasibility Study
Houston-Galveston Navigation Channels, Texas

FEASIBILITY REPORT

U.S. Army Corps of Engineers
Southwestern Division
Galveston District
February 2017

EXECUTIVE SUMMARY

The Galveston District is converting the vertical datum for all navigation projects from Mean Low Tide (MLT) to Mean Lower Low Water (MLLW) in accordance with U.S. Army Corps of Engineers (USACE (2014)), memorandum directing conversion from USACE Headquarters (HQ). The goal of the conversion is to maintain effective depth, rounding channel depths in accordance with USACE (2014). This has resulted in changes in reported authorized channel depths to the new datum. Reference Section 1.7 Vertical Datum for an explanation of the conversion. This report presents all channel depths in terms of the MLLW datum. For the Galveston Harbor Channel Extension (GHCE) Entrance Channel the conversion from MLT to MLLW is one foot deeper, for example where prior reports reference deepening to 45 feet MLT this report will reference 46 feet MLLW.

The GHCE Project, Texas was part of an earlier study for improving the deep-draft navigation channels within the Galveston Bay area implemented pursuant to resolutions of the House Committee on Public Works in April 1950 and in October 1967. The Galveston Harbor and Channel were deepened to a depth of 41 feet pursuant to Section 201 of the 1965 Flood Control Act, as amended (42 U.S.C. 1962d-5), in accordance with the Report of the Chief of Engineers dated November 6, 1970, House Document 92-121, 92nd Congress, 1st Session (1971).

Subsequently, the deepening of the Houston-Galveston Navigation Channels (HGNC) Project was authorized by Section 101(a)(30) of the Water Resources Development Act (WRDA) of 1996, P.L. 104-303. This authorization included deepening both the Houston Navigation Channel and the Galveston Navigation Channel to a depth of 46 feet, substantially in accordance with the Report of the Chief of Engineers dated May 9, 1996, and the Houston-Galveston Navigation Channels, Texas, Limited Reevaluation Report and Final Supplemental Environmental Impact Statement (1995 LRR) dated November 1995.

Deepening of the Houston Channel to 46 feet was completed in 2005. Deepening of the Galveston Channel did not proceed at that time due to the lack of funds of the Port of Galveston, the non-Federal sponsor on that portion of the HGNC Project. Once funds became available, the benefits and costs of the recommended plan for the Galveston Channel, as identified in the 1995 LRR and authorized by WRDA 1996, were updated by the Houston-Galveston Navigation Channels, Texas, Galveston Channel Project, Final Limited Reevaluation Report, dated May 31, 2007.

The deepening of the Galveston Navigation Channel to 46 feet was completed in January 2011, not including the last 2,571 feet which remained at a 41 feet depth. This remaining 2,571 feet had been evaluated for deepening to 46 feet in the 1995 LRR but was determined not to be economically justified at that time since no portside facilities were in place. In the intervening years, conditions changed, and beginning in 2006 portside service facilities began operating and utilizing the 41-foot channel. In addition, there are now two end users, Gulf Sulphur Services and Texas International Terminals.

In order to continue the study to evaluate deepening the last 2,571 feet of Galveston Harbor Channel, the Port of Galveston entered into a new Feasibility Cost Share Agreement (FCSA) with the U.S. Army Corps of Engineers on February 29, 2016, pursuant to Section 216 of the Flood Control Act of 1970 (33 U.S.C. 549a). The plan recommended by this feasibility report involves extending the 46 feet deep Galveston Harbor Channel the remaining 2,571 feet to reach the end of the limits of the authorized and currently maintained 41-foot channel.

The results of the economic analysis show that there is an economically rational justification to deepen the Galveston Harbor Channel to 46 feet through the reaches that are presently authorized to 41 feet. The average annual cost is $585,000 for a 46-foot channel at the current interest rate of 2.875 percent.

The benefit-cost ratio (BCR) was determined by comparing average annual benefits to the corresponding average annual costs. The 46-foot channel has the highest net benefit results and an expected BCR value of 2.7 at the current interest rate of 2.875 percent. The estimated fully funded total cost of the project is approximately $16 million.

Environmental impacts are expected to be negligible because construction will occur within the existing project footprint which is regularly dredged for routine operations and maintenance (O&M), and an existing upland confined placement area (PA) will be used.

This project is in support of two of the four goals for USACE contained in the latest (as of 1 May 2015) USACE Campaign Plan. This plan is available on the internet at the following address: http://www.usace.army.mil/about/campaignplan.aspx. Specifically, this project supports Goal 2 (Transform Civil Works) and Goal 4 (Prepare for Tomorrow).

Galveston Navigation Channels, Texas
Galveston Harbor Channel Extension Project

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Galveston Harbor Channel Extension Feasibility Study
Houston- Galveston Navigation Channels, Texas

1.0 INTRODUCTION

1.1 Purpose of Report/Study Authority

The Galveston Harbor Channel Extension (GHCE) study authorization is Section 216 of the Flood Control Act (FCA) of 1970, P.L. 91-611, which authorizes the Secretary of the Army to review existing USACE constructed projects due to changes in physical and economic conditions and report to Congress recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest. This current Feasibility report presents an evaluation of extending the 46 feet deep Galveston Harbor Channel the remaining 2,571 feet (Station 20+000 to Station 22+571) to reach the west end of the limits of the authorized and currently maintained 41-foot channel.

An Environmental Assessment (EA) was prepared and has been updated to document changes in existing conditions and species listings in accordance with the National Environmental Policy Act (NEPA).

1.2 Existing Conditions

The project area includes the eastern end of Galveston Island and Pelican Island. Galveston Island is a low-lying barrier island two miles off the Texas coast and approximately 50 miles southeast of Houston, Texas. Galveston Island was formed as an offshore bar at the beginning of the present sea-level stand and grew through the accretion of sand from littoral drift. Pelican Island, a natural sand-spit, has been expanded substantially over the years through the placement of dredged material from maintaining the Galveston Harbor and Texas City Channels; a practice which has continued to the present. The Galveston Harbor Channel is a very active shipping lane providing deep-draft vessel access to the Port of Galveston, an important Texas deep-water port. This channel, inclusive of the portion that will be deepened, is lined with various wharves, docks and commercial and industrial facilities associated with Port of Galveston (POG) operations and other port users. Texas City, an important Gulf port city and producer of refined petroleum products, is located approximately seven miles from the project area.

The Galveston community has a diversified income base; however, jobs are predominantly dependent upon tourism, the Port of Galveston, commercial fishing, the University of Texas Medical Branch, and the American National Insurance Company.

1.3 History of Project

Galveston Bay, the largest inland bay on the Texas coast, is an important commercial and recreational fishing resource and provides access to the deep-water ports of Houston, Texas City, and Galveston. The Houston and Galveston Channels traverse the Galveston Bay area. This area is located along the northeastern Texas coastline as shown on Figure 1.

The Galveston Harbor and Channel, Texas, Project was part of an earlier study for improving the deep-draft navigation channels within the Galveston Bay area authorized by a resolution of the House Committee on Public Works in October, 1967. This resolution authorized a review of previous reports on the Houston Ship Channel (HSC), Galveston Harbor Channel (GHC), and the Texas City Channel. The channels at this time were 37 feet in depth.

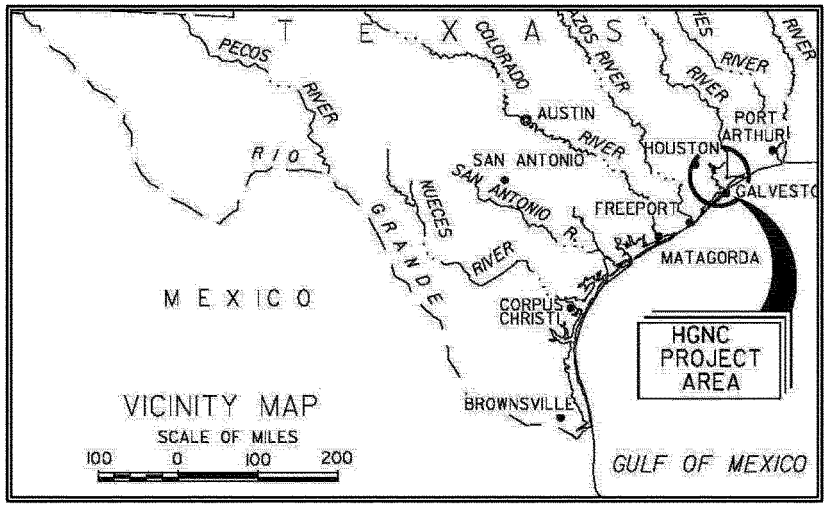

Figure 1 - Houston-Galveston Navigation Channels Project Location on Texas Coastline

The Galveston Bay Area Navigation Study (GBANS), Feasibility Report and Environmental Impact Statement (EIS) for improving the Houston and Galveston channels was completed in 1987, and recommended that the Galveston Harbor and Channel be deepened to 51 feet and widened to 450 feet to provide access to deeper water in the Gulf of Mexico. Issues raised during the Washington review of the 1987 GBANS resulted in a decision by the Assistant Secretary of the Army for Civil Works (ASA (CW)) that a reevaluation study would be performed.

A limited reevaluation report (LRR) was completed in November 1995 and made recommendations for project implementation. The Port of Houston Authority (PHA) and the City of Galveston were the non-Federal sponsors of the Houston-Galveston Navigation Channels, Texas Project (HGNC). By letter dated May 24, 2006, the NFS for the project transferred from the City of Galveston to the Board of Trustees of the Galveston Wharves (Port of Galveston, (POG)).

The 1995 LRR presented a plan that consisted of deepening and widening the HSC and deepening of the Galveston Harbor and Channel in two phases. Phase I consisted of deepening the channels to a depth of 46 feet; Phase II further proposed deepening the channels to 51 feet. Environmental studies were conducted at that time to assess the impacts of a 51-foot channel; however, it was later determined that deepening the channel to 51 feet was not economically justified.

Deepening of the Houston portion to 46 feet was completed in 2005. Deepening of the Galveston Channel did not proceed at that time due to the NFS lack of funds. Once funds were available, the benefits and costs of the Recommended Plan as identified in the 1995 LRR and authorized by WRDA 1996, were updated by the *Houston-Galveston Navigation Channels, Texas, Galveston Channel Project, Final Limited Reevaluation Report*, dated May 31, 2007, (2007 LRR). The 2007 LRR updated project design, cost, benefits and environmental impacts specifically related to the Galveston Channel Reach. The 2007 LRR recommended plan consisted of deepening portions of the Galveston Harbor Channel to 46 feet from Station 0+000 to Station 20+000 (2.16 miles) with a bottom width varying from 650 to 1,112 feet and a side slope of 1 vertical to 3 horizontal. Deeping was completed in January 2011, not including the last 2,571 feet which remained at a 41 feet depth.

1.4 Current Study

On February 29, 2016 a new FCSA was signed between USACE and the Board of Trustees of The Galveston Wharves to resume investigations on deepening the remaining 2,571 feet of the GHCE from 41 feet to 46 feet under this Feasibility Study.

1.5 Authorization

Table 1: Authorized Project Features for HGNC Project

Date	Project and Work Authorized	Documents
October 12, 1996	The project for navigation and environmental restoration, Houston-Galveston Navigation Channels, Texas: Report of the Chief of Engineers, dated May 9, 1996, at a total cost of $298,334,000, with an estimated Federal cost of $197,237,000 and an estimated non-federal cost of $101,097,000, and an average annual cost of $786,000 for future environmental restoration over the 50-year life of the project, with an estimated annual Federal cost of $590,000 and an estimated annual non-federal cost of $196,000. The removal of pipelines and other obstructions that are necessary for the project shall be accomplished at non-federal expense. Non-federal interests shall receive credit toward cash contributions required during construction and subsequent to construction for design and construction management work that is performed by non-federal interests and that the Secretary determines is necessary to implement the project.	Water Resources Development Act 1996, Section 101(a)(30), P.L. 104-303
October 27, 2000	That the Secretary of the Army, acting through the Chief of Engineers, is directed to design and construct barge lanes at the Houston-Galveston Navigation Channels, Texas, project immediately adjacent to either side of the Houston Ship Channel, from Bolivar Roads to Morgan Point, to a depth of 12 feet with prior years' Construction, General carry-over funds.	Energy and Water Development Appropriations Act, 2001, P.L. 106-377, Section 1(a)(2) Appendix B - H.R. 5483, 106th Congress

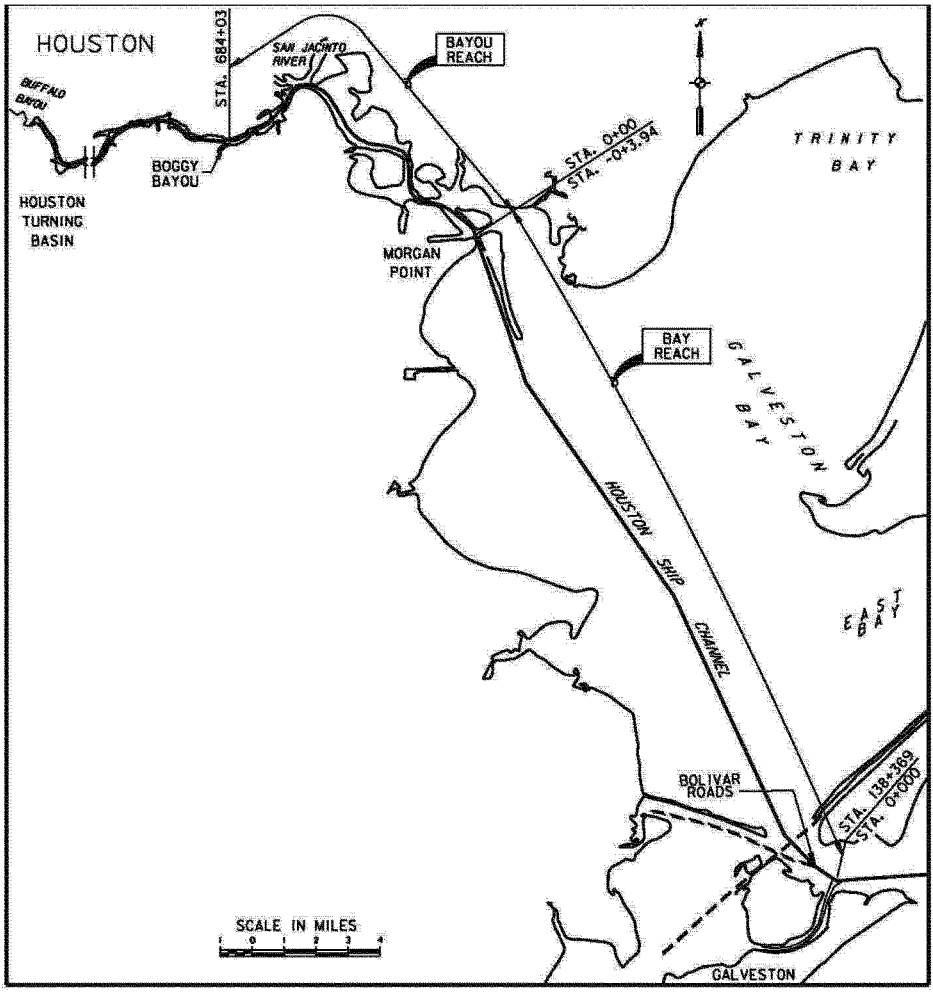

Figure 2 – Map of Houston Portion of HGNC Reach Designations

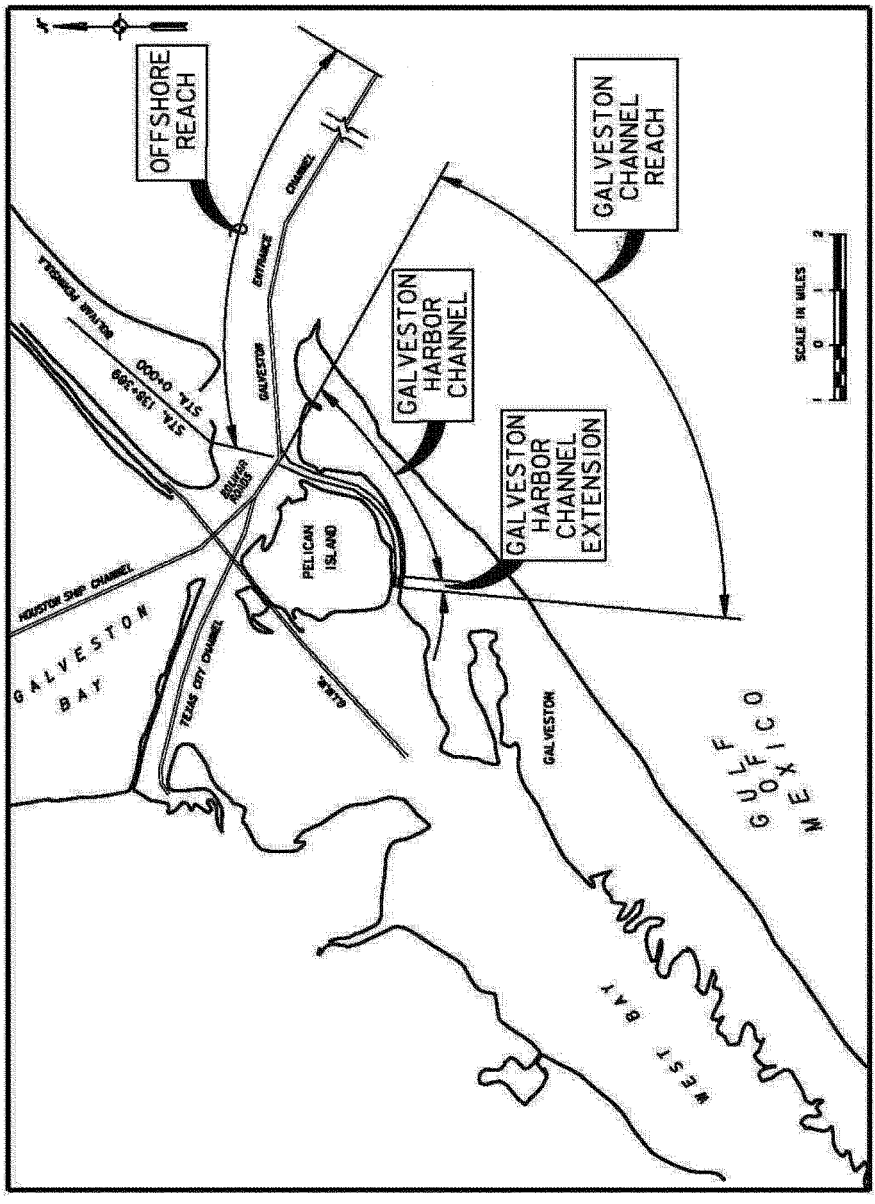

Figure 3 – Map of Galveston Portion of HGNC Reach Designations
6

1.6 Description of Previously Authorized Project

Additional information pertaining to the Station numbers, depths, bottom widths and channel lengths for the GHCE channel reaches is presented in Table 2. The term "Station" refers to a horizontal distance in feet measured along the centerline of the channel and is used to indicate the relative location of a particular portion of the channel.

Table 2: Approximate Channel Segments for the GHCE Reaches

Reach	Channel Segments and Station Numbers for Each Reach of the GHCE Project	Depth *(Feet below MLLW)*	Bottom Width *(feet)*	Channel Length *(feet)*	Channel Length *(miles)*
Galveston Harbor and Channel portion of the HGNC Project					
Offshore Reach *(Galveston Entrance Channel)*	Extended Entrance 55+840 to 76+000	48	800	20,160	3.8
	Entrance 30+515 to 55+840	48	800	25,325	4.8
	Outer Bar 21+753 to 30+515	48	800	8,763	1.7
	Inner Bar 4+490 to 21+753	46	800	17,262	3.3
	Bolivar Roads 0+000 to 4+490	46	800	4,490	0.8
Galveston Channel Reach *(Galveston Channel)*	Galveston Harbor Channel *(from Bolivar Roads to Pier 9)*† 0+000 to 8+000	46	Varies 650–1,133	8,000	3.9
	Galveston Harbor Channel *(from Pier 9 to Pier 38)* 8+000 to 20+000	46		12,000	2.3
	Galveston Harbor Channel *(from Pier 38 to 43rd Street)*†† 20+000 to 22+571	41	1,085	2,571	0.5

† The existing 46-foot Galveston Harbor Channel terminal end at Station 20+000 functions as a turning basin as it encompasses the entire width and length of the channel which is 1,075 feet wide by approximately 4,700 feet in length.

††The section of Galveston Harbor Channel referred to in this document as the Galveston Harbor Channel Extension was not included in the 1995 LRR project/HGNC Project and is not reflected in channel length total.

Dredged material from the Offshore and Bolivar Roads area (see Figure 3) was designated to be deposited in the Gulf, within a beneficial use berm and in an Ocean Dredged Material Disposal Site (ODMDS). Material from the Galveston Channel Reach and the Bayou Reach of the HSC was authorized for placement in upland, fully confined placement areas (PAs). Material from the Bay Reach was designated to be used beneficially for the environmental restoration plan described below.

The environmental restoration portion of the authorized HGNC consists of the initial construction of tidal marsh habitat and a colonial waterbird nesting island through the beneficial use of new work dredged material, and incremental development (deferred construction) of additional marsh habitat through the beneficial use of maintenance materials dredged from Galveston Bay. The

HSC portion of the HGNC involved environmental restoration and navigation; whereas, the Galveston portion of the HGNC only involved navigation. Figure 4 shows the location of the environmental restoration features for the HSC portion of the HGNC.

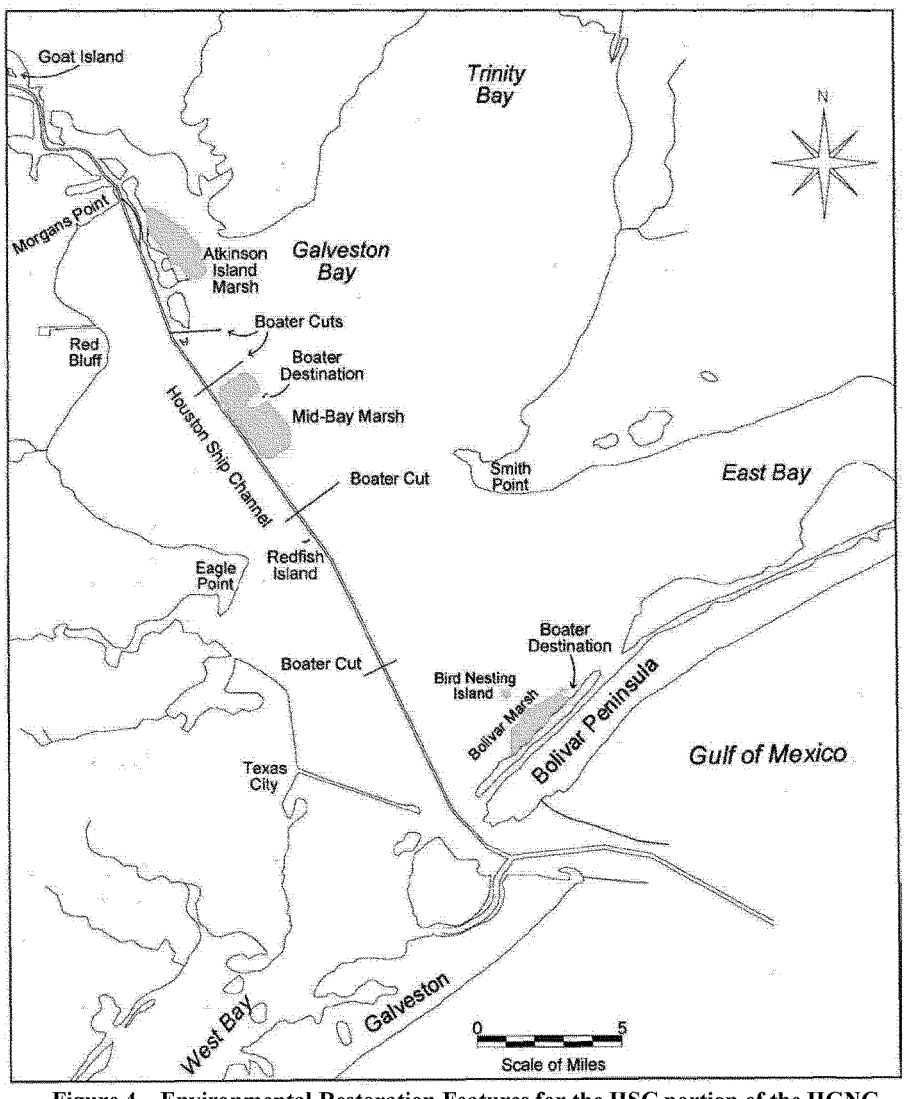

Figure 4 – Environmental Restoration Features for the HSC portion of the HGNC

Responsibility for the Offshore Reach is shared by both of the current NFSs of the HGNC. The Bay and Bayou Reaches are the responsibility of the PHA, and the Galveston Channel Reach is the responsibility of the POG.

1.7 Vertical Datum

Army regulations and U.S. Army Corps of Engineers (USACE) Headquarters guidance on tidal datum, provided in Engineering Technical Letter (ETL) 1110-2-349 *REQUIREMENTS AND PROCEDURES FOR REFERENCING COASTAL NAVIGATION PROJECTS TO MEAN LOWER LOW WATER DATUM*, dated April 1, 1993, and Engineer Manual (EM) 1110-2-1003, April 1, 2002, stress the necessity of converting local datum, such as mean low tide (MLT) to mean lower low water (MLLW). EM 1110-2-1003 further states that MLLW should be tied to the North American Vertical Datum of 1988 (NAVD 88). The predominate reasons for conversion to MLLW is the need for consistency throughout the ports of the U.S., to enhance the continuity of National Oceanic and Atmospheric Administration (NOAA) and U.S. Coast Guard (USCG) navigation charts and to avoid misconceptions within the shipping and dredging industries with regard to channel depths.

The Galveston District has recently converted the local Mean Low Tide (MLT) datum to the Mean Lower Low Water (MLLW) datum. Reference the *Draft MLT to MLLW Vertical Datum Conversion: Galveston Harbor, Texas City Ship Channel, Houston Ship Channel, Engineering Documentation Report, June 2015* (2015 MLT to MLLW EDR). The calculated MLLW datum for the Galveston Harbor Channel Project is 1.18 feet above zero MLT at the Texas Coastal Ocean Observation Network (TCOON) Gage 1450 (Galveston Pier 21). The calculated conversion was rounded to the nearest foot for application to authorized channel depths. The elevations in this appendix and Feasibility report have been converted to MLLW except as noted as MLT. Engineering analysis done prior to the datum conversion have remained in MLT. The Vertical Tidal Datum Table below provides the depth conversion relationship between MLT to MLLW for the existing GHC.

TABLE 3: VERTICAL TIDAL DATUM CONVERSION

Project Name	Station Nos.	Project Depths MLT, ft	Project Depths MLLW, ft	Conversion from MLT to MLLW, ft
GHC	0+000 to 20+000	-45	-46	-1
GHC	20+000 to 22+571	-40	-41	-1

Additional References for consultation during Pre-Construction Engineering and Design (PED) may include the following post-2003 guidance pertaining to tidal datum:

1. ER 1110-2-8160, "Policies for Referencing Project Elevation Grades to Nationwide Vertical Datums", dated March 1, 2009;
2. Engineer Circular (EC) 1110-2-6070, "Guidance for a Comprehensive Evaluation of Vertical Datums on Flood Control, Shore Protection, Hurricane Protection, and Navigation Projects", dated July 1, 2009;
3. EM 1110-1-1005, "Engineering and Design – Control and Topographic Surveying", Appendix B-6. Implementation Actions, dated January 1, 2007; and
4. EM 1110-2-6056, "Standards and Procedures for Referencing Project Evaluation Grades to Nationwide Vertical Datums", dated December 31, 2010.

1.8 Previously Authorized Project Cost Information

Table 4 provides a comparison of 1) the estimated cost for the project as authorized by Congress; 2) the project last presented to Congress in which barge lanes were authorized for construction under the HSC portion of the project; 3) the authorized project updated to FY 17 price level. These last costs were developed by price leveling the costs from the certified Total Project Cost Summary (TPCS), dated 23 August 2016 (see Appendix C) to FY 17 price levels.

The $13,395,000 shown under the "Galveston Channel - Navigation" portion of Table 4 is the estimated cost (less associated costs) of the Recommended Plan identified later in this report.

The most current cost estimate dated 1 October 2016, for GHCE estimates the Constant Dollar Cost (does not include inflation) at FY 17 price levels as $15,333,000 (Table 4). For the purpose of calculating the Section 902 limit once the project is authorized, the total estimated project first cost is $13,395,000, FY 17 price level, including an estimated Federal share of $10,046,250 and an estimated non-Federal share of $3,348,750.

Table 4: Total Project First Costs

Total Project Cost Summary - FY 17 Price Level				
Construction Item		Total Costs	Federal	Non-Federal
Channel Dredging		$11,490,000		
41'-46'	75/25		$8,617,500	$2,872,500
Berthing Costs (NF)		$1,938,000		$1,938,000
PED (75/25)		$1,504,000	$1,128,000	$376,000
Construction Estimate Totals		$401,000	$300,750	$100,250
Total Project First Costs[1] (includes 24% contingency)		$13,395,000	$10,046,250	$3,348,750
Total		$15,333,000	$10,046,250	$5,286,750

[1]For the purpose of calculating the Section 902 limit, the total estimated first cost of the project at FY 17 price levels (1 October 2016) is: $13,395,000 including an estimated Federal share of $10,046,250; and an estimated non-Federal share of $3,348,750.

2.0 PROBLEMS AND OPPORTUNITIES

2.1 Problems

Insufficient Federal channel depth and transportation cost inefficiencies.
Larger ships that transit the Galveston Harbor Channel Reach, Station 00+000 to Station 20+000, currently experience transportation delays due to insufficient Federal channel depths. In order to reach port terminals beyond Station 20+000 (Gulf Sulphur Services and Texas International Terminals) larger ships must light-load or cargo must be shipped using smaller vessels. The remaining 2,571 feet of authorized channel in the Galveston Channel Reach is only 41 feet deep, and the local sponsor and facilities at the far end of the Galveston Channel Reach are not able to take full advantage of the 46 feet depth of the remainder of the channel.

The economy of the U.S. has become increasingly dependent on waterborne transportation for a wide range of manufactured goods and raw material. The 41-foot authorized channel serves Piers 39, 40 and 41, which have historically handled general cargo, and two additional docks that handle sulphur and dry bulk commodities (e.g. barite). While container vessels have not historically been light-loaded, deep-draft vessels carrying bulk dry commodities that are transiting the 41-foot portion of the Galveston Harbor Channel must arrive and depart light-loaded.

2.2 Opportunities

Reduce transportation costs.
There is an opportunity to reduce transportation costs for vessels transiting the Galveston Harbor Channel due to the recent addition of portside service facilities utilizing the existing 41-foot channel. This translates to an opportunity to seek the additional authorization needed to extend the limits of the currently authorized 46-foot channel which stops 2,571 feet short of these relatively new facilities.

Deepening the remainder of the channel will allow the facilities at the end of the channel to transport larger volumes of goods with each movement via more fully loaded vessels or deeper draft vessels. This improves productivity by moving cargo more efficiently with less energy expended.

2.3 Existing Conditions

The Galveston Channel intersects at the Inner Bar Channel Station 5+547 and is subdivided into two reaches: Station -8+648.85 to Station 1+700 at Pier 9, and Station 1+700 to Station 13+900, from Pier 9 to 43rd Street. The Extension, Entrance, Outer and Inner Bar Channels have been deepened to their new depths (46 feet) through the previous Houston-Galveston Navigation

Channels, Texas Project. The previously authorized and maintained depth for the area of the Galveston Channel known as the Galveston Channel Reach is 41 feet deep with a width of approximately 1,085 feet. The authorized project template would deepen the channel to 46 feet. The width of the channel would remain the same or smaller than the existing channel, except for the area that intersects with the Houston Ship Channel (HSC). Dredged material from the project is currently disposed of at the San Jacinto and Pelican Island PAs. The Pelican Island PA is located north of the Galveston Channel, approximately 1,100 acres in size and currently divided into three cells. The San Jacinto PA is approximately 500 acres in size and located on the east end of Galveston Island, just north of the Seawall.

2.4 Future Without-Project Condition (FWOP)

USACE is required to consider the option of "No-Action" as one of the alternatives in order to comply with the requirements of the NEPA. With the No-Action plan, which is synonymous with the "Future Without-Project Condition," it is assumed that no project would be implemented by the Federal Government or by local interests to achieve the planning objectives. The No-Action Plan forms the basis against which all other alternative plans are measured. The future without project condition forms the basis from which alternative plans are formulated and impacts are assessed. Under the future without-project conditions there would be no Federal action to address the navigation concerns. Alternatives are compared to the same without-project condition.

The No-Action Alternative is the continued maintenance of the existing 41 feet deep by 1,085 feet wide channel segment extending a distance of 2,571 feet between Station 20+000 and Station 22+571 (Figure 5). Maintenance dredging of this section is typically performed every four years to maintain project depth. During each four year maintenance cycle approximately 648,000 cubic yards of material are dredged and placed in the existing, designated upland confined Pelican Island PA. Under the No-Action Alternative deeper draft vessels seeking access to the bulk cargo and sulphur facilities at the far west end of the channel would continue to be constrained by channel depth and would continue current non-structural practice of light-loading Panamax vessels to access and depart the bulk cargo facilities. The future without-project condition alternative would retain the 41-foot deep and the 1,085-foot width. The current channel depth and width would continue to limit the efficient movement of commodities by vessels traveling the waterway. The efficiency of the channel would be further burdened by the fact that the adjacent Houston Navigation and Galveston entrance channels are currently dredged to -46 feet. For discussion concerning vessel draft distribution see the economic analysis section on Fleet Characteristics.

2.5 Future With-Project Condition

The future with-project condition includes deepening most of the Galveston Channel, known as the Galveston Channel Reach, to a depth of 46 feet. The alignment of the Galveston Channel as presented in the 2007 LRR and shown in Figure 5 is the recommended plan. There were no significant changes within the project area that warranted a complete reevaluation of potential alternatives or preparation of a new NEPA document; therefore, this report updates project economics and costs of the 2007 recommended plan, and includes limited, required updates of environmental coordination. Details on the original alternatives can be found in the 1995 LRR. No increases in sedimentation are expected as a result of the proposed deepening. Based on this consideration, there is no change to maintenance dredging requirements in the with- versus without project condition.

3.0 PLAN FORMULATION

3.1 Federal Objective

The Federal Objective of water and related land resources project planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. NED objectives stress increasing the net values of the national output of goods and services and improving economic efficiency on a national level. The plan that reasonably maximizes net benefits is the NED plan.

Federal objectives are designed to assure systematic interdisciplinary planning, assessment, and evaluation of plans addressing natural, cultural, and environmental concerns, which will be responsive to Federal laws and regulations.

3.2 USACE Environmental Operating Principles (EOPs)

Throughout the study process, EOPs are considered at the same level as economic issues. The seven re-energized EOP principles (July 2012) are:

1. Foster a culture of sustainability throughout the organization;
2. Proactively consider environmental consequences of all USACE activities and act accordingly;
3. Create mutually supporting economic and environmental solutions;
4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE which may impact human and natural environments;
5. Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs;
6. Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner; and
7. Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.

3.3 Planning Objectives

The planning objectives and constraints reflect the reasons for conducting the planning effort. The objectives provide the result that is desired from a project while the constraints tell us what to avoid during the formulation of our plans. The following planning objectives were used in formulation and evaluation of alternative plans:

- Increase deep-draft navigation efficiency for Galveston Harbor Channel over the 50-year

period of analysis;

- Develop an alternative that is environmentally sustainable for the 50-year period of analysis; and
- Reduce navigation transportation costs to and from Galveston Harbor Channel to the extent possible over the 50-year period of analysis.

3.4 Planning Constraints

Unlike planning objectives which represent the desired positive changes, planning constraints represent restrictions that should not be violated. The following constraints apply to this Feasibility Study:

- The study process and plans must comply with Federal and State laws and policies;
- Fish and wildlife habitat affected by a project should be minimized as much as possible and preserved, if possible; and
- Alternative plans that resolve problems in one area should not create or amplify problems in other areas.
- Project depths in excess of 46 feet at Galveston Harbor Channel would not provide additional navigation efficiency benefits vessels are constrained by the adjacent 46-foot authorized channel to reach the study area.

3.5 Plan Formulation Process

During discussions with the Vertical Team (VT), USACE Headquarters (HQ) and Southwestern Division (SWD), in May 2016 on the appropriate path forward for expediting completion of this Feasibility study the team agreed to convert the prior 2013 study Post-Authorization Change Report (PACR) to a Feasibility Report under the Legacy path rather than SMART planning process. No reformulation would be required as the scope of the recommended plan remains the same, deepening the remaining 2,571 feet of the GHCE to 46 feet. The major updates required to finalize this feasibility report are updating the economics, costs, and NEPA coordination.

The planning process for this study has been primarily driven by the overall objective of reviewing and updating the 2013 PACR which analyzed various channel deepening configuration to identify the NED plan. The NED plan included a recommendation to deepening the remainder of the GHCE to match the existing 46-foot depth, allowing for end users to accrue cost savings and benefits while ensuring safe ship traffic along the Galveston Harbor and Channel and protecting the Nation's environmental resources. Prior studies were reviewed to identify areas of data collection needed to move forward with reevaluating the study. Additional alternatives from the 1995 LRR were not developed. This study and subsequent studies were a reevaluation of an existing authorized plan with the primary purpose of updating the project economics and costs. Alternatives developed

during the 1995 LRR study were vetted through the USACE Engineering Research and Development Center (ERDC) ship simulation laboratory. The ship simulation defined the minimum design width required; therefore, no widening alternatives were considered. The terminal end of the GHC functions as a turning basin as it encompasses the entire width and length of the channel which is 1,075 feet wide by approximately 4,700 feet in length. Vessels require this area due to the strong currents within the GHC in order to maintain steerage. The width of the channel in the extension matches this 1,075 feet width. As such, measures for widening and turning basins were not considered for the extension as the ship simulation already verified the width as adequate.

The planning objectives and constraints form the basis for subsequent plan formulation, alternative screening and the identification of the Recommended Plan. The expected FWOP Condition (synonymous to the "No-Action Plan") was developed for comparison with other alternatives. Additionally, structural and non-structural alternatives were developed. For the structural plans, a variety of channel depths with dredged material placement alternatives were developed, evaluated and screened.

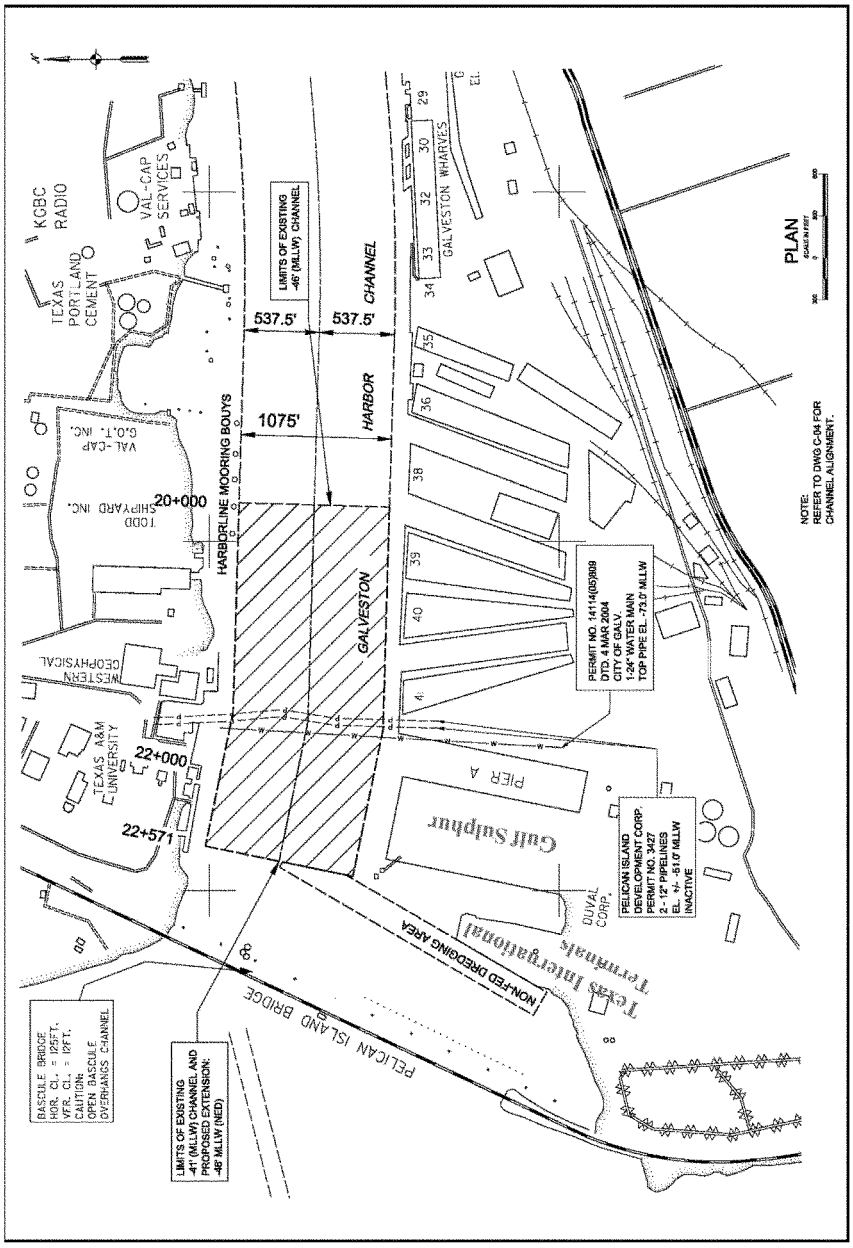

Figure 5 – Location of Proposed Extension within Galveston Harbor Channel

3.6 Structural Alternatives

The following Structural Alternatives were considered:

1. 43 feet Deep Channel;
2. 44 feet Deep Channel;
3. 45 feet Deep Channel; and
4. 46 feet Deep Channel.

Net benefits are still rising at 46 feet; however, as addressed under the Section 3.4 Planning Constraints, project depths in excess of 46 feet would not provide additional navigation efficiency benefits as vessels must traverse the adjacent 46-foot authorized channel to reach the study area. Therefore, depths below 46 feet have not been considered for the extension.

Ship simulation performed for the 1995 LRR study validated the required dimensions for the design vessels safe maneuverability for the entire Galveston Harbor Channel. The recommendation for this specific reach of the Galveston Harbor Channel was constructed for the 46-foot depth project. The ship simulation defined the minimum design width required; therefore, no widening alternatives were considered. No lengthening was considered as the channel terminates at the end of the 3.6 mile Galveston Harbor Channel.

The width of the channel in the extension matches this 1,075 feet width. As such, measures for widening and turning basins were evaluated using ship simulation; which provided the with-project footprint.

Construction of the 43, 44, 45, and 46-foot channel alternatives would involve dredging the bottom width of the existing channel only. The existing channel width in the extension is 1,085 feet whereas the new bottom width will be 1,075 feet as shown on Figure 7 in Section 5.1 Project Description. New work materials identified in the Engineering Appendix, Section 6.2.1, consist primarily of stiff to hard high-plasticity clays. Project design elements (e.g., channel width, side slopes, advanced maintenance and allowable over-depth), annual maintenance quantities and impacts for all channel deepening alternatives being considered are essentially the same, but the initial new work dredged quantities generated from the construction of each of alternative would vary. Table 5 presents estimated channel construction new work quantities for each alternative considered.

Table 5: Initial Dredged Quantities for Channel Alternatives

Channel Alternative	Total Estimated [1]New Work Volume *(cubic yards)*	New Work Federal Channel Dredge Volume *(cubic yards)*	[2]Third-Party Facilities *(cubic yards)*
43 feet Deep Channel Project	255,100	200,400	54,700
44 feet Deep Channel Project	373,233	304,867	68,367
45 feet Deep Channel Project	491,367	409,333	82,033
46 feet Deep Channel Project	609,500	513,800	95,700

[1]New work volume includes quantities for advance maintenance and allowable overdepth.
[2]The Third-Party Facilities dredged volume is not dredged from the Federal Channel; it is dredging of the Third-Party berth. This is necessary for the Third-Party Facility to benefit from the deepening of the Federal Channel to 46 feet. This work is considered an associated cost used in the BCR and is also considered in the placement area capacity analysis.

For all channel project alternatives considered, deepening of the channel and future maintenance would be performed using a hydraulic pipeline dredge with channel dimensions matching the new 46-foot project authorized by WRDA 1996. Shoaling rates at the project location were determined to be stable (the same as the FWOP) and not impacted by the proposed channel depths, based upon a long history of maintenance dredging at the site and engineering analysis. Estimated maintenance dredging for each of the proposed channel alternatives would remain at 648,000 cubic yards per dredging cycle (every four years), representing no increase over current maintenance dredging quantities for the existing 41-foot channel.

3.8. Dredged Material Placement Alternatives

Several dredged material placement alternatives were considered, including the existing upland confined PA (i.e., Pelican Island PA), a new upland confined PA on Pelican Island, and a new beneficial use site (marsh) located off the west end of Pelican Island (Figure 6). The Engineering Appendix includes more detailed information on the following placement options, including existing soils data and foundation conditions.

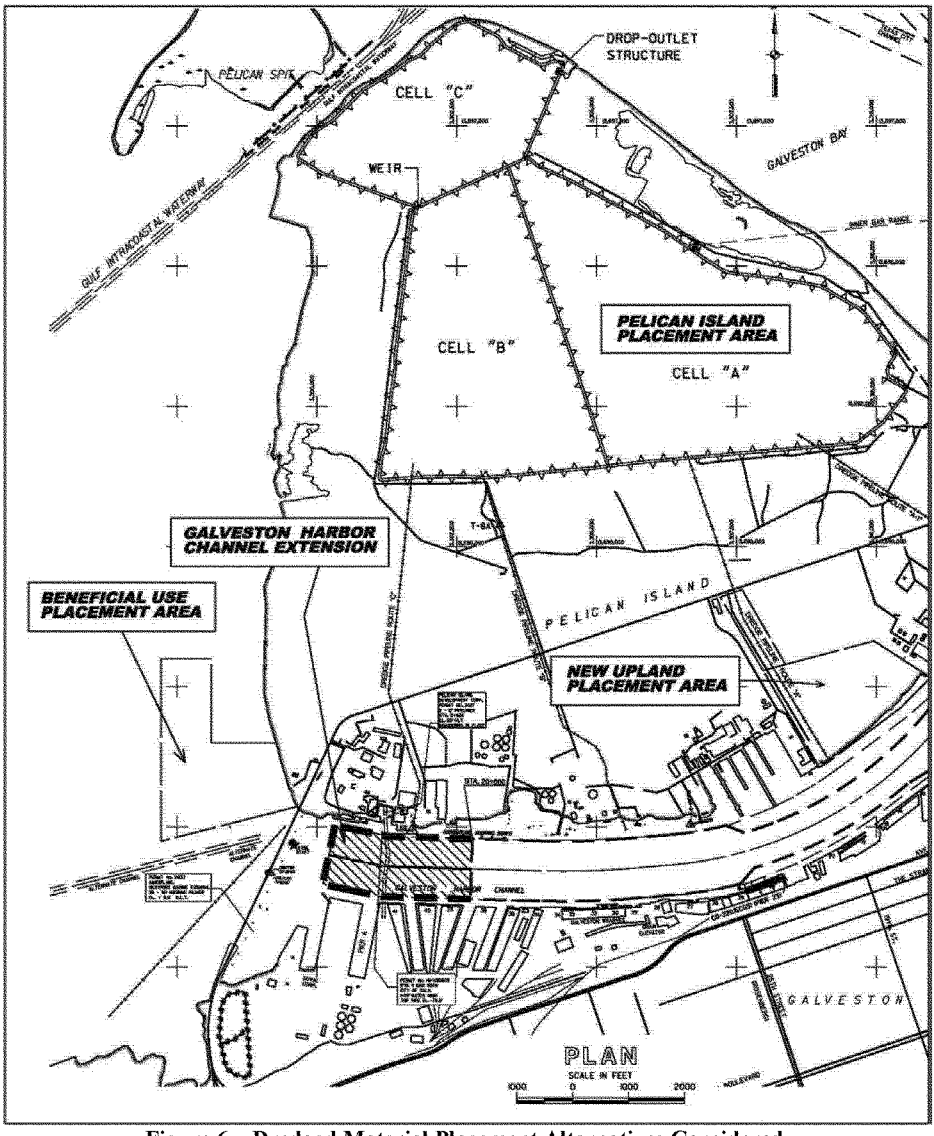

Figure 6 – Dredged Material Placement Alternatives Considered

Beneficial use was considered during plan formulation and discussed in the EA; however, marsh creation was not selected as part of the NED plan. The construction process and design for marsh creation is similar regardless of the beneficial use quantity and corresponding marsh size. Marsh creation would entail mechanically constructing a perimeter dike at an elevation of +5 feet, assuming the average elevation of bay bottom along the west side of Pelican Island is around -5 feet. It was assumed that about 4 feet of the existing bay bottom material is soft and would be removed and replaced with suitable materials. The perimeter dike would be constructed by hydraulic fill methods using new work from the channel deepening. The perimeter dike would be armored using a combination of geotextile, blanket stone, and riprap.

The new work material from the construction of the channel deepening project would be pumped into the marsh site, and amphibious equipment would be used to guide the dredge discharge for fairly even placement across the site. As a follow up measure, five feet deep circulation channels would be constructed inside the marsh cell. Excavated material from construction of the circulation channels would be placed in the eastern area of marsh near the Pelican Island shoreline. Outlet structures would also be put into place. More detailed information on the Beneficial Use Alternative is available in Section 6.3 Beneficial Use Site Alternatives in the Engineering Appendix. Conceptual Drawing B-02, showing the beneficial use alternative, is also available in that appendix.

3.9 Non-Structural Alternatives

Light-loading vessels to accommodate larger vessels under the existing depths was identified as a non-structural alternative. Light-loading is already in use under the without-project condition and therefore was eliminated from the study as it does not provide transportation cost savings. Each alternative also assumes some amount of light-loading continues to occur.

4.0 EVALUATION OF CHANNEL AND PLACEMENT ALTERNATIVES

4.1 Screening of Alternatives

The alternatives were evaluated on their ability to meet the planning objectives to;

- Increase deep-draft navigation efficiency for Galveston Harbor Channel over the 50-year period of analysis;
- Develop an alternative that is environmentally sustainable for the 50-year period of analysis; and
- Reduce navigation transportation costs to and from Galveston Harbor Channel to the extent possible over the 50-year period of analysis.

Each alternative was evaluated with respect to the aforementioned criteria (Table 6).

Table 6: Alternatives Screening Matrix

Screening Criteria / Channel Alternative[1]	Increase deep-draft navigation efficiency	Be environmentally acceptable	Maximize Net Benefits
No-Action Alternative (41 feet Deep Channel)		✓	
43 feet Deep Channel Alternative	✓	✓	
44 feet Deep Channel Alternative	✓	✓	
45 feet Deep Channel Alternative	✓	✓	
46 feet Deep Channel Alternative (Recommended Plan)	✓	✓	✓

[1] *The channel width for all alternatives, not including the No-Action Alternative, is 1,075 feet. The No-Action Alternative maintains the existing authorized width of 1,085 feet associated with the currently authorized -41 feet MLLW depth of this channel segment.*

The No-Action Alternative is considered environmentally acceptable since it would continue to involve only minor temporary impacts to bay bottom experienced during routine maintenance activities. However, deeper draft vessels attempting ingress and egress to the bulk cargo facilities at the far west end of the channel would continue to be constrained by existing channel depth, and would continue current practices of light-loading to access and depart the bulk cargo facilities.

4.2 Increasing Navigation Efficiency

Navigation efficiency is based upon transportation cost savings which produces economic benefits. As detailed in the economic appendix and summarized in Table 7, each alternative produces transportation cost savings.

Table 7: Transportation Cost Savings per Ton

Channel Depth	41 feet	42 feet	43 feet	44 feet	45 feet	46 feet
Cost per Ton	$33.82	$30.91	$29.93	$29.02	$28.16	$27.35
Savings per Ton	--	**$2.91**	**$3.89**	**$4.81**	**$5.67**	**$6.47**

All proposed channel deepening alternatives increased navigation efficiency since deeper channels allow larger volumes of goods to be transported with each vessel movement, as light-loaded vessels can be more fully loaded or smaller vessels are replaced with larger deeper-drafting vessels. As shown in the bottom line, the savings per ton increases from $2.91 for a 42-foot channel to $6.47 for a 46-foot channel (Appendix A – Economic Analysis; Fleet Characteristics).

Costs, including dredging, placement, and Operations and Maintenance (O&M) costs for the 50-year period of analysis were estimated from all of the alternatives and compared to the project benefits.

Table 8 displays a summary of the economic analysis and includes benefit-cost ratios (BCRs) and net excess benefits compared to the cost of the proposed project modifications. Only the 46 feet deep channel alternative would accommodate fully-loaded deep-draft vessels traversing the adjacent 46-foot authorized channel ingress and egress of the Port's bulk and sulphur terminal facilities located at the end of the channel thus maximizing project benefits as shown in Table 8.

Table 8: Summary of Economic Analysis
Galveston Harbor Channel Extension BCR @ 2.875%

Galveston Harbor Channel Extension Summary of Economic Analysis				
Item	**43-foot**	**44-foot**	**45-foot**	**46-foot**
Project Cost	$6,828,000	$9,002,000	$11,202,000	$13,395,000
Associated Costs	$1,108,000	$1,385,000	$1,661,000	$1,938,000
Months to Construct	5	5	5	5
Interest During Construction	$38,000	$50,000	$62,000	$74,000
NED Investment Cost	$7,974,000	$10,437,000	$12,925,000	$15,407,000
Average Annual Cost	$303,000	$396,000	$491,000	$585,000
Average Annual Benefits	$960,000	$1,186,000	$1,398,000	$1,597,000
Net Excess Benefits	$657,000	$790,000	$908,000	$1,012,000
Benefit-Cost Ratio @ 2.875%	3.2	3.0	2.9	2.7

4.3 Environmental Acceptability

Impacts resulting from any of the proposed channel deepening alternatives would involve only minor temporary impacts to bay bottom comparable in type and magnitude to those experienced during routine dredging maintenance that occurs under the FWOP to maintain the existing channel template. Therefore, all proposed channel alternatives are considered environmentally acceptable and no mitigation would be required for any of the alternatives.

4.4 Identification of the Recommended Plan

The 46-foot channel is the national economic development (NED) plan; the NED plan reasonably maximizes net benefits (benefits minus costs), meets the planning objectives, and is environmentally acceptable; as such it is the Recommended Plan.

A hydraulic pipeline dredge would be used to minimize turbidity during initial dredging. Initial dredging would temporarily increase water column turbidity during dredging activities for any of the proposed channel deepening alternatives; however, these are considered minor and are comparable in type and magnitude to those experienced during routine maintenance dredging that occurs for the existing channel template. Typical cut depth of maintenance material would be identical to the new work.

The least cost (base plan) for dredged material management is to use the Pelican Island PA. Beneficial use may be further explored as needed during preconstruction, engineering, and design (PED) or in the future using Section 204 of WRDA 1992 or Section 207 as amended by Section 2037 of WRDA 2007. The NFS supports upland placement and does not request beneficial use at this time.

This alternative was evaluated in further detail and refined in Section 5, Selected Plan. In addition, its relationship to the overall HGNC project is described.

5.0 SELECTED PLAN

The identification of the Recommended Plan from the various alternatives was based upon economic and environmental factors. The environmental consequences are fully described in Section 4 of the EA. There are no adverse environmental impacts anticipated from deepening the remainder of the GHCE. Impacts resulting from the proposed deepening are considered comparable in type and magnitude to those experienced during routine maintenance of the existing channel.

(1) *NED.* For all project purposes except ecosystem restoration, the alternative plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment, the NED plan, shall be selected. The ASA (CW) may grant an exception when there are overriding reasons for selecting another plan based upon other Federal, State, local, and international concerns. The Recommended Plan is the NED plan.

(2) *Regional Economic Development (RED).* The RED account identifies changes in the distribution of regional economic activity. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population (ER 1105-2-100). Construction of the 46-foot channel from Station 20+000 to Station 22+571 would provide the navigable depths to the facilities at the end of the channel and allow these users to benefit from the adjacent 46-foot channel and reduce transportation costs realized through the more efficient loading of vessels on a per trip basis. During project construction, the study area would likely have an increase in construction employment and local purchases of construction materials, although this would be temporary. The primary economic bases of the study area include container ship and barge terminal for handling general cargo, sulphur, and dry bulk commodities. As a result of the Recommended Plan, positive economic effects to the study area would occur.

(3) *Effects on Environmental Quality (EQ).* The EQ account identifies the nonmonetary effects on significant natural and cultural resources (ER 1105-2-100). Environmental considerations associated with these actions include those related to dredging and disposal of dredged material.

(4) *Other Social Effects (OSE).* The OSE account identifies the plan effects from perspectives that are relevant to the planning process, but are not reflected in the NED/NER, EQ, and RED accounts (ER 1105-2-100). Structural and nonstructural alternatives must reflect close coordination with interested Federal and State agencies and the affected public. The effects of these measures on the environment must be carefully identified and compared with technical, economic, and social considerations and evaluated in light of public input. The proposed project would not have a disproportionate adverse impact on minority or low-income population groups within the project area.

5.1 Project Description

The proposed channel improvements consist of deepening a segment of the existing 41 feet deep by 1,085 feet wide channel to 46 feet, for a distance of 2,571 feet. The deepening will originate near POG Pier-38 at Station 20+000, continue westward towards Pelican Island Bridge and end at Station 22+571. Station 20+000 demarcates the farthest extent of the authorized 46-foot Galveston Harbor Channel. The project limits for the newly constructed 46-foot Galveston Harbor Channel and the GHCE study area shown previously in Figure 5.

Advanced maintenance and allowable over-depth will remain at the current requirement of 3 feet and 2 feet, respectively, such that the maximum channel depth following periodic maintenance would not exceed 51 feet.

The existing 41-foot channel template that was authorized under the Galveston Harbor and Channel, Texas, project has a bottom width of 1,085 feet. The 46-foot channel bottom width would be 1,075 feet, 10 feet less in width than existing bottom width. Side slopes will be constructed at 1V:3H (1 foot vertical and 3 foot horizontal) as shown in Figure 7. Side slopes will be maintained at 1V:2H.

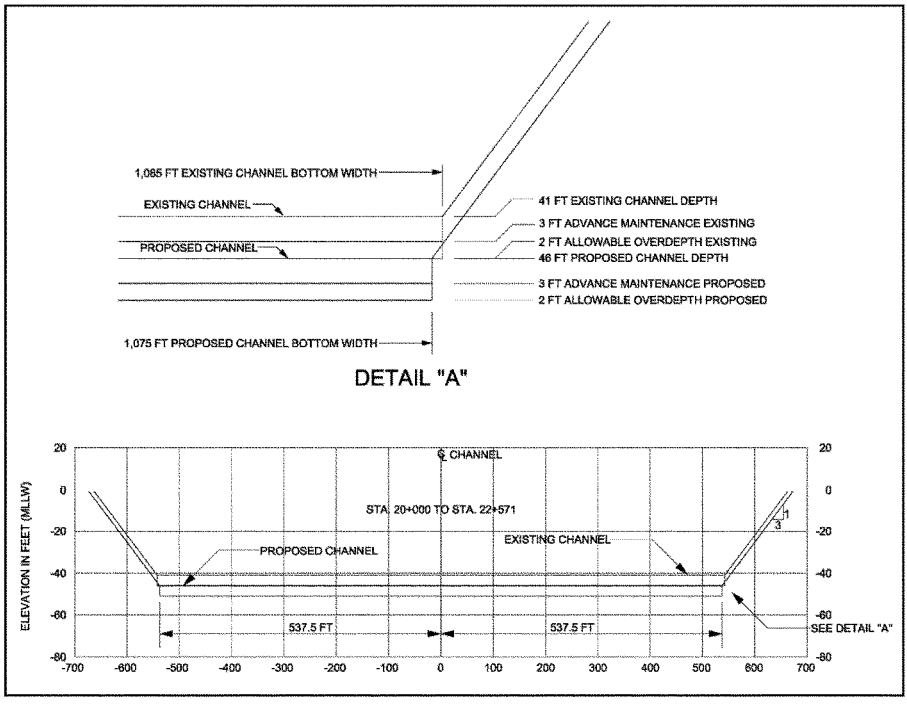

Figure 7 – Typical Cross Section of Proposed Extension within Galveston Harbor Channel

New work materials from channel construction, identified in the Engineering Appendix, Section 6.2.1, would consist primarily of stiff to hard high-plasticity clays. This material would be placed in the upland confined Pelican Island PA (Figure 8), located north of the Galveston Harbor Channel on the northernmost end of Pelican Island. The PA is approximately 1,100 acres in size and is currently divided into a three cell system. For an in-depth description of the Pelican Island PA see Engineering Appendix, Section 6.2.2.

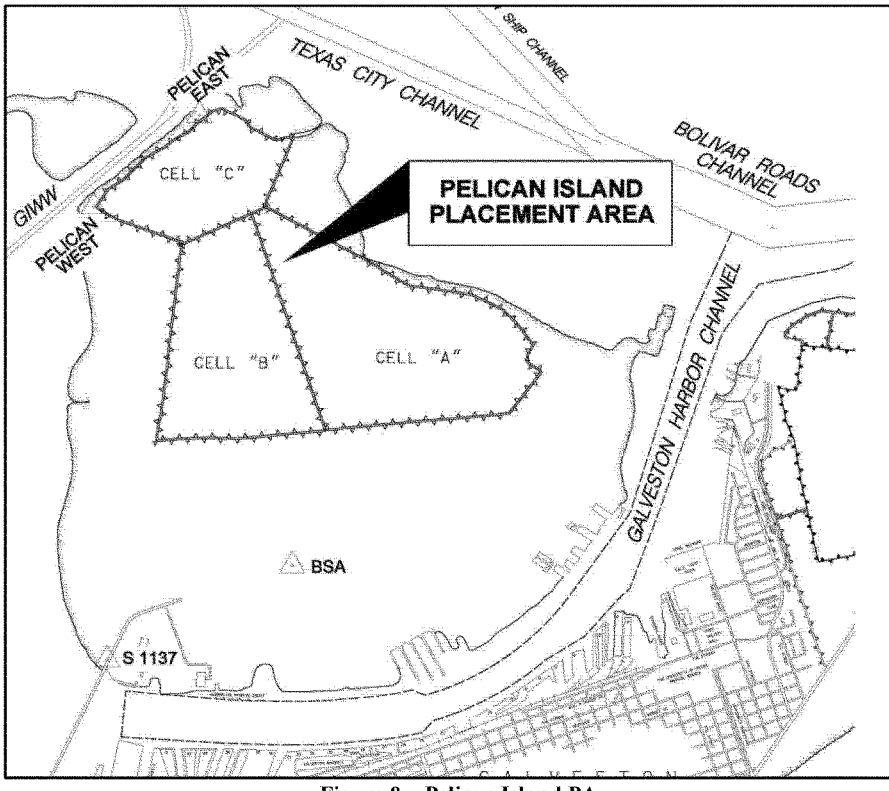

Figure 8 – Pelican Island PA

The current estimated dredged material capacity in the Pelican Island PA is 70.9 million cubic yards (MCY) based on an ultimate dike height of + 50 feet and required freeboard of 3 feet, as discussed in the 1995 LRR. The total new work volume anticipated for placement in the PA from construction of the channel extension, 726,900 CY includes 513,800 CY from construction of the extension, 95,700 CY from third-party facilities, plus 102,400 CY of non-pay dredging for the extension and 15,000 CY of non-pay dredging for the third-party facilities. Non-pay dredging would be defined as dredging outside the paid allowable overdepth that may occur due to such factors as unanticipated variations in substrate, incidental removal of submerged obstructions, or unusual wind and wave conditions. See the Engineering Appendix, Section 2.8 for definitions of the various dredging volumes included in the total new work volume.

The maintenance dredging cycle of the channel is defined as the average number of years between the O&M dredging operations for a historical period. Each channel or reach may or may not have its own dredging frequency. The District's Dredging Histories Database, a Microsoft Access-based computer program, was utilized to establish the existing shoaling rate and dredging frequency

for the newly constructed 46-foot Galveston Harbor Channel.

Referencing the 2007 LRR, Engineering Appendix document, an analysis of 24 years of dredging history identified six maintenance dredging cycles with an estimated shoaling rate of 1,425,500 cubic yards per year for the complete 22,571-foot long channel. The newly constructed 46-foot deep channel shoaling rate will be assumed to remain the same as the existing channel; therefore, a linear interpolation of the channel dredging data produces a shoaling rate of approximately 162,000 cubic yards per year for the proposed extension. The maintenance dredging frequency will remain the same (four years) as the existing 46-foot channel (Engineering Appendix, Section 2.6).

About 7.8 MCY of maintenance material (12 maintenance cycles) is forecast for the project (Station 20+000 to Station 22+571) over the 50-year period of analysis, the same as is required for the existing 41-foot channel. All maintenance material would be placed in the existing upland confined Pelican Island PA, consistent with current practices. However, the PA must have capacity for storage of maintenance dredging volumes from the entire GHC (Station 0+000 to Station 22+571) which totals about 68.4 MCY over the 50-year period of analysis. Including the projected new work volume (726,900 cubic yards), the total forecast dredging volume for the 50-year period of analysis is about 69.2 MCY, leaving about 1.7 MCY of available capacity.

No increment of maintenance volumes over and above the historic dredging volumes is anticipated as a result of deepening the channel to 46 feet; therefore, Pelican Island PA has more than sufficient remaining capacity to accommodate the new work volume generated by this project. Based on analysis of the Pelican Island PA capacity, there is no requirement for additional placement areas to contain the new work or maintenance dredge materials over the 50-year period of analysis.

According to the 1995 LRR, previous estimates made near or prior to 1995 indicate that the make-up of dredged maintenance material from the channel has consisted in the past of approximately 80 percent fine grained materials and approximately 20 percent coarse grained or sandy materials (Engineering Appendix, Section 6.2.1).

A hydraulic pipeline dredge would be used to minimize turbidity during initial dredging. Initial dredging would temporarily increase water column turbidity during dredging activities for any of the proposed channel deepening alternatives; however, these are considered minor and are comparable in type and magnitude to those experienced during routine maintenance dredging that occurs for the existing channel template. Typical cut depth of maintenance material would be identical to the new work. For O&M dredging, standard operating procedures employ a pipeline dredge.

The extension would continue to allow the same advanced maintenance and allowable over-depth after it is deepened (Appendix B - Engineering Appendix).

Past NEPA documentation and coordination for the adjacent 46-foot channel identified impacts to bay bottom (benthic habitat) as minor and temporary and required no mitigation. Deepening the extension involves deepening only 2,571 linear feet of channel to match the bottom depth of the recently constructed 46-foot channel. Environmental impacts were analyzed for deepening the GHC and no significant or adverse impacts were identified. Policy compliance and agency coordination is documented in the EA.

5.2 Design and Construction Considerations

The GHCE project would involve deepening a portion of the Galveston Harbor Channel that is currently authorized and maintained at 41 feet deep. All dredged material resulting from the deepening would be placed in the existing Pelican Island PA. No additional land acquisition is required for dredged material placement or channel dredging.

The proposed channel center alignment extends westward from Station 20+000 to the end of the existing 41-foot channel at Station 22+571. This portion of channel would be constructed to match the design of the adjacent newly constructed 46-foot channel with channel side slopes at 1V:3H, and bottom width of 1,075 feet.

5.3 Total Project First Costs

The costs from the certified TPCS dated 1 October 2016 (see Appendix C) were updated to FY 17 price levels. The Total Project Cost (October 2016 price levels) for this feasibility report estimates the constant dollar cost of the GHCE Project at $15,333,000. The fully funded (total project cost) project estimate, including contingencies and escalation, is $16,305,000. The study expenditures are not included in that figure.

New authorization is required for the GHCE. The project first cost (less associated costs) of $13,395,000 (1 October 2016 price level) for the approximately half mile long project would serve as the basis for any future 902 limit calculations.

5.4 Project Benefits

The existing HGNC project benefits result from navigation improvements and environmental restoration improvements. Navigation benefits associated with the various deepening and widening alternatives were derived from reductions in vessel transportation costs, reductions in vessel delays,

and reductions in vessel casualties. The proposed deepening of the channel from Station 20+000 to 22+571 will provide navigation improvements to the facilities at the end of the channel by providing the additional depth to allow these users to benefit from the adjacent 46-foot channel described in the 1995 and 2007 LRR and reduce transportation costs realized through the more efficient loading of vessels on a per trip basis. Table 9 shows the Average Annual Benefits for the HGNC 1995 LRR and the recommended project.

Table 9: Average Annual Benefits

HGNC 1995 LRR Average Annual Benefits (October 1994 prices, 7.75% interest),	Galveston Harbor Channel Extension Average Annual Benefits (October 2016 prices, 2.875% interest)
$87,232,000	$1,597,000

There will be some slight overall increase in the cost of the project due to the one time construction cost of deepening the extension; however, overall there is expected to be a positive change in project benefits with the deepening of the extension.

5.5 Benefit-Cost Ratio

The BCR for the GHCE project and the recommended project is shown in Table 10.

HGNC 1995 LRR (October 1994 prices, 7.75% interest)	HGNC - Galveston Channel Project 2007 LRR; updated economics on Galveston Portion (October 2006 prices, 4.875% interest)	Galveston Harbor Channel Extension Feasibility (October 2016 prices, 2.875% interest)
BCR: 2.3	BCR: 2.3	BCR: 2.7

The 2007 LRR updated economics for the Galveston Channel Project portion of the HGNC and showed a BCR of 2.3 using October 2006 prices and 4.875 percent interest.

The BCR for the Recommended Plan is 2.7. The benefits for the recommended project were calculated for a 50-year period of analysis using FY 2017 Federal Discount rate of 2.875 percent and the deep-draft vessel operating costs contained in the Economic Guidance Memorandum (EGM 15-04).

5.6 Cost Apportionment

Initial construction for the project deepening from 41 feet to 46 feet would be apportioned 75 percent Federal and 25 percent non-Federal with POG, the Sponsor for the GSC portion of the HGNC. Project First Costs for the recommended project are detailed in Table 11. Upon completion of construction the local sponsor must provide an additional cash contribution equal to 10 percent of GNF costs. The costs may be paid over a period not exceeding 30 years. The sponsor's costs for Land, Easements, Rights-Of-Way, and Removals/Relocations (LERR) are credited against the additional cash contribution. No LERR credits are anticipated since the recommended plan will utilize an existing PA, and if constructed deepen the remaining portion of the channel already in use by the NFS. New aids to navigation are not required for this extension.

Table 11: Recommended Plan - First Costs Allocation

(Price Level October 2016)

Costs Allocated to 46-foot Depth			
	Total Costs	**Federal Share**	**Non-federal Share**
General Navigation Features			
Lands – Federal	0	0	0
Navigation	$11,490,000		
Channel Dredging (41-46 feet)*		$8,617,500	$2,872,500
Planning, Engineering and Design	$1,504,000	$1,128,000	$376,000
Construction Management	$401,000	$300,750	$100,250
Total Project First Costs**	**$13,395,000**	**$10,046,250**	**$3,348,750**
Associated Non-Federal Costs (owner cost)			
Portside Dock	$1,938,000	$0	$1,938,000
With Associated Non-Federal Costs Added	**$15,333,000**	**$10,046,250**	**$5,286,750**

**WIIN 2016 returns cost share up to 50 feet MLLW to 75/25*

***TPCS includes a 24 percent contingency*

In reference to cost sharing purposes the recommended plan would be authorized at 46 feet deep and therefore does meet the definition for a deep-draft project as defined by Section 214 (1) of WRDA 86. Section 101(a)(4) of WRDA 86 states that the non-Federal Sponsor "...shall perform or assure performance of all relocations of utilities necessary to carry out the project, except in the case of a project for a deep-draft harbor and in the case of a project constructed by non-Federal interest under Section 204..." neither exception of which apply in this instance.

5.7 Recommended Plan Environmental Consequences

A Final EA has been prepared that addresses the environmental consequences of the recommended plan to the GHCE. Environmental impacts resulting from deepening the 41-foot channel to 46 feet are expected to be negligible because construction will occur within the existing project footprint and an existing PA will be used. For a detailed discussion of the environmental consequences of the recommended plan, please refer to Section 4.0 of the Final EA. Summary points of the environmental consequences discussed in the Final EA are included in the following paragraphs.

The environmental review of the recommended modifications included consideration of impacts from sea level rise and to vegetation, wildlife, aquatic resources including Essential Fish Habitat (EFH), threatened and endangered species, cultural resources, socioeconomic resources, Environmental Justice, Prime and Unique Farmlands, Hazardous, Toxic, and Radioactive Wastes, air, noise, water quality, as well as alternative courses of action and cumulative impacts.

The deepening of GHCE would have negligible impacts to very low quality bay bottom habitat comparable in type and magnitude to those experienced during routine maintenance that occurs for the existing channel template. No special aquatic sites, including wetlands, would be impacted. Therefore, no mitigation would be required for this project. Only minor, temporary increases in turbidity, noise and navigation traffic are anticipated. However, such effects would not be "new", but would be among the cyclical recurring impacts that occur during maintenance of the channel. All affected resources are expected to recover to pre-project conditions after the work is completed. The proposed project is expected to contribute beneficially to navigation efficiency and is not expected to contribute negative cumulative impacts to the area.

The EA includes a Draft General Conformity Determination. To comply with the Clean Air Act, the General Conformity Determination will be completed during Preconstruction Engineering and Design (PED) when the timing and design of the project is known. The proposed project was found to be compliant with the Endangered Species Act, Clean Water Act, EFH, the Texas Coastal Management Plan (TCMP) and other relevant laws and executive orders as discussed in Section 7.0 of the Final EA.

5.10 Public Involvement

Public comment was conducted during the PACR/EA (10 May 2013 to 10 Jun 2013). No adverse comments were received. Appendix B and E of the 2016 EA contains the coordination record. The GHCE Project is very limited in scope, non-controversial, and affects only a previously deepened and regularly maintained channel. No further public review is planned.

6.0 FEDERAL AND NON-FEDERAL RESPONSIBILITIES

By an agreement dated January 22, 2016, the Government and the NFS agreed to cooperate in the Feasibility Study of the GHCE, Texas. The proposed work is not within the provisions of the existing agreement, thus a new PPA will be necessary. Cost sharing of the $13,395,000 will be 75/25 from 41 to 46 feet MLLW.

As discussed in Section 5.2 Changes in Local Cooperation Requirements (outlined in ER 1105-2-100, Appendix E, Paragraph E-8b(4)(b)), this navigation improvement would serve multiple properties with different owners.

7.0 SUMMARY AND CONCLUSIONS

For the purpose of calculating the Section 902 limit, the total estimated first cost of the project at FY 17 price levels (1 October 2016) is: $13,395,000 including an estimated Federal share of $10,046,250; and an estimated non-Federal share of $3,348,750.

The results of the economic analysis in Appendix A show that it is economically justified to deepen the Galveston Channel to 46 feet through the reach presently authorized to 41 feet. Volume continues to increase at the bulk terminal for minerals used in oil and gas exploration and a significant share of this volume is constrained by the current channel depth.

Construction of the 46-foot channel from Station 20+000 to Station 22+571 would provide the navigable depths to the facilities at the end of the channel and allow these users to benefit from the adjacent 46-foot channel and reduce transportation costs realized through the more efficient loading of vessels on a per trip basis. All basic features of the project remain the same. The addition of the 2,571 feet of deepened channel does not add or delete any project purpose.

The economic cost for construction of the extension is approximately $15,333,000, to include an estimated $1,938,000 in associated costs. The navigation improvements have an average annual cost of $585,000 and average annual benefits of $1,597,000 and a BCR of 2.7.

These recommendations are made with the provision that Congressional Authorization be obtained and that prior to implementation of the recommended improvements, the Federal Government and the NFS (POG) would enter into a Design Agreement for Preconstruction, Engineering, and Design (PED) and a new PPA prior to construction.

8.0 RECOMMENDATIONS

Since this Feasibility Report is for new additional authorization and the newly authorized costs it would serve as the basis for any future 902 calculation.

All of the GNF project costs and associated costs are included in the BCR calculation. Total average annual costs for the project are $585,000 for construction. There are no additional O&M costs over the existing project. Fully Funded Cost of the project, which includes Project Costs and expected escalation totals, is $16,305,000.

These recommendations are made with the provision that, prior to implementation of the recommended improvements, the NFS shall enter into binding agreements with the Federal government to comply with the following requirements:

The NFS, prior to implementation, shall agree, through the amendment to the PPA, to perform items of project partnership which may include, if applicable, the following:

a. Provide 10 percent of the total cost of construction of the general navigation features (GNFs) attributable to dredging to a depth not in excess of 20 feet, plus 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20 feet but not in excess of 46 feet, as further specified below:

    (1) Provide 25 percent of design costs allocated by the Government to commercial navigation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project.

    (2) Provide, during construction, any additional funds necessary to make its total contribution for commercial navigation equal to 10 percent of the total cost of construction of the GNFs attributable to dredging to a depth not in excess of 20 feet, plus 25 percent of the total cost of construction of the GNFs attributable to dredging to a depth in excess of 20 feet but not in excess of 46 feet.

b. Provide all lands, easement, rights-of-way, relocations and disposal (LERRD), including those necessary for the borrowing of material and disposal of dredged or excavated material, and perform or assure the performance of all relocations, including utility relocations, all as determined by the Government to be necessary for the construction or operation and maintenance of the GNFs;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNFs, an additional amount equal to 10 percent of the total cost of construction of GNFs less the amount of credit afforded by the Government for the value of the LER and relocations, including utility relocations, provided by the NFS for the GNFs. If the amount of credit afforded by the Government for the value of LER, and relocations, including utility relocations, provided by the NFS equals or exceeds 10 percent of the total cost of construction of the GNFs, the NFS shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of LER and relocations, including utility relocations, in excess of 10 percent of the total costs of construction of the GNFs;

d. Provide, operate, and maintain, at no cost to the Government, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Government;

e. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon property that the NFS owns or controls for access to the project for the purpose of completing, inspecting, operating, and maintaining the GNFs;

f. Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors:

g. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 C.F.R., Section 33.20;

Perform, or ensure performance of, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601–9675, that may exist in, on, or under LERRD that the Government determines to be necessary for the construction or operation and maintenance of the GNFs. However, for lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude, only the Government

shall perform such investigations unless the Government provides the NFS with prior specific written direction, in which case the NFS shall perform such investigations in accordance with such written direction;

h. Assume complete financial responsibility, as between the Government and the NFS, for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under LERRD that the Government determines to be necessary for the construction or operation and maintenance of the project;

i. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA;

j. Comply with Section 221 of P.L. 91-611, Flood Control Act of 1970, as amended, (42 U.S.C. 1962d-5b) and Section 101(e) of the WRDA 86, Public Law 99-662, as amended, (33 U.S.C. 2211(e)) which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended, (42 U.S.C. 4601-4655) and the Uniform Regulations contained in 49 C.F.R. 24, in acquiring lands, easements, and rights-of-way necessary for construction, operation, and maintenance of the project including those necessary for relocations, the borrowing of material, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

l. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, P.L. 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "*Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army*"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

m. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of one percent of the total amount authorized to be appropriated for the project; and

n. Not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the NFS's obligations for the project costs unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the project.

Construction of the recommended channel improvements is estimated to take four months to complete. During this period, the Government and the NFS shall diligently maintain the projects at their previously authorized dimensions according to the previous cooperation agreement. Maintenance materials that have accumulated in the channels at the time that "before dredging" profiles are taken for construction payment shall be considered as new work material and cost-shared according to the new cooperation agreement. Any dredging in a construction contract reach after the improvements have been completed and the construction contract closed will be considered to be maintenance material and cost-shared according to the new agreement.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels with the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorizations and implementation funding. However, prior to transmittal to the Congress, the N F S , the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

_____
Date

_____
Lars N. Zetterstrom
Colonel, Corps of Engineers
District Engineer

9.0 REFERENCES

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Water Resources Reform and Development Act 2014 (Public Law 113-121), Section 2102(b), dated 10 June 2014.



U.S. Army Corps
of Engineers
Galveston District

Galveston Harbor Channel Extension
Feasibility Study
Houston-Galveston Navigation Channels, Texas

APPENDIX A
ECONOMIC ANALYSIS

U.S. Army Corps of Engineers
Southwestern Division
Galveston District
2016

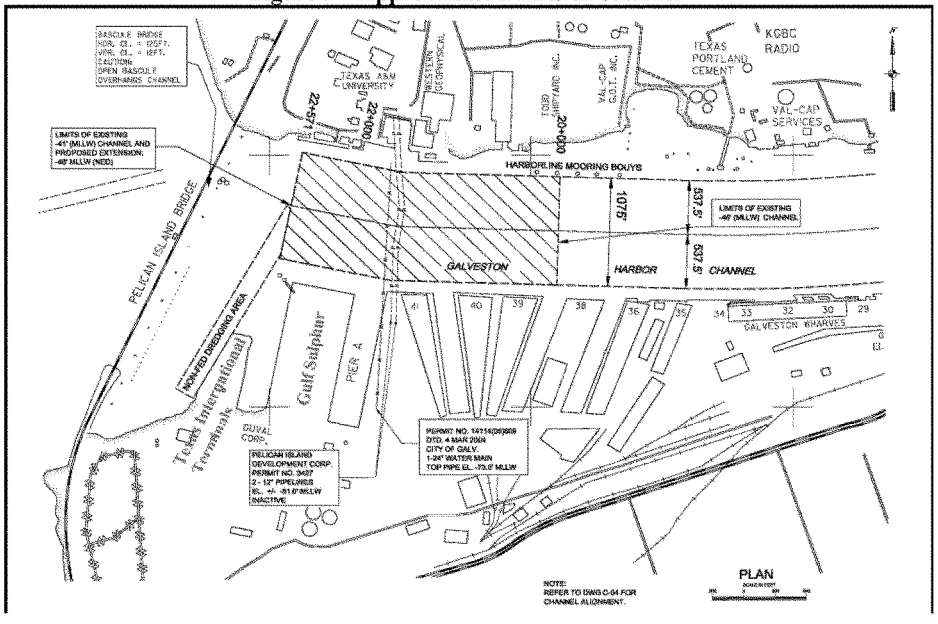
APPENDIX A – ECONOMIC ANALYSIS

Economic Analysis
Galveston Harbor Channel Extension

1.0 Introduction and Purpose

This analysis was conducted to consider the economic feasibility of deepening an additional segment of the Galveston Harbor Channel. A 2007 limited reevaluation confirmed the feasibility of deepening the Galveston Harbor Channel to 46 feet; however, the deepened channel only extends as far as Pier 38. The remainder of the channel has a depth of 41 feet and serves two docks, Gulf Sulphur Services and Texas International Terminals, which handle bulk commodities, such as liquid sulphur, dry sulphur, and barite, among other things, and will benefit from a deeper channel. The un-deepened portion of the channel also serves Port of Galveston Piers 39, 40, and 41, which handle general cargo, but are not routinely subject to draft constraints, and therefore are not considered benefiting by the channel deepening. This analysis focuses on the benefits and costs of deepening the remainder of the channel to a 46-foot depth. Figure 1 shows the approximate limits of the 46-foot channel, the 41-foot channel, and their relation to docks along the channel.

Figure 1 – Approximate Limits of Channel



1.1 Prior Studies

The recent deepening of the Galveston Harbor Channel was initially recommended in the 1987 Galveston Bay Area Navigation Study (GBANS), which evaluated various channel depths on the Houston and Galveston Ship Channels. The environmental complexities of the project required further study and a reevaluation report was completed in 1995. The reevaluation recommended that the Houston and Galveston ship channels be deepened to 46 feet, after determining that the originally recommended 51-foot channel was no longer economically feasible. The Houston Ship Channel was deepened to 46 feet in 2005, but the local sponsor did not have funding available to complete the Galveston channel deepening, so that portion of the project was deferred. The Port of Galveston assumed the role of non-Federal sponsor from the City of Galveston in 2006 and requested that the deepening project be resumed. The 2007 limited reevaluation report (LRR) was conducted to update the economic analysis of the previously recommended and authorized plan. Following the 2007 LRR, the Galveston Harbor Channel was deepened to 46 feet in 2011, with the exception of the last 2,571 feet. A draft Post Authorization Change Report (PACR) was developed in 2010 to evaluate the deepening of the remaining segment up to 46 feet, but was not finalized due to the Houston-Galveston Navigation Channel 902 limit exceedance. The remaining section of the channel is being analyzed in this report under the authorization of Section 216 of the Flood Control Act (FCA) of 1970, P.L. 91-611.

1.2 Basis for the Analysis

Economic benefits can accrue to a navigation project in several ways, because wider and deeper channels reduce the overall cost of transporting goods to markets here and abroad. Wider channels generally reduce delay times that result when vessels are required to pass, and deeper channels allow larger volumes of goods to be transported with each vessel movement, as light-loaded vessels are more fully loaded or smaller vessels are replaced with deeper-drafting vessels.

This analysis is focused solely on the economics of deepening the channel. The national economic benefits are a result of lowering the cost of transporting goods to market over the entire period of analysis, which is 50 years in this case (2020-2069). In order to estimate benefits and costs over that time period, a forecast will be made of the commodities to be transported, vessel characteristics and operating costs, and channel dredging and maintenance costs. A Microsoft Excel spreadsheet model was used to calculate benefits in this analysis. The model was first approved for use on 6 June 2012 by Headquarters USACE for the PACR, and on 24 February 2016, the Deep Draft Navigation Planning Center of Expertise (DDN-PCX) endorsed the recommendation to use the model again for this update.

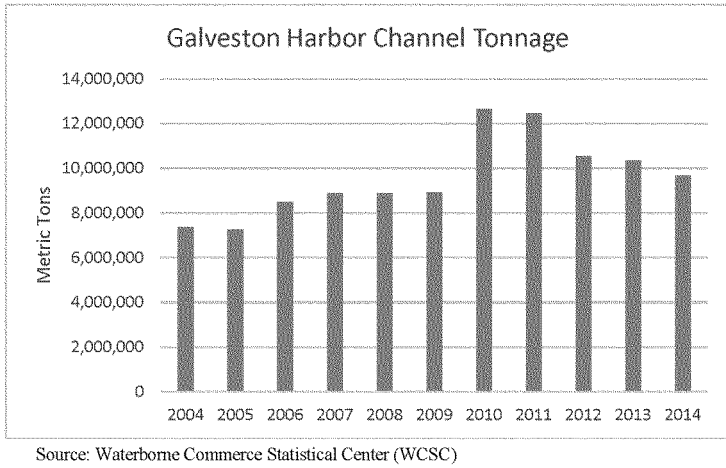
Additional economic impacts may follow from the project in the form of increased employment, tax revenues, and business income, among others. These effects are categorized as regional

economic benefits. Regional economic benefits are important in the consideration of local support for a project, but they do not increase the national economic benefits that are used to calculate the benefit-cost ratio (BCR). Because they are not included in the BCR, regional economic benefits have not been calculated at this stage of the analysis.

2.0 Historical and Existing Conditions

Figure 2 graphs total tonnage moving through the entire Galveston Channel between 2004 and 2014. From 2004 to 2009, there were between 8 million and 10 million metric tons moving in all directions (imports and exports) with an upward trend. There was a spike in tonnage in 2010 and 2011 when the amount of imported and exported tonnage was close to 14 million tons each year, largely based on an increase in exports of petroleum and petroleum products. Tonnage amounts leveled out in the following three years when the amount of tons imported and exported has remained between 10 million and 12 million tons.

Figure 2 – Galveston Channel Tonnage (2004-2014)

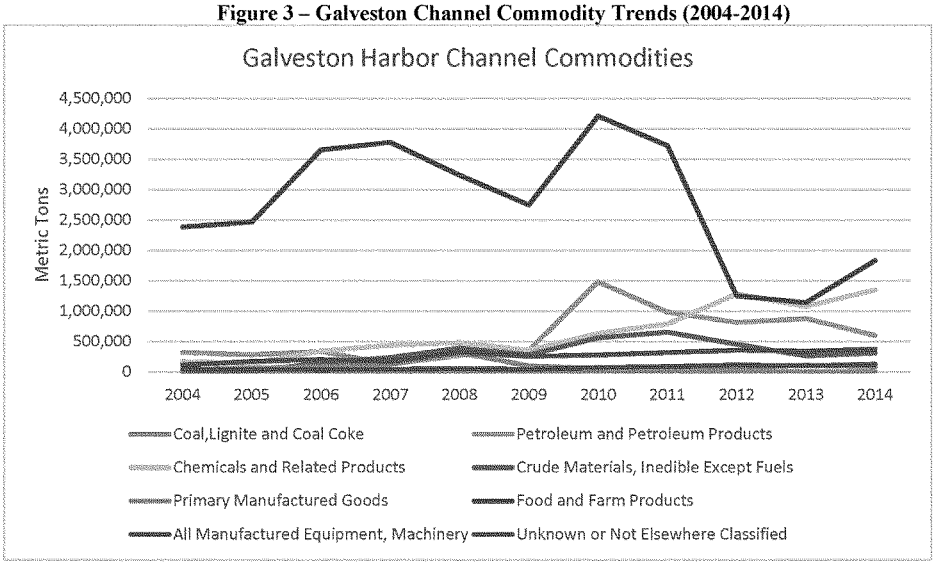


Source: Waterborne Commerce Statistical Center (WCSC)

2.1 Galveston Commodity Trends

Figure 3 displays the trends in foreign imports and exports by commodity group that have moved through Galveston Channel between 2004 and 2014.

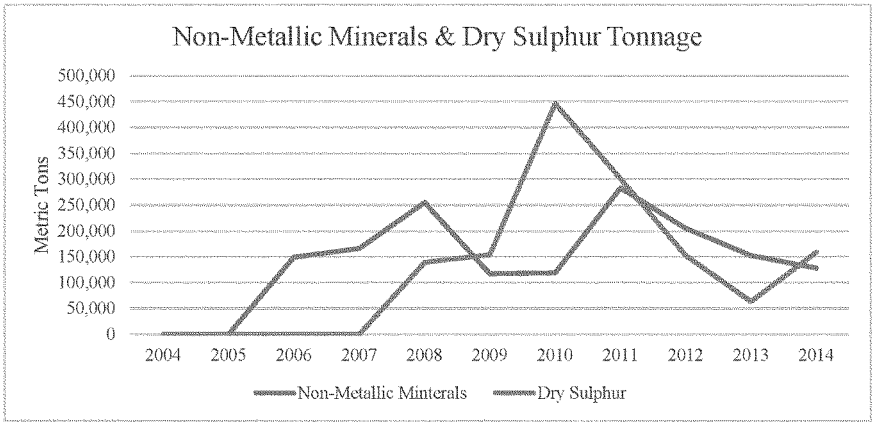
Figure 3 – Galveston Channel Commodity Trends (2004-2014)



Source: Waterborne Commerce Statistical Center (WCSC)

The two commodities that were identified as immediately benefiting from the proposed extension, barite and sulphur, are encompassed in the Crude Materials category from Figure 3 above. Within that category, barite is classified as a non-metallic mineral. These commodities will be discussed in more detail in sections 4.1 and 4.2. Figure 4 graphs the tonnage trends of non-metallic minerals and dry sulphur within Galveston Harbor in the last ten years.

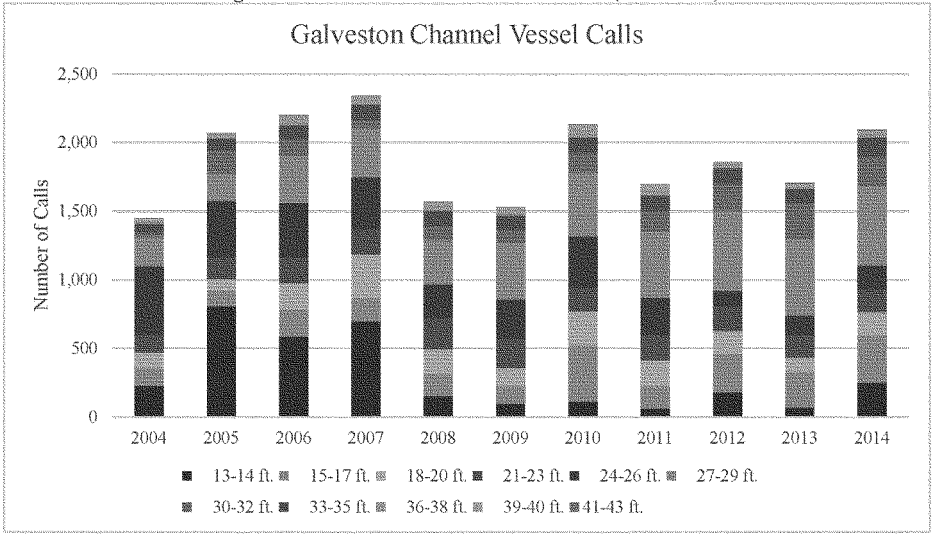
Figure 4 – Galveston Channel Non-Metallic Minerals and Dry Sulphur (2004-2014)



2.2 Galveston Channel Vessel Call Trends

Figure 5 graphs the number of calls by sailing draft to Galveston Harbor for all vessel types between 2004 and 2014, excluding those with drafts of less than 13 feet. Though not a large percentage of total vessel calls in Galveston Harbor, the number of 40 to 43 foot calls have been increasing in Galveston Harbor with the most calls in this category occurring in 2013 and 2014.

Figure 5 – Galveston Channel Vessel Calls (2004-2014)



3.0 Study Reach

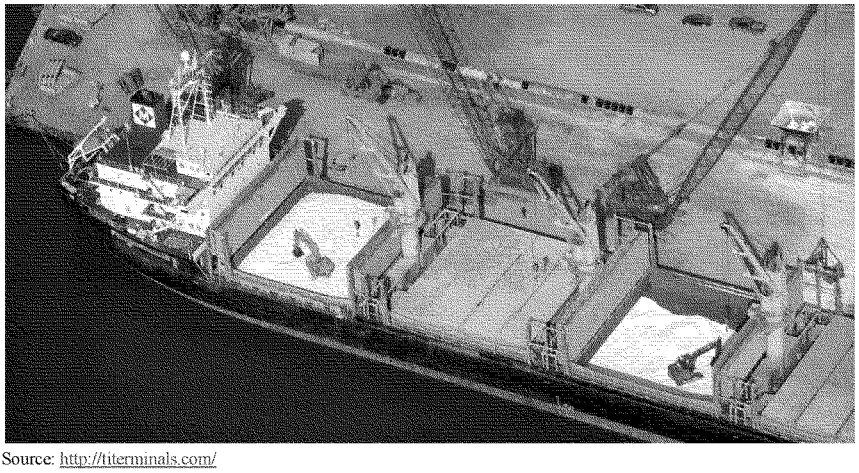
The Galveston Harbor Channel Extension focuses on the most westward end of the Galveston Ship Channel, beginning at Station 20+000 and ending at Station 22+571. There are five docks within the reach that moved 5.6 million metric tons of cargo between 2010 and 2014. Of that tonnage, it was estimated that approximately 152,000 tons could benefit from a deeper channel.

3.1 Commodities and Benefiting Docks

Waterborne Commerce Statistics Center (WCSC) data were examined to identify the commodities that are moving through this segment of the channel. The 1995 reevaluation report indicated that this segment of the channel was not included in the deepening plan because of the lack of shipping activity from facilities along this segment. While piers 39, 40, and 41 show intermittent usage, mostly for general cargo and other goods moved by barge, there is now a sulphur terminal, Gulf Sulphur Services, and a bulk terminal, Texas International Terminals, that demonstrate the largest need for a deeper channel. Between 2010 and 2014, WCSC records show that Texas International Terminals and Gulf Sulphur Services handled approximately 3.2 million and 389,000 metric tons of cargo, respectively.

Texas International Terminals, a portion of which is displayed in Figure 6, handles both liquid products and dry bulk. The terminal has a deep draft berth capable of accommodating vessels with up to a 760 length overall (LOA), 11,000 feet of onsite rail tracks, 350,000 square feet of covered storage capacity for bulk goods, and 325,000 barrels of storage capacity for liquid products.

Figure 6 – Texas International Terminal



Source: http://titerminals.com/

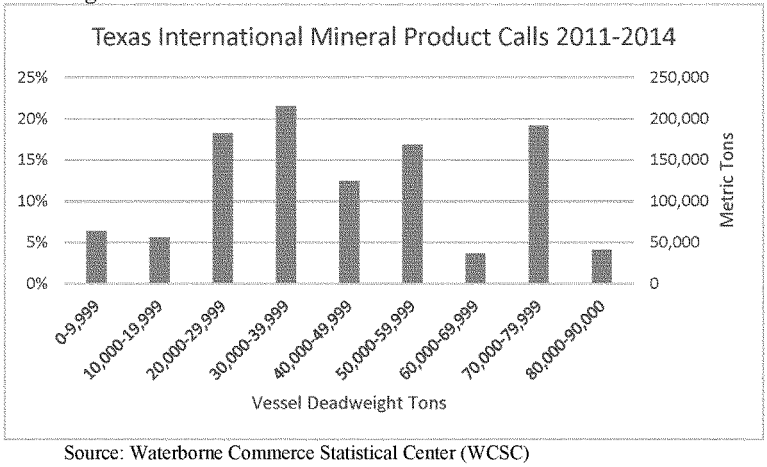
Gulf Sulphur Services is the largest liquid sulphur transportation, storage, and logistics system in the United States. Its terminal in Galveston handles both liquid in dry sulphur and has siqnificant liquid storage and solid facilities with a current capacity of approximately 1.1 million tons per year.

3.2 Vessels

There were 1,063 calls to docks in the extension portion of the channel between the years of 2010 and 2014. These trips were on an assortment of vessel types including bulk carriers, crude/oil products tankers, liquid barges, and general cargo ships with maximum design drafts ranging from 12 to 50.4 feet.

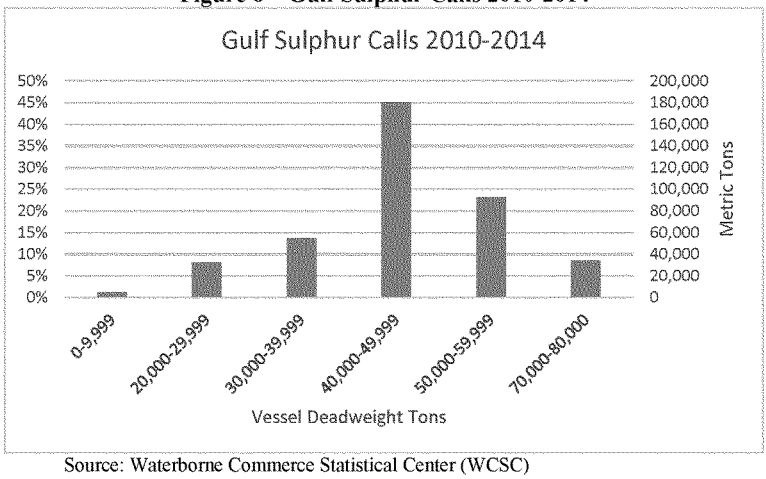
Figures 7 and 8 display the calls to the benefiting terminals carrying the commodity types of interest, barite and sulphur, at Texas International Terminals and Gulf Sulphur Services, respectively. The figures show that there is a vessel fleet mix carrying the commodities of interest. This analysis focuses on the vessels ranging from 40,000-90,000 deadweight tons, as these are the sizes of vessels that could potentially be constrained by the channel depth. Table 7 in section 4.3 describes the characteristics of benefiting vessels in greater detail.

Figure 7 – Texas International Mineral Product Calls 2011-2014



Source: Waterborne Commerce Statistical Center (WCSC)

Figure 8 – Gulf Sulphur Calls 2010-2014



Source: Waterborne Commerce Statistical Center (WCSC)

4.0 Study Reach - Benefitting tonnage summary

In examining the WCSC data from Texas International Terminals between 2011 and 2014 and Gulf Sulphur between 2010 and 2014, it was determined that imports of barite to Texas International Terminals and exports of sulphur from Gulf Sulphur are the two commodities that would currently benefit from the proposed channel deepening. These commodities are routinely shipped on light loaded or fully loaded Panamax vessels.

From the WCSC data, any calls on Panamax vessels (i.e., vessels with design drafts of 39 and above) were considered potentially benefiting. Of these calls, the ones with a sailing draft of 37 or greater were considered light-loaded for purposes of this analysis. Vessels that were fully loaded with design drafts of 39 were also considered to be benefitting under the assumption that this tonnage will shift to a larger vessel in the future. Table 11 in section 4.3 displays a table of the maximum sailing versus the design draft of all Panamax vessels calling at Texas International Terminals and Gulf Sulphur during the aforementioned timeframe.

4.1 Barite

Barite is a non-metallic mineral that is primarily used in the petroleum industry. The mineral has a high specific-weight, which makes it useful as a weighting agent in the drilling mud used when new wells are drilled during oil and gas exploration. Annual U.S. consumption is largely tied to the number of active drilling rigs in any given year. A comparison of the barite consumption levels to active drill rig counts each year from 1998-2008, shows that 76% of the variance in barite consumption is explained by the drill rig counts. This indicates that barite consumption is fairly

well correlated to drill rig activity levels.

Table 1 displays annual imports and annual consumption of barite in the U.S. from 2004 to 2014. Annual consumption has hovered around 3 million metric tons annually since 2005, and 96% of annual U.S. consumption is used in oil and gas exploration. Domestic production is centered largely in the Rocky Mountain region and is consumed within that region or exported to Canada. Imports have risen from 2 million metric tons in 2004 to 2.9 million in 2014. Imports comprise approximately 80% of total U.S. consumption. Sixty eight percent of imports come from China; the remaining 32% is imported from various countries. The U.S. barite historical imports was analyzed for its application to a trend line estimation. A historical trend line produced a 1.05% cumulative average growth rate from the United States Geological Survey (USGS) historical data of U.S. barite import.

Table 1 – U.S. Barite Consumption and Imports

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013e	2014e
Imports	2,000	2,690	2,550	2,600	2,400	1,430	2,110	2,320	2,920	2,240	2,900
Consumption	2,460	3,080	3,070	3,040	2,960	1,780	2,660	2,930	3,430	2,770	3,400
Net import as % of consumption	0.78	0.84	0.81	0.85	0.79	0.78	0.75	0.76	0.81	0.74	0.79
Import growth rate, year over year		34.50%	-5.20%	2.00%	-7.70%	-40.40%	47.60%	10.00%	25.90%	-22.90%	20.00%
Compound Ann Growth, Imports, 2004		34.50%	12.92%	9.14%	4.66%	-6.49%	0.90%	2.14%	4.84%	1.32%	3.05%

Source: USGS 2014 Mineral Commodity Summary - Barite

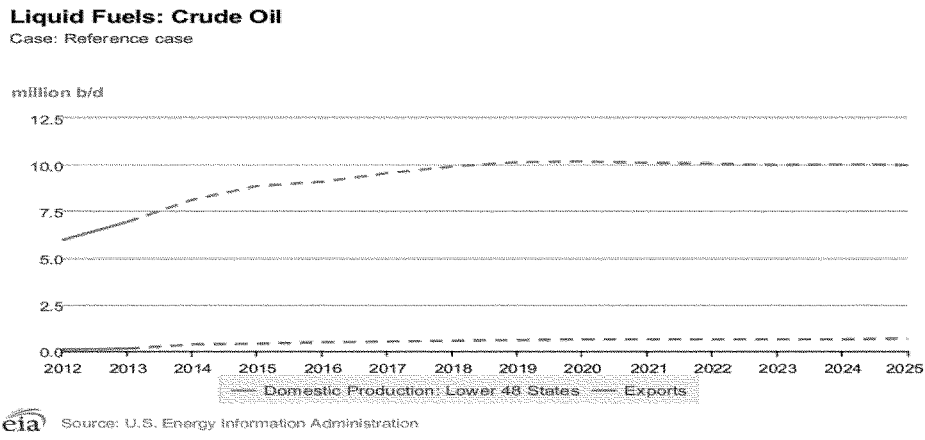
In 2013, the U.S. was the world's leading consumer of barite. Strong demand for barite is driven by domestic production of natural gas and crude petroleum. Oil and gas exploration in the U.S. will require imports of barite from China to the gulf coast of the U.S. Annual volumes will be driven by the active number of drill rigs, which is driven in turn by the market prices of natural gas and crude oil. It is expected that crude oil and natural gas production expectation would be a good proxy for barite imports. The American Energy Outlook 2015 and 2016 was reviewed for their application to the study purposes.

The 2016 Annual Energy Outlook (AEO) expects domestic crude oil and lease condensate production to grow at an annual rate of 0.9% from 2015-2040. The demand for barite in the production function of the crude oil and lease condensates are relatively correlated. The USGS historical patterns of barite produced an annual trend line growth rate of 1.05%, which was used as the median growth rate in this analysis. The 2016 AEO 0.9% growth rate was used as a good practicality check on the growth rate the historical trend provided. The difference between the

2016 AEO 0.9% and USGS historical trend can mostly be attributed to the other drilling operation not considering in the 2016 AEO expectation for crude oil and lease condensates.

Prior to December 2015 there was a ban on U.S. crude oil exports. The ban was lifted last December 2015. The crude oil industry also experienced relatively low crude oil prices late in 2015. The 2015 AEO estimated crude oil production to grow at a rate of 0.1% due to these factors. As shown in Figure 7, the 2015 AEO also expected the effects of removing restrictions on U.S. crude oil exports to produce an annual growth rate of 2.7% and 3.1% on the lower 48 states from (2013-2025). The analysis used the low 0.1% to capture a low price, low expectations on crude oil exports. The analysis then used 1.05% from the USGS historical trend line for the most likely and the 3.1% high growth to capture the scenario of rebounded prices and lifting of the crude oil exports ban.

Figure 9 – Annual Energy Outlook (AEO) Domestic Production Forecast



Galveston bulk terminals has the capacity to continue handling barite, and the access to deep water makes the GSC a rational choice for staging barite and other materials used in Gulf of Mexico oil and gas exploration. Waterborne Commerce (WCSC) records were reviewed back to 1991 and the data show varying volumes of foreign imports and exports of bulk commodities. Beginning in 2006, the operators of the bulk terminal began receiving shipments of barite on light-loaded Panamax vessels. Other materials move through the facility on barges, but it is the light-loaded shipments of barite that are of primary interest in this economic analysis. A review of the detailed WCSC data confirmed that barite increased significantly in 2006, after several years of little or no activity.

For purposes of this evaluation, actual tonnage data at the docks in this segment from 2011 through 2014 were used to establish an estimate of base year tonnage levels, as shown in Table 2. Then, three scenarios were developed for growth over the remainder of the period. The median growth rate scenario was meant to represent the most likely growth rate, and the low and high growth rate scenarios are analyzed to cover uncertainty in the estimates. Between 2011 and 2014, an average of 157, 000 metric tons per year of barite were imported on Panamax vessels. An average of sixty five percent of all shipments traveling to the bulk terminal on Panamax vessels were determined to be subject to draft constraints. These figures are in line with the historical constraints calculated for both 2007 and 2008 (72- and 68-% respectively).

Table 2 – Galveston Channel Extension Barite Tonnage

	2011	2012	2013	2014	2011-2014	2011-2014 Average (Base Tonnage)
Tonnage	308,339.34	137,843.50	69,752.47	113,031.08	628,966.39	157,241.60
Depth Constrained	208,518.55	132,845.32	6,039.66	64,533.14	411,936.67	102,984.17
% Constrained	68%	96%	9%	57%	65%	65%

Source: Waterborne Commerce Statistical Center (WCSC)

Three rates of growth were used to extrapolate from present levels. At the low end, 0.1% growth rate was used. A median growth rate of 1.05% annually was used as an approximation of the cumulative average growth rate of U.S. barite imports from 2004-2014, shown in table 2 and represents the most likely growth rate based on historical evidence. The high rate is assumed to be correlated with the AEO scenario accounting for the effects of lifting the crude oil export ban, or 3.1%. These rates for the median and high scenarios assume that the bulk terminal would hold onto a constant share of the U.S. import volume. Table 3 displays the forecast volume of bulk imports at the end of each decade during the period of analysis, assuming that 2020 is the first year that a newly deepened channel and associated facilities are in full operation. The forecast displayed in the table applies a constant annual growth rate throughout the period of analysis; however, in calculating benefits, growth was capped at year 25 of the project, or 2044.

Table 3 – Galveston Channel Forecast of Barite Tonnage (metric tons)

Year	Low 0.1%	Median 1.05%	High 3.10%
Base Tonnage	157,242	157,242	157,242
2020	158,188	167,496	189,712
2029	159,617	183,913	248,569
2039	161,220	204,162	337,314
2049	162,840	226,641	457,742
2059	164,475	251,595	621,166
2069	166,128	279,296	842,935

4.2 Sulphur

Elemental sulphur is recovered from petroleum refineries and is used in the production of fertilizer. In 2013, Louisiana and Texas accounted for 54% of domestic production of elemental sulphur, according to USGS.

Figure 10 – Sulphur Operation



Source: http://www.sulphurinstitute.org/

Table 4 below displays U.S. exports of sulphur from 1994-2014. The USGS data shows that despite some volatility year to year, sulphur exports have more than doubled in the past twenty years. As with barite, three growth rates were used to forecast growth from present levels. A zero-percent growth rate was assumed for the low growth scenario. Because the growth rate in the last 10 years has been exceptionally high, the cumulative average growth rate in exports from the last 20 years (1994-2014) as opposed to the past 10 years (2004-2014) was used to calculate a median growth rate. Examination of the USGS data on U.S. exports of Sulphur produced a growth rate of 4.10%. The high growth rate is assumed to be 6.15% to capture the shorter term period trend. The median growth rate is considered the most likely; the low and high growth rates are to account for uncertainty in future volumes.

Table 4 – U.S. Sulphur Exports

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Exports	945,000	962,000	893,000	742,000	940,000	736,000	849,000	780,000	757,000	907,000	1,020,000
Export growth rate, year over year		1.80%	-7.17%	-16.91%	26.68%	-21.70%	15.35%	-8.13%	-2.95%	19.82%	12.46%
Export growth rate, compound			-2.79%	-7.74%	-0.13%	-4.88%	-1.77%	-2.70%	-2.73%	-0.45%	0.77%
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Exports		794,000	716,000	1,030,000	1,040,000	1,510,000	1,520,000	1,420,000	1,910,000	1,830,000	2,050,000
Export growth rate, year over year		-22.16%	-9.82%	43.85%	0.97%	45.19%	0.66%	-6.58%	34.51%	-4.19%	12.02%
Export growth rate, compound		-1.57%	-2.29%	0.66%	0.69%	3.17%	3.02%	2.42%	3.99%	3.54%	3.95%

Source: USGS 2014 Mineral Commodity Summary – Sulphur

There is a terminal within the proposed extension, Gulf Sulphur Services, which is an exporter of both liquid and dry sulphur. Though liquid sulphur shipments have the longest recent record of continuous deep-draft activity on this segment of the Galveston Harbor Channel, these are currently short, domestic trips on 25,000 DWT vessels. The WCSC data displayed in Figure 3 below shows that in 2008, dry sulphur began moving through Galveston Harbor. A portion of this tonnage is international exports from Gulf Sulphur on draft constrained vessels. It is anticipated that exports from Gulf Sulphur are expected to continue and grow in future years. The movement of sulphur is vital to the refining industry as a key product of petrochemical refining in the great Houston-Galveston area.

According to the AEO 2016 petroleum product U.S. imports and exports are expected to grow at 3.0% and 2.1%, respectively. Sulphur is used in fertilizers, normally in the form of ammonium sulphate, where there is a deficiency of sulphur in the soil. Sulphur is also used to make sulphuric acid from sulphur dioxide. Sulphur dioxide is used to make dyes and as a bleaching agent.

There are two key sources of processing sulphur. The first is the Frasch process, where sulphur is extracted from underground without mining it. In the Frasch process, underground deposits of sulphur are forced to the surface using superheated water and steam (to melt the sulphur) and compressed air. This gives molten sulphur, which is allowed to cool in large basins. Purity can reach 99.5%. The process is energy intense. Another source of sulphur is as a by-product of processing crude oil and natural gas, which contain hydrogen sulphide. As the production of crude oil from off the coast, lease condensates from west Texas and natural gas from Oklahoma continue to be refined in the Houston/Galveston region, we should expect that a major by-product, sulphur, will be exported to meet international fertilizer demand.

Specific dock tonnage from WCSC was examined to establish an estimate of base year tonnage levels. Based on detailed WCSC data from 2010-2014, it is estimated that approximately 60,000 metric tons per year of sulphur were exported on Panamax vessels from the Sulphur dock in this

reach with an average of 82% of those tons being draft constrained. Table 5 displays actual tonnage, both constrained and unconstrained, being exported from Gulf Sulphur on Panamax vessels between 2010 and 2014.

Table 5 – Galveston Channel Extension Sulphur Tonnage

	2010	2011	2012	2013	2014	2010-2014	2010-2014 Average (Base Tonnage)
Tonnage	81,414.18	81,994.64	76,639.35	-	58,719.12	298,767.29	59,753.46
Depth Constrained	81,414.18	28,081.64	76,639.35	-	58,719.12	244,854.29	48,970.86
% Constrained	100%	34%	100%	-	100%	82%	82%

Source: Waterborne Commerce Statistical Center (WCSC)

Based on the growth rates described above, Table 6 displays the forecast volume of sulphur exports at the end of each decade during the period of analysis, assuming that 2020 is the first year that a newly deepened channel and associated facilities are in full operation. Again, the forecast in the table applies a constant annual growth rate throughout the period of analysis, but growth was capped at year 25 of the project, or 2044, in calculating benefits.

Table 6 – Galveston Channel Forecast of Sulphur Tonnage (metric tons)

Year	Low 0.00%	Median 4.10%	High 6.15%
Base Tonnage	59,753	59,753	59,753
2020	59,753	76,662	87,105
2029	59,753	109,175	146,273
2039	59,753	163,167	265,683
2049	59,753	243,859	482,573
2059	59,753	364,457	876,522
2069	59,753	544,695	1,592,073

4.3 Benefiting Fleet Characteristics

As summarized in Table 7, the vessels involved in the commodity activity of interest mentioned above are generally 50,000 – 85,000 DWT vessels with design drafts of 40-48 feet, measuring 620-752-feet long by 95-106-feet wide.

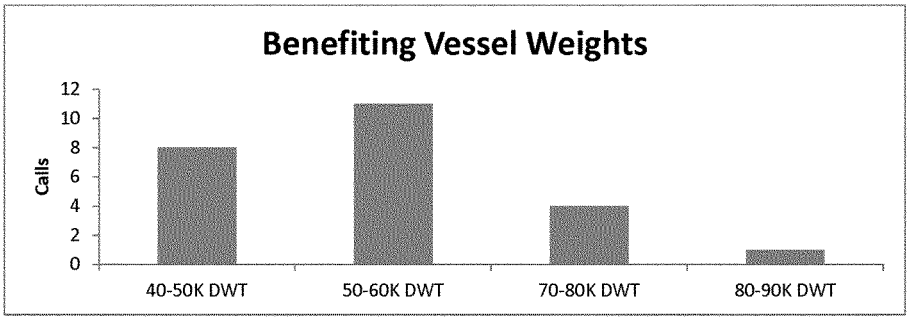
Table 7 – Galveston Channel Extension Benefiting Vessel Characteristics

Vessel DWTs	40,000-49,999	50,000-59,999	70,000-79,999	80,000-89,999
LOA	611.7-653.6	600.4-700.2	738.1-738.2	751.3
Beam	98.4-101.7	101.7-105.8	105.6-105.8	105.8
Design Draft	38.7-39.5	39.4-42.1	44.2-46.5	47.7
Number of Calls	8	11	4	1

Source: Waterborne Commerce Statistical Center (WCSC)

Figure 11 shows that while the largest majority of benefiting calls are from vessels in the 50,000 to 60,000 DWT range followed by the 40,000 to 50,000 DWT range, there are also vessels with 70,000 to 90,000 DWT capacity that are currently using the channel and could benefit immediately from its deepening.

Figure 11 – Galveston Channel Extension Benefiting Vessel Weights



Source: Waterborne Commerce Statistical Center (WCSC)

The existing conditions distribution of these calls tend to center around the 65,000 DWT vessels. In the without project condition it is unlikely that the facilities will utilize the larger DWT vessels with any regularity due to the approximately eight feet of light loading they currently experience. With a deepened channel, it is assumed that the 80,000 DWT vessel is a representative vessel of the total vessel size distribution. It is calling with some frequency in the without project condition, and it will be an average of the more cost efficient vessels calling with significant frequency in the future with project condition.

The routes of existing benefiting vessels were examined to calculate a weighted mileage to be used in calculating the savings per ton under each alternative scenario. Table 8 below displays the regions to and from which the benefiting tonnage is being imported/exported as well as the estimated round-trip mileage from Galveston Harbor, and the weights applied to each.

Table 8 – Galveston Channel Extension Benefiting Mileage

Country/Region	Miles Round Trip	Percent of Benefiting Tonnage
Gulf Coast	1,200	9%
Canada	13,800	15%
South America	13,500	38%
Far East Asia	29,500	23%
Middle East	22,000	15%
Weighted Average	17,390	100%

Source: Waterborne Commerce Statistical Center (WCSC)

Table 9 displays the characteristics of the current representative vessel and the with-project representative vessel. The table presents results for each incremental foot of dredging, showing the cost savings available for channels from 42 to 46 feet in depth. The results were calculated using the aforementioned Microsoft Excel spreadsheet model that was approved on 6 June 2012. Because the with-project vessel is assumed to be the same in each increment, the total voyage costs is the same, but the maximum load is constrained by the depth of the channel, resulting in lower costs per ton as the channel is dredged deeper. As shown in the bottom line, the savings per ton increase from $2.91 for a 42-foot channel to $6.47 for a 46-foot channel.

Table 9 – Transportation Cost Savings Per Ton

Channel Depth	41 foot	42-foot	43-foot	44-foot	45-foot	46-foot
Vessel Deadweight Tons	60,000	80,000	80,000	80,000	80,000	80,000
Design Draft (ft)	41.6	45.6	45.6	45.6	45.6	45.6
Cargo Capacity (%)	95%	95%	95%	95%	95%	95%
Cargo Capacity (metric tons)	57,000	76,000	76,000	76,000	76,000	76,000
Immersion Factor (tons per inch)	150.5	180.2	180.2	180.2	180.2	180.2
Underkeel Clearance (ft)	1	1	1	1	1	1
Weighted Mileage	17,390	17,390	17,390	17,390	17,390	17,390
Speed (Knots)	12.9	12.8	12.8	12.8	12.8	12.8
Total Voyage Cost (mileage/speed)*(hourly vessel cost)	$1,666,765	$1,855,082	$1,855,082	$1,855,082	$1,855,082	$1,855,082
Maximum Load	52,304	63,891	66,053	68,215	70,378	72,540
Total Loading and Unloading Cost	$51,168	$59,890	$61,020	$62,150	$63,280	$64,410
Total Cost Per Ton	$33.82	$30.91	$29.93	$29.02	$28.16	$27.35
Savings Per Ton		$2.91	$3.89	$4.81	$5.67	$6.47

The present value of bulk commodity transportation savings that could be realized during each year of the period of analysis was calculated by multiplying the unit cost savings at each depth by the annual benefiting tonnage forecast under each of the low, median and high scenarios discussed previously.

The amount of benefiting tonnage was determined by examining individual calls from Texas International Terminals and Gulf Sulphur Services. First, tonnage from calls on Panamax vessels (i.e., vessels with design drafts of 39 or greater) carrying the commodities of interest was aggregated. From the aggregated number, tonnage carried by vessels with a sailing draft of 37 or greater was considered to be benefiting. The number of tons carried by vessels with design drafts of 37 or greater was divided by the aggregate tonnage to obtain a percentage of depth constrained tons. From these numbers, an annual average benefiting tonnage was calculated. This amount of benefiting tonnage is the base tonnage to which the growth rates and savings per ton were applied. The amount of benefiting tonnage for each dock as well as the total amount of benefiting tonnage is summarized in Table 10.

Table 10 – Benefiting Tonnage Summary

	Texas International	Gulf Sulphur	Total
Panamax Tonnage	157,242	59,753	216,995
Benefiting Tonnage	102,984	48,971	**151,955**

Source: Waterborne Commerce Statistical Center (WCSC)

Table 11 displays the sailing and design drafts of the Panamax vessels that called at either Gulf Sulphur Services dock between 2010 and 2014 or Texas International Terminals between 2011 and 2014.

Table 11 - Drafts of Panamax Calls in Galveston Channel Extension (2010-2014)

Design Draft (Feet) \ Sailing Draft (Feet)	31	32	33	34	35	36	37	38	39	40	41	42	Total
39		1							3				4
40							1		1	7	1		10
41		1			1			1					3
42	1					2		2		2		2	9
43													-
44			1									1	2
45												1	1
46				1		1			1				3
47										1			1
48									1				1
Total	1	2	1	1	1	3	1	3	6	10	1	4	54*

*Total includes calls where sailing draft was less than 30 feet (excluded in table)

Source: Waterborne Commerce Statistical Center (WCSC)

The growth rates discussed in sections 4.1 and 4.2 were then applied to estimate benefiting tonnage in each of the years in the period of analysis. The equivalent annual value for each scenario was then calculated from the total present values by amortizing the total over a 50-year period using the FY 2017 discount rate of 2.875%. These numbers were carried forward to Table 11 to calculate total benefits and the benefit-cost ratios.

The benefiting tonnage forecast was loaded onto vessels for all the period of analysis. Table 12 depicts the fleet forecast given that total trip tons and non-benefiting tonnage remains constant.

Table 12 - Fleet Forecast

	Without Project Vessels	With Project Vessels
2015	13.10	-
2019	14.08	13.18
2029	14.86	13.74
2039	15.96	14.54
2044*	16.74	15.09

Benefits capped at year 25 of project (2044)

5.0 Comparison of Alternatives

Table 13 displays a summary of the economic analysis for the most likely, or median growth rate, scenario rounded to the nearest thousand. The benefits were calculated for a 50-year period of analysis using FY 2017 Federal Discount rate of 2.875 percent and the deep-draft vessel operating costs Economic Guidance Memorandum (EGM 15-04). Though the forecasts were made throughout the 50-year period of analysis, growth rates applied to the benefits were capped at year 25 of the project, or 2044. The deepening calculations were estimated using a Microsoft Excel spreadsheet model, certified for one time use on 6 June 2012. Columns are presented for 43-, 44-, 45-, and 46-foot channels. The benefits from sulphur and barite are estimated from tonnage reported by the Waterborne Commerce Statistics Center between 2010 and 2014. The annual savings per ton for each commodity are combined and presented as Average Annual Benefits. Average annual benefits range from a low of $960,000 for the 43-foot channel to $1,597,000 for the 46-foot channel (FY 2017 price level).

The table goes on to present average annual costs for each increment of channel depth, increasing from $303,000 for a 43-foot channel to $585,000 for a 46-foot channel (FY 2017 price level). The costs include the amortized value of project first and estimated associated costs plus interest during construction, but exclude any incremental operations and maintenance costs above the costs to maintain the present 41-foot channel.

Benefit-cost ratios (BCR) were determined for each alternative by comparing average annual

benefits to the corresponding average annual costs. The 46-foot channel has the highest net benefit results and an expected BCR value of 2.7 for the median growth scenario.

Table 13 – Summary of Economic Analysis @ 2.875% Interest Rate

Galveston Harbor Channel Extension Summary of Economic Analysis				
Item	**43-foot**	**44-foot**	**45-foot**	**46-foot**
Project Cost	$6,828,000	$9,002,000	$11,202,000	$13,395,000
Associated Costs	$1,108,000	$1,385,000	$1,661,000	$1,938,000
Months to Construct	5	5	5	5
Interest During Construction	$38,000	$50,000	$62,000	$74,000
NED Investment Cost	$7,974,000	$10,437,000	$12,925,000	$15,407,000
Average Annual Cost	$303,000	$396,000	$491,000	$585,000
Average Annual Benefits	$960,000	$1,186,000	$1,398,000	$1,597,000
Net Excess Benefits	$657,000	$790,000	$908,000	$1,012,000
Benefit-Cost Ratio @ 2.875%	3.2	3.0	2.9	2.7

Table 14 presents low, median and high scenarios that consider the growth rate of tonnage volumes

moving through the terminals in Galveston for sensitivity purposes. In all scenarios, the 46-foot channel has the highest net benefits. These numbers while not absolute, they are reasonable approximations of how benefits can vary. The amount of risk in the decision is based on expectation of volumes and vessel size that a dock can facilitate in the future versus the needs of the customers. The low and high scenarios show that the BCR is likely to fall between 1.7 and 4.4 for the 46-foot channel. The critical factors in achieving a result in the upper end of this range is the volume and transport distance of foreign imports arriving at the bulk terminals.

Table 14 – Sensitivity Analysis for Alternatives

Item	43-foot			44-foot			45-foot			46-foot		
	Low	Median	High	Low	Median	High	Low	Median	High	Low	Median	High
Average Annual Benefits	$601,000	$960,000	$1,556,000	$742,000	$1,186,000	$1,922,000	$875,000	$1,398,000	$2,266,000	$999,000	$1,597,000	$2,590,000
Average Annual Cost	$303,000			$396,000			$491,000			$585,000		
Net Excess Benefits	$298,000	$657,000	$1,253,000	$346,000	$790,000	$1,526,000	$385,000	$908,000	$1,776,000	$414,000	$1,012,000	$2,005,000
Benefit-Cost Ratio	2.0	3.2	5.1	1.9	3.0	4.9	1.8	2.9	4.6	1.7	2.7	4.4

6.0 Summary

The results of the economic analysis show that there is an economically rational justification to deepen the Galveston Harbor Channel to 46-feet through the reaches that are presently authorized to 41 feet. Volume continues to increase at the bulk terminal for minerals used in oil & gas exploration and a significant share of this volume is constrained by the current channel depth. An even more significant share of sulphur tonnage is estimated to be constrained by the channel. Sulphur volumes have been stable over the last decade or more, and it is believed these trends will continue, as they are tied to petroleum refinery operations. In addition, these bulk docks are located at the end of the deep-draft channel, and bulk commodities stand to gain the most economic efficiencies by their very nature as bulk items that make best use of deeper drafting vessels.



U.S. Army Corps
of Engineers
Galveston District

Galveston Harbor Channel Extension
Feasibility Study
Houston-Galveston Navigation Channels, Texas

APPENDIX B
ENGINEERING APPENDIX

U.S. Army Corps of Engineers
Southwestern Division
Galveston District
2016

Engineering Appendix
Galveston Harbor Channel Extension
Feasibility Study
Houston-Galveston Navigation Channels, Texas

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REFERENCES

1 Houston-Galveston Navigation Channels, Texas Limited Reevaluation Report and Final Supplemental Environmental Impact Statement, November 1995 (1995 LRR)

2 Houston-Galveston Navigation Channels, Texas Galveston Channel Project Final Limited Reevaluation Report, May 31,2007 (2007 LRR)

3 Draft MLT to MLLW Vertical Datum Conversion: Galveston Harbor, Texas City Ship Channel, Houston Ship Channel, Engineering Documentation Report, June 2015 (2015 MLT to MLLW EDR)

1.0 GENERAL

Engineering studies for the Galveston Harbor Channel (GHC) Extension Section 216 Feasibility Study Report (GHCE Feasibility Report) included: preliminary geotechnical investigations (sampling and laboratory analysis); preparation of a preliminary dredged material management plan (DMMP); beneficial use concept studies; in-house hydrographic surveys of the channel; and land surveys. Other engineering and design features considered include surveying and mapping, environmental quality features, civil design, geotechnical design, structural design, access roads, operations and maintenance (O&M), cost estimates, data management and schedules for design and construction. Preliminary alternative designs and screening level cost estimates were developed in sufficient detail to substantiate the recommended plan and baseline cost estimate.

The Design Team assisted the Planning and Environmental Leads during the Plan Formulation process. Refer to the GHCE Feasibility Report for detailed discussion/analyses not covered here. This includes Planning Objectives, Preliminary Plan Formulation, including the No-Action Alternative and Structural Alternatives consisting of navigation channel improvements.

Plan Formulation Phase – Channel bottom elevations at -43, -44, -45, and -46 feet Mean Lower Low Water (MLLW) were evaluated during plan formulation. The width considered for each depth alternative was kept constant at 1,075 feet and matches the existing 46-foot (45-foot MLT) GHC at Station 20+000.

During the course of this study, the tidal datum used to describe channel depths changed from Mean Low Tide (MLT) to MLLW. Throughout the remainder of this appendix, channel bottom elevations will be referred to as channel depths (positive number) with the value shown as MLLW. Depths shown in parenthesis (if any) are referenced to MLT. See Section 3.3.2 *Vertical Datums* for more information on the datum change.

Plan Formulation Phase – Alternatives Advanced for Further Screening:

1) No-Action Alternative;
2) 43-foot and 46-foot channel depth alternatives;
3) Alternatives for the Management of Dredged Material
   The following types of placement areas were evaluated:
   - Marsh creation
   - Existing Pelican Island Upland confined placement area (PA)
   - Proposed 81.76-acre Pelican Island Upland confined PA.

The considered plan alternatives are discussed in detail in this Appendix and the GHCE Feasibility Report.

1.1 Project Description

The study produced a National Economic Development (NED) Plan consisting of deepening the western most portion of the currently authorized 41-foot deep GHC, resulting in a 2,571 foot extension of the existing 46-foot channel. The plan includes keeping the width of the channel extension equal to the existing 46-foot channel at 1,075 feet. The NED Plan includes using the existing Pelican Island upland confined PA for containment of the resulting dredged new work materials from the channel deepening and the future dredged maintenance material for the 50-year period of analysis.

2.0 CIVIL ENGINEERING

The plan of improvement described in this document pertains to the Galveston Harbor Channel, Texas. A study area map and pertinent channel design information are shown on Drawing Nos. C-0 through C-05 attached to this appendix.

2.1 Galveston Channels

The Galveston portion of the Houston-Galveston Navigation Channels, Texas Project (HGNC) consists of a series of channels as shown in Table 1.

TABLE 1 - CURRENTLY AUTHORIZED GALVESTON CHANNELS

Reach	Station	to	Station	Nominal Bottom Width (feet)	Authorized Project Depth (feet-MLLW)	Channel Depth (feet-MLLW)	Allowable Overdepth (feet)	Advanced Maintenance (included in Channel Depth)
Galveston Entrance Channel (aka Offshore Reach)								
Extended Entrance Channel	55+840		76+000	800	-48*	-50	2	2
Entrance Channel	30+515		55+840	800	-48*	-50	3	2
Outer Bar Channel	21+753		30+515	800	-48*	-50	2	2
Inner Bar Channel	4+490		21+753	800	-46	-48	1	2
Bolivar Roads Channel	0+000		4+490	800	-46	-48	1	2
Galveston Channel								
Galveston Harbor Channel	0+000		20+000	Varies	-46	-49	2	3
Galveston Harbor Channel	20+000		22+571	1,085	-41	-44	2	3

*Note: Depths are increased 2 feet to allow for wave motion (pitch) in the entrance channel reaches.

2.2 Galveston Harbor Channel

The GHC is subdivided into two reaches: Station 0+000 to Station 20+000 and Station 20+000 to Station 22+571. The existing 46-foot deep GHC reach, part of the HGNC, intersects the Inner Bar Channel at Station 0+000, and extends to about Pier 38 at Station

20+000. The existing 41-foot GHC reach extends from Station 20+000 to about 43rd Street at Station 22+571. The Extended Entrance, Entrance, Outer and Inner Bar Channels were deepened to their existing depths during the recent Houston-Galveston 46-foot Widening and Deepening Project for the Houston Ship Channel (HSC). Refer to Drawing C-01 for a plan view of the GHC.

The recently completed 46-foot GHC has a bottom width that varies from about 650 feet to 1,133 feet between Station 1+400 and Station 20+000. A widened transition begins at Station 1+400 and ends with the connection to the HGNC Bolivar Roads Channel. The 46-foot GHC footprint does not include the entire originally-authorized 41-foot GHC footprint. Those portions of the 41-foot channel footprint that lie outside the 46-foot channel will continue to be maintained as per the HGNC authorization. Within the proposed GHC Extension reach (Station 20+00 to Station 22+571) the proposed 46-foot channel footprint replaces the 41-foot footprint, and thus the 41-foot channel will not be maintained after construction of the 46-ft channel. Drawing C-05 shows the existing authorized 41-foot channel footprint, the existing 46-foot channel, and the proposed 46-foot extension footprint. The proposed 46-foot extension would have a design width of 1,075 feet, thus matching the width of the existing 46-foot GHC at Station 20+000.

2.3 Site Selection and Project Development

The feasibility study was conducted in three phases: Preliminary Plan Formulation, Plan Formulation, and Detail phases.

2.3.1 Preliminary Plan Formulation Phase

Preliminary Plan Formulation Phase considered channel depths of 42, 43, 44, 45, and 46-feet. All alternative plans considered a 1,075-foot wide channel, thus matching the existing 46-foot GHC width. Refer to the GHCE Feasibility Report for complete descriptions of the alternative plans studied. Several dredged material disposal options were considered including the existing upland confined Pelican Island PA, a new upland confined PA on Pelican Island, and a new beneficial use site (marsh) located off the west end of Pelican Island.

2.3.2 Plan Formulation Phase

The Plan Formulation phase re-focused on the 43-foot through 46-foot depths while maintaining a proposed channel bottom width of 1,075-ft channel. This bottom width will

be 10 feet less than the existing 41-foot GHC width. Placement alternatives considered in this phase included the existing Pelican Island PA and the marsh described above.

2.3.3 Detail Phase

The Detail Phase of this study produced the selected plan. The selected plan was identified as the 46-foot deep channel extending 2,571 feet from the end of the currently authorized 46-foot channel to the existing 41-foot channel limits to the west (Station 20+000 to Station 22+571). The dredged new work material would be placed in the existing Pelican Island PA. Refer to the Geotechnical Design section of this appendix for details.

2.3.3.1 Proposed Extension Channel

The proposed channel centerline alignment extends westward from Station 20+000 to the end of the existing 41-foot channel at Station 22+571. The channel would have side slopes of 1V:3H and a bottom width of 1,075 feet. See Table 2 for a summary of the proposed channel dimensions and Drawing No. C-03 for the proposed channel cross section.

TABLE 2 - PROPOSED GALVESTON HARBOR CHANNEL

Reach	Station	to	Station	Nominal Bottom Width (feet)	Authorized Project Depth (feet-MLT)	Channel Depth (feet-MLT)	Allowable Overdepth (feet)	Advanced Maintenance (included in Channel Depth)
Existing Galveston Harbor Channel	0+000		20+000	Varies	-46	-49	2	3
Proposed Galveston Harbor Channel Extension	20+000		22+571	1075	-46	-49	2	3

2.4 Real Estate

No additional land will be required for the selected plan.

2.5 Relocations and Removals

Relocations and removals associated with the project and considered for this analysis included aids to navigation, structures, pipelines and utilities.

2.5.1 Relocations and Removals

During the Detail Phase, the latest pipeline crossing information was incorporated and re-analyzed for the selected depth. One pipeline was identified in the project area as shown in Table 3. This identified pipeline requires neither relocation nor removal for this project.

TABLE 3 - GALVESTON HARBOR CHANNEL EXTENSION PIPELINE LIST

Approximate Station	Description	Owner	Permit No.	Relocate	Remove
21+400	24" Water Main, -72' MLT	City of Galveston	14114(05)809	No	No

2.5.2 Aids to Navigation

The GHC Extension, beyond the channel improvements, will not require changes to the navigation aids.

2.5.3 Structures

2.5.3.1 Berthing Dock Areas

Docks and berthing areas which will utilize the new project depth had dredging volumes calculated. Port facility information was obtained through facility owners, and the local sponsor.

2.5.3.2 Structure Stability Analyses

Information was received from Texas International Terminals facility, located on the south side and at the west end of the proposed GHC Extension indicating that this bulk materials handling facility would take advantage of the proposed deeper draft channel. Texas International Terminals plans to dredge their berthing area and will retrofit their existing bulkhead facility to accommodate the deeper draft. This retrofit is a third-party portside facilities associated project cost and has been accounted for in the economics portion of this study. Design drawings were received for the existing Sulphur Terminal dock facility located on the south side of the GHC Extension at approximately Station 22+000. This facility lies about 170 feet south of the proposed channel bottom alignment and consists of a concrete dock supported on square precast concrete piles driven to an elevation of about -101.66 feet MLLW. Upon review of the provided structural drawings, it was determined that the structure will not be impacted by the channel deepening.

The Edison-Chouest bulkhead lies approximately 100 feet north of the proposed channel bottom alignment at approximately Station 21+300 and handles predominantly light draft vessel traffic. A stability analysis of the existing Edison-Chouest bulkhead was performed using the CWALSHT computer program developed by the U.S. Army Corps of Engineers (USACE) Waterways Experiment Station (WES) Information Technology Laboratory currently known as the Engineer Research and Development Center (ERDC). A global slope stability of the channel side slope in the vicinity of the Edison-Chouest bulkhead using the SLOPE/W computer program. SLOPE/W is one component of a suite of geotechnical analysis tools called Geostudio which is distributed by GEO-SLOPE International, Ltd. SLOPE/W analyzes slope stability models using the limit equilibrium method. The Morgenstern-Price method of analysis was used which satisfies both moment and force equilibrium equations are satisfied. The CWALSHT and SLOPE/W stability analyses indicated the existing bulkhead will not be affected by the channel deepening. Results of the two analyses are attached to this appendix. It was determined that other water-front structures along this project will not be affected because of their distance from the channel template.

2.6 Maintenance Dredging Frequency and Shoaling Rate

The dredging cycle of the existing channel was determined by the average number of years between the O&M dredging operations for a historical period. Each channel or reach may or may not have its own dredging frequency. The Galveston District's Dredging History Database, a Microsoft Access-based computer database, was utilized to establish the existing shoaling rate and dredging frequency for the existing 46-foot GHC for the 2007 Galveston Channel Limited Reevaluation Report (2007 LRR), Engineering Appendix. For that report, an analysis of 24 years of dredging history identified six maintenance dredging cycles with an estimated shoaling rate of 1,425,500 cubic yards per year for the complete 22,571-foot long GHC channel. The 46-foot deep channel shoaling rate will be assumed to remain the same as the existing channel, with 1,425,500 cubic yards per year, and a dredging frequency of four years. Shoaling will be assumed to be evenly distributed along the length and width of the channel; therefore, a linear interpolation of the channel dredging data produces a shoaling rate of approximately 162,000 cubic yards per year for the proposed GHC Extension reach. The dredging frequency will remain the same (four years) as the existing 46-foot channel.

2.7 Design Considerations

Several design assumptions were made in conjunction with this study. Hydrographic survey data provided by the area office were utilized in defining new work volumes. Maintenance materials identified in the surveys were discounted and new work volumes were calculated as material below the existing template, including advance maintenance and allowable overdepth. The proposed 46-foot channel bottom width would be 10 feet narrower than the existing 41-foot channel.

2.8 New Work Dredging

The term "new work" refers to the material below the existing channel template which will be removed to increase the channel depth to the new project depth. The new work material quantities were calculated using a 3-dimensional surface (*.dtm) generated by the InRoads software program. The surface is a 3-D representation of the existing channel geometry. The channel has existing and proposed templates which are trapezoidal shapes, defined by bottom width and side slopes. Those templates were used to model the channel and calculate new work volumes. The existing template included the current advance maintenance and allowable overdepth values of three feet and two feet, respectively. The proposed new channel template also included an advance maintenance depth of three feet and a constant two feet of allowable overdepth for calculation of new work volumes. New work material volumes are shown in Table 4.

TABLE 4 - NEW WORK DREDGING VOLUMES FOR 46-FOOT PLAN

Reach	Station Nos.	Federal Channel Estimated New Work CY	Third-Party Facilities* Estimated New Work CY	Total Estimated New Work CY
Galveston Harbor Channel Extension	20+000 to 22+571	513,800	95,700	609,500

* non-Federal portside facilities

2.8.1 Non-Pay Dredging

Non-pay dredging would be defined as dredging outside the paid allowable overdepth that may occur due to such factors as unanticipated variations in substrate, incidental removal of submerged obstructions, or unusual wind and wave conditions. An estimated volume of 102,400 cubic yards of non-pay dredging is assumed for new work in the federal channel. This estimate is based on non-pay depth of 1 foot below the bottom of the allowable overdepth and within the channel toe width of 1,075 feet. Non-pay dredging is not assumed on the side slopes because it is anticipated that no new work will be performed on the side slopes based on the geometry of the new verses old channel templates. Non-pay dredging within the private facility is estimated at 15,000 cubic yards. Non-pay volumes are included in the maintenance dredging volumes presented in Section *2.6 Maintenance Dredging Frequency and Shoaling Rate.*

2.8.2 Third-Party Portside Facilities Dredging

Third-party (non-Federal) portside facilities new work dredging volume is calculated using the square footage of the third-party facilities and multiplying by the depth of new work dredging. The third-party maintenance volume would be based on the GHC shoaling rate and dredging frequency determined as described in Section 2.6. Using the GHC shoaling rate and the area of third-party maintenance dredging, a shoaling rate of 85,700 cubic yards per four-year dredging cycle would be assumed. The third-party maintenance dredging volume described above is not an incremental increase over and above the third-party maintenance volume for the existing project. The third-party new work and maintenance material would be placed within the Pelican Island PA. An existing tipping fee charged to third-party users for use of the Pelican Island PA covers the cost of lost capacity as a result of third-party dredging volumes placed in the PA. This work is considered an associated cost used in the benefit-cost ratio calculation and PA capacity analysis.

2.8.3 Allowable Overdepth

Additional depth outside the required channel template would be permitted to allow for inaccuracies in the dredging process. Per Engineering Regulation (ER) 1130-2-520, *Navigation and Dredging Operations and Maintenance Policies,* "District Commanders may dredge a maximum of two feet of allowable overdepth in coastal regions..., and inland navigation channels." This additional dredging allowance would be referred to as a dredging tolerance, or allowable overdepth. The existing channel has a two-foot allowable overdepth. It is anticipated that large pipeline dredges, similar in size used for maintenance dredging of the existing channel, will be utilized to construct the proposed 45-foot channel

extension. District policy recommends a two-foot allowable overdepth in reaches where these large dredges operate.

2.8.4 Advance Maintenance

Advance maintenance consists of dredging deeper than the authorized channel template to provide for the accumulation and storage of sediment. In critical and fast-shoaling areas advance maintenance would be required to avoid frequent re-dredging and to ensure the most reliability for navigation within the channel and the least overall cost for operating and maintaining the project authorized dimensions. ER 1130-2-520 authorizes Major Subordinate Command (MSC) Commanders to approve advance maintenance. The existing 46-foot (Station 0+000 to Station 20+000) and 41-foot (Station 20+000 to Station 22+571) channels have an authorized three-foot advance maintenance depth. Advance maintenance for the proposed 46-foot GHCE would be three feet. This would allow the GHCE to be maintained at the same frequency (4-year cycle) as the existing adjacent 46-foot channel, thus operations and maintenance cost over the 50-year project life would be optimized because of the reduction in the number of required maintenance dredging contracts (and mobilization costs).

2.9 Beneficial Use of Dredged Material

Conceptual designs for beneficial use of dredged material were performed during the Plan Formulation Phase. Four beneficial use alternatives were evaluated for this project. General assumptions were used. The least cost methods were generally used in developing designs. It was assumed that no relocations would be necessary, and that right-of-ways (ROWs) and right-of-entries (ROEs) would be available. Specific field and design data was provided by the Environmental Section. During the Detail Phase, the selected marsh creation features were individually evaluated and updated. The evaluated marsh creation site adjoins Pelican Island near the southwest corner with most of the site currently under water. The following design and construction assumptions were developed based on the proposed site existing conditions and on typical sections proven successful in the Galveston Bay area for similar projects. Swamp accessible machinery would be required during marsh construction. Hydraulic dikes would be built with the new work dredged material and the dredge pipeline routes are assumed to be the shortest distance to the middle of the site. Dike side slopes were designed to have slope protection such as rip-rap and concrete cellular mats. Marsh fill would occur with selective placement of dredged material within the marsh site boundary. Marsh fill could be new work or maintenance material, depending on the requirements of the marsh design. Where plantings would occur, it was assumed that abundant local species are available. Marsh creation was not selected as part of the

NED Plan. The evaluated Marsh site location and conceptual plan are shown on Drawing No. B-02.

3.0 SURVEYING, MAPPING, AND OTHER GEOSPATIAL DATA REQUIREMENTS

3.1 Surveys

Extensive land surveys were not performed for this study. The district utilized color orthodigital aerial maps taken in 2004 to identify existing topographical features such as shoreline, docks, creeks, open or wooded areas, etc. Hydrographic surveys provided by the Galveston Area Office provided after-dredged surveys at 200-foot intervals for the channel, and represent ground surface ranging from elevation -30 feet to the bottom of the channel. Additional land elevations were implied from the ortho maps. Interpolation between hydrographic surveys and land surveys were performed using the InRoads software program. An overall 3-D surface (*.dtm) was generated, providing a representation of the existing conditions along the channel.

3.1.1 Additional Surveys

During the preconstruction, engineering and design (PED) phase of this project, a complete land survey of the PA site will be required. Hydrographic condition surveys of the channel will be performed by the area office and will be utilized and coordinated during PED to the extent practical.

3.2 Mapping

For this study, existing maps of the project area available at Galveston District (SWG) were used during the initial and plan formulation phases. Updated mapping was developed for the Detail phase, to include current conditions.

3.2.1 Additional Mapping

It will be assumed the existing maps of the project area will require only minor updating as time progresses. It is not anticipated that major changes will occur related to the mapping presented in the Engineering Appendix.

3.3 Datums

3.3.1 Horizontal Datum

Horizontal Datum referenced in this appendix is the Texas State Plane Coordinate System, South Central Zone, North American Datum (NAD) of 1983.

3.3.2 Vertical Datums

The Galveston District has recently converted the local Mean Low Tide (MLT) datum to the Mean Lower Low Water (MLLW) datum. Reference the *Draft MLT to MLLW Vertical Datum Conversion: Galveston Harbor, Texas City Ship Channel, Houston Ship Channel, Engineering Documentation Report, June 2015* (2015 MLT to MLLW EDR). The calculated MLLW datum for the Galveston Harbor Channel Project is 1.18 feet above zero MLT at the Texas Coastal Ocean Observation Network (TCOON) Gage 1450 (Galveston Pier 21). The calculated conversion was rounded to the nearest foot for application to authorized channel depths. The elevations in this appendix and Feasibility report have been converted to MLLW except as noted as MLT. Engineering analysis done prior to the datum conversion have remained in MLT. The Vertical Tidal Datum Table below provides the depth conversion relationship between MLT to MLLW for the existing GHC.

TABLE 5 - VERTICAL TIDAL DATUM CONVERSION

Project Name	Station Nos.	Project Depths MLT, ft	Project Depths MLLW, ft	Conversion from MLT to MLLW, ft
GHC	0+000 to 20+000	-45	-46	-1
GHC	20+000 to 22+571	-40	-41	-1

Existing after-dredging hydrographic surveys performed using the MLT datum were used in calculating new work volumes.

Existing land survey data for the Pelican Island PA used North American Vertical Datum of 1988 (NAVD 88).

4.0 PROJECT SITE ACCESS

The Pelican Island PA has existing access roads available. No public roads require improvement for access to the project site.

5.0 ENVIRONMENTAL ENGINEERING

5.1 Environmental Objectives and Requirements

Environmental objectives and requirements described herein will be fulfilled by compliance with plans for the management of dredged material in the Pelican Island upland confined PA and by adopting and enforcing prudent and reasonable measures to avoid impacts and by the completion of measures described in the Environmental Assessment (EA) performed for this study.

5.2 Environmental Considerations

5.2.1 Energy Savings Features of the Design

Energy saving features of the design includes minimizing pumping distances between dredge vessels and the PA thereby reducing the load on the pump and minimizing the amount of diesel fuel and other commodities required to execute the planned project goals.

5.2.2 Environmental Effects of the Project

a. Emissions from the dredging vessel and other heavy equipment will locally degrade air quality during channel dredging and dredged material pumping operations.

b. Water clarity and quality at the dredging sites and the PAs will be temporarily affected by the dredging process. Some soil particles are temporarily lost in the water column during the dredging process. With time, the sediments are winnowed out, and settle back down on the channel and bay bottom thus re-establishing water clarity and quality as it existed prior to the dredging.

c. On a microorganism level, the dredged channel bottom will temporarily be affected while the area adjusts to the new environment the project created.

5.2.3 Integration of Environmental Sensitivity into All Aspects of the Project

Water and sediment quality of new work and maintenance dredging will be monitored to manage any impacts from dredging in the channel and dredged material pumping, placement, and decanting operations in the Pelican Island upland PA.

5.2.4 Lessons Learned During Past Project

The Environmental Review Guide for Operations (ERGO) was reviewed to identify environmental lessons learned on past projects. The identified lessons learned were applied to the design concepts considered for this project.

For some time now, the SWG geotechnical section has been refining the science of PA design and utilization. Included in the design concepts for this project is the use of improved drop-outlet structures that provide more effective sediment control to minimize turbidity of the effluent in the surrounding water column. Innovative dike construction techniques have been incorporated into the conceptual design. These techniques include placing selected soil types desirable for building dikes directly into berms alongside the interior of existing dikes during dredging operations to provide dike building materials for more efficient access during dike raising construction. Desirable dredged material may also be placed directly within proposed marsh dike templates to minimize later manipulation and therefore less turbidity in the surrounding water column.

5.2.5 Incorporation of Environmental Compliance Measures into the Project Design

There are numerous environmental drivers which govern protection of the public and environment during the construction phase of a project that were incorporated into the feasibility design for this project. Local, State and Federal environmental compliance measures incorporated into the project include:

- The Texas Pollutant Discharge Elimination System (TPDES) administered by the Texas Commission on Environmental Quality (TCEQ)
- Protection of Environmental Resources
- Preservation and Recovery of Historical, and Cultural Resources
- Protection of Water Resources
- Protection of Fish and Wildlife Resources
- Protection of Air Resources
- Protection from Sound Intrusions

- Pollution Prevention

5.3 Hazardous Toxic Radioactive Waste (HTRW)

Historic dredging events within the channel have not encountered HTRW. Therefore, based upon the HTRW assessment performed as described in the EA and additional in-house research, it has been determined that there would be a low probability of encountering contaminated sites or toxic substances during project construction.

6.0 GEOTECHNICAL ENGINEERING

6.1 Terminology

A variety of special terms used in this document shall be defined as follows:

Hydraulic placement referred to in this document shall be defined as discharging a slurry of water and soil from a dredge pipe.

Mechanical construction referred to in this document shall be defined as construction operations performed on land with conventional construction equipment (bulldozers, draglines, tractors, etc.).

Shaping referred to in this document shall be defined as the construction operations in connection with forming and constructing materials to a specified dike template.

New Work referred to in this document would be defined as new and currently undisturbed soils obtained from the deepening portion of the GHC.

Ponding shall be defined as the accumulation of water and or dredge fluid to some elevation behind dikes within a PA.

Pure New Work refers to new work materials which are dredged separately from maintenance materials.

Mixed New Work refers to new work materials which are dredged with maintenance material mixed in with the new work material. For clarification however, whenever quantities of mixed new work are referred to in the design or cost estimates, these mixed quantities only represent the quantity of the new work material, and exclude the quantity of maintenance material allowed to mix with the new work material.

6.2 Existing Soils Data - Channel

Soil borings drilled within and near the channel extension in 1965 and 1980 were reviewed to identify the existing channel bottom soil conditions. Additional soil borings were not performed for this study. A boring layout and plotted boring logs are shown on Drawing Nos. B-08 and B-09. As shown by the boring logs the new work materials that will be dredged to deepen the channel will consist primarily of stiff to hard high-plasticity clays classified as CH soils. According to the Houston-Galveston Navigation Channels, Texas Limited Reevaluation Report and Final Supplemental Environmental Impact Statement,

November 1995 (1995 LRR), previous estimates made near or prior to 1995 indicate that the make-up of dredged maintenance material from the channel has consisted in the past of approximately 80 percent fine grained materials and approximately 20 percent coarse grained or sandy materials.

6.3 Placement Areas

6.3.1 Pelican Island PA

6.3.1.1 Background

A boring location layout along with the plotted boring logs, for borings drilled at the site in 1972, 1977, 1979, and 1993 can be found in the 2007 LRR Engineering Appendix. A brief description of the soils conditions within the Pelican Island PA is also included in the referenced 2007 LRR Engineering Appendix. Since the preparation of the 2007 LRR, new work and maintenance materials have been dredged from the GHC from Station 0+000 to Station 20+000 and pumped to the Pelican Island PA during the time period from late-2009 through mid-2010. Maintenance materials have been dredged from the GHC from Station 20+000 to Station 22+571 and placed in the Pelican Island PA during the same time period. New work materials were placed in interior berms and on dikes within Cells A, B, and C. In addition, perimeter dikes at Cell C that had been damaged during Hurricane Ike were repaired and incrementally raised. Graded stone riprap shoreline protection was constructed along two sections of the Cell C perimeter dike at the northeast end of the PA. A new weir was constructed to replace the existing weir at the northwest end of Cell B to control dredge ponding levels and flow into Cell C. The new weir is 40-feet wide and is constructed using structural steel members, timber bulkheads, and has a cast-in-place concrete base. The design elevation of top of the concrete base is +18.0 feet (NAVD88). The weir is capable of restricting flow using stop log timbers up to elevation +30.0 feet; therefore, this flow control elevation adjustment is available from elevation +18.0 to +30.0 feet (NAVD88). An existing weir at the northeast end of Cell A was removed. A new five-bay drop-outlet structure was constructed near the southeast corner of Cell C, replacing the old structure, providing the only discharge of effluent into the bay from the PA. The effluent is discharged through two 48-inch diameter steel pipes to the south. Flow of effluent is controlled using stop-log timbers at elevations ranging from about +12.0 feet to +30.0 feet (NAVD88). The drop-outlet structure will be periodically raised and moved laterally in the future as required to accommodate dike raisings and/or realignments.

6.3.1.2 Dredged Material Placement Capacity

Dredging needs for the proposed deepened channel section (Station 20+000 to Station 22+571) include requirements for the new work during initial construction and for 50 years of maintenance dredging following construction. From Section *2.6 Maintenance Dredging Frequency and Shoaling Rate*, the estimated annual shoaling rate for the GHCE is 162,000 cubic yards, resulting in a forecast of about 7.8 MCY of maintenance material for placement in the PA over the 50-year period. The estimated 50-yr non-Federal maintenance dredging volume is about 1.0 MCY. The total new work volume anticipated for placement in the PA from construction of this channel extension is 726,900 cubic yards (581,520 cubic yards after shrinkage), including 513,800 CY of new work from construction of the extension, 95,700 CY of new work from third-party facilities, plus 102,400 CY and 15,000 CY of non-pay dredging for the extension and third-party facilities, respectively. The PA must have capacity for storage of maintenance dredging volumes from the entire GHC (Station 0+000 to Station 22+571) which totals about 69.4 MCY over the 50-year period of analysis. This total includes the forecast 7.8 MCY of maintenance material from the GHCE and 1.0 MCY from non-Federal sources. Therefore, the total forecast dredging volume planned for placement in Pelican Island PA over the 50-year period is about 70.1 MCY including maintenance and new work.

Per the 50-Year Disposal Plan presented in the 1995 LRR, in order to have enough capacity for maintenance material over the 50-year period of analysis, the final projected elevation of the PA, after a series of dike lifts in the O&M phase, would be approximately +50 feet MLT. The current estimated remaining neat line volume in the Pelican Island PA is about 46.1 MCY based on an ultimate dike elevation of +50 feet and required freeboard of 3 feet, as discussed in the 1995 LRR. This neat line volume is approximately equivalent to an in situ volume (in channel dredging volume) of about 70.9 MCY (using a shrinkage factor of 0.65 for long term storage, as discussed in the section of the 2007 LRR Engineering Appendix entitled CONSTRUCTION PROCEDURE). Therefore, the remaining capacity of Pelican Island PA after construction of the GHCE and the 50 years of maintenance would be about 0.8 MCY. See Table 6 presented below for a summary of the estimated new work and maintenance dredging quantities and PA capacity.

TABLE 6 – DREDGING VOLUMES AND PLACEMENT AREA CAPACITY

Channel	Reach Station Nos.	New Work Volume, MCY	Federal & non-Federal 50-YR Maintenance Volume, MCY	Total Dredging Volume, MCY	Pelican Is. PA Remaining Capacity
Existing 46-ft GHC	0+500 to 20+000	NA	60.6	60.6	70.9
GHCE	20+000 to 22+571	0.7	8.8	9.5	10.3
Totals	0+500 to 22+571	0.7	69.4	70.1	0.8

No incremental increase in shoaling within the Federal channel or private facilities is anticipated as result of this project. Therefore, Pelican Island PA has sufficient remaining capacity to accommodate the new work and maintenance volume generated by this channel extension.

Based on the above analysis of the Pelican Island PA capacity, there is no requirement for additional placement areas to contain the new work or maintenance dredge materials over the 50-year period of analysis.

6.3.2 Proposed Upland PA on Pelican Island

At the request of the Port of Galveston, an 81.76-acre tract located on the north edge of the GHC and between the Halliburton Energy Services Galveston Terminal Slip and the Pennzoil/Oxy USA Slip was explored for consideration as a new dredged material upland confined PA. A total of eight soil borings were performed within the proposed PA to characterize the soil conditions. As described in the 1995 LRR, the soils at emergent areas of Pelican Island are the result of dredged material discharges over the past 70 or so years. The soil borings taken within this tract of land on Pelican Island indicate the soils in this area are a mixture of fill materials, consisting of medium to high plasticity clays, sands, silty sands, and clayey sands. A review of the soil types encountered indicate that approximately 70 percent (or-that the majority) of the encountered soils consist of sands, silty sands, and clayey sands with the remainder being fine-grained sandy clays to clays, The encountered soil types are typical of the fill soils encountered on Pelican Island in historic borings. Consideration of this tract for upland disposal for inclusion in the NED Plan was abandoned during the Detail Phase of this study because of the high cost to develop the site compared to the relatively small placement capacity of the completed PA. A conceptual PA plan, soil boring layout, and boring logs are shown on Drawing Nos. B-03 through B-07.

6.4 Beneficial Use Site Alternatives

A beneficial use site (hereinafter referred to as the Marsh Site) was considered during the Preliminary Plan Formulation and Plan Formulation Phases of this study. The Marsh Site considered would be located just off and west of the southwest corner of Pelican Island. The studied Marsh Site ranged in area from about 48 acres to 103 acres to accommodate the volume of new work material for the various proposed channel depth alternatives studied. Preliminary dike construction design and dike erosion and wave protection systems were developed and construction quantities were estimated for preliminary construction cost determinations. The conceptual dike and wave protection designs are based on designs used successfully in the Galveston Bay area having similar fetch lengths. The Marsh Site alternatives were not selected for inclusion in the NED plan because of the high cost to construct and develop compared to placement of the dredged materials into the existing Pelican Island PA and the lack of a cost share partner to offset those costs. A conceptual beneficial use site plan and dike cross section are shown on Drawing No. B-02 attached to this appendix.

6.5 Dike Work

6.5.1 Initial Mechanical Dike Work

The proposed plan involves mechanically raising the dikes at Pelican Island PA, prior to deepening the channel, to sufficient height to: 1) allow for the containment of the new work material; and 2) account for any initial maintenance material that may be encountered above the new work material during the channel deepening. Neither the existing weir structure located at the northwest corner of Cell B, nor the existing drop-outlet structure located in Cell C, would be required to be raised as a result of the proposed dike raising.

6.5.2 Hydraulically Placed Dike Foundation

Using the proposed channel extension configuration (46-foot channel), the most current estimate of new work material from the channel deepening (not including maintenance material) would be around 726,900 cubic yards including Federal and non-Federal, and non-pay volumes. It would be proposed that the new work materials from the channel be stacked hydraulically along the perimeter dikes, to the inside of the PA in Cell B, serving the dual purpose of providing usable dike building material following the channel deepening, and providing added foundational strength by displacing and consolidating some of the softer materials from beneath the hydraulically placed new work materials.

During hydraulic placement of the new work material along the dike perimeter, it would be expected that up to half of the new work material pumped in from the channel may displace softer soils within the PA. By replacing some of the softer soils with stronger new work materials through displacement, the goal will be to create a stronger counteractive shear surface within the dike embankment to help prevent or reduce the chance of deep dike failures as the dikes are raised in the future. The discharge point of the dredge pipe will be moved along the dike as the hydraulic fill is placed; therefore, incurring additional cost to the dredging contract. The additional cost for moving the dredge discharge has been considered in the economic analysis.

After hydraulic placement, but prior to the next dredge cycle, it is proposed that the remaining available mounded new work then be shaped to a selected slope, crown width, and dike elevation as directed by USACE. In addition, during the shaping process of the new hydraulically placed foundation, it is proposed that the new shaped dike be slightly offset inward from the current dike configuration which will increase the overall length of the counteractive shear surface in the dike embankment, allowing for an increased counteracting force against the driving weight of the dike embankment. The hydraulically placed new work dike foundation will serve as the base for all future dike lifts, and be shaped to a uniform elevation. A conceptual typical cross section for Pelican Island dike construction is shown on Drawing No. B-01.

During future O&M dike construction on top of the hydraulically placed new work foundation, it is recommended that periodic checks of the foundation and embankment be made. Additional core borings, soils sampling, soils testing, and follow up stability analyses, should be performed periodically as conditions require. The additional soils data will be used to verify to what extent consolidation and foundation strength gain has occurred over time, and determine if additional stability measures should be taken (such as offsetting the dikes further into the PA if necessary or other measures). Per the 50-Year Disposal Plan presented in the 1995 LRR, in order to have enough capacity for maintenance material over the 50 year period of analysis, the final projected elevation of the PA, after a series of dike lifts in the O&M phase, would be approximately +50 feet MLT.

The assumption that dikes may be built to at least elevation +50 feet is based on "a report submitted to the Port of Houston Authority by a private consultant, *Geotechnical Memorandum Disposal Area Management Plan, Spilman Island, Alexander Island, Lost Lake, Houston Ship Channel, Harris County, Texas (1994)*...which shows that a dike could be built to +60.0 feet at Alexander Island, without failure." The 1995 LRR goes on to state that, "The District believes that Alexander Island has the weakest foundation conditions." Note the 1995 LRR disposal plan included Pelican Island. The District will perform

additional geotechnical exploration and stability analysis over the course of the project life during the PED phase of future dike-raising projects to confirm dike configuration, stability and allowable ultimate height.

6.6 Proposed Order of Work

The proposed order of work includes first mechanically raising the Pelican Island PA, Cell B west dike and mechanically constructing retention dikes within the interior of the Cell. Dredging of the GHC Extension will follow with placement of maintenance and new work materials hydraulically within Cell B. The new work material will be placed in berms along the interior of the Cell B west perimeter dike. The dredge pipe shall have a "Y" valve installed such that when maintenance or "mixed new work" materials are encountered that contain materials unsuitable for dike construction, the discharge can be directed toward the interior of Cell B and not in the proposed interior berms (see paragraph above entitled Terminology).

6.7 Dike and Channel Templates

Typical dike slope templates proposed for the Pelican Island upland PA were developed for the 1995 Engineering Supplement to LRR and the 2007 LRR Engineering Appendix referenced herein. Drawing No. B-01 of this report presents a conceptual hydraulic fill and dike template for this project. The proposed channel slopes for the channel deepening construction are 1V on 3H. The channel slopes will be maintained at a 1V on 2H slope during O&M as per existing practices for the GHC.

6.8 Proposed Additional Soils Investigations

As discussed in Section **6.4.2 Hydraulically Placed Dike Foundation**, it would be recommended that future periodic checks of the dike foundation and embankment be made by performing additional exploratory soil borings, sampling, and testing. The data obtained from the additional investigations would be used to verify consolidation and foundation strength gain over time and stability of the dike embankments. The resulting analyses would be used during future O&M dike raising design and construction. Additional geotechnical data will be obtained for the PED phase of this project by drilling soil borings within the proposed channel extension template in accordance with the guidance outlined in Engineer Manual (EM) 1110-1-1804, *Geotechnical Investigations*. Samples of the channel foundation soils will be obtained for classification and strength measurement. The data will be analyzed to develop estimated quantities of acceptable materials available for dike building and to verify channel side slopes will be stable after the deepening project.

7.0 OPERATION AND MAINTENANCE

The O&M phase of the project will be accomplished using the existing procedure for all the navigation channels in the Galveston District. The procedure would be composed of the following steps:

1) Historical records are kept for shoaling rates in various reaches of the navigation channel. The data in the historical records are continually updated based on actual dredging volumes for the various reaches.

2) Condition Surveys are conducted twice a year to determine the actual cross-sections at several stations along the navigation channel. The cross-sections are used to compute the actual shoaling rate in the various reaches. The actual shoaling rates are compared with the expected rates obtained from the historical data.

3) Dredging contracts are prepared to restore the channel to its design template as required for the various reaches of the channel.

4) The Corps of Engineers performs all the activities indicated above. The Local Sponsors provide the land for dredged materials placement and the containment dikes required.

5) The structural components in this project are limited to the interior weir and drop-outlet structure used to drain the excess water from the Pelican Island PA. The structures are composed of structural steel members and access/working platforms. Water drainage would be controlled by the use of timber planks. These structures will be periodically painted as needed, and the timber planks replaced. As the dike heights are raised to accommodate future dredged material, the drop-outlet structure will also be raised and repositioned laterally as required depending on the new dike configuration.

6) Other structures impacted by the project may be industrial wharfs and docks. The maintenance of these structures would be the responsibility of their owners.

7) The anticipated dredged maintenance material quantities for future O&M are not anticipated to change from those previously calculated for the existing 41-foot project. The existing shoaling rate has been determined to be approximately 162,000 cubic yards per year for the proposed 46-foot channel extension. The required maintenance dredging frequency is once every four years. The cost estimates for maintenance dredging over the 50-year period of analysis can be found in Section **9.0 COST ENGINEERING** of this Appendix.

8.0 HYDROLOGY AND HYDRAULICS

Studies performed for the Galveston Bay Area Navigation Study (GBANS), Feasibility Report and Environmental Impact Statement (EIS) for improving the Houston and Galveston channel (GBANS 1987) and subsequent studies to support the 1995 and 2007 LRR's are viable for this GHCE Feasibility Report. Below is a summary of hydraulic and hydrology studies that have been completed and their applications.

8.1 Hydrodynamic and Salinity Model Study

A number of hydrodynamic and salinity models have been developed as part of the GBANS study. These models assist in refining estimates of project induced changes to the circulation patterns and salinity regime of Galveston Bay. Studies of freshwater inflows were conducted for the GBANS, 1987. For the 1995 LRR the Texas Water Development Board (TWDB)-Soil Conservation Service Model was applied to obtain existing condition runoff for gaged and ungaged basins. The future hydrology described in the GBANS report was updated and revised to incorporate new data.

As part of the GBANS, 1987 report, a two dimensional model utilized by the State of Texas was used to evaluate the hydrodynamics of all the bay systems along the Gulf Coast. The model; however, did not fully capture all the pertinent physical processes in the Bay. Therefore, a detailed RMA-10-WES three dimensional model was developed as part of the 1995 LRR. Two new data collection efforts were used to acquire the boundary conditions, initial conditions, and verification data for the model: an intensive 25-hour survey for vertical current and salinity data and a long-term (180 days) monitoring program to obtain water level, salinity, and currents. The results from the hydro-salinity study were coordinated with an oyster model study directed by Dr. Eric Powell of Texas A&M University used to assess project-induced impacts on oysters for the EIS in the 1995 LLR. The currents produced by the hydro-salinity model were also used as a key input parameter for the ship simulation study. A discussion and analysis of model results is found in "*Houston-Galveston Navigation Channels, Texas Project, Report 4, Three-Dimensional Numerical Modeling of Hydrodynamics and Salinity*, TR HL-92-7." Figures and a summary from this report can be found in the 1995 LRR. A brief discussion of modeled parameters is described below.

The model was run for existing condition (40 feet MLT), 46 feet MLT and 51 feet MLT for low, medium, and high freshwater inflows for tidal, meteorological, and hydrologic conditions. The resulting time series, isohaline charts, and cross sections plots can be viewed in the WES Technical Report TR-HL-92-7. The isohaline charts can also be

viewed in the Appendices of the 1995 LRR. According to the WES report, "The typical Galveston Bay trend is for low salinity values through early summer. The large drop in freshwater inflow beginning in July along with the higher Gulf salinity causes a rise in salinity, usually, reaching a maximum around October. The simulated Gulf salinity drops quickly in September and the Bay salinities follow later. The overall increase in salinity of the 45' deepening in comparison to the existing conditions was regionally most noticeable in the upper bay; and time-wise in the fall (for all regions). During freshwater flow periods this region and Trinity Bay were practically fresh for both existing and 45' deepening. Generally, the maximum increase in salinity was greater during the high flow scenario than in the low."

In summary, for this GHCE LRR study, the conclusions from the 1995 LRR RMA report are applicable – channel deepening resulted in a larger salinity gradient from the channel to the bay. The salinity increase in the lower bay was much less significant than in other areas, typically about 1 part per thousand (ppt). Salinity values are lower in the summer months and highest in October.

8.2 Ship-Handling Simulation Model Study

This study was conducted as part of the 1995 LRR. Results are applicable to the channel extension. The study tested both the proposed 45-foot and 50-foot channels for safe two-way navigation, efficient design, and recommended design changes where needed. The ship simulation provided a template design for the GHC that provided for safe ship maneuverability for a design vessel 990 feet long, 160 feet wide, and a draft of 44 feet. The simulation resulted in a recommendation for a minimum 4,500-foot long turning area extending past Pier 36 or approximately Station 19+300. The 1995 LRR adopted a turning area of 4,700 feet long by 1,075 feet wide which ends at Station 20+000 or the end of the existing 45-foot channel. The GHC Extension further extends the turning area to the end of the proposed Extension, resulting in a 1,075-foot wide by 7,271-foot long turning area. The extended turning area would allow pilots additional leeway in selecting appropriate vessel turning locations within the channel to account for variable factors such as current and location of docked vessels. Refer to the 1995 LRR, Section 4.3 "Ship Simulation Study" for a detailed analysis of the ship simulation study.

8.3 Shoaling Rate Investigation

During the re-evaluation study, annual maintenance rates for the existing 45-foot GHC were derived by observing the results for detailed investigations of the bayou and bay reaches for the HSC and taking into account the quadratic equation in WES Technical

Report TR H-78-5, "*Methods of Estuarine Shoaling Analysis*", Trawle, 1981. The predictions were verified in analysis of the historical shoaling rates. Based on observations, predicted rates for the proposed project were the same as the existing channel. The results from this investigation combined with additional analysis of shoaling rates in the District's Dredging History Database were used to develop the shoaling estimates for the GHC Extension. Estimated shoaling is 162,000 cubic yards per year.

8.4 Dredging Frequency Study

The proposed maintenance cycle of four years for the existing GHC will be used for the extension. This value was derived during the shoaling rate investigation. Historically the channel had been dredged every four years during the prior 24 years for a total of six cycles. Because the shoaling rates were not predicted to increase the same dredging frequency is applicable.

8.5 Advance Maintenance Study

This was conducted to ascertain the effectiveness of the advance maintenance depths. Existing O&M practices since the year the channel was initially dredged to the 41-foot project have yielded an advance maintenance depth of three feet as being adequate in maintaining the project depth between dredging contracts. This existing depth of three feet will be used for the channel extension in this GHCE Feasibility Report. The allowable overdepth will be two feet.

8.6 Relative Sea Level Change

Current USACE guidance was used to assess relative sea level change (RSLC) for this GHCE Feasibility Report. USACE guidance (ER 1100-2-8162, December 2014 and Engineer Technical Letter (ETL) 1100-2-1, June 2014) specify the procedures for evaluating and incorporating climate change and relative sea level change into USACE planning studies and engineering design projects.

USACE guidance recommend that projects be evaluated using three different projections of future sea level change, i.e., "low, intermediate, and high," as follows:

- Low – Use the historic rate of local mean sea level change as the "low" rate. The guidance further states that historic rates of sea level change are best determined by local tide records (preferably with at least a 40 year data record).

- Intermediate – Estimate the "intermediate" rate of local mean sea level change using the modified NRC Curve I. The modified curve corrects for the local rate of vertical land movement.
- High – Estimate the "high" rate of local mean sea level change using the modified NRC Curve III. The modified curve corrects for the local rate of vertical land movement.

Additionally, USACE guidance also recommend that RSLC be evaluated at planning horizons other than the one used in the economic analysis, recommending at a minimum, RSLC analysis at 20, 50 and 100 years post-construction.

The recent historic rate of local sea level change can be obtained from local tide records. The tide gage nearest the GCHE is located at Pier 21 in Galveston, Texas (NOAA gage 8771450). The NOAA mean sea level trend at this site (from 1908 to 2013) is equal to 6.35 millimeters (mm)/year with a 95 percent confidence interval of ± 0.25 mm/year. This equates to a rise of 0.42 feet in 20 years. If the estimated historic eustatic (global) rate equals that given for the Modified NRC curves (1.7 mm/year), this results in an observed subsidence rate of 6.35 – 1.7 = 4.65 mm/year.

Utilizing the online sea level calculator referenced in ER 1100-2-8162, estimates of future RSLC were determined. The computed future rates of RSLC in the table below give the predicted low, intermediate, and high estimates of sea level change at the 20-, 50- and 100-year planning horizons.

TABLE 7 – ANTICIPATED FUTURE RELATIVE SEA LEVEL CHANGE*

Year	Low (feet)	Intermediate (feet)	High (feet)
2036 (20 years)	0.42	0.54	0.92
2066 (50 years)	1.05	1.48	2.86
2116 (100 years)	2.10	3.41	7.58

**Based on nearest NOAA tidal gage at Pier 21, Galveston, Texas.*

Relative sea level change is not expected to have a significant impact on dredging frequency, shoaling or ship handling.

9.0 COST ENGINEERING

A Limited Reevaluation Report (LRR) and Environmental Impact Statement (EIS), dated November 1995 for the Houston-Galveston Navigation Channels (HGNC) Study was prepared by the Galveston District Corps of Engineers. The plan presented in the LRR consisted of deepening and widening the Houston Ship Channel and the Galveston Harbor Channel. The Galveston Channel was subdivided into two reaches designated as the Offshore Reach and the Galveston Channel Reach. The Galveston Channel Reach, referred to as the GHC in this document, is authorized to -46 feet (-45-foot MLT) deep from Station 0+000 to Station 20+000. From Station 20+000 to Station 22+571 the channel was only authorized to a depth of -40-feet MLT. As such, the local sponsor and facilities at the far end of the Galveston Ship Channel (last 0.5 mile) are not able to receive deeper draft vessels at their facilities without practices such as light-loading.

A Post Authorization Change Report (PACR) and integrated Environmental Assessment was developed in 2010 to evaluate deepening the remaining segment up to 45 feet in order to update the results of the 1995 LRR. The PACR was never finalized due to the Houston-Galveston Navigation Channel (HGNC) 902 limit exceedance.

On February 29, 2016 a new Federal Cost Share Agreement (FCSA) was signed, which removed the GHCE from the HGNC study in order to resume the GHCE study under Section 216 of the Flood Control Act (FCA) of 1970, Public Law (P.L.) 91-611, authorizes the Secretary of the Army to review existing Corps of Engineers (USACE) constructed projects due to changes in physical and economic conditions and report to Congress recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest, and the Galveston Harbor Channel is a constructed separable element of the authorized Houston-Galveston Navigation Channels, Texas project.

This current Feasibility report would involve extending the -46 foot (-45-foot MLT) deep Galveston Harbor Channel the remaining 2,571 feet to reach the end of the limits of the authorized and currently maintained -41-foot (-40-foot MLT) deep channel. The Mii estimate was prepared for this report. The NED proposes deepening it from -41-foot (-40-foot MLT) to -46-foot (-45-foot MLT) deep. This would be accomplished by pipeline dredging the channel and placing the material into the existing Pelican Island placement area (PA). Pelican Island PA is located north of the Galveston Channel.

The placement area would be conventional earthen dikes with the material excavated from the site. Quantities and design features were developed by the Galveston District (SWG) Engineering Branch.

This estimate was prepared using the latest Unit Price Books and labor rates for fiscal year 2017 (October 2016). The estimate was set-up as one contract, being subdivided into Non-Federal and Federal Costs. The costs were further organized in accordance with the work breakdown structure. The midpoint date of each account code was provided by the project manager for developing the fully funded costs. The estimate was prepared in accordance with ER 1110-2-1302, dated 15 September 2008. The costs were escalated in accordance with the above Engineering Regulation and EM 1110-2-1304, dated 31 March 2012, amend #8, Tables Revised as of 31 March 2016. All this data was input into the Total Project Cost Summary Sheet (TPCS). The baseline estimate provides for all pertinent elements for a complete project ready for operations.

Since the project is under 40 million dollars, a formal cost risk analysis using Crystal Ball software was not needed. Instead an Informal Risk Analysis develop by Walla Walla District was used to come-up with the project contingences. The results of the Mii and contingencies are presented in the total project cost summary.

The Operation and Maintenance estimate was prepared in May 2016.

ACCOUNT CODE 12 -- NAVIGATION PORTS AND HARBORS: Dredge quantities were developed by the design engineer. The channel was assumed to be dredged using traditional dredging methods for the area, a 30" pipeline, with the material going into existing Pelican Island PA located back from the waterway. The dredging cost was developed using CEDEP. The dredge production rates were reduced to account for the stiffer "new work" material to be encountered. The cost for mobilization and demobilization was developed using CEDEP, and assuming the pipeline dredge was based in New Orleans. The Dredging estimates were based on standard operating practices for the Galveston. No overtime would be required to perform the work.

The cost for creating Cell B was included under this code of accounts. Part of the cost for creating the Cell B included clearing, grubbing, and stripping the area; as well as turfing the outside of the new levee. Labor rates and overhead costs were adjusted to reflect Region 6. Soil characteristics were provided by SWG, Engineering Division, Geotechnical and Structures Section.

ACCOUNT CODE 30 -- ENGINEERING AND DESIGN: The cost for this account was developed using the guidelines provided in the TPCS, with the agreement of the cost engineer and the project manager.

ACCOUNT CODE 31 -- CONSTRUCTION MANAGEMENT: The cost for this account was developed using the guidelines provided in the TPCS, with the agreement of the cost engineer and the project manager.

10.0 CHANNEL CONSTRUCTION

10.1 General

The project will be dredged in one contract. All material will be excavated with a hydraulic pipeline dredge, and placed into the confined upland Pelican Island PA.

10.2 Construction Method

The construction will utilize traditional dredging techniques, such as the hydraulic pipeline dredge. Placement of the material for the GHC Extension will also be traditional, in that the material will be contained in a confined upland site. The Pelican Island PA will be decanted during and following dredging to reduce hydraulic material volume and with the intent to minimize dispersal of sediments into the bay through the effluent. The PA construction is such that flow will be directed from Cell B through the weir into Cell C, then around training dikes in Cell C toward the drop-outlet box and finally discharging into the bay. This labyrinth of weir and training dikes maximizes the distance that the dredge pipe discharge water and sediment must travel. Elevations of the weir and drop-outlet box would be controlled using adjustable stop-log timbers to control flow volume and velocities within the PA, thus allowing the maximum amount of sediment to settle prior to discharge into the bay.

11.0 PROJECT SECURITY

Security measures for protecting the project against attacks, such as terrorism attacks, are not considered necessary because of the nature of the project. The only likely attack would be attempts to sink a vessel in order to block navigation. The sunken vessel can usually be removed within a few days to allow navigation to resume. The only vertical structures in this project are the existing drop-outlet and weir structures in the Pelican Island PA, but they are not considered likely attack targets because of the unimportant consequences of failure, and because they can be repaired fairly quickly to restore their function.

12.0 DATA MANAGEMENT

The electronic version of the Engineering Appendix, related civil and geotechnical design, and cost information is located on the Districts "W" drive. Location of the folder is at the following address: W:\Cadd\Projects\Galv\Galveston Har Ext 2016.

13.0 USE OF METRIC SYSTEM MEASUREMENTS

The existing GHC, Texas is established in English units. The navigation industry exclusively uses English units. In the District, water depths are typically expressed in feet and accuracy standards are expressed in feet. Distances are measured in feet, or miles. Engineering project coordinates are normally in English units (feet). Construction measurement quantities are normally measured in linear feet, square feet, or cubic yards. The Districts' Dredging History Database uses English units.

14.0 ENVIRONMENTAL OPERATING PRINCIPLES (EOP)

The purpose of this section is to provide examples of how the Engineering Appendix integrates EOPs as applicable to engineering and design as required for sustainability, preservation, stewardship, and restoration of the project area's natural resources.

Throughout the study process USACE Environmental Operating Principles (EOP) are considered. The EOP's are outlined in Appendix A of ER 200-1-5 "*Environmental Quality - Policy for Implementation and Integrated Application of the U.S. Army Corps of Engineers (USACE) Environmental Operating Principles (EOP) and Doctrine*," dated 30 October 2003. The re-energized EOP principles (announced in 2012) are considered at the same level as economic issues and are listed below.

1) Foster a culture of sustainability throughout the organization;
2) Proactively consider environmental consequences of all USACE activities and act accordingly;
3) Create mutually supporting economic and environmental solutions;
4) Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE which may impact human and natural environments;
5) Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs;
6) Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner; and
7) Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.

Various project planning and design processes were carried out to achieve practical balance between environmental and economic considerations. The following paragraphs discuss various planning and design considerations that incorporate ways and means to minimize the environmental impact of the project.

14.1 Dredging

In order to minimize water quality degradation, the most efficient dredging techniques and equipment would be utilized for new work and maintenance dredging. Sediment sampling and soil core borings would be performed during the PED phase of the project to classify

the new work and maintenance material proposed to be dredged and to identify existing contaminants for appropriate disposal during dredging operations.

14.2 Dredged Material Disposal

Selection of the existing Pelican Island PA site and placement of dredged material within the PA was optimized for proximity to the project. Thus, the need for construction of additional upland disposal sites was eliminated and the distance required to pump the dredged material was minimized. This will result in saving energy and reducing equipment exhaust emissions.

14.3 Design

The project is designed to provide increased navigational safety and efficiency along the channel.

14.4 Effluent Water and Sediment Quality

The effluent water and sediment quality will be monitored during dredging operations to insure it meets state and national quality requirements.

14.5 Geotechnical Engineering

In an effort to "proactively consider environmental consequences of Corp programs" as part of the EOP's, PA containment dike design practices have been focused on providing a dike layout design with sufficient freeboard, to provide the needed settling time for soil particles within the effluent discharge material, to promote lower levels of turbidity in the drop-outlet structure effluent. Other factors may influence settling time including the discharge flow rate implemented by the dredging contractor. Specification language is added at the time plans and specifications are produced. This language provides additional restrictions on contractor dredging operations such that effluent concentrations at drop-outlet structure are within legal and allowable limits.

14.6 Environmental Engineering

Section 5.0 ENVIRONMENTAL ENGINEERING of this document discusses the application of EOP's.

15.0 RISK AND UNCERTAINTY

This section provides detail as applicable for addressing USACE policy concerning risk and uncertainty with regard to estimated construction quantities. Typical changes in channel shoaling rates are attributed to several major factors including: increase in bottom width; decreased flow velocity due to enlarged cross-section; modified salinity regime; increased vessel traffic; channel bank failure; and, sediment brought down by rivers, etc.

The only change in the channel dimensions for this project is an increase in depth and a slight decrease in bottom width. Based on the hydrodynamic and salinity model study performed for the 1995 LRR, the salinity in the Lower Bay area will remain the same or change very little with channel deepening. The channel bank in the area has a proven history of stability and there is no river to increase sediment load. The cross section is enlarged because of the increased depth thereby providing a possible decrease in current velocities.

Navigable vessels and docks are predicted to experience insignificant impacts of higher water elevation resulting from RSLC.

Because of the uncertainty involved in the assumptions and calculations of velocity data and channel side slope stability, the estimated shoaling quantities for the proposed project may not match the actual shoaling rates and are therefore subject to a certain degree of uncertainty.

Since the project is under 40 million dollars, a formal cost risk analysis using the Crystal Ball software was not required. Therefore, cost contingencies were developed using the Informal Risk Analysis method developed by the Walla Walla District. Refer to Section 9.0 COST ENGINEERING of this appendix.

ATTACHMENTS

ATTACHMENT 1
Page 1 of 10

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS
DATE: 13-SEPTEMBER-2016 TIME: 8:35:26

****
* INPUT DATA *
****

I.--HEADING
'EDISON-CHOUEST BULKHEAD

II.--CONTROL
ANCHORED WALL DESIGN
FACTOR OF SAFETY FOR ACTIVE PRESSURES = 1.00
FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.50

III.--WALL DATA
ELEVATION AT TOP OF WALL = 10.00 FT.
ELEVATION AT ANCHOR = -2.00 FT.

IV.--SURFACE POINT DATA

IV.A.--RIGHTSIDE

DIST. FROM WALL (FT)	ELEVATION (FT)
0.00	10.00

IV.B.--LEFTSIDE

DIST. FROM WALL (FT)	ELEVATION (FT)
0.00	-26.00
40.00	-26.00
70.00	-36.00
100.00	-46.00
100.50	-51.00

V.--SOIL LAYER DATA

V.A.--RIGHTSIDE
LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE = 1.00
LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = 1.50

		ANGLE OF		ANGLE OF				<-SAFETY->	
SAT.	MOIST	INTERNAL	COH-	WALL	ADH-	<--BOTTOM-->		<-FACTOR->	
WGHT.	WGHT.	FRICTION	ESION	FRICTION	ESION	ELEV.	SLOPE	ACT.	PASS.
(PCF)	(PCF)	(DEG)	(PSF)	(DEG)	(PSF)	(FT)	(FT/FT)		
110.00	110.00	30.00	0.00	20.00	0.00	-2.00	0.00	1.00	1.50
120.00	120.00	26.00	0.00	20.00	0.00	-30.00	0.00	1.00	1.50
120.00	120.00	20.00	150.00	17.00	50.00	-46.00	0.00	1.00	1.50
120.00	120.00	20.00	120.00	17.00	50.00	-65.00	0.00	1.00	1.50
120.00	120.00	20.00	200.00	17.00	50.00			1.00	1.50

V.B.--LEFTSIDE
LEVEL 2 FACTOR OF SAFETY FOR ACTIVE PRESSURE = 1.00

ATTACHMENT 1
Page 2 of 10

LEVEL 2 FACTOR OF SAFETY FOR PASSIVE PRESSURE = 1.50

SAT. WGHT. (PCF)	MOIST WGHT. (PCF)	ANGLE OF INTERNAL FRICTION (DEG)	COH-ESION (PSF)	ANGLE OF WALL FRICTION (DEG)	ADH-ESION (PSF)	<--BOTTOM--> ELEV. (FT)	SLOPE (FT/FT)	<-SAFETY-> <-FACTOR-> ACT.	PASS.
120.00	120.00	20.00	150.00	17.00	50.00	-46.00	0.00	1.00	1.50
120.00	120.00	20.00	120.00	17.00	50.00	-65.00	0.00	1.00	1.50
120.00	120.00	20.00	200.00	17.00	50.00			1.00	1.50

VI.--WATER DATA
UNIT WEIGHT = 64.30 (PCF)
RIGHTSIDE ELEVATION = 0.00 (FT)
LEFTSIDE ELEVATION = 0.00 (FT)
NO SEEPAGE

VII.--VERTICAL SURCHARGE LOADS

VII.A.--VERTICAL LINE LOADS
NONE

VII.B.--VERTICAL UNIFORM LOADS

LEFTSIDE (PSF)	RIGHTSIDE (PSF)
0.00	250.00

VII.C.--VERTICAL STRIP LOADS
NONE

VII.D.--VERTICAL RAMP LOADS
NONE

VII.E.--VERTICAL TRIANGULAR LOADS
NONE

VII.F.--VERTICAL VARIABLE LOADS
NONE

VIII.--HORIZONTAL LOADS
NONE

ATTACHMENT 1
Page 3 of 10

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS
DATE: 13-SEPTEMBER-2016 TIME: 8:35:31

****
* SUMMARY OF RESULTS FOR *
* ANCHORED WALL DESIGN *
****

I.--HEADING
'EDISON-CHOUEST BULKHEAD

II.--SUMMARY

RIGHTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

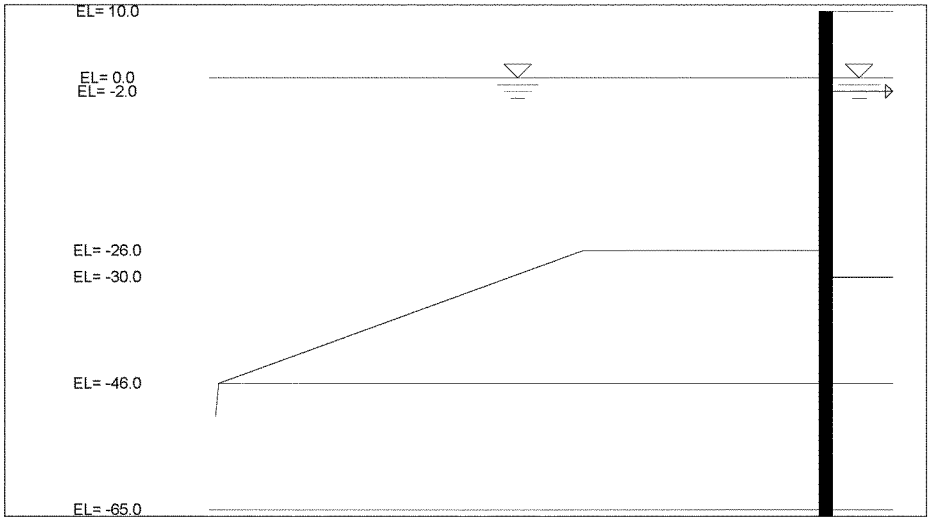
LEFTSIDE SOIL PRESSURES DETERMINED BY SWEEP SEARCH WEDGE METHOD.

*****WARNING: STANDARD WEDGE SOLUTION DOES NOT EXIST
AT ALL ELEVATIONS. SEE COMPLETE OUTPUT.

METHOD	:	FREE EARTH	FIXED EARTH
WALL BOTTOM ELEVATION (FT)	:	-43.26	-58.23
PENETRATION (FT)	:	17.26	32.23
MAXIMUM BENDING MOMENT (LB-FT)	:	-9.4769E+04	-7.9088E+04
AT ELEVATION (FT)	:	-19.87	-18.70
MAXIMUM SCALED DEFLECTION (LB-IN^3)	:	2.5537E+10	2.0652E+10
AT ELEVATION (FT)	:	-21.00	-21.00
ANCHOR FORCE (LB)	:	1.4132E+04	1.3224E+04

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF
ELLASTICITY IN PSI TIMES PILE MOMENT
OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
IN INCHES.

'EDISON-CHOUEST BULKHEAD



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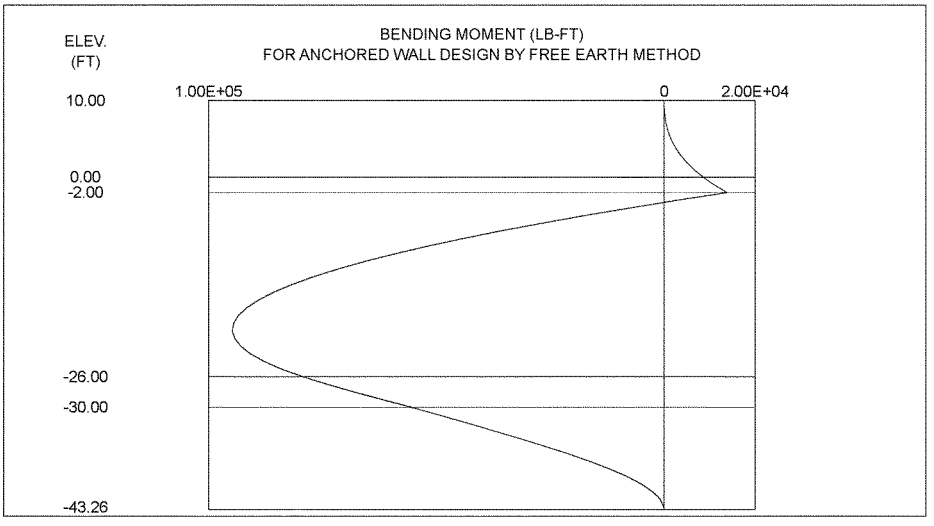

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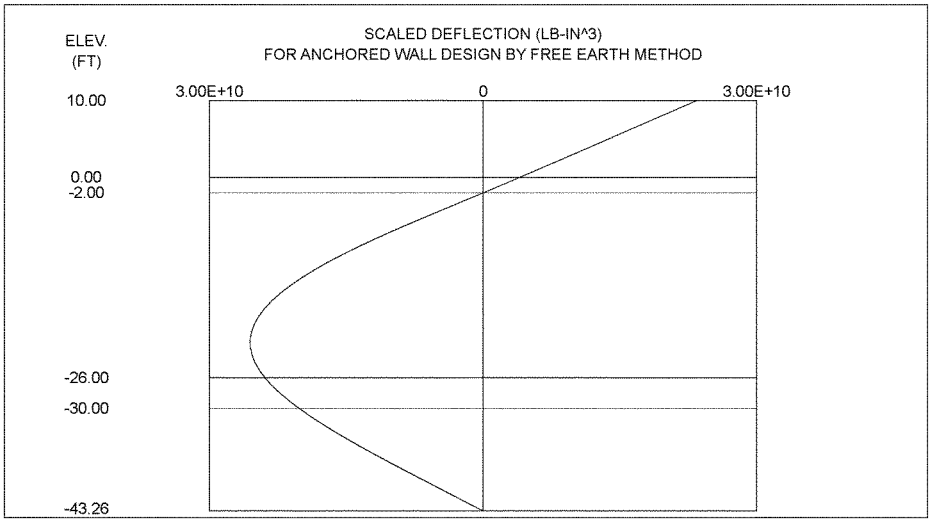

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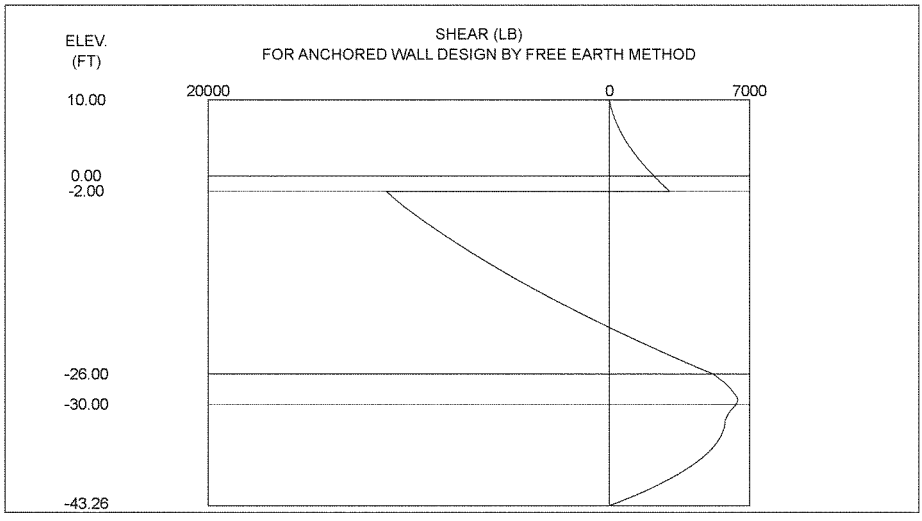

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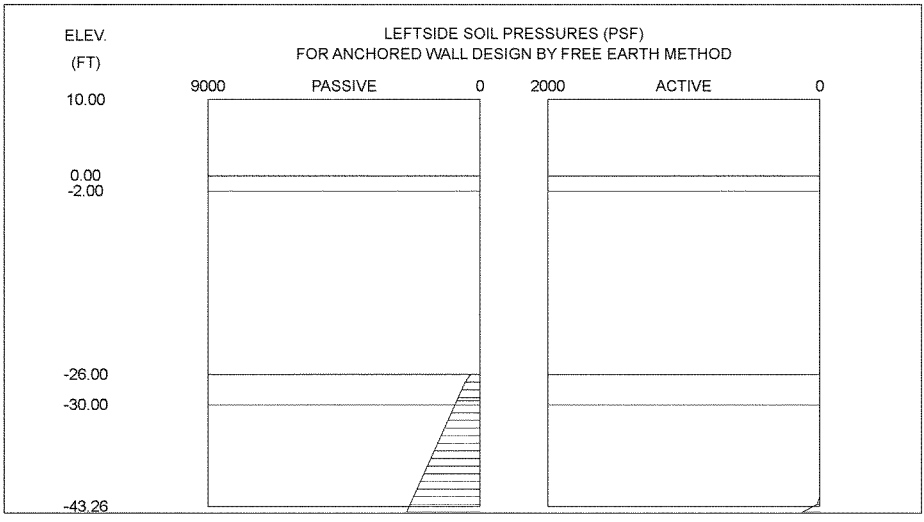
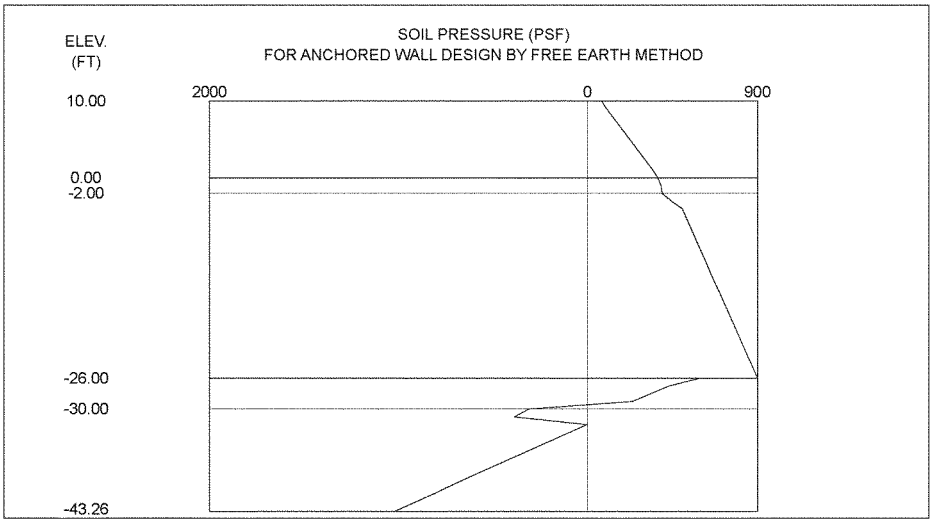
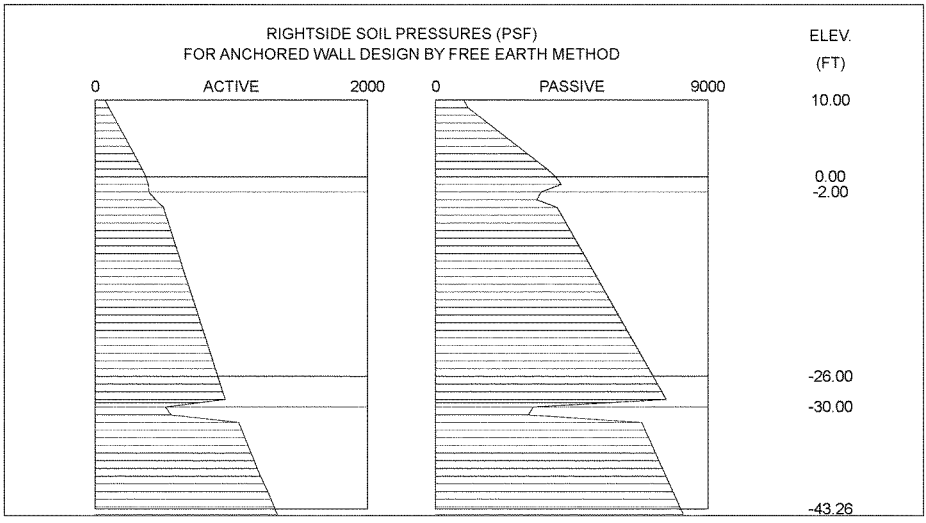


'EDISON-CHOUEST BULKHEAD



'EDISON-CHOUEST BULKHEAD



Galveston Harbor Channel Extension Feasibility Study
Edison-Chouest Bulkhead
Channel Slope - Short Term Condition
Name: EdisonChouestBulkhead-60.250psf.ST1

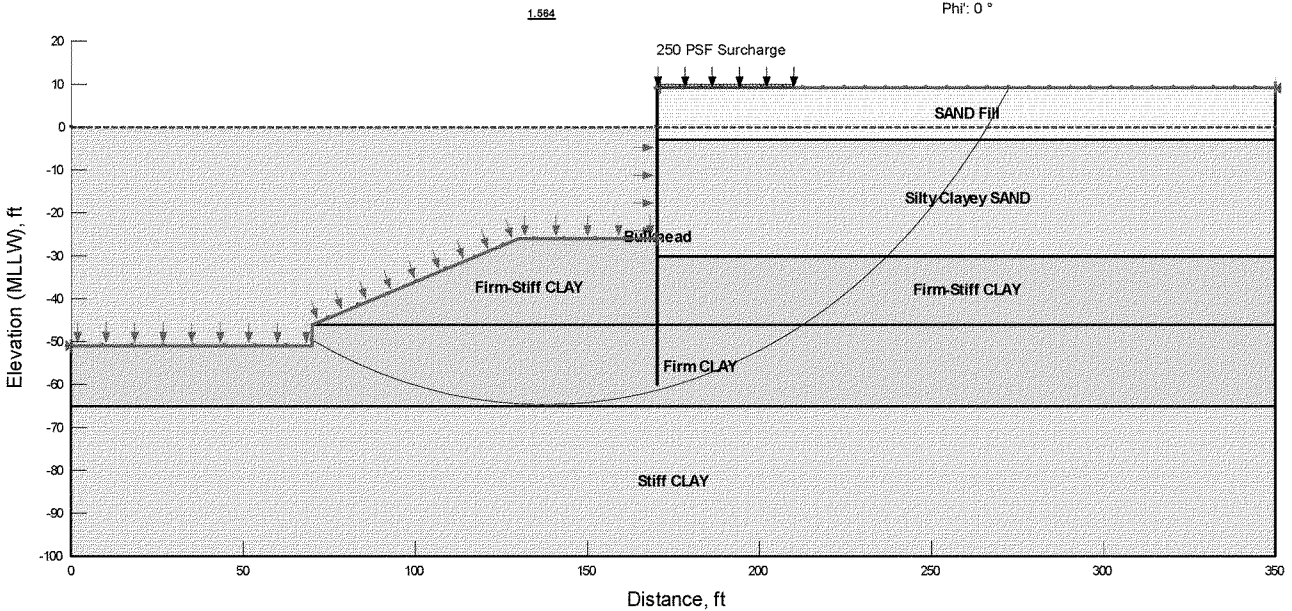
Name: Stiff CLAY
Unit Weight: 120 pcf
Cohesion': 1,500 psf
Phi': 0 °

Name: Silty Clayey SAND
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 26 °

Name: Firm CLAY
Unit Weight: 120 pcf
Cohesion': 1,000 psf
Phi': 0 °

Name: SAND Fill
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Firm-Stiff CLAY
Unit Weight: 120 pcf
Cohesion': 1,250 psf
Phi': 0 °



Galveston Harbor Channel Extension Feasibility Study
Edison-Chouest Bulkhead
Channel Slope - Long Term Condition
Name: EdisonChouestBulkhead-60.250psf.LT1

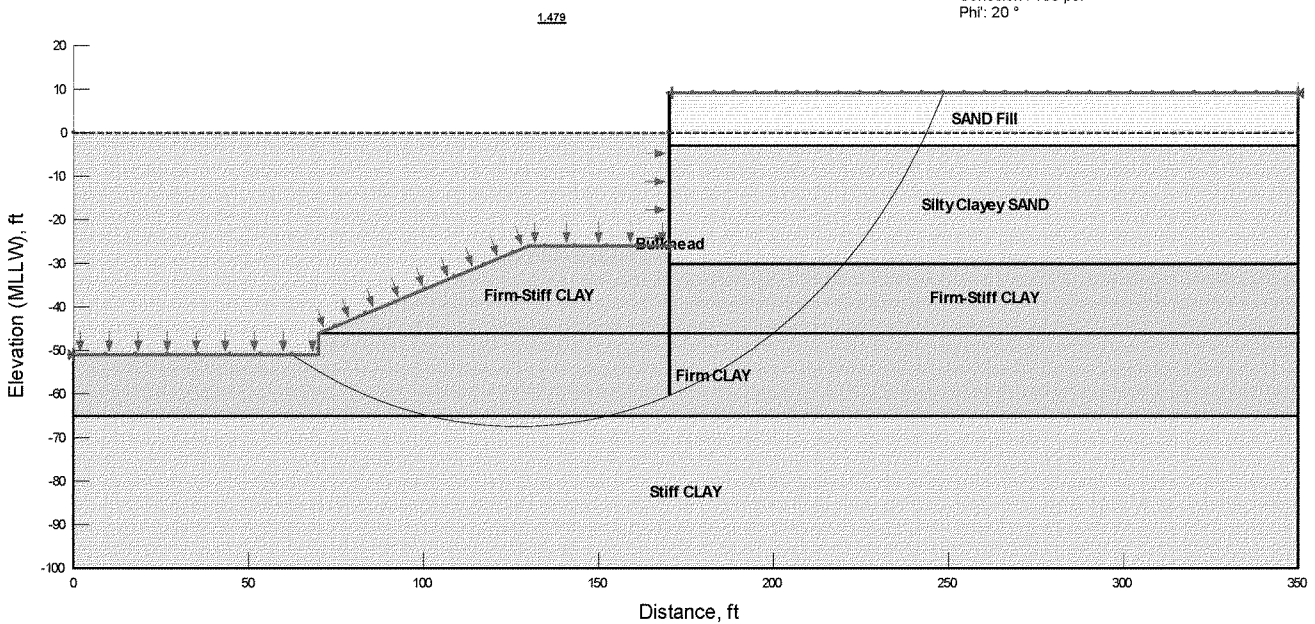
Name: Stiff CLAY
Unit Weight: 120 pcf
Cohesion': 200 psf
Phi': 20 °

Name: Silty Clayey SAND
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 26 °

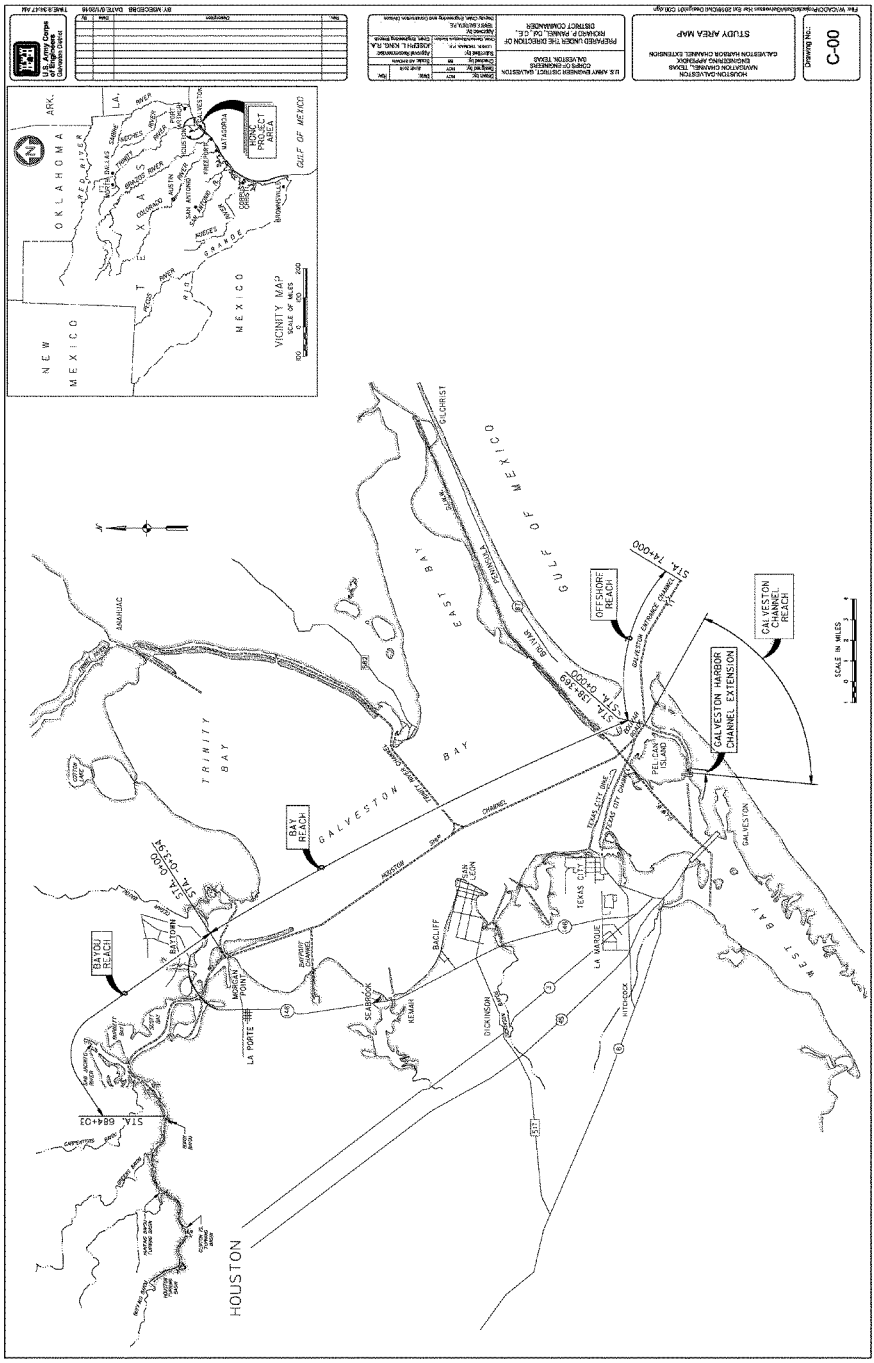
Name: Firm CLAY
Unit Weight: 120 pcf
Cohesion': 120 psf
Phi': 20 °

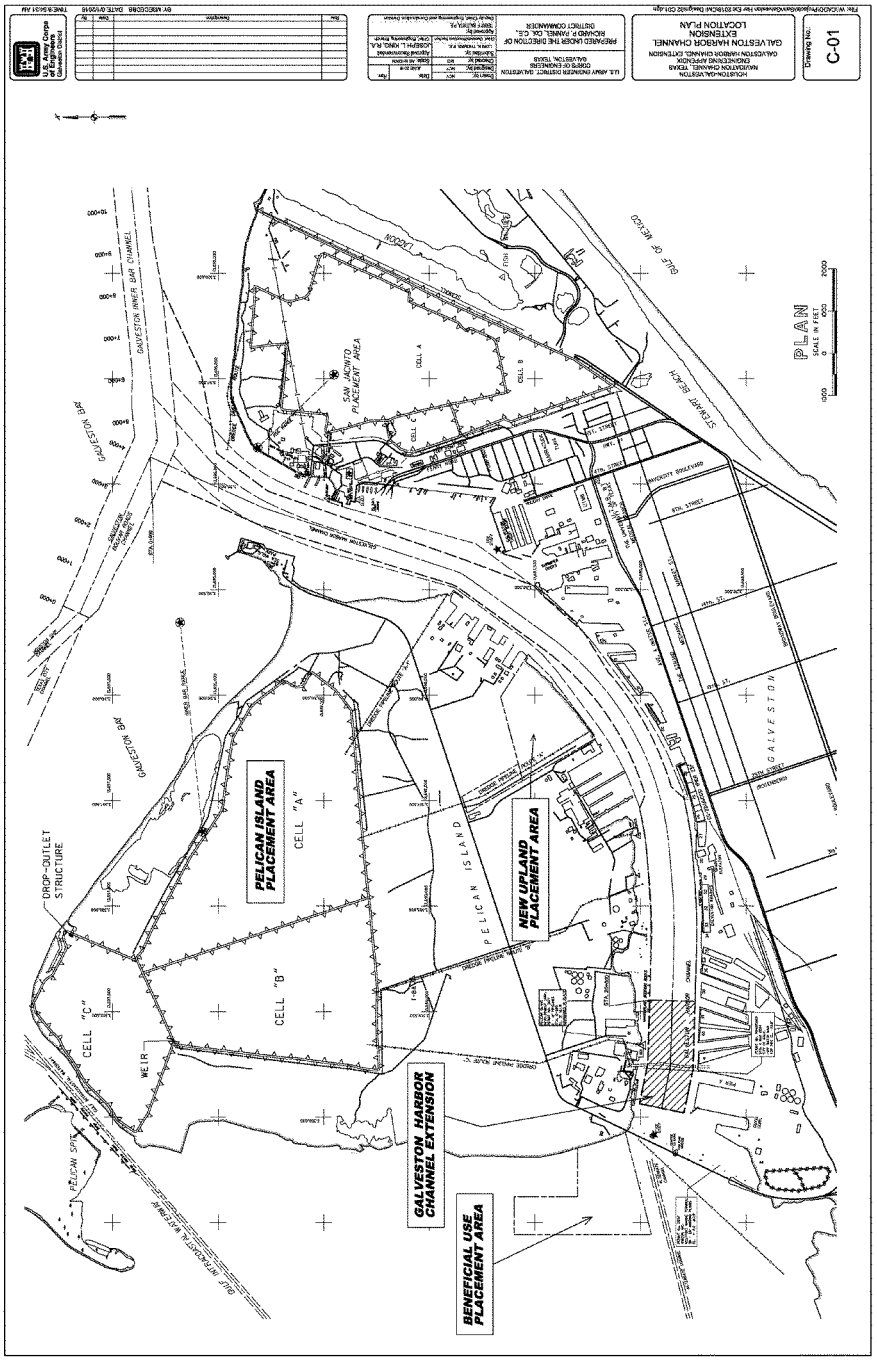
Name: SAND Fill
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

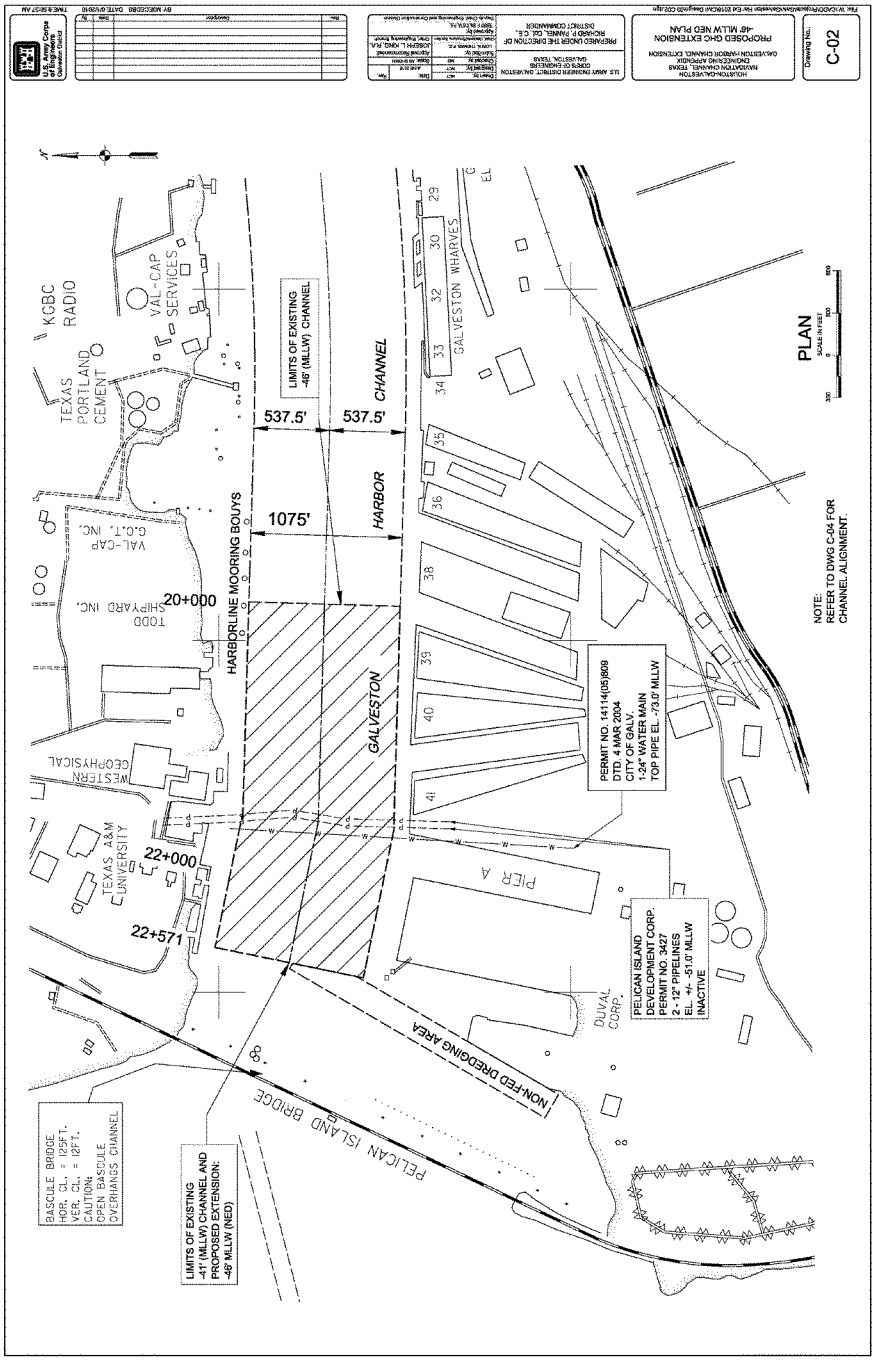
Name: Firm-Stiff CLAY
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 20 °

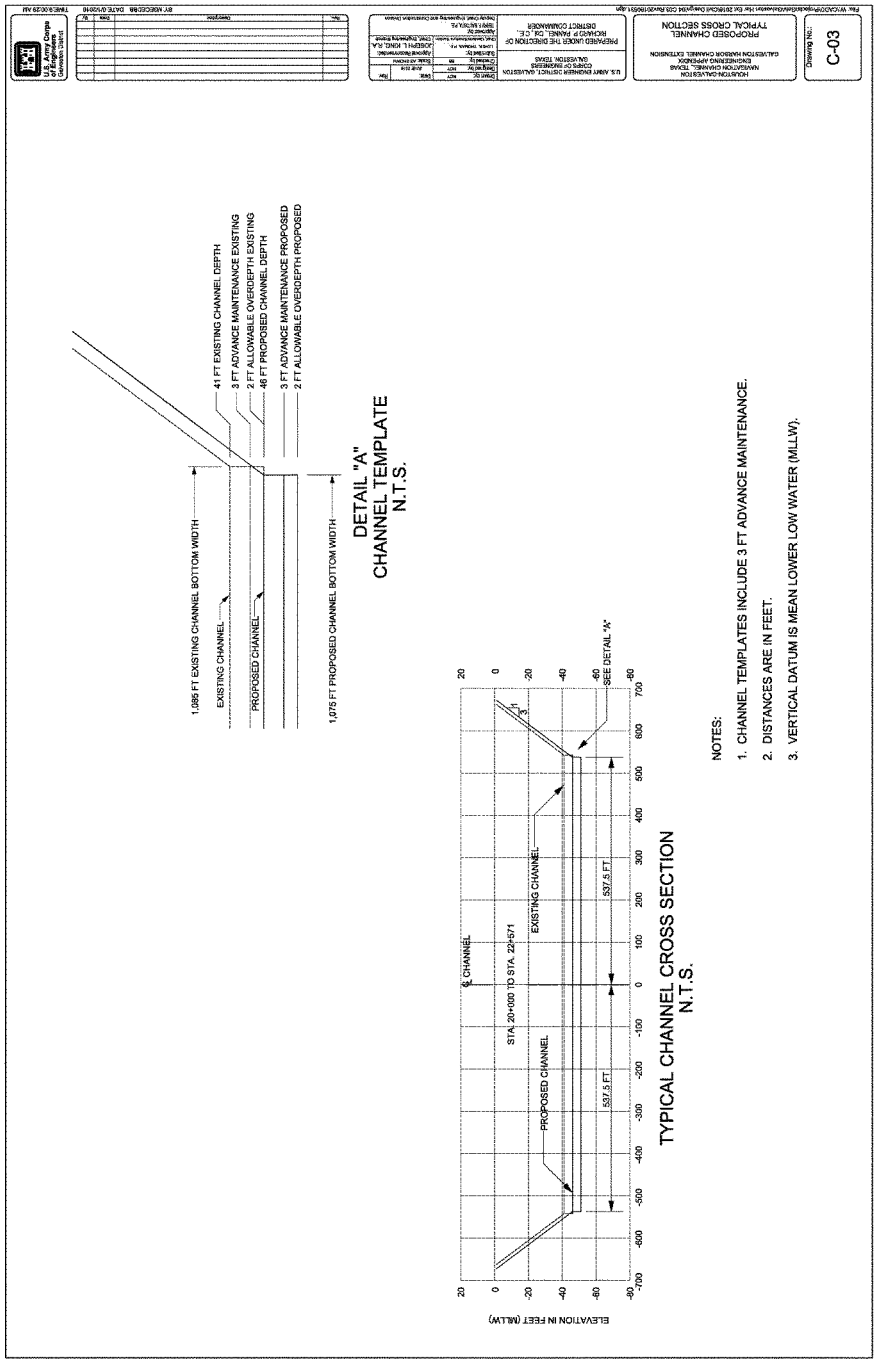


DRAWINGS AND PLATES


HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
GALVESTON HARBOR CHANNEL EXTENSION
GALVESTON CHANNEL EXTENSION
STUDY AREA MAP
C-00
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON TEXAS
PREPARED UNDER THE DIRECTION OF
RECOMMENDED FOR APPROVAL:
DISTRICT COMMANDER
U.S. Army Corps of Engineers
Galveston District
VICINITY MAP
PROJECT AREA
GULF OF MEXICO
EAST BAY
TRINITY BAY
GALVESTON BAY
OFFSHORE REACH
GALVESTON CHANNEL REACH
GALVESTON HARBOR CHANNEL EXTENSION
BAY REACH
BAYTOWN REACH
HOUSTON
GALVESTON
TEXAS CITY
LA PORTE
SEABROOK
KEMAH
BACLIFF
LA MARQUE
HITCHCOCK
DICKINSON
TEXAS CITY
PELICAN ISLAND
SCALE IN MILES


GALVESTON-HOUSTON
MAINTENANCE DREDGING
GALVESTON HARBOR CHANNEL
GALVESTON-HOUSTON CHANNEL EXTENSION
DEPTH AND WIDTH
ENGINEERING APPENDIX
GALVESTON HARBOR CHANNEL
EXTENSION
LOCATION PLAN
C-01
PREPARED UNDER THE DIRECTION OF
RICHARD P. PAMES, COL, U.S.
DISTRICT COMMANDER
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS
U.S. Army Corps of Engineers
PLAN
SCALE IN FEET
GULF OF MEXICO
STEWART BEACH
GALVESTON BAY
GALVESTON
PELICAN ISLAND
PELICAN ISLAND PLACEMENT AREA
CELL "A"
CELL "B"
CELL "C"
NEW UPLAND PLACEMENT AREA
SAM JACINTO PLACEMENT AREA
CELL A
CELL B
CELL C
DROP-OUTLET STRUCTURE
WEIR
PELICAN SPIT
GALVESTON HARBOR CHANNEL EXTENSION
BENEFICIAL USE PLACEMENT AREA
GULF INTRACOASTAL WATERWAY
GALVESTON INNER BAR CHANNEL
GALVESTON BAR
TEXAS
BY MSCCR86 DATE 07/2016
TIME 8:58:31 AM


HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
GALVESTON HARBOR CHANNEL EXTENSION
CHANNEL-TO-HARBOR EXTENSION
PROPOSED GHC EXTENSION
-40' MLLW NED PLAN
Drawing No.
C-02
U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
OPERATIONS DIVISION
CHANNELS AND HARBORS BRANCH
PLAN
SCALE IN FEET
NOTE:
REFER TO DWG C-04 FOR
CHANNEL ALIGNMENT.
LIMITS OF EXISTING
-49' (MLLW) CHANNEL
537.5'
537.5'
CHANNEL
1075'
HARBOR
HARBORLINE MOORING BOUYS
20+000
22+000
22+571
GALVESTON
KGBC
RADIO
VAL-CAP
SERVICES
TEXAS
PORTLAND
CEMENT
VAL-CAP
G.O.T., INC.
TODD
SHIPYARD INC.
WESTERN
GEOPHYSICAL
TEXAS A&M
UNIVERSITY
GALVESTON WHARVES
PIER A
DUVAL
CORP.
PERMIT NO. 14114(05)609
DTD. 4 MAR 2004
CITY OF GALV
1-24" WATER MAIN
TOP PIPE EL. -13.0' MLLW
PELICAN ISLAND
DEVELOPMENT CORP.
PERMIT NO. 3427
2 - 12" PIPELINES
EL. +/- -51.0' MLLW
INACTIVE
NON-FED DREDGING AREA
PELICAN ISLAND BRIDGE
BASCULE BRIDGE
HOR. CL. = 125FT.
VER. CL. = 12FT.
CAUTION:
OPEN BASCULE
OVERHANGS CHANNEL
LIMITS OF EXISTING
-41' (MLLW) CHANNEL AND
PROPOSED EXTENSION:
-49' MLLW (NED)


HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
GALVESTON HARBOR CHANNEL EXTENSION
ENTRANCE AND APPROACH
PROPOSED CHANNEL
TYPICAL CROSS SECTION
Drawing No.:
C-03
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF
RICHARD P. PANNEL, DA, C.E.
DISTRICT COMMANDER
1,086 FT EXISTING CHANNEL BOTTOM WIDTH
EXISTING CHANNEL
PROPOSED CHANNEL
1,075 FT PROPOSED CHANNEL BOTTOM WIDTH
41 FT EXISTING CHANNEL DEPTH
3 FT ADVANCE MAINTENANCE EXISTING
2 FT ALLOWABLE OVERDEPTH EXISTING
46 FT PROPOSED CHANNEL DEPTH
3 FT ADVANCE MAINTENANCE PROPOSED
2 FT ALLOWABLE OVERDEPTH PROPOSED
DETAIL "A"
CHANNEL TEMPLATE
N.T.S.
ELEVATION IN FEET (MLLW)
PROPOSED CHANNEL
STA. 20+000 TO STA. 22+571
℄ CHANNEL
EXISTING CHANNEL
537.5 FT.
537.5 FT.
SEE DETAIL "A"
TYPICAL CHANNEL CROSS SECTION
N.T.S.
NOTES:
1. CHANNEL TEMPLATES INCLUDE 3 FT ADVANCE MAINTENANCE.
2. DISTANCES ARE IN FEET.
3. VERTICAL DATUM IS MEAN LOWER LOW WATER (MLLW).

GALVESTON HARBOR CHANNEL- 46' PROJECT

	CENTERLINE ALIGNMENT									LEFT TOE			RIGHT TOE		
POINT TYPE	STATION	NORTHING (Y)	EASTING (X)	DISTANCE (FEET)	DEGREE OF CURVE	DELTA	RADIUS (FEET)	TANGENT (FEET)	LENGTH (FEET)	NORTHING (Y)	EASTING (X)	DISTANCE (FEET)	NORTHING (Y)	EASTING (X)	DISTANCE (FEET)
POB	0+000.00	13,696,609.10	3,315,647.34												
	0+500.00	13,696,153.27	3,315,441.87							13,695,858.20	3,316,096.47	718.03	13,696,320.93	3,315,069.91	408.00
	1+140.34	13,695,569.51	3,313,178.73							13,695,121.47	3,316,172.68	1,290.25	13,695,737.16	3,314,836.17	408.00
	1+400.00	13,695,332.78	3,315,072.02							13,695,034.70	3,315,733.31	725.36	13,695,500.44	3,314,700.07	408.00
CURVE 1				2,869.56											
PC	2+869.56	13,693,983.03	3,314,468.12							13,693,825.36	3,314,840.08	408.08	13,694,160.69	3,314,096.16	408.00
									52.53						
PI	2+922.09	13,693,945.14	3,314,446.53		5°43'46"	6°00'50"	1,000.00	104.96							
									52.53						
PT	2+974.53	13,693,895.25	3,314,430.08							13,693,767.48	3,314,817.56	408.00	13,694,023.02	3,314,042.61	408.00
CURVE 2				4,790.57											
PC	7+725.10	13,689,383.64	3,312,942.38							13,689,281.86	3,313,251.03	325.00	13,689,485.41	3,312,633.72	325.00
									154.43						
PI	7+879.53	13,686,238.98	3,312,884.01		5°43'46"	11°35'28"	1,000.00	306.43							
									154.43						
PT	8+031.53	13,689,111.74	3,312,803.67							13,688,893.13	3,313,105.87	372.64	13,689,301.89	3,312,540.09	325.00
	9+435.15	13,687,973.42	3,311,982.47							13,687,530.72	3,312,596.12	706.67	13,688,163.56	3,311,718.89	325.00
	9+751.98	13,687,716.46	3,311,797.10							13,687,310.34	3,312,368.06	694.16	13,687,908.61	3,311,533.53	325.00
CURVE 3				2,354.94											
PC	10+386.47	13,687,201.91	3,311,425.69							13,686,831.98	3,311,833.12	529.45	13,687,392.05	3,311,152.31	325.00
	11+000.00	13,686,720.72	3,311,045.61							13,686,339.74	3,311,486.49	582.66	13,686,933.19	3,310,739.69	325.00
	12+000.00	13,686,013.23	3,310,340.07							13,685,767.89	3,310,553.22	325.00	13,686,258.56	3,310,126.91	325.00
									3,208.89						
PI	13+358.27	13,684,989.53	3,308,548.50		0°49'07"	49°15'13"	7,000.00	6,017.59							
									3,208.89						
	13+900.00	13,684,583.18	3,307,728.53							13,684,271.45	3,307,820.85	325.00	13,684,894.91	3,307,637.00	325.00
	15+300.00	13,684,504.52	3,307,439.45							13,683,980.93	3,307,549.25	537.50	13,685,026.11	3,307,329.64	537.50
PT	16+404.06	13,684,323.31	3,308,351.52							13,683,787.80	3,308,397.78	537.50	13,684,858.81	3,306,305.25	537.50
CURVE 4				743.01											
PC	17+147.07	13,684,259.35	3,308,611.27							13,683,723.84	3,308,657.53	537.50	13,684,794.85	3,306,265.00	537.50
									809.63						
PI	17+956.70	13,684,189.66	3,309,604.64		0°24'33"	6°37'10"	14,000.00	1,617.46							
									809.63						
PT	18+764.53	13,684,213.41	3,303,995.36							13,683,676.14	3,303,976.58	537.50	13,684,750.68	3,304,011.13	537.50
				1,235.46											
POE	20+000.00	13,684,249.66	3,302,760.42							13,683,712.39	3,302,744.65	537.50	13,684,786.93	3,302,776.19	537.50

PROPOSED GALVESTON HARBOR CHANNEL EXTENSION- 45' PROJECT

POB	20+000.00	13,684,249.66	3,302,760.42							13,683,712.39	3,302,744.65	537.50	13,684,786.93	3,302,776.19	537.50
				1,548.16											
	21+548.77	13,684,295.11	3,301,212.51							13,683,759.24	3,301,148.62	537.50	13,684,830.97	3,301,276.00	537.50
				1,022.59											
POE	22+571.36	13,684,528.63	3,300,211.61							13,683,979.02	3,300,103.45	537.50	13,685,031.01	3,300,324.65	537.50

NOTES:

1. HORIZONTAL DATUM: NAD 83, TEXAS STATE PLANE SOUTH CENTRAL ZONE
2. VERTICAL DATUM: MEAN LOWER LOW WATER (MLLW) FOR NAVIGATION CHANNEL
   NAVD 88 FOR LAND BASED CONSTRUCTION

U.S. Army Corps of Engineers
Galveston District

Rev. By Description Date

BY:KERSTENS DATE:9/2016

U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF:
ROBERT L. PRADA, P.E.
DISTRICT COMMANDER

Design by: ACT
Drawn by: ACT
Checked by:
Certified by:
Lead Geotechnical Engineer:
Lead Civil Engineer:

Date
Geotechnical Branch
Approved Geotechnical Engineering Section
Chief, Engineering Division

HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
(BRAZORIA AND GALVESTON COUNTIES)

GALVESTON HARBOR CHANNEL EXTENSION
GALVESTON HARBOR CHANNEL
ALIGNMENT

Drawing No.:
C-04

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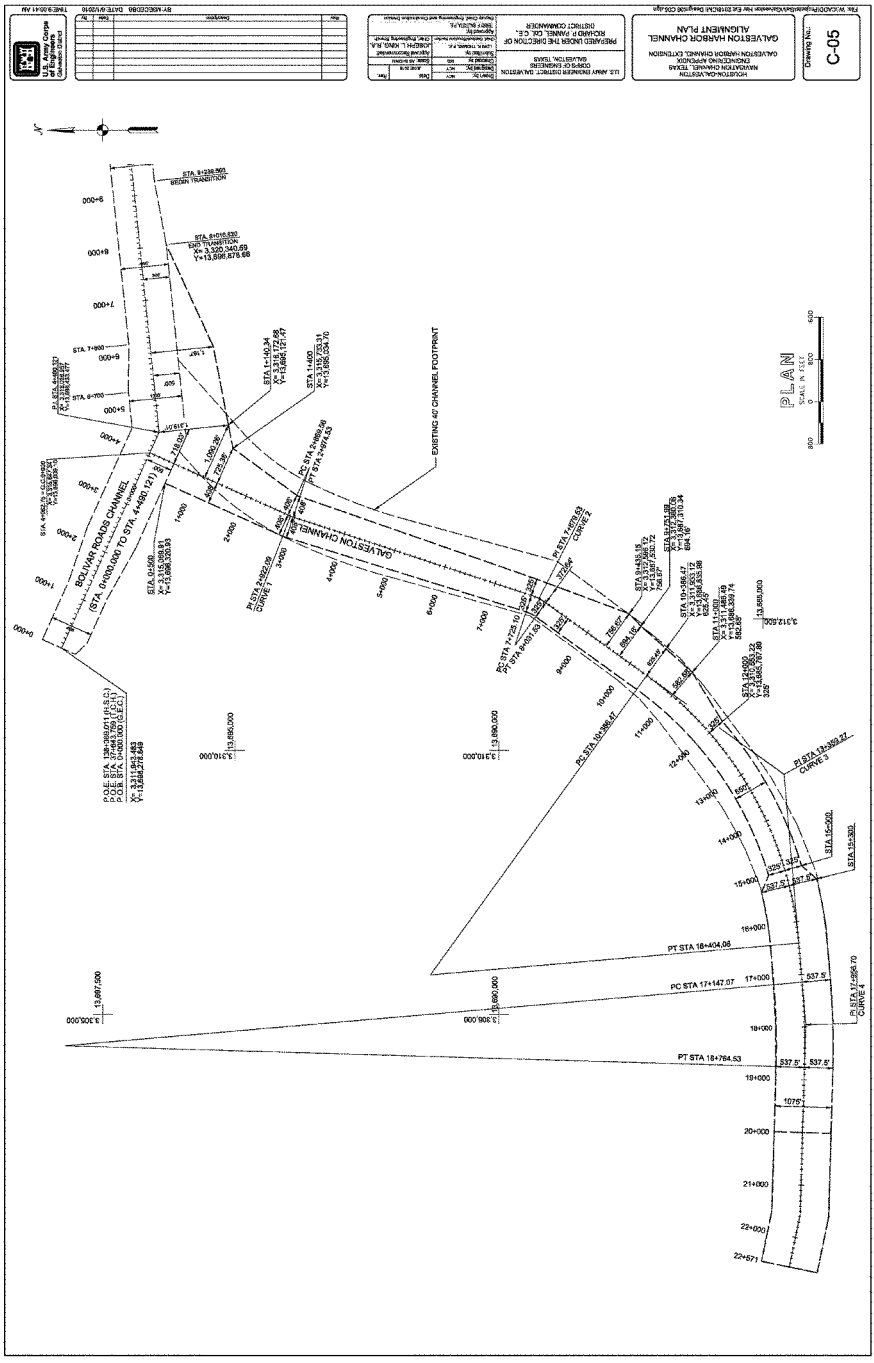
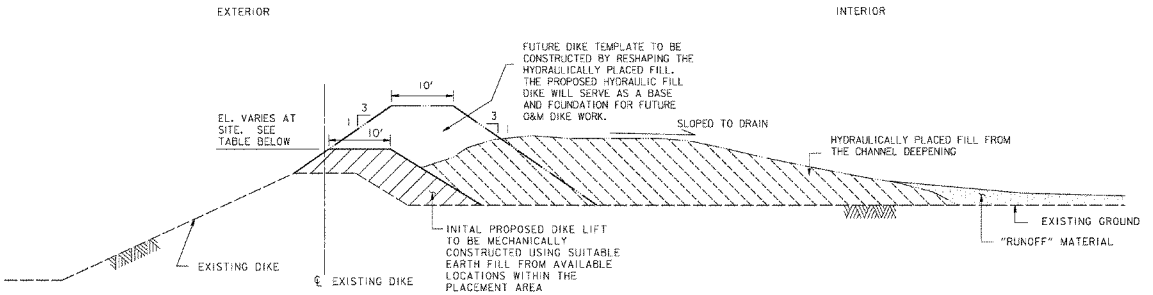

GALVESTON HARBOR CHANNEL
ALIGNMENT PLAN
Drawing No.
C-05
PLAN
EXISTING 40' CHANNEL FOOTPRINT
GALVESTON CHANNEL
BOLIVAR ROADS CHANNEL
(STA. 0+000.000 TO STA. 44+80.121)
PC STA 7+255.10
PT STA 8+031.66
PC STA 10+366.47
PT STA 18+404.06
PC STA 17+147.07
PT STA 18+764.53
CURVE 1
CURVE 2
CURVE 3
CURVE 4
STA 15+300
STA 15+000
537.5'
1076'
3,310,000
13,890,000
3,312,600
13,895,000
3,306,000
13,897,500



TYPICAL SECTION
INITIAL LIFT & FUTURE HYDRAULIC FILL DIKE
AT PELICAN ISLAND PLACEMENT AREA

N.T.S.

NOTES:

1. THE PROPOSED ELEVATIONS FOR DIKE LIFTS, AS SHOWN IN THE TABLE, ARE BASED ON ESTIMATED INITIAL CAPACITY REQUIREMENTS FOR BOTH NEW WORK DREDGE MATERIALS FROM THE CHANNEL DEEPENING AND ANTICIPATED MAINTENANCE MATERIALS THAT MAY BE ENCOUNTERED ABOVE THE NEW WORK MATERIALS. THE EXISTING INTERIOR AND DIKE ELEVATIONS, USED TO DETERMINE THE APPROPRIATE INITIAL DIKE LIFT ELEVATIONS FOR SUFFICIENT INITIAL CAPACITY, ARE GENERALLY BASED ON SURVEY ELEVATIONS SHOWN ON PREVIOUS PLANS OR ESTIMATED. DURING THE PRODUCTION OF PLANS AND SPECIFICATIONS ASSOCIATED WITH THE GALVESTON CHANNEL EXTENSION, THE DIKE LIFT ELEVATIONS AND REACHES PROPOSED ON THIS DRAWING MAY BE SUBJECT TO CHANGE, TO REFLECT FACTORS WHICH INCLUDE BUT MAY NOT BE LIMITED TO:
   1) MORE RECENT SURVEY DATA MADE AVAILABLE,
   2) CHANGES TO THE INTERIOR ELEVATIONS DUE TO ADDTIONAL DREDGE MAINTENANCE MATERIALS PLACED AT THE SITES PRIOR TO THE ISSUANCE OF PLAN AND SPECIFICATIONS FOR THIS PROJECT,
   3) CHANGES TO THE AMOUNT OF INITIAL ANTICIPATED MAINTENANCE MATERIAL TO BE DREDGED ALONG WITH NEW WORK MATERIALS FROM THE CHANNEL EXTENSION, DUE TO ADDITIONAL MAINTENANCE DREDGING PERFORMED PRIOR TO THE ISSUANCE OF PLANS AND SPECIFICATIONS FOR THIS PROJECT, OR
   4) CHANGES TO THE AMOUNT OF INITIAL ANTICIPATED MAINTENANCE MATERIAL AS A RESULT OF ADDITIONAL SEDIMENTATION ACCUMULATION PRIOR TO THE ISSUANCE OF PLANS AND SPECIFICATIONS.
2. THE INITIAL DIKE LIFTS TO BE CONSTRUCTED PRIOR TO PLACEMENT OF HYDRUALIC FILL MATERIALS FROM THE CHANNEL, WILL BE CONSTRUCTED ALONG THE EXTERIOR DIKES AT THE PLACEMENT AREA.
3. THE NEW WORK MATERIALS FROM THE CHANNEL WILL ONLY BE PLACED AND SHAPED ALONG THE INTERIOR OF THE EXTERIOR PERIMETER DIKES.

INITIAL DIKE LIFT ELEVATIONS (NAVD 88)				
PLACEMENT AREA	CELL	LEVEE REACH	ESTIMATED APPROX. EXISTING DIKE ELEVATION	PROPOSED INITIAL DIKE LIFT ELEVATION
PELICAN ISLAND	B	ENTIRE PERIMETER DIKE	28'	30'

U.S. Army Corps of Engineers Galveston District

Dwg. No.

BY MSD22168 DATE 9/1/2016

U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS P.O. BOX 1229 GALVESTON, TEXAS 77553-1229

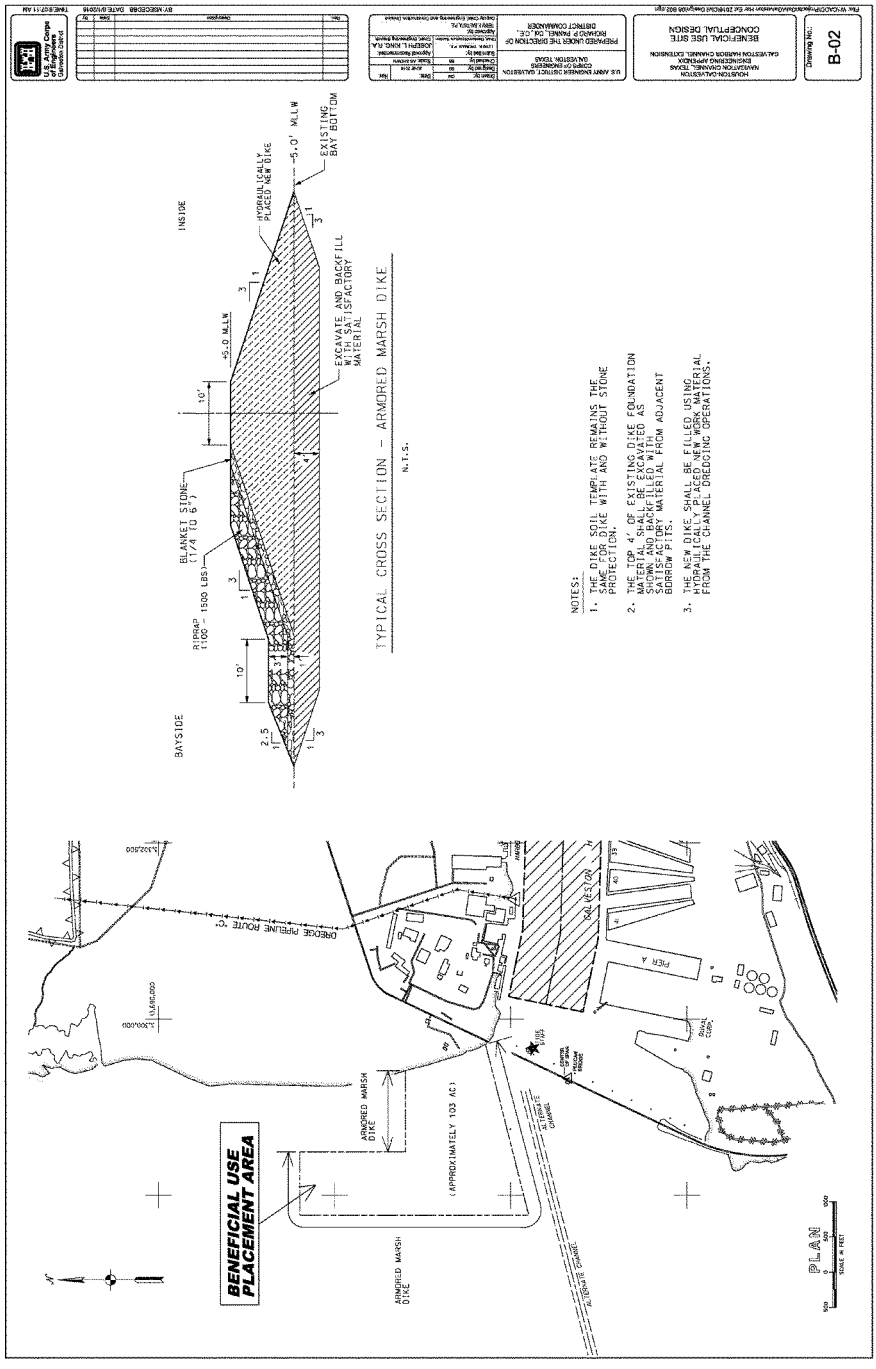
PREPARED UNDER THE DIRECTION OF: ROBERT J. PRADO, JR., P.E. DISTRICT COMMANDER

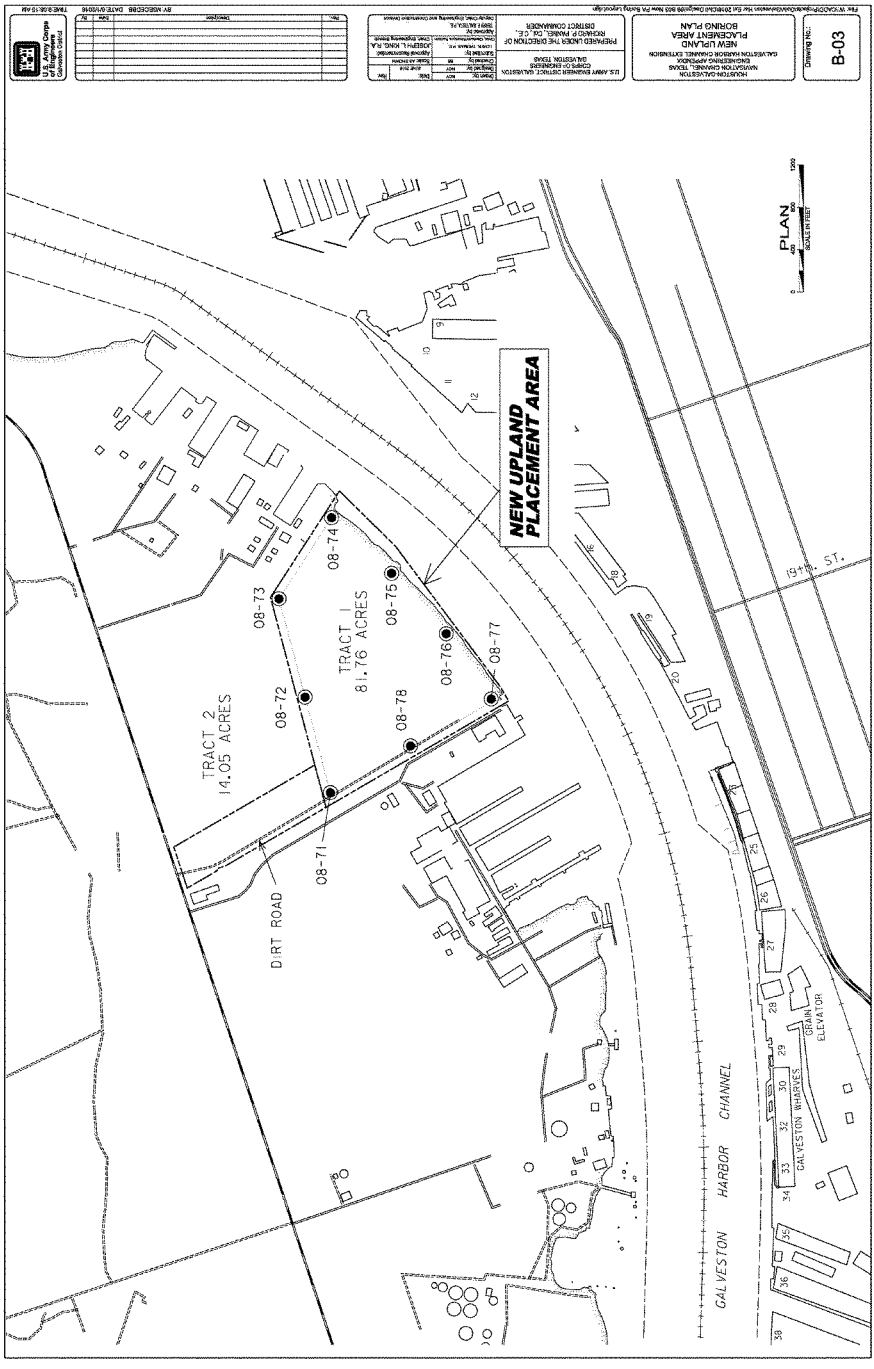
HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS GALVESTON HARBOR AND CHANNEL PROJECT NO. 2404 GALVESTON HARBOR CHANNEL EXTENSION

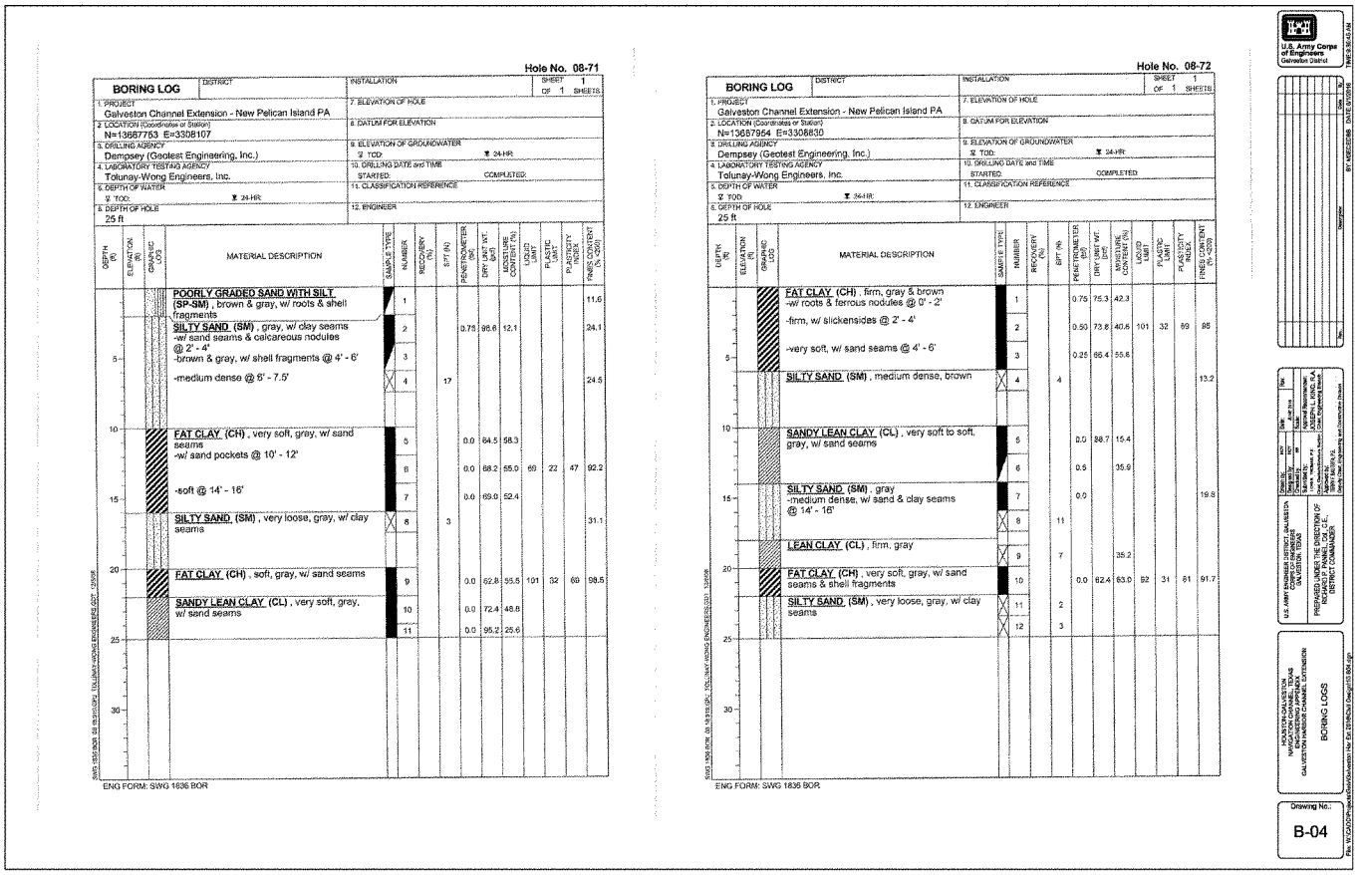
TYPICAL SECTION - INITIAL & PROPOSED DIKE ENLARGEMENT AT PELICAN ISLAND

Drawing No.: B-01

File: W:\CAD\Projects\Galv\Extension Har Ext 69\Mod\Cadgal69P REV TYP DIKE.DGN


HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
GALVESTON HARBOR CHANNEL EXTENSION
BENEFICIAL USE SITE
CONCEPTUAL DESIGN
B-02
PREPARED UNDER THE DIRECTION OF
ROCKWOOD P.PANNEL, LT. COL., C.E.
DISTRICT COMMANDER
TYPICAL CROSS SECTION - ARMORED MARSH DIKE
N.T.S.
NOTES:
1. THE DIKE SOIL TEMPLATE REMAINS THE SAME FOR DIKE WITH AND WITHOUT STONE PROTECTION.
2. THE TOP 4' OF EXISTING DIKE FOUNDATION MATERIAL SHALL BE EXCAVATED AS SATISFACTORY MATERIAL FROM ADJACENT BORROW PITS.
3. THE NEW DIKE SHALL BE FILLED USING HYDRAULICALLY PLACED NEW WORK MATERIAL FROM THE CHANNEL DREDGING OPERATIONS.
EXISTING BAY BOTTOM
-5.0' MLLW
HYDRAULICALLY PLACED NEW DIKE
EXCAVATE AND BACKFILL WITH SATISFACTORY MATERIAL
+5.0 MLW
BLANKET STONE (1/4 TO 6')
RIPRAP (100 - 1500 LBS)
INSIDE
BAYSIDE
BENEFICIAL USE PLACEMENT AREA
ARMORED MARSH DIKE
(APPROXIMATELY 103 AC)
GEOCHE PIPELINE ROUTE 'C'
PIER A
PLAN


NEW UPLAND PLACEMENT AREA
TRACT 2
14.05 ACRES
TRACT 1
81.76 ACRES
08-71
08-72
08-73
08-74
08-75
08-76
08-77
08-78
DIRT ROAD
GALVESTON HARBOR CHANNEL
GALVESTON WHARVES
GRAIN ELEVATOR
19TH ST.
PLAN
HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
GALVESTON HARBOR CHANNEL EXTENSION
GALVESTON JETTIES
NEW UPLAND PLACEMENT AREA
BORING PLAN
B-03
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON TEXAS
PREPARED UNDER THE DIRECTION OF
RICHARD P. MARIEL, COL, C.E.
DISTRICT COMMANDER
U.S. Army Corps of Engineers
Galveston District



Hole No. 08-71

BORING LOG — DISTRICT — INSTALLATION — SHEET 1 OF 1 SHEETS

1. PROJECT: Galveston Channel Extension - New Pelican Island PA
2. LOCATION (Coordinates or Station): N=13687753 E=3308107
3. DRILLING AGENCY: Dempsey (Geotest Engineering, Inc.)
4. LABORATORY TESTING AGENCY: Tolunay-Wong Engineers, Inc.
5. DEPTH OF WATER: ▽ TOD: ▼ 24-HR:
6. DEPTH OF HOLE: 25 ft
7. ELEVATION OF HOLE
8. DATUM FOR ELEVATION
9. ELEVATION OF GROUNDWATER: ▽ TOD: ▼ 24-HR:
10. DRILLING DATE and TIME: STARTED: COMPLETED:
11. CLASSIFICATION REFERENCE
12. ENGINEER

DEPTH (FT)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	NUMBER	RECOVERY (%)	SPT (N)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (% <#200)
			POORLY GRADED SAND WITH SILT (SP-SM), brown & gray, w/ roots & shell fragments		1									11.6
			SILTY SAND (SM), gray, w/ clay seams -w/ sand seams & calcareous nodules @ 2' - 4' -brown & gray, w/ shell fragments @ 4' - 6'		2			0.75	95.8	12.1				24.1
5					3									
			-medium dense @ 6' - 7.5'		4		17							24.5
10			**FAT CLAY (CH)**, very soft, gray, w/ sand seams -w/ sand pockets @ 10' - 12'		5			0.0	84.5	58.3				
					6			0.0	88.2	55.0	69	22	47	92.2
15			-soft @ 14' - 16'		7			0.0	69.0	62.4				
			SILTY SAND (SM), very loose, gray, w/ clay seams		8		3							31.1
20			**FAT CLAY (CH)**, soft, gray, w/ sand seams		9			0.0	62.8	55.5	101	32	69	98.5
			SANDY LEAN CLAY (CL), very soft, gray, w/ sand seams		10			0.0	72.4	48.8				
					11			0.0	95.2	25.6				
25														
30														

ENG FORM: SWG 1836 BOR

Hole No. 08-72

BORING LOG — DISTRICT — INSTALLATION — SHEET 1 OF 1 SHEETS

1. PROJECT: Galveston Channel Extension - New Pelican Island PA
2. LOCATION (Coordinates or Station): N=13687954 E=3308830
3. DRILLING AGENCY: Dempsey (Geotest Engineering, Inc.)
4. LABORATORY TESTING AGENCY: Tolunay-Wong Engineers, Inc.
5. DEPTH OF WATER: ▽ TOD: ▼ 24-HR:
6. DEPTH OF HOLE: 25 ft
7. ELEVATION OF HOLE
8. DATUM FOR ELEVATION
9. ELEVATION OF GROUNDWATER: ▽ TOD: ▼ 24-HR:
10. DRILLING DATE and TIME: STARTED: COMPLETED
11. CLASSIFICATION REFERENCE
12. ENGINEER

DEPTH (FT)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	NUMBER	RECOVERY (%)	SPT (N)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (% <#200)
			FAT CLAY (CH), firm, gray & brown -w/ roots & ferrous nodules @ 0' - 2'		1			0.75	75.3	42.3				
			-firm, w/ slickensides @ 2' - 4'		2			0.50	73.8	40.6	101	32	69	95
5			-very soft, w/ sand seams @ 4' - 6'		3			0.25	66.4	55.6				
			SILTY SAND (SM), medium dense, brown		4		4							13.2
10			**SANDY LEAN CLAY (CL)**, very soft to soft, gray, w/ sand seams		5			0.0	88.7	15.4				
					6			0.5		35.9				
15			**SILTY SAND (SM)**, gray -medium dense, w/ sand & clay seams @ 14' - 16'		7			0.0						19.8
					8		11							
			LEAN CLAY (CL), firm, gray		9		7			35.2				
20			**FAT CLAY (CH)**, very soft, gray, w/ sand seams & shell fragments		10			0.0	62.4	63.0	92	31	61	91.7
			SILTY SAND (SM), very loose, gray, w/ clay seams		11		2							
					12		3							
25														
30														

ENG FORM: SWG 1836 BOR

U.S. Army Corps of Engineers, Galveston District

No.	Date	By	Description
			Designed
			Drawn
			Checked

U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS GALVESTON, TEXAS

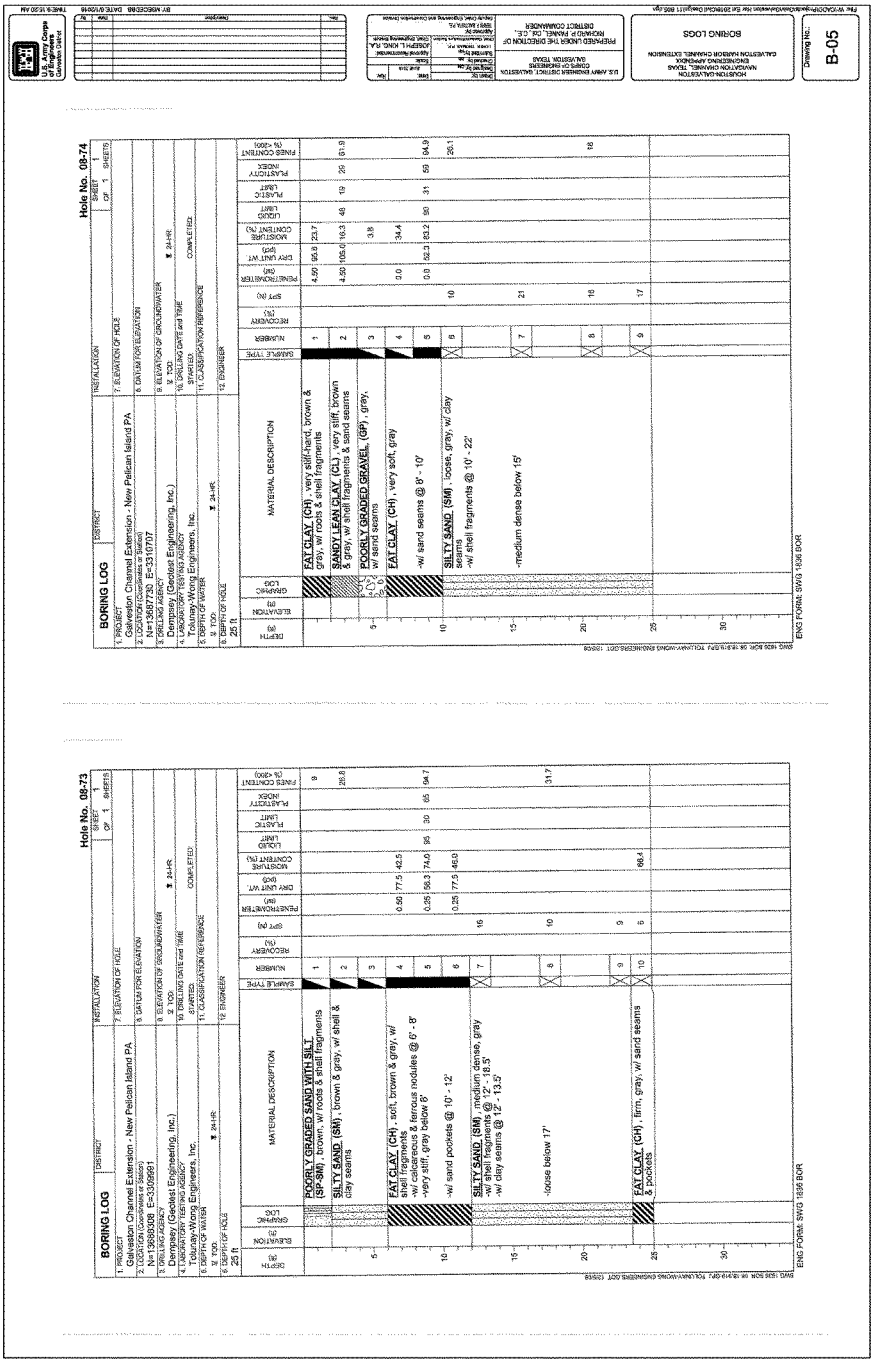
PREPARED UNDER THE DIRECTION OF: COLONEL CHRISTOPHER A. KLOTZ DISTRICT COMMANDER

HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS HARRIS AND GALVESTON COUNTIES GALVESTON HARBOR CHANNEL EXTENSION

BORING LOGS

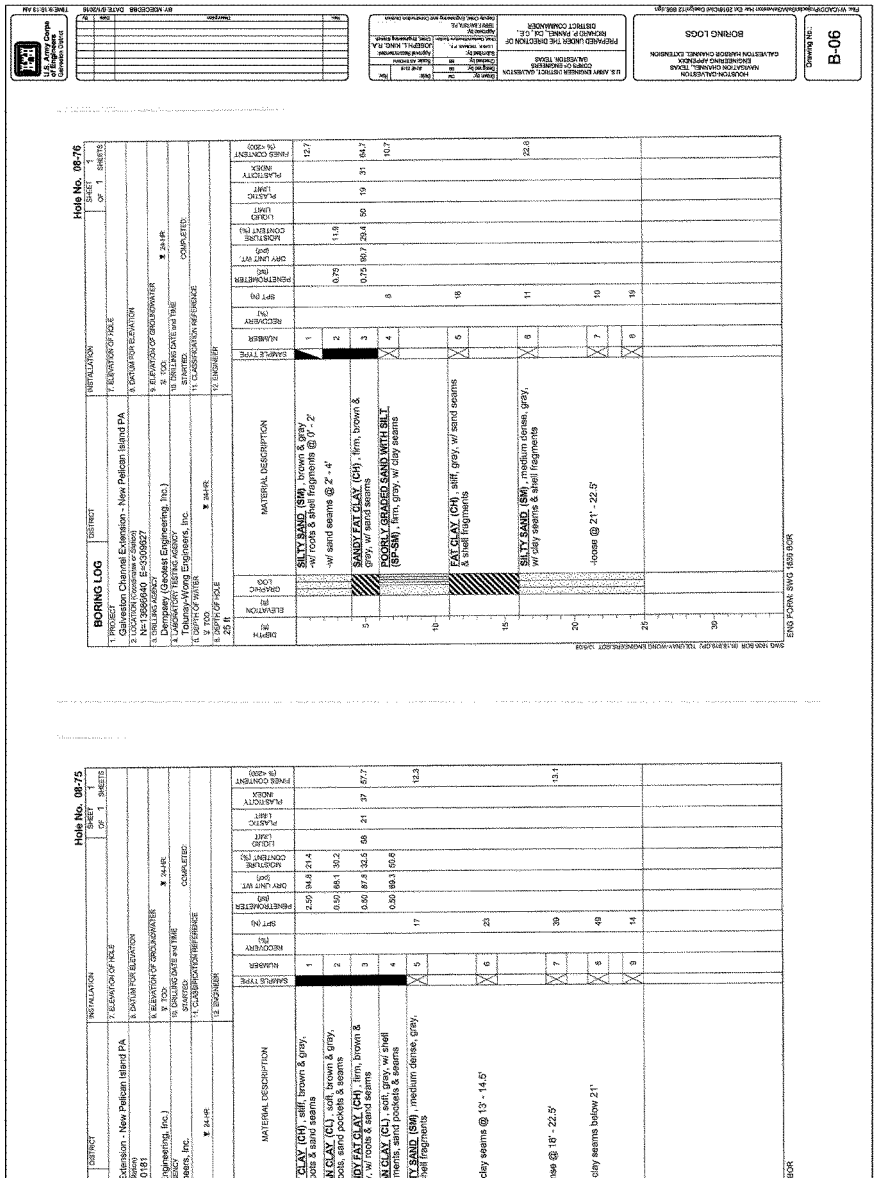
Drawing No.: B-04

135


Hole No. 08-73
BORING LOG
DISTRICT
INSTALLATION
SHEET 1 OF 1 SHEETS
1. PROJECT
Galveston Channel Extension - New Pelican Island PA
2. LOCATION (Coordinates or Station)
NAD1983/2008, E-C-3308661
3. DRILLING AGENCY
Dempsey (Geotest Engineering, Inc.)
4. LABORATORY TESTING AGENCY
Rabalais Watts Engineers, Inc.
5. DEPTH OF HOLE
25.8
6. DATUM FOR ELEVATION
7. ELEVATION OF HOLE
8. ELEVATION OF GROUNDWATER
▼ 24-HR.
9. TOD
▼ 24-HR.
10. DRILLING DATE and TIME
COMPLETED
11. CLASSIFICATION REFERENCE
12. ENGINEER
MATERIAL DESCRIPTION
POORLY GRADED SAND WITH SILT (SP-SM) , brown, w/ roots & shell fragments
SILTY SAND (SM) , brown & gray, w/ shell & clay seams
FAT CLAY (CH) , soft, brown & gray, w/ shell fragments -w/ sand seams & ferrous nodules @ 6' - 8' -very stiff, gray below 8'
-w/ sand pockets @ 10' - 12'
SILTY SAND (SM) , medium dense, gray -w/ shell fragments @ 12' - 16.5' -w/ clay seams @ 12' - 13.5'
-loose below 17'
FAT CLAY (CH) , firm, gray, w/ sand seams & pockets
DEPTH (ft)
ELEVATION (ft)
GRAPHIC LOG
SAMPLE TYPE
NUMBER
RECOVERY (%)
SPT (N)
PENETRATION (tsf)
DRY UNIT WT (pcf)
MOISTURE CONTENT (%)
LIQUID LIMIT
PLASTIC LIMIT
PLASTICITY INDEX
PASS #200 (% <.0029)
0.50
0.25
0.25
77.5
58.3
77.5
42.5
74.0
49.0
16
10
9
6
9
10
8
7
65
30
95
88.4
94.7
31.7
20.8
9
SWG 1836.SGM 08-73.GPJ TOLLWAY-MDMS ENGINEERING.GDT 7/26/16
ENG FORM. SWG 1836 BOR

Hole No. 08-74
BORING LOG
DISTRICT
INSTALLATION
SHEET 1 OF 1 SHEETS
1. PROJECT
Galveston Channel Extension - New Pelican Island PA
2. LOCATION (Coordinates or Station)
NAD1983/2008, E-C-3310707
3. DRILLING AGENCY
Dempsey (Geotest Engineering, Inc.)
4. LABORATORY TESTING AGENCY
Rabalais Watts Engineers, Inc.
5. DEPTH OF HOLE
25.8
6. DATUM FOR ELEVATION
7. ELEVATION OF HOLE
8. ELEVATION OF GROUNDWATER
▼ 24-HR.
9. TOD
▼ 24-HR.
10. DRILLING DATE and TIME
COMPLETED
11. CLASSIFICATION REFERENCE
12. ENGINEER
MATERIAL DESCRIPTION
FAT CLAY (CH) , very stiff-hard, brown & gray, w/ roots & shell fragments
SANDY LEAN CLAY (CL) , very stiff, brown & gray, w/ shell fragments & sand seams
POORLY GRADED GRAVEL (GP) , gray, w/ sand seams
FAT CLAY (CH) , very soft, gray
-w/ sand seams @ 8' - 10'
SILTY SAND (SM) , loose, gray, w/ clay seams -w/ shell fragments @ 10' - 22'
-medium dense below 15'
DEPTH (ft)
ELEVATION (ft)
GRAPHIC LOG
SAMPLE TYPE
NUMBER
RECOVERY (%)
SPT (N)
PENETRATION (tsf)
DRY UNIT WT (pcf)
MOISTURE CONTENT (%)
LIQUID LIMIT
PLASTIC LIMIT
PLASTICITY INDEX
PASS #200 (% <.0029)
4.50
4.50
3.0
0.0
10
21
18
17
105.0
95.9
16.3
23.7
3.8
34.4
52.3
53.2
49
19
95
31
25
55
61.9
94.9
26.1
SWG 1836.SGM 08-74.GPJ TOLLWAY-MDMS ENGINEERING.GDT 7/26/16
ENG FORM. SWG 1836 BOR

U.S. Army Corps of Engineers Galveston District
BY: NEBOSEBA DATE: 9/1/2016 TIME: 9:30:00 AM
HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS CALVESTON HARBOR CHANNEL EXTENSION ENCINO/SEABOARD ANNEX
BORING LOGS
U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS GALVESTON TEXAS
PREPARED UNDER THE DIRECTION OF: NOHAMD P. HANEL, COL, C.E. DISTRICT COMMANDER
Drawing No.
B-05
File: W:\CAD\Projects\Navigation\Galveston Ship Channel\Galveston Ship Channel Extension\Sheets\Boring Logs\B-05.dgn


Hole No. 08-75
BORING LOG
Hole No. 08-76
BORING LOGS
B-06
U.S. Army Corps of Engineers
Galveston District

Hole No. 08-77

BORING LOG | DISTRICT | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Galveston Channel Extension - New Pelican Island PA
2. LOCATION (Coordinates or Station): N=13686202 E=3308998
3. DRILLING AGENCY: Dempsey (Geotest Engineering, Inc.)
4. LABORATORY TESTING AGENCY: Tolunay-Wong Engineers, Inc.
5. DEPTH OF WATER: ▼ 24-HR
6. DEPTH OF HOLE: 25 ft
7. ELEVATION OF HOLE
8. DATUM FOR ELEVATION
9. ELEVATION OF GROUNDWATER: ▽ TOD ▼ 24-HR
10. DRILLING DATE and TIME: STARTED COMPLETED
11. CLASSIFICATION REFERENCE
12. ENGINEER

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	NUMBER	RECOVERY (%)	SPT (N)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (% <200)
			LEAN CLAY WITH SAND (CL), very stiff-hard, gray & brown, w/ roots, shell fragments & sand seams		1			4.50	104.0	13.0				
			SILTY SAND (SM), gray -w/ plastic @ 2' - 3' -w/ clay balls @ 2' - 4' -w/ plastic @ 4' - 5' -w/ slickensides, sand seams & roots @ 4' - 6'		2									31.3
5					3			0.25						19.7
			FAT CLAY (CH), very soft, gray, w/ sand seams & shell fragments		4			0.25	76.3	48.1				
			SILTY SAND (SM), dense, gray		5		35							
10														
			POORLY GRADED SAND WITH SILT (SP-SM), dense, gray, w/ shell fragments		6		32							7
15														
			SILTY SAND (SM), dense, gray, w/ shell fragments		7		49							
20														
			CLAYEY SAND (SC), gray, w/ sand seams		8			0.25	81.5	38.5	39	20	19	47.7
			LEAN CLAY WITH SAND (CL), very soft, gray, w/ shell fragments & sand seams		9			0.0		32.9				
25														
30														

SWG_1936 BOR_08-77.GPJ_TOLUNAY-WONG ENGINEERS.GDT_1/29/08

ENG FORM: SWG 1836 BOR

Hole No. 08-78

BORING LOG | DISTRICT | INSTALLATION | SHEET 1 OF 1 SHEETS

1. PROJECT: Galveston Channel Extension - New Pelican Island PA
2. LOCATION (Coordinates or Station): N=13686997 E=3308843
3. DRILLING AGENCY: Dempsey (Geotest Engineering, Inc.)
4. LABORATORY TESTING AGENCY: Tolunay-Wong Engineers, Inc.
5. DEPTH OF WATER: ▼ 24-HR
6. DEPTH OF HOLE: 25 ft
7. ELEVATION OF HOLE
8. DATUM FOR ELEVATION
9. ELEVATION OF GROUNDWATER: ▽ TOD ▼ 24-HR
10. DRILLING DATE and TIME: STARTED COMPLETED
11. CLASSIFICATION REFERENCE
12. ENGINEER

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	NUMBER	RECOVERY (%)	SPT (N)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (% <200)
			FAT CLAY (CH), firm, brown -w/ roots & shell fragments @ 0' - 2'		1			1.25	86.5	34.2				
			-soft @ 2' - 4' -brown & gray @ 2' - 6'		2			0.50	70.8	48.3	72	23	49	97.9
5			-w/ ferrous nodules @ 4' - 6'		3			0.75	83.6	61.0				
			-soft @ 6' - 10'		4			0.50	84.4	89.5	116	30	86	
			-brown & gray @ 8' - 14'		5			0.50	72.1	50.2				
10			-w/ shell fragments @ 10' - 12' -w/ sand seams below 10'		6			0.75	72.2	54.3				
			-w/ ferrous & calcareous nodules @ 12' - 14'		7			0.75	84.5	34.8				
			-very soft, w/ sand partings & pockets @ 14' - 16'		8			0.0		62.4				
15			**CLAYEY SAND (SC)**, dense, gray		9			0.0	89.7	33.8	44	20	24	47.4
			SILTY SAND (SM), dense, gray -w/ clay seams @ 18' - 19.5'		10		37							
20					11		40							12.7
			-w/ clay seams @ 23.5' - 25'		12		39							
25														
30														

SWG_1936 BOR_08-78.GPJ_TOLUNAY-WONG ENGINEERS.GDT_1/29/08

ENG FORM: SWG 1836 BOR

U.S. Army Corps of Engineers, Galveston District

No.	Description	Date	By

BY MERCEDES DATE 9/30/08

Plotted: 9/30/08 10:40 AM

U.S. ARMY ENGINEER DISTRICT, GALVESTON CORPS OF ENGINEERS P.O. BOX 1229 GALVESTON, TEXAS

PREPARED UNDER THE DIRECTION OF: ROBERT L. VAN ANTWERP, JR. DISTRICT COMMANDER

Chief, DC | Date: | Div
Chief, ED-G | Date: | Br
Chief, ED-D | Date: | Sec
Surveyed by: Approval Recommended:
Designed by: Chief, Engineering Branch
Drawn by: Approved for Construction:
Checked by: Chief, Engineering Division

HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS HOUSTON SHIP CHANNEL EXTENSION GALVESTON HARBOR CHANNEL EXTENSION

BORING LOGS

Drawing No.: B-07

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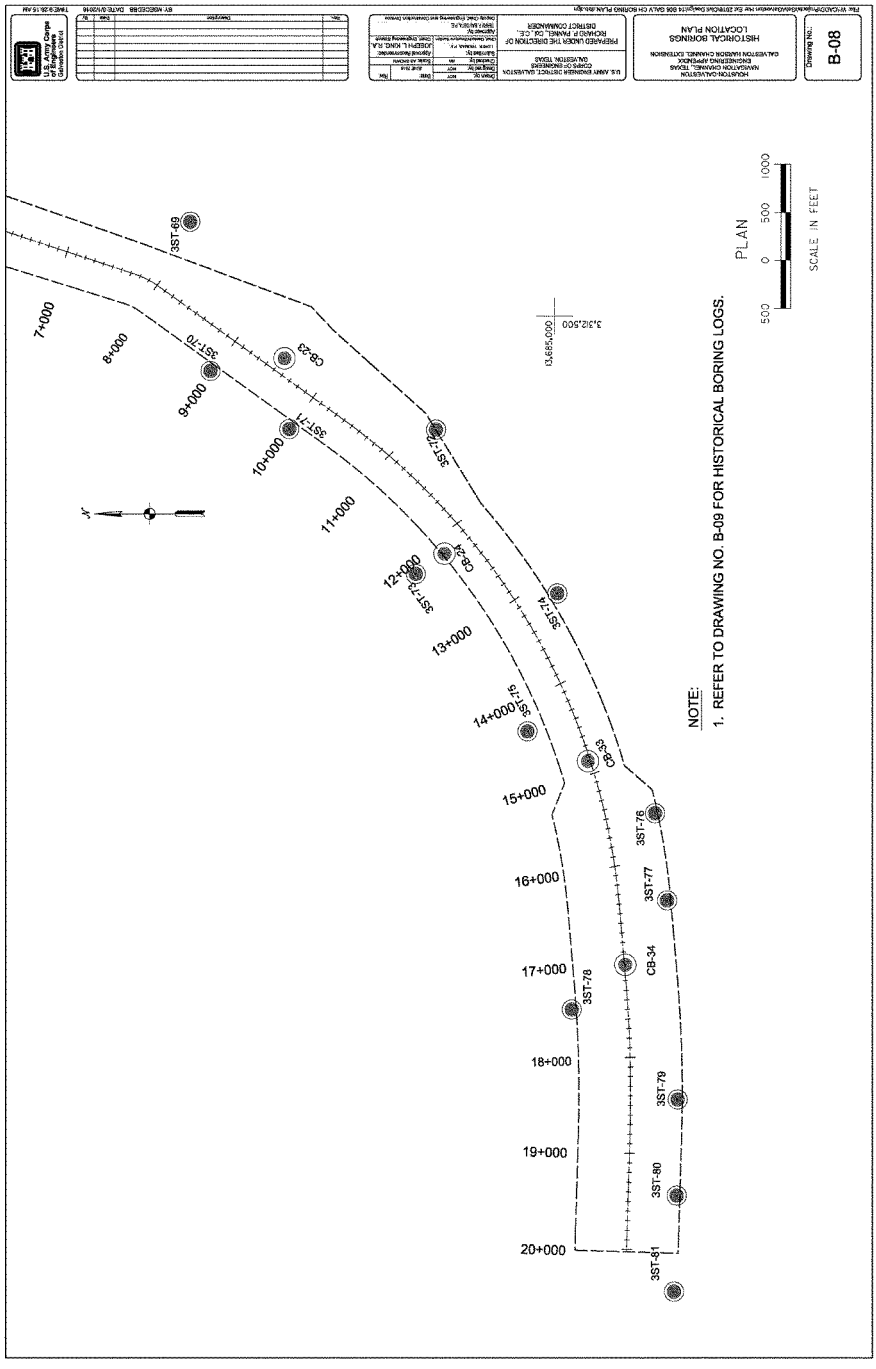
HISTORICAL BORINGS
LOCATION PLAN
B-08
PLAN
SCALE IN FEET
NOTE:
1. REFER TO DRAWING NO. B-09 FOR HISTORICAL BORING LOGS.
3ST-69
3ST-70
3ST-71
3ST-72
3ST-73
3ST-74
3ST-75
3ST-76
3ST-77
3ST-78
3ST-79
3ST-80
3ST-81
CB-23
CB-24
CB-33
CB-34
7+000
8+000
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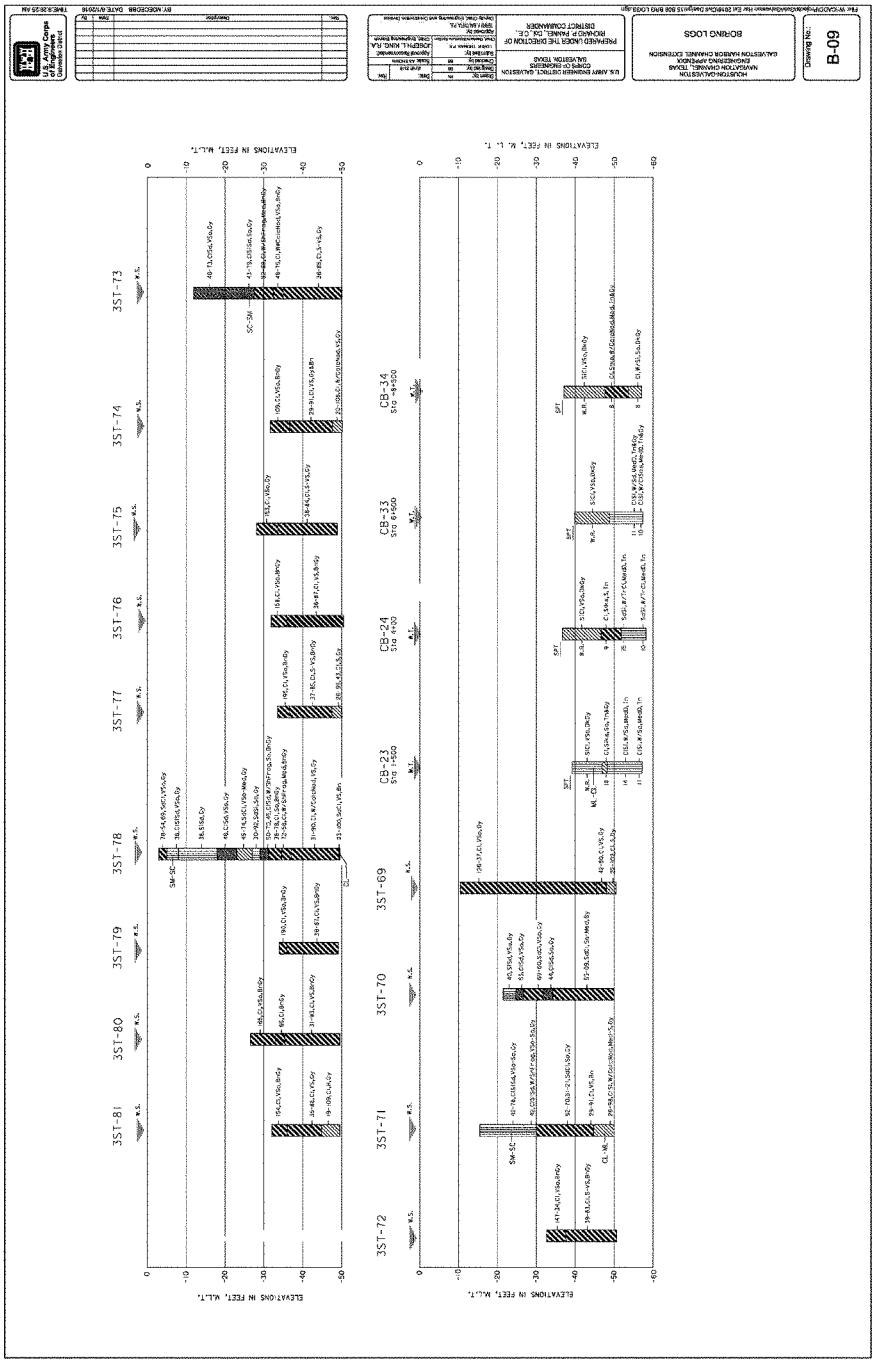

HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
GALVESTON HARBOR CHANNEL EXTENSION
GALVESTON DEEPENING AND WIDENING
BORING LOGS
Drawing No.
B-09
U.S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS
PREPARED UNDER THE DIRECTION OF
RICHARD P. PANNELL, COL, C.E.
DISTRICT COMMANDER
JOSEPHAL HOUSTON, P.E.A.
CHIEF, ENGINEERING DIVISION
U.S. Army Corps of Engineers
Galveston District
ELEVATIONS IN FEET, M.S.L.T.
3ST-72
3ST-71
3ST-81
3ST-80
3ST-79
3ST-78
3ST-70
3ST-69
3ST-77
3ST-76
3ST-75
3ST-74
3ST-73
CB-23
Sta 1+500
CB-24
Sta 4+00
CB-33
Sta 6+500
CB-34
Sta 8+500

Galveston Ch Ext V4.3 Feb 2017
Galveston Harbor Channel Extension Feasibility

Estimated by	J. Lockhart
Designed by	CESWG-EC
Prepared by	Jackie Lockhart
Preparation Date	2/7/2017
Effective Date of Pricing	2/7/2017
Estimated Construction Time	120 Days

This report is not copyrighted, but the information contained herein is For Official Use Only.

Description	Quantity	UOM	DirectCost	ContractCost	ProjectCost
Project Cost Summary Report			**8,489,399**	**8,804,360**	**8,804,360**
02 Contract 1 - 45' - NED, Ch to Peican Island Cell B	**1.00**	**LS**	**8,489,399**	**8,804,360**	**8,804,360**
0202 Federal Costs	**1.00**	**LS**	**8,489,399**	**8,804,360**	**8,804,360**
020212 Navigation Ports and Harbors	**1.00**	**LS**	**8,489,399**	**8,804,360**	**8,804,360**

Description	Page
Project Cost Summary Report	**1**
02 Contract 1 - 45' - NED, Ch to Pelican Island Cell B	1
0202 Federal Costs	1
020212 Navigation Ports and Harbors	1

PLATE NO. 1
Page 3 of 3

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For P2 401250

SWG Houston-Galveston Ship Channel Extension
45' Depth

The Houston Galveston Ship Channel Extension as presented by Galveston District has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of February 14, 2017, the Cost MCX certifies the estimated total project cost of:

FY 17 Project First Cost: $15,333,000
Fully Funded Amount: $16,305,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management through the period of Federal interest.

CALLAN.KIM.C.1231558221

Digitally signed by CALLAN.KIM.C.1231558221
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CALLAN.KIM.C.1231558221
Date: 2017.02.14 07:32:42 -08'00'

US Army Corps of Engineers®

Kim C. Callan, PE, CCE, PM
Chief, Cost Engineering MCX
Walla Walla District

PLATE NO. 2
Page 1 of 3

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: Houston-Galveston Navigation Channels, Texas
PROJECT NO: P2 401250
LOCATION: Galveston, Texas

DISTRICT: Galveston District
POC: CHIEF, COST ENGINEERING, Willie Joe Honza, P.E.

PREPARED: 2/13/2017

This Estimate reflects the scope and schedule in report; Galveston Harbor Channel Extension Project Post Authorization Change Report and Environmental Assessment Draft

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2017 Effective Price Level Date: 1 OCT 16									
WBS NUMBER A	Civil Works Feature & Sub-Feature Description B	COST ($K) C	CNTG ($K) D	CNTG (%) E	TOTAL ($K) F	ESC (%) G	COST ($K) H	CNTG ($K) I	TOTAL ($K) J	Spent Thru: 1-Oct-15 ($K)	TOTAL FIRST COST ($K) K	INFLATED (%) L	COST ($K) M	CNTG ($K) N	FULL ($K) O
02	RELOCATIONS	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
12	NAVIGATION PORTS & HARBORS														
12	Federal Costs	$8,804	$2,113	24.0%	$10,917	5.2%	$9,266	$2,224	$11,490	0	$11,490	5.9%	$9,811	$2,355	$12,166
12	Non-Fed Costs - Berthing Area	$1,485	$356	24.0%	$1,841	5.2%	$1,563	$375	$1,938	0	$1,938	5.9%	$1,655	$397	$2,052
	CONSTRUCTION ESTIMATE TOTALS:	$10,289	$2,469		$12,758	5.2%	$10,829	$2,599	$13,428	$0	$13,428	5.9%	$11,466	$2,752	$14,218
01	LANDS AND DAMAGES	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN	$1,181	$283	24.0%	$1,464	2.7%	$1,213	$291	$1,504	$0	$1,504	8.9%	$1,321	$317	$1,638
31	CONSTRUCTION MANAGEMENT	$315	$76	24.0%	$391	2.7%	$324	$78	$401	$0	$401	11.8%	$362	$87	$449
	PROJECT COST TOTALS:	$11,785	$2,828	24.0%	$14,613		$12,365	$2,968	$15,333	$0	$15,333	6.3%	$13,149	$3,156	$16,305

CHIEF, COST ENGINEERING, Willie Joe Honza, P.E.

PROJECT MANAGER, Andrea Catanzaro

CHIEF, REAL ESTATE, Timothy Nelson

CHIEF, PLANNING, Eric Verwers

CHIEF, ENGINEERING, Joe King, R.A., LEED Green Assoc.

CHIEF, OPERATIONS, Joseph Hrametz, P.E.

CHIEF, CONSTRUCTION, Donald W. Carelock, P.E.

CHIEF, CONTRACTING, Kathrine Freeman

CHIEF, PM-G, Valerie Miller

CHIEF, DPM, Edmond J. Russo Jr., PhD, P.E., D.CE, D.NE

ESTIMATED TOTAL PROJECT COST: **$16,305**

Filename: Non-CAP TPCS 7 Feb 2017 - MCX CHECK.xlsx
TPCS

PLATE NO. 2
Page 2 of 3

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Houston-Galveston Navigation Channels, Texas
LOCATION: Galveston, Texas
This Estimate reflects the scope and schedule in report; Galveston Harbor Channel Extension Project Post Authorization Change Report and Environmental Assessment Draft

DISTRICT: Galveston District
POC: CHIEF, COST ENGINEERING, Willie Joe Honza, P.E.
PREPARED: 2/13/2017

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 16-May-16 Effective Price Level: 1-Oct-15				Program Year (Budget EC): 2017 Effective Price Level Date: 1 OCT 16								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J	P	L	M	N	O
	CONTRACT 1													
12	NAVIGATION PORTS & HARBORS													
12	Channel Dredging	$8,804	$2,113	24.0%	$10,917	5.2%	$9,266	$2,224	$11,490	2020Q1	5.9%	$9,811	$2,355	$12,166
12	(Depth 41' to 45')	$7,043	$1,690	24.0%	$8,733	5.2%	$7,412	$1,779	$9,191	2020Q1	5.9%	$7,849	$1,884	$9,732
12	(Depth 45' to 46')	$1,761	$423	24.0%	$2,184	5.2%	$1,853	$445	$2,298	2020Q1	5.9%	$1,962	$471	$2,433
12	Non-Fed Costs - Berthing Area	$1,485	$356	24.0%	$1,841	5.2%	$1,563	$375	$1,938	2020Q1	5.9%	$1,655	$397	$2,052
	CONSTRUCTION ESTIMATE TOTALS:	$10,289	$2,469	24.0%	**$12,758**		$10,829	$2,599	$13,428			$11,466	$2,752	$14,218
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.6%	Project Management	$57	$14	24.0%	$71	2.7%	$59	$14	$73	2019Q2	8.7%	$64	$15	$79
0.7%	Planning & Environmental Compliance	$68	$16	24.0%	$84	2.7%	$70	$17	$87	2019Q2	8.7%	$76	$18	$94
7.0%	Engineering & Design	$720	$173	24.0%	$893	2.7%	$739	$177	$917	2019Q2	8.7%	$804	$193	$996
1.0%	Reviews, ATRs, IEPRs, VE	$103	$25	24.0%	$128	2.7%	$106	$25	$131	2019Q2	8.7%	$115	$28	$143
0.5%	Life Cycle Updates (cost, schedule, risks)	$51	$12	24.0%	$63	2.7%	$52	$13	$65	2019Q2	8.7%	$57	$14	$71
0.3%	Contracting & Reprographics	$34	$8	24.0%	$42	2.7%	$35	$8	$43	2019Q2	8.7%	$38	$9	$47
1.0%	Engineering During Construction	$103	$25	24.0%	$128	2.7%	$106	$25	$131	2020Q1	11.8%	$118	$28	$147
0.0%	Planning During Construction	$0	$0	24.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.4%	Project Operations	$45	$11	24.0%	$56	2.7%	$46	$11	$57	2019Q2	8.7%	$50	$12	$62
31	CONSTRUCTION MANAGEMENT													
2.2%	Construction Management	$225	$54	24.0%	$279	2.7%	$231	$55	$287	2020Q1	11.8%	$258	$62	$320
0.4%	Project Operation:	$45	$11	24.0%	$56	2.7%	$46	$11	$57	2020Q1	11.8%	$52	$12	$64
0.4%	Project Management	$45	$11	24.0%	$56	2.7%	$46	$11	$57	2020Q1	11.8%	$52	$12	$64
	CONTRACT COST TOTALS:	$11,785	$2,828		$14,613		$12,365	$2,968	$15,333			$13,149	$3,156	$16,305

Filename: Non-CAP TPCS 7 Feb 2017 - MCX CHECK.xlsx
TPCS

PLATE NO. 2
Page 3 of 3

Abbreviated Risk Analysis

Project Example
Feasibility (Recommended Plan)

Meeting Date: 6-Jan-12

PDT Members
Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	Byron Williams
Study Manager:	Cheryl Jaynes
Real Estate:	Kenny Pablo
Relocations:	Nancy Young
Engineering & Design:	Nancy Young/David Boothby
Cost Engineering:	Jackie Lockhart

Abbreviated Risk Analysis

Project (less than $40M): Project Example
Project Development Stage/Alternative: Feasibility (Recommended Plan)
Risk Category: Low Risk: Typical Construction, Simple

Alternative: N/A
Meeting Date: 1/6/2012

Total Estimated Construction Contract Cost = $ 8,804,360

	CWWBS	Feature of Work	Estimated Cost	% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -	0%	$ -	$ -
1	12 NAVIGATION, PORTS AND HARBORS	Mob/Demob	$ 1,100,000	19%	$ 214,459	$ 1,314,459
2	12 NAVIGATION, PORTS AND HARBORS	Dredging	$ 6,453,328	24%	$ 1,540,394	$ 7,993,722
3	12 NAVIGATION, PORTS AND HARBORS	Placement Area (PA)	$ 1,251,032	26%	$ 326,969	$ 1,578,001
4				0%	$ -	$ -
5				0%	$ -	$ -
6				0%	$ -	$ -
7				0%	$ -	$ -
8			$ -	0%	$ -	$ -
9			$ -	0%	$ -	$ -
10			$ -	0%	$ -	$ -
11			$ -	0%	$ -	$ -
12	All Other	Remaining Construction Items	$ - 0.0%	0%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ -	0%	$ -	$ -
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ -	0%	$ -	$ -
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)				$ -	

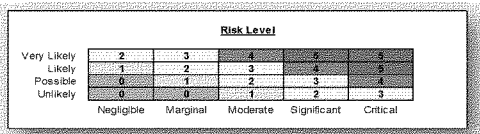
Totals					
Real Estate	$ -	0%	$ -	$ -	
Total Construction Estimate	$ 8,804,360	24%	$ 2,081,823	$ 10,886,183	
Total Planning, Engineering & Design	$ -	0%	$ -	$ -	
Total Construction Management	$ -	0%	$ -	$ -	
Total Excluding Real Estate	**$ 8,804,360**	**24%**	**$ 2,081,823**	**$ 10,886,183**	
		Base	**50%**	**80%**	
Confidence Level Range Estimate ($000's)		$8,804k	$10,053k	$10,886k	

* 50% based on base is at 8% CL

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

PLATE NO. 3
Page 2 of 4

Project Example N/A
Feasibility (Recommended Plan)
Abbreviated Risk Analysis
Meeting Date: 6-Jan-12



Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				Maximum Project Growth		40%
PS-1	Mob/Demob	None	No Issue	Negligible	Unlikely	0
PS-2	Dredging	Potential for scope changes before and after construcion contract award	As design are further developed, there is a potential that the location in the PA may change	Marginal	Likely	2
PS-3	Placement Area (PA)	Potential for scope changes before and after construcion contract award	As design are further developed, there is a potential that the location in the PA may change	Negligible	Likely	1
Acquisition Strategy				Maximum Project Growth		30%
AS-1	Mob/Demob	Bidding Climate	PDT feels this is not likely to be an issue. Ther is always a chance of a disaster response that would occupy the available dredge fleet. Historically this has not been a problem	Moderate	Possible	2
AS-2	Dredging	Bidding Climate	PDT feels this is not likely to be an issue. Ther is always a chance of a disaster response that would occupy the available dredge fleet. Historically this has not been a problem	Moderate	Possible	2
AS-3	Placement Area (PA)	None	No Issue	Moderate	Possible	2
Construction Elements				Maximum Project Growth		15%
CON-1	Mob/Demob	None	Standard type work for the district	Negligible	Unlikely	0
CE-2	Dredging	None	Standard type work for the district	Negligible	Unlikely	0
CE-3	Placement Area (PA)	None	Potential modification	Marginal	Likely	2
Specialty Construction or Fabrication				Maximum Project Growth		50%
SC-1	Mob/Demob	None	N/A	Negligible	Unlikely	0
SC-2	Dredging	None	N/A	Negligible	Unlikely	0
SC-3	Placement Area (PA)	None	N/A	Negligible	Unlikely	0
Technical Design & Quantities				Maximum Project Growth		20%

PLATE NO. 3
Page 3 of 4

T-1	Mob/Demob	None	No Issue	Negligible	Unlikely	0
T-2	Dredging	None	No Issue	Negligible	Unlikely	0
T-3	Placement Area (PA)	Design has not been finalized	Quantities may increase or decrease based on final design	Marginal	Likely	2
Cost Estimate Assumptions				**Maximum Project Growth**		**25%**
EST-1	Mob/Demob	Don't know what the bid climate at time of bid opening	PDT feels this is not likely to be an issue. There is always a chance of a disaster response that would occupy the available dredge fleet. Historically this has not been a problem	Marginal	Likely	2
EST-2	Dredging	Don't know what the bid climate at time of bid opening	Depending on the bidding climate the estimate could go up	Marginal	Likely	2
EST-3	Placement Area (PA)	Don't know what the bid climate at time of bid opening	Depending on the bidding climate the estimate could go up	Marginal	Possible	1
External Project Risks				**Maximum Project Growth**		**20%**
EX-1	Mob/Demob	None	No Issue	Negligible	Unlikely	0
EX-2	Dredging	Potential for political influence	Political pressure to use another PA. This could increase the unit cost, if the pipeline lengths need to increase	Marginal	Unlikely	0
EX-3	Placement Area (PA)	Potential for political influence	Political pressure to use another PA. This could increase the unit cost, if the pipeline lengths need to increase	Marginal	Unlikely	0

PLATE NO. 3
Page 4 of 4



U.S. Army Corps
of Engineers
Galveston District

Galveston Harbor Channel Extension
Feasibility Study
Houston-Galveston Navigation Channels, Texas

APPENDIX C
REAL ESTATE APPENDIX

U.S. Army Corps of Engineers
Southwestern Division
Galveston District
2016

APPENDIX C - REAL ESTATE APPENDIX

HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS
GALVESTON HARBOR CHANNEL EXTENSION
FEASIBILITY REPORT
GALVESTON COUNTY, TEXAS

1. **General Background**: This report is intended to supplement the information presented in the 1995 Houston-Galveston Navigation Channels Project, Texas, Limited Reevaluation and Final Supplemental Environmental Impact Statement (SEIS) by addressing issues related specifically to the Galveston Harbor Channel, and will accompany the Project Cooperation Agreement (PCA) when it is forwarded to Congress. The original study for improving the deep-draft navigation channels within the Galveston Bay area was authorized by a resolution of the House Committee on Public Works adopted on October 19, 1967. The Feasibility study for improving the Houston and Galveston channels was completed in July 1987, and a Report and Supplemental EIS were produced. The Non-Federal Sponsor (NFS) for this Project is the Board of Trustees of the Galveston Wharves (Port of Galveston), which was purchased in 1940 by and is a separate utility of the City of Galveston.

2. **Project Location.** The Galveston Channel is subdivided into two reaches designated as the Offshore Reach and the Galveston Channel Reach. The Galveston Channel Reach is authorized to 45 feet deep from Station 0+000 to Station 20+000. From Station 20+000 to Station 22+571 the channel is only authorized to a depth of 40-feet. As such, the NFS and facilities at the far end of the 40-foot Galveston Ship Channel (last 0.5 mile) are not able to receive deeper draft vessels at their facilities without practices such as light-loading.

3. **Project Description.** The section of the Galveston Harbor Channel addressed in this Project begins at Station 20+000 and continues to 22+571 in Galveston, Texas, as seen in Exhibit "A" attached hereto. Once construction occurs in this reach, the channel will be deepened to 45 feet with a maximum width of 1,075 feet. All channel improvements will take place within the previously established U.S. Harbor Line. The U.S. Harbor Line, as it pertains to the subject Project boundaries, shall be defined as 537.5 feet north and 537.5 feet south of the Galveston Harbor Channel center line.

4. Real Estate Requirements. The Galveston Harbor Channel will be dredged to a depth of 45 feet; new work dredging will take place from Station 20+000 to Station 22+571. Galveston Harbor Channel is shown on Exhibit "A". All dredging will occur within the navigational servitude. New work dredged material and all maintenance material for this reach of the Project will be placed in the confined Pelican Island Placement Area as shown on Exhibit "B", including the associated dredge material pipeline route. This area is fee-owned by the U.S. Government known as tract 301 & tract A. Tract 301 was acquired through General Warranty Deed granted by Mitchell Development Corporation of the Southwest to the United States of America dated 28 June 1974 filed on Book 2517 Page 595 of the Real Property Official Records at the Galveston County Clerk's Office. Tract A was acquired from the City of Galveston on 23 April 1859 and is recorded in Volume P, Page 37 of the Deed Records of Galveston County, Texas. The controlling agency is the U.S. Army Corps of Engineers. These areas are currently in use for the existing Project.

Two pipelines, described as: 12-inch waterline (-51 feet MLLW) and 12-inch sewer line (- 51 feet MLLW) were located at approximately Station 21+500 and 21+550, respectively, on the Galveston Harbor Channel within the Project area. The Preliminary Attorney's Opinion of Compensability (PAOC) described these pipelines as being solely the responsibility of the NFS for removal and/or relocation prior to the construction of this project. On 19 December 2016, the pipelines were removed by the City of Galveston.

Therefore, there are no new lands, easements, rights-of-way and relocations and disposal (LERRDs) required for the construction / implementation of the proposed Galveston Harbor Channel extension.

5. Borrow Material. The proposed Project does not require any borrow material.

6. Access/Staging Area. The proposed Project does not require any access/staging areas. All of the proposed work will be performed within the existing right-of-way of the Galveston Harbor Project. There are existing public roads to all work and placement areas.

7. Recreation Features. There are no recreation features for the proposed Project.

8. Induced Flooding. There will be no induced flooding by virtue of the construction of the Project. The proposed deepening and widening of the channel will be constructed within the existing U.S. Harbor Line.

9. Mitigation. Section 5.0 of EA states: "No impacts are expected to occur to natural resources or cultural resources as a result of the proposed Project." Therefore, no mitigation is needed for the proposed Project activities. This determination is consistent with the recommendations of the January 14, 2011, USFWS PAL for the Galveston Harbor Channel Extension (Appendix B)."

10. Federally-Owned Land & Existing Federal Project. HGNC is an existing Federal project. Exhibit "C" is the Galveston Harbor Project Real Estate Segment Map that shows all the federally-owned property within the Galveston Harbor Channel reach of the Project. Virtually all the land owned by the government within the Project limits was acquired for the Galveston Harbor. The U.S. Army Corps of Engineers is the controlling agency. Land acquired for the previously authorized Project is available for the proposed Project. However, the Non-Federal Sponsor will not receive LERRD credit for lands made available for the Project by the Corps of Engineers for lands previously credited as a LERRD for a project with Federal funds participation.

11. Non-Federal Sponsor Owned Land. The Port of Galveston, sponsor for the Project, has no fee-owned land within the Project area.

12. Navigation Servitude. All lands required for the proposed channel extension Project that lie below the ordinary mean high water mark are subject to Navigational Servitude and will not require acquisition.

Navigation servitude is the dominant right of the Government under the Commerce Clause of the U.S. Constitution (U.S. CONST. Art. I, §8, cl.3) to use, control and regulate the navigable waters of the United States and the submerged lands thereunder for various commerce-related purposes including navigation and flood control. In tidal areas, the servitude extends to all lands below the ordinary mean high water mark. In non-tidal areas, the servitude extends to all lands within the bed and banks of a navigable stream that lie below the ordinary high water mark.

13. Public Law 91-646 Relocation Assistance. Public Law 91-646, Uniform Relocation Assistance, provides entitlement for various payments associated with federal participation in acquisition of real property. Title II makes provision for relocation expenses for displaced persons, and Title III provides for reimbursement of certain expenses incidental to transfer of property. There will be no relocation of persons, Title II, or Title III costs associated with the proposed Project.

14. Assessment of Non-Federal Sponsor Land Acquisition Capabilities. Should land acquisition become necessary during the PED phase, the NFS, Port of Galveston, has the authority and capability to furnish LERRDs as stated in the previous Feasibility Cost-Sharing Agreement. Due to this previous agreement and the fact that additional acquisition is not expected for this extension, a Capability Assessment and Risk Notification is not included herein.

15. Baseline Cost Estimate for Real Estate. The cost estimate below reflects the estimated Federal cost for the Project. These costs include team meetings, mapping of Project and administrative costs. The Federal real estate costs for the proposed Project are

$11,250.00. The non-Federal real estate costs for the proposed Project are $0.00.

GALVESTON HARBOR CHANNEL EXTENSION
Real Estate Federal Cost Estimate

REAL ESTATE COST ESTIMATE FOR PROJECT IMPLEMENTATION					
GALVESTON HARBOR CHANNEL EXTENTION-FEDERAL COST					
GALVESTON COUNTY, TEXAS					
ACCOUNT	DESCRIPTION	ESTIMATE		CONTINGENCIES	
		TOTAL	MITIGATION	TOTAL	MITIGATION
0102	Acquisitions (Review RE Planning Documents & Mapping)	$5,000.00		$1,250.00	
0103	Condemnations				
0104	In-Lease				
0105	Appraisals (SWG Review Appraiser Review for 201acre expansion of PA 4)				
0106	Real Estate PL 91-646 Relocation Assistance				
0107	Temporary Permits/Licenses/R.O.W.				
0108	Audits				
0109	Encroachments and Trespass				
0110	Disposals				
0111	Real Property Accountability				
0112	Project Related Administration	$2,000.00		$500.00	
0113	Facility/Utility Relocations				
0114	Withdrawals (Public Domains)				
0115	Real Estate Payments				
011501	Payments by Sponsor (Land & Improvements)				
011502	Payments by Sponsor (PL 91-646)				
011503	Payments by Sponsor (Damages)				
02	Planning by Non Federal Sponsor				
02-0117	LERRD Crediting (SWG Technical, Appraisal, and Management Review plus Admin Cost)	$,2,000.00		$500.00	
	Total Admin & Payments (FED COSTS)	$7,000.00			
	Total Admin & Payments (FED COSTS)			$2,250.00	
	Total Admin & Payments (FED COSTS)	**$11,250.00**			

GALVESTON HARBOR CHANNEL EXTENSION
Non-Federal Cost Estimate

REAL ESTATE COST ESTIMATE FOR PROJECT IMPLEMENTATION					
GALVESTON HARBOR CHANNEL EXTENTION- NON-FEDERAL COST					
GALVESTON COUNTY, TEXAS					
ACCOUNT	DESCRIPTION	ESTIMATE		CONTINGENCIES	
		TOTAL	MITIGATION	TOTAL	MITIGATION
0102	Acquisitions				
0103	Condemnations				
0104	In-Lease				
0105	Appraisals				
0106	Real Estate PL 91-646 Relocation Assistance				
0107	Temporary Permits/Licenses/R.O.W.				
0108	Audits				
0109	Encroachments and Trespass				
0110	Disposals				
0111	Real Property Accountability				
0112	Project Related Administration				
0113	Facility/Utility Relocations				
0114	Withdrawals (Public Domains)				
0115	Real Estate Payments				
011501	Payments by Sponsor (Land)				
011502	Payments by Sponsor (PL 91-646)				
011503	Payments by Sponsor (Damages)				
02	Planning by Non Federal Sponsor				
02-0117	LERRD Crediting				
	Total Admin & Payments (NON-FED COSTS)				
	Total Contingencies (NON-FED COSTS)				
	GRAND TOTAL NON-FED COSTS	**$0.00**			

16. **Acquisition Schedule.** Project requirements are within navigational servitude and the federal fee owned Pelican Island placement area.

17. **Mineral Activity.** There is no mineral activity within the Project area.

18. **Facilities/Utilities/Pipeline Relocations & Removals.** As described in Section 4, the City of Galveston removed two pipelines on 19 December 2016. Therefore there will be no facility/utilities/pipeline relocations and removals within the Project area.

19. **HTRW or Other Environmental Contaminants.** Section 3.14 of the EA in the main report states, "No visual signs of environmental contamination or recognized environmental conditions, including spills or illegal waste disposal, were observed during the site inspection."

20. **Attitudes of the Landowner.** Privately-owned shipping industry companies, The Port of Galveston, and the Federal Government own the majority of lands surrounding the Project boundaries. As owners, they are supportive and in favor of the Project. No resistance to the Project by other landowners is expected.

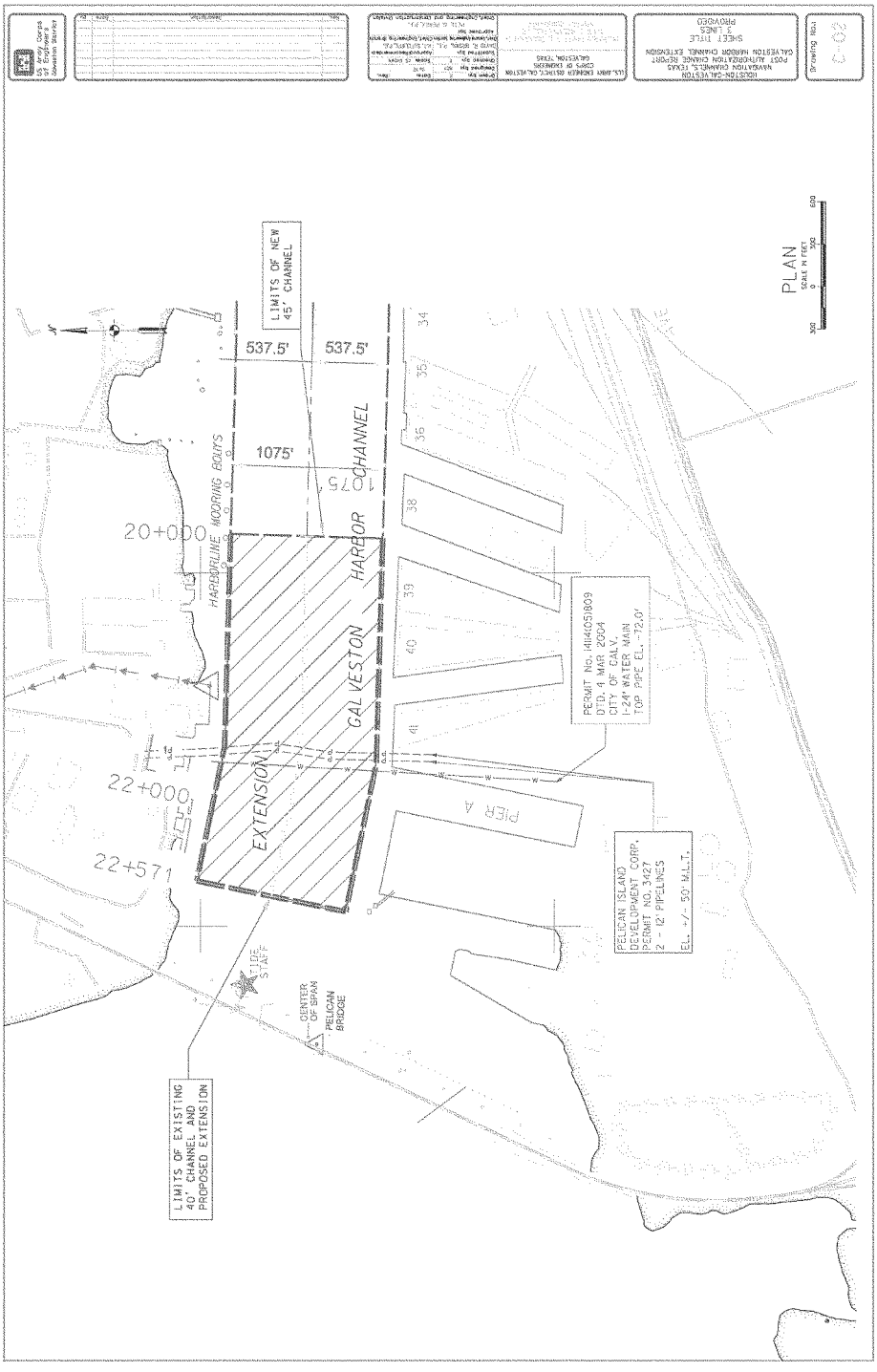
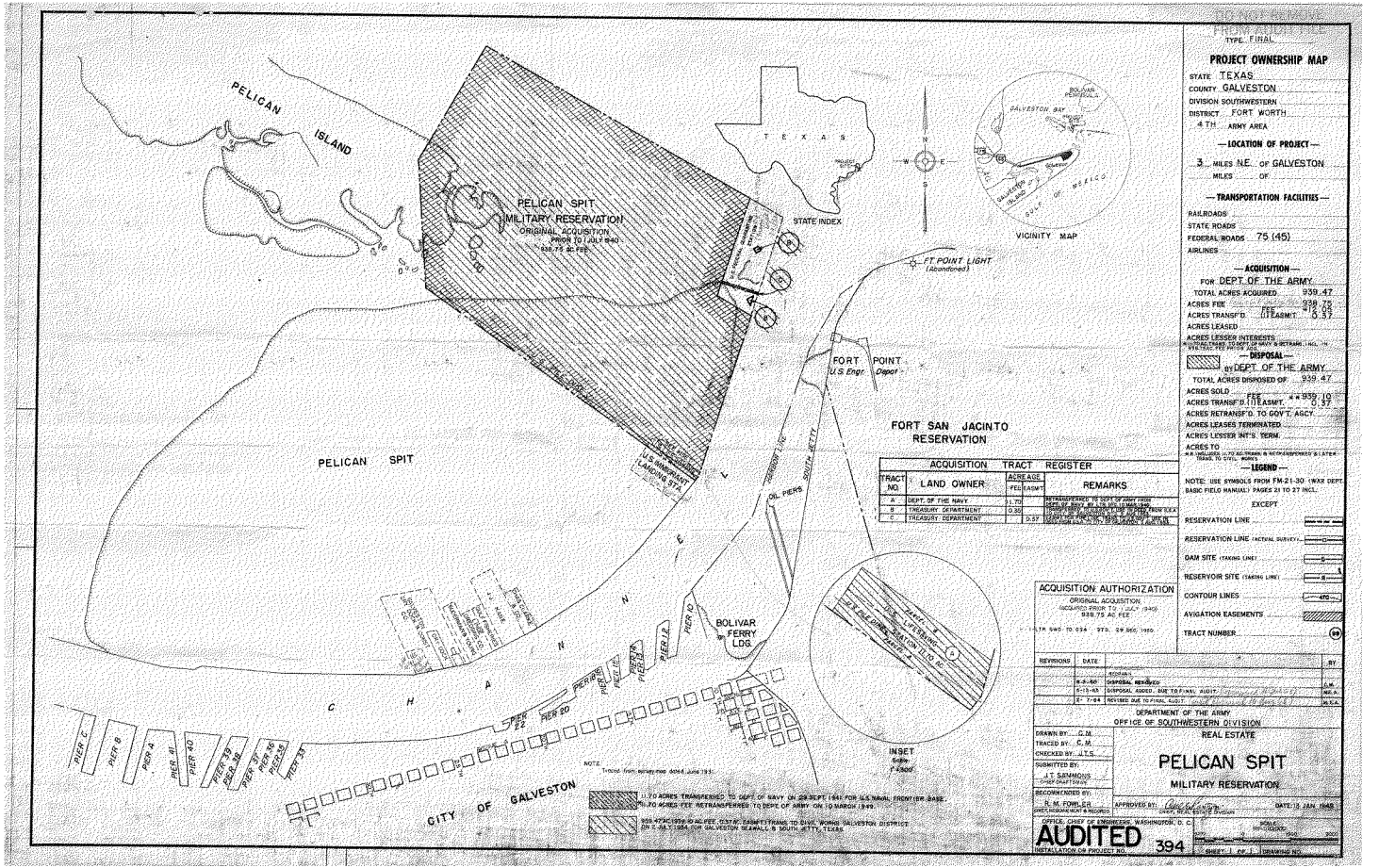

LIMITS OF NEW 45' CHANNEL
537.5'
537.5'
1075'
HARBORLINE MOORING BOYS
45' CHANNEL
GALVESTON HARBOR
EXTENSION
20+000
22+000
22+571
PIER A
PERMIT No. MM4051809
DTD. 4 MAY 2004
CITY OF GALV.
24" WATER MAIN
TOP PIPE EL. -72.0'
PELICAN ISLAND
DEVELOPMENT CORP.
PERMIT NO. 3427
2 - 12" PIPELINES
EL. +/- 50' M.L.T.
LIMITS OF EXISTING
40' CHANNEL AND
PROPOSED EXTENSION
CENTER
OF SPAN
PELICAN
BRIDGE
PLAN
SCALE IN FEET
300
0
300
600
34
35
36
38
39
40
41
C-02

EXHIBIT "A"


G.H.M.
Hawaiian Islands



ACQUISITION TRACT REGISTER

TRACT NO.	LAND OWNER	ACREAGE FEE	ACREAGE EASM'T	REMARKS
A	DEPT. OF THE NAVY	1.70		RETRANSFERRED TO DEPT OF ARMY FROM DEPT OF NAVY BY C.S. NO. 11-1954-245
B	TREASURY DEPARTMENT	0.30		TRANSFERRED TO DEPT OF ARMY FROM U.S. COAST GUARD BY DEPT OF TREASURY LETTER DATED 10 MAY 1954
C	TREASURY DEPARTMENT		0.57	EASEMENT FOR RIGHT OF WAY FOR JETTY PURPOSES GRANTED TO THE U.S. BY DEPT OF TREASURY

ACQUISITION AUTHORIZATION

ORIGINAL ACQUISITION
(ACQUIRED PRIOR TO 1 JULY 1940)
939.75 AC FEE

1TH SWD TO 034 - 970, 29 DEC 1950

REVISIONS	DATE	BY
	8-3-60 DISPOSAL REVISED	C.M.
	4-15-63 DISPOSAL ADDED - SUB TO FINAL AUDIT	MD.
	E 7-64 REVISED DUE TO FINAL AUDIT	M.T.A.

DEPARTMENT OF THE ARMY
OFFICE OF SOUTHWESTERN DIVISION
REAL ESTATE

DRAWN BY: C.M.
TRACED BY: C.M.
CHECKED BY: J.T.S.
SUBMITTED BY: J.T. SAMMONS
Chief Drafting Section
RECOMMENDED BY: R.M. FOWLER
Chief, Engineering Plant & Records Branch

APPROVED BY: Chief, Real Estate Division
DATE: 15 JAN 1965

OFFICE, CHIEF OF ENGINEERS, WASHINGTON, D. C.

AUDITED
INSTALLATION OR PROJECT NO. 394

SHEET NO. 1 OF 1 SHEETS DRAWING NO.

PROJECT MAP
TYPE FINAL

PROJECT OWNERSHIP MAP

STATE TEXAS
COUNTY GALVESTON
DIVISION SOUTHWESTERN
DISTRICT FORT WORTH
4TH ARMY AREA

— LOCATION OF PROJECT —

3 MILES NE OF GALVESTON
MILES OF

— TRANSPORTATION FACILITIES —

RAILROADS
STATE ROADS
FEDERAL ROADS 75 (45)
AIRLINES

— ACQUISITION —

FOR DEPT OF THE ARMY
TOTAL ACRES ACQUIRED 939.47
ACRES FEE 939.75
ACRES TRANSF'D FEE 1.70
EASM'T 0.57
ACRES LEASED
ACRES LESSER INTERESTS ACQUIRED TO DEPT OF NAVY & RETRANS. INCL. IN

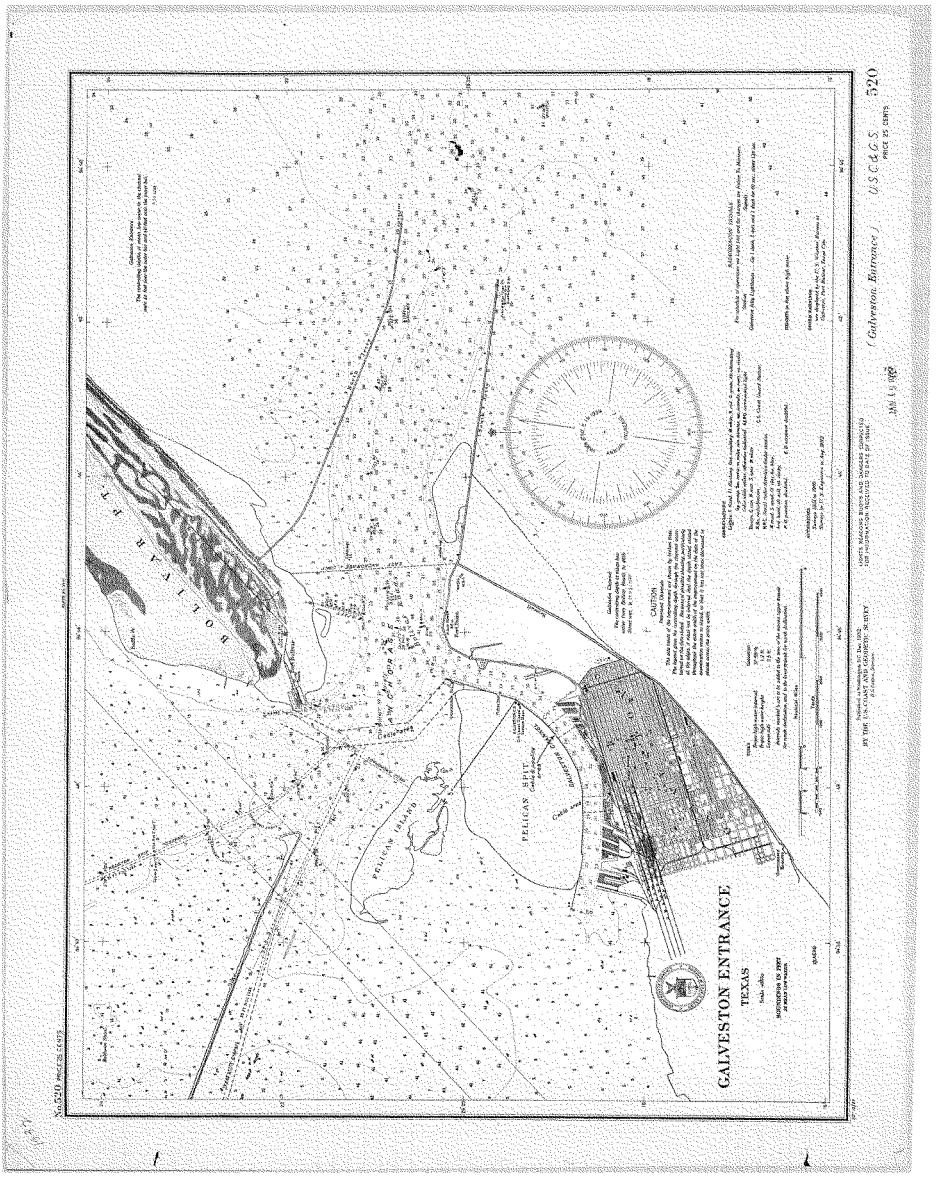
— DISPOSAL —

BY DEPT OF THE ARMY
TOTAL ACRES DISPOSED OF 939.47
ACRES SOLD FEE 4.4 939.10
ACRES TRANSF'D FEE EASM'T 0.57
ACRES RETRANSF'D TO GOV'T. AGCY.
ACRES LEASES TERMINATED
ACRES LESSER INT'S. TERM.
ACRES TO 4.4 INCLUDES 0.70 AC FRANK & MCFADDEN'S & LATER TRANS. TO CIVIL WORKS

— LEGEND —

NOTE: USE SYMBOLS FROM FM 21-30 (WAR DEPT. BASIC FIELD MANUAL) PAGES 21 TO 27 INCL. EXCEPT

RESERVATION LINE
RESERVATION LINE (ACTUAL SURVEY)
DAM SITE (TAKING LINE)
RESERVOIR SITE (TAKING LINE)
CONTOUR LINES
AVIGATION EASEMENTS
TRACT NUMBER


GALVESTON ENTRANCE
TEXAS
BOLIVAR PT.
PELICAN ISLAND
PELICAN SPIT
CAUTION
No.520 PRICE 15 CENTS
520
PRICE 15 CENTS

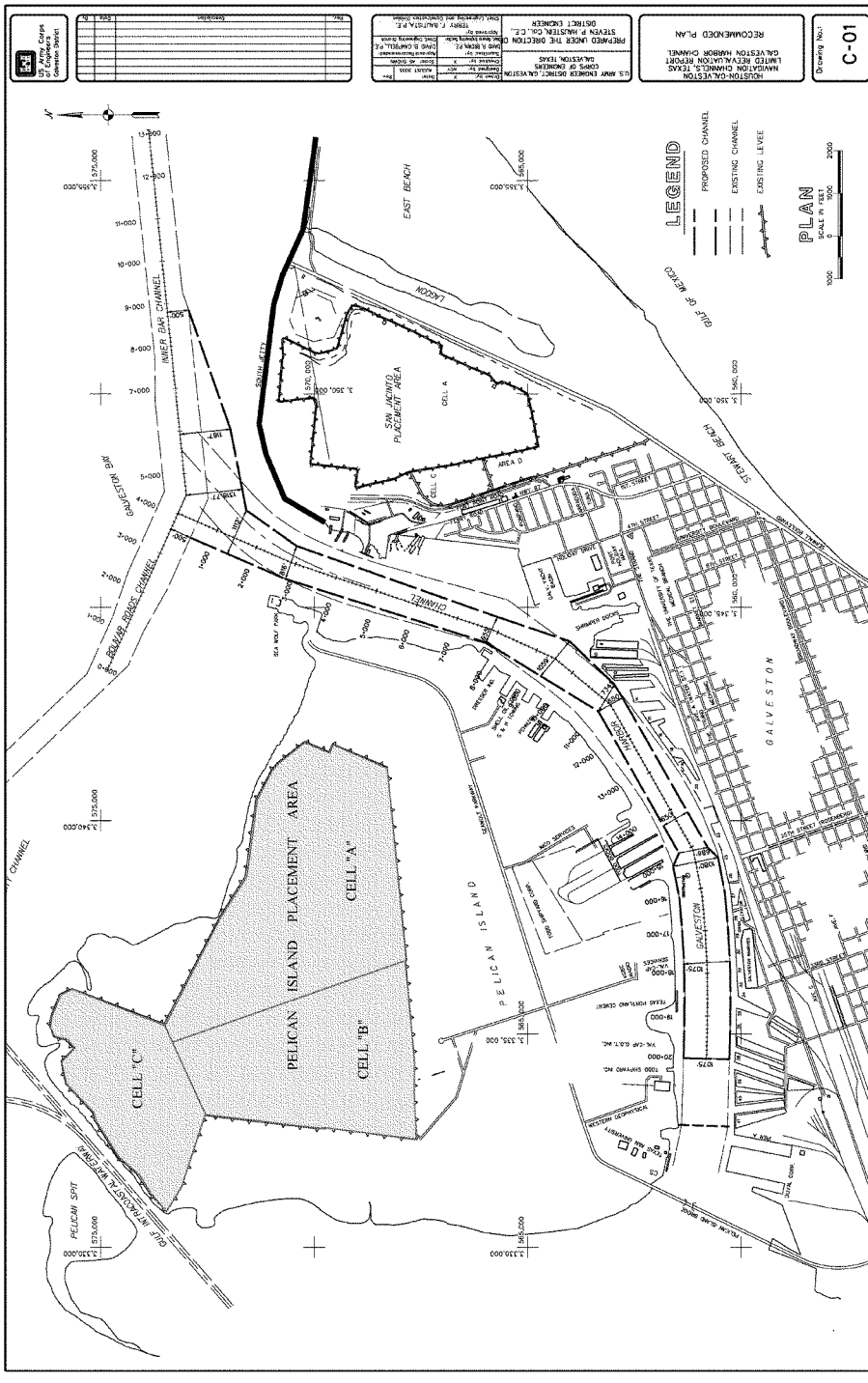

HOUSTON-GALVESTON
NAVIGATION CHANNELS, TEXAS
LIMITED REEVALUATION REPORT
GALVESTON HARBOR CHANNEL
RECOMMENDED PLAN
C-01
PREPARED UNDER THE DIRECTION OF:
COPIES OF DOCUMENTS
STEPHEN P. MALSTEN, COL, C.E.
DISTRICT ENGINEER
U.S. ARMY ENGINEER DISTRICT, GALVESTON
TEXAS
LEGEND
PROPOSED CHANNEL
EXISTING CHANNEL
EXISTING LEVEE
PLAN
SCALE IN FEET
1000 0 1000 2000
PELICAN ISLAND PLACEMENT AREA
CELL "A"
CELL "B"
CELL "C"
SAN JACINTO PLACEMENT AREA
CELL A
CELL C
AREA D
EAST BEACH
LAGOON
GULF OF MEXICO
STEWART BEACH
GALVESTON
PELICAN ISLAND
PELICAN SPIT
INNER BAR CHANNEL
BOLIVAR FERRY CHANNEL
GALVESTON BAY
CHANNEL
SOUTH JETTY
GULF INTRACOSTAL WATERWAY
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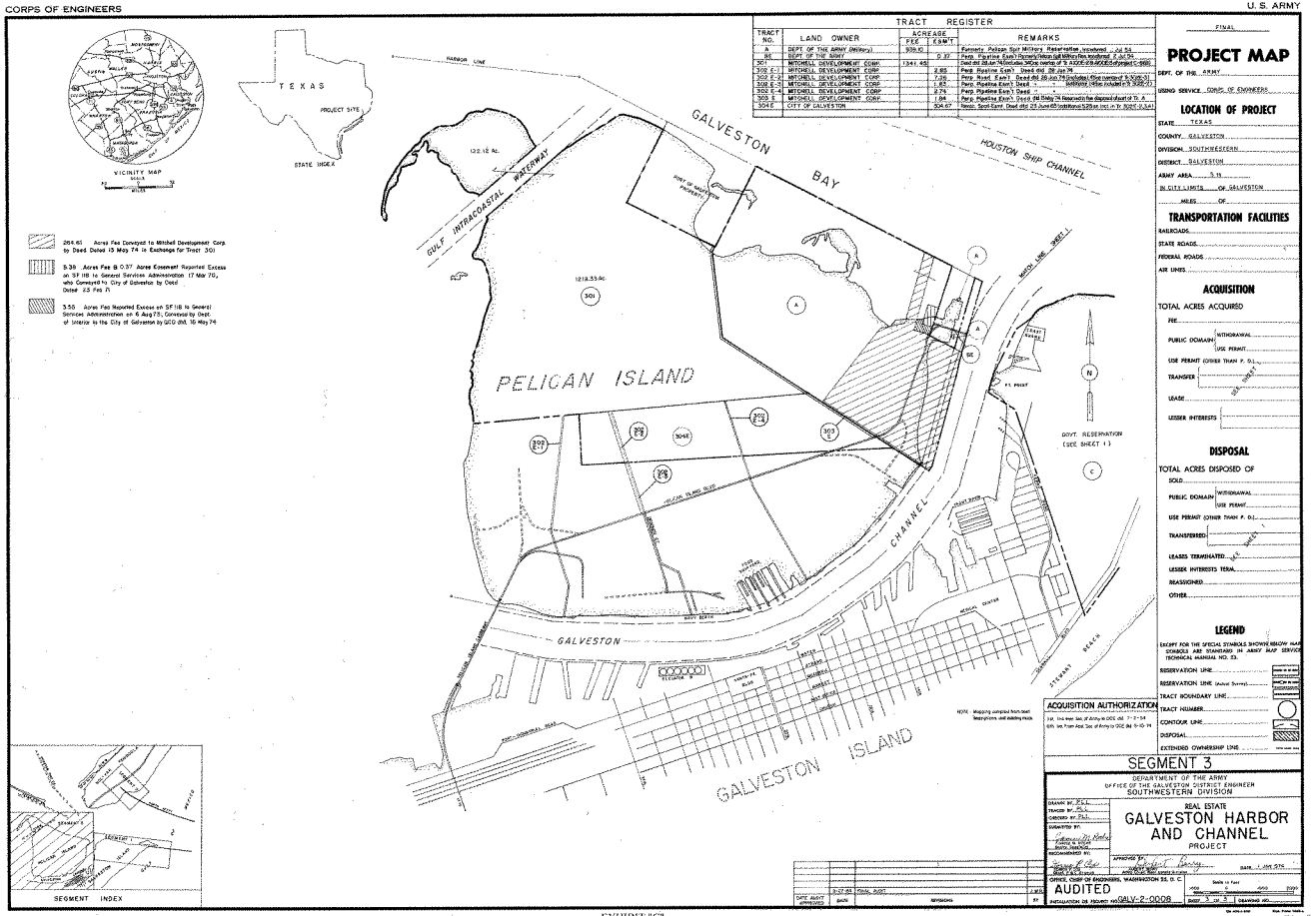
EXHIBIT "B"

CORPS OF ENGINEERS

U. S. ARMY



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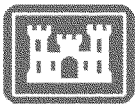

U.S. Army Corps
of Engineers
Galveston District

Galveston Harbor Channel Extension Feasibility Study Houston-Galveston Navigation Channels, Texas

APPENDIX D
ACRONYMS AND ABBREVIATIONS

U.S. Army Corps of Engineers
Southwestern Division
Galveston District
2016

APPENDIX D - ACRONYMS AND ABBREVIATIONS

(Used in Report and Appendices)

ANS	Aquatic Nuisance Species
AST/UST	Registered Above Ground/Underground Storage Tanks
BA	Biological Assessment
BCR	Benefit-Cost-Ratio
CBRA	Coastal Barrier Resources Act of 1982
CCA	Clean Air Act of 1972, as amended
CERCLIS	Comprehensive Environmental Response Compensation, and Liability Information System Database
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
dBA	Decibels
DNL	Day-Night Average Sound
DSHS	Texas Department of State Health Services
DWT	Deadweight Ton
EA	Environmental Assessment
EGM	Economic Guidance Manual
EIS	Environmental Impact Statement
EM	Engineer Manual
EO	Executive Order
EOP	Environmental Operating Principles
EPA	Environmental Protection Agency
ER	Engineering Regulation
ERNS	Emergency Response Notification System
ESA	Endangered Species Act of 1973, as amended
FAA	Federal Aviation Administration
FY	fiscal year
GBANS	Galveston Bay Area Navigation Study
GC	Galveston Harbor Channel
GHCE	Galveston Harbor Channel Extension
GIS	Geographic Information System
GIWW	Gulf Intracoastal Waterway
GSC	Galveston Ship Channel
HGB	Houston-Galveston-Brazoria
HGNC	Houston-Galveston Navigation Channels, Texas Project
HHS	Department of Health and Human Services
HSC	Houston Ship Channel
HTRW	Hazardous, Toxic, and Radioactive Waste

IHW NOR	Texas Industrial Hazardous Waste Notice of Registration
IOP	Innocent Owner/Operator
LERRD	Land, Easements, Rights-Of-Way, and Relocation
LRR	Limited Reevaluation Report
LUST	Leaking Underground Storage Tanks
MBTA	Migratory Bird Treaty Act
M-CACES	Micro-Computer Aided Cost Estimating System
Mii	Micro-Computer Aided Cost Estimating System, second generation
MLLW	Mean Lower Low Water
MLT	Mean Low Tide
MOA	Memorandum of Agreement
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act of 1996
NAAQS	National Ambient Air Quality Standards
NED	National Economic Development
NEPA	National Environmental Policy Act
NFRAP	No Further Remedial Action Planned
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxides
NPL	National Priority List
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NW	New Work
NWLON	National Water Level Observation Network
NTDE	National Tidal Datum Epoch
O&M	Operation and Maintenance
PA	Placement Area
PACR	Post Authorization Change Report
PCA	Project Cooperation Agreement
PCBs	Dioxin and Polychlorinated Biphenylns
PED	Preconstruction, Engineering and Design
PHA	Port of Houston Authority
POG	Board of Trustees of the Galveston Wharves (Port of Galveston) (Sponsor)
Ppt	part per thousand
RCRA COR	Resource Conservation and Recovery Information System – Corrective Action Sites
RCRA GEN	Resource Conservation and Recovery Information System - Large and Small Quantity Generators

RCRA TSD	Resource Conservation and Recovery Information System - Treatment, Storage and Disposal Facilities
RO/RO	Roll-On/Roll-Off
SEIS	Supplemental Environmental Impact Statement
SH	State Highway
SHPO	State Historical Preservation Officer
SIP	State Implementation Plans
SLR	Sea Level Rise
SS URGO	Soil Survey Geographic Database
SWG	Galveston District
SWL	State Superfund Sites; City/County Solid Waste Landfills
TCEQ	Texas Commission on Environmental Quality
TCMP	Texas Coastal Management Program
TEU	Tons Equivalent Unit
TPCS	Total Project Cost Summary
TCMP	Texas Coastal Management Program
TNRIS	Texas National Resource Information System
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSS	Total Suspended Solids
TWDB	Texas Water Development Board
TXVOL	State Sites (e.g., Texas Commission on Environmental Quality Voluntary Cleanup Program Site Listing
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USCG	United States Coast Guard
USFWS	U.S. Fish and Wildlife Service
UTMB	University of Texas Medical Branch
VOX	Volatile Organic Compounds
WCSC	Waterborne Commerce Statistics Center
WRDA	Water Resources Development Act



U.S. Army Corps
Of Engineers
Galveston District

FINAL
ENVIRONMENTAL ASSESSMENT
GALVESTON HARBOR CHANNEL EXTENSION FEASIBILITY STUDY HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS

U.S. Army Corps of Engineers
Southwestern Division
Galveston District
JULY 2016

Environmental Assessment
Galveston Harbor Channel
Extension Feasibility Study
Houston-Galveston Navigation
Channels, Texas

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Final Environmental Assessment
Galveston Harbor Channel Extension
Feasibility Study

Galveston County, Texas

1.0 PROPOSED PLAN

1.1 Introduction

This U.S. Army Corps of Engineers (USACE) Environmental Assessment (EA) describes the environmental impacts associated with extending the limits of the existing authorized 46-foot deep Galveston Harbor Channel for a distance of 2,571 feet to reach the end of the limits of the authorized and currently maintained 41-foot portion of the channel. The project is located on the upper Texas coast at the mouth of Galveston Bay in Galveston County, Texas. The approximate 4-mile-long Galveston Harbor Channel is included in the Galveston Channel Reach of the Houston-Galveston Navigation Channels (HGNC), Texas, Project and provides entry to the Port of Galveston, Texas (Figure 1).

The recommended channel improvement would increase navigation efficiency for deep draft vessels using this portion of the Galveston Harbor Channel as it would enable maximum vessel loading and allow users of dock facilities at the far end of Galveston Harbor Channel to take advantage of fully loaded vessels alleviating the current practices of light-loading. The project sponsor is the Port of Galveston (POG).

1.2 Project Background and Authority

The Galveston Harbor Channel Project was part of an earlier study for improving the deep-draft navigation channels within the Galveston Bay area authorized by a resolution of the House Committee on Public Works in October, 1967. This resolution authorized a review of previous reports on the Houston Ship Channel, the Galveston Harbor Channel, and the Texas City Channel. The Reconnaissance Report for this study was completed in January 1980. The report

demonstrated that channel modifications necessary to improve the efficiency and safety of Galveston Bay channels were feasible and recommended that studies continue into the feasibility phase.

The Galveston Bay Area Navigation Study (GBANS), Feasibility Report and Environmental Impact Statement for improving the Houston and Galveston Channels, was completed in 1987. The GBANS recommended that the Galveston Harbor Channel be deepened to 50 feet and

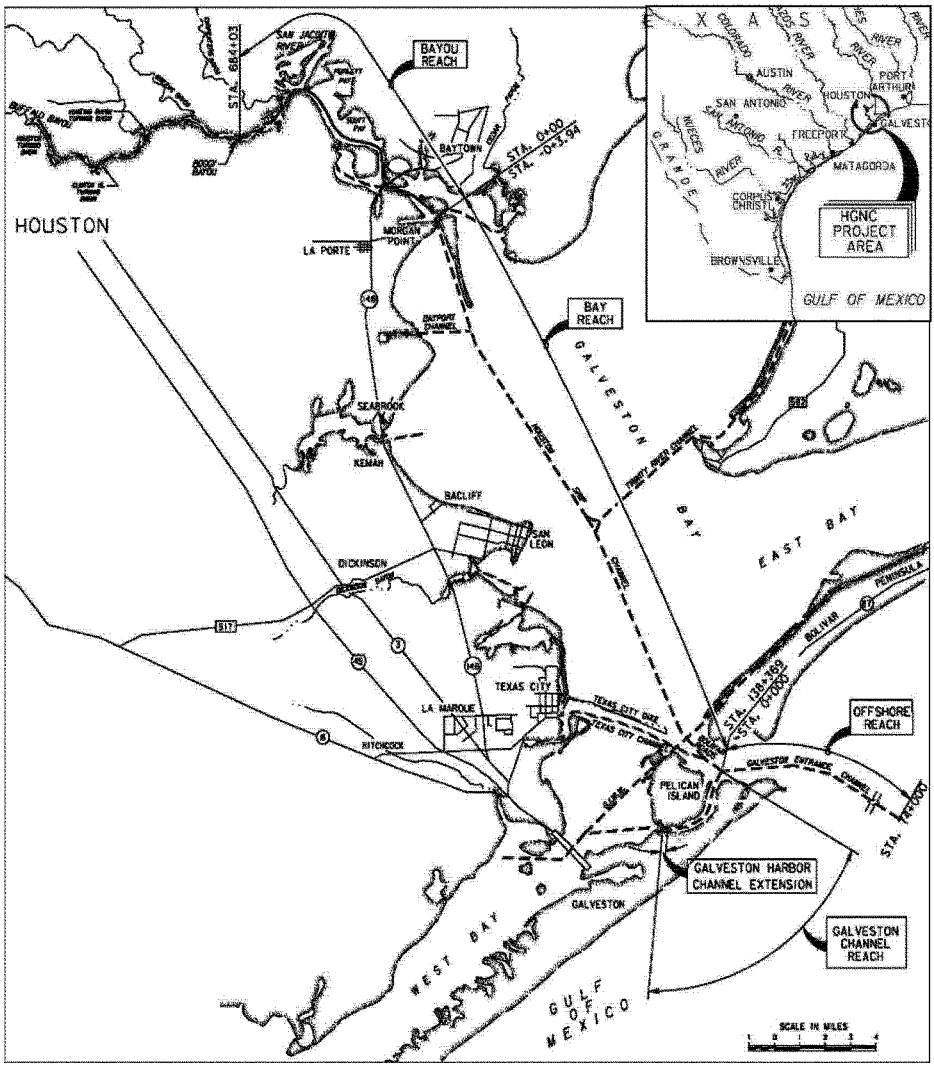

FIGURE 1: Houston-Galveston Navigation Channels Reach Designations and Project Area.

widened to 450 feet to provide access to deeper water in the Gulf of Mexico. Issues raised during the Washington review of the 1987 GBANS resulted in a decision by the Assistant Secretary of the Army for Civil Works that a reevaluation study would be performed.

The Houston-Galveston Navigation Channels, Texas, Limited Reevaluation Report (LRR) and Final Supplemental Environmental Impact Statement (SEIS) was completed in November 1995 and made recommendations for project implementation. A copy of the Record of Decision for the SEIS is included in Appendix A. The HGNC Project was authorized under Section 101(a)(30) of the Water Resources Development Act (WRDA) of 1996 and Section 1(a)(2) of the Energy and Water Development Appropriations Act of 2001 (Public Law 106-377).

The authorized navigation portion of the 46-foot HGNC Project consists of an Offshore Reach, which includes the Galveston Entrance and Extended Entrance Channels; the Outer Bar and Inner Bar Channels; Bolivar Roads; Bay and Bayou Reaches, which include the Houston Ship Channel; and the Galveston Channel Reach, which includes the Galveston Harbor Channel. Additional information on the specific authorized limits, depths and widths for each of these reaches is presented in Table 1.

TABLE 1: Approximate Channel Reach Designations for the HGNC Project.

Reach	Reach Elements and Station Numbers	Depth *(Feet below MLLW)*	Bottom Width *(feet)*	Channel Length *(feet)*	Channel Length *(miles)*
Galveston Harbor and Channel portion of the HGNC Project					
Offshore Reach	Outer Bar, Entrance and Extended Entrance Channels Offshore Station (Sta.) 21+753 0 to 76+000	48	800	54,248	10
	Bolivar Roads and Inner Bar Channels Offshore Sta. 0+000 to 21+753	46	800	21,752	4
Galveston Channel Reach	Galveston Harbor Channel (Bolivar Roads to Pier 38) Galveston Channel Sta. 0+000 to 20+000	46	1,133 (max)	20,000	6.1
	Galveston Harbor Channel (Pier 38 to 43rd Street) † Galveston Channel Sta. 20+000 to 22+571	41	1,075	2,571	0.5
Houston Ship Channel portion of the HGNC Project					
Bay Reach	Bolivar Roads to Morgans Point Bay Sta. -0+3.94 to 138+369 ††	46	530	138,373	26
Bayou Reach	Morgans Point to Boggy Bayou Bayou Sta. 0+00 to 684+03	46	530	68,600	13
Approximate Channel Length Authorized for Deepening Under the HGNC Project				302,973	59.6

†This section of Galveston Harbor Channel referred to in this document as the Galveston Harbor Channel Extension was not recommended for deepening in the 1995 LRR project/HGNC Project.

††Bay Sta. -0+3.94 is the same location as Bayou Sta. 0+00; Bay Sta. 138+369 is the same location as Offshore Sta. 0+000

The environmental restoration portion of the authorized HGNC Project consists of the initial construction of tidal marsh habitat and a colonial water bird nesting island through the beneficial use of new work dredged material, and incremental development (deferred construction) of additional marsh habitat over the life of the navigation project through the beneficial use of maintenance materials dredged from Galveston Bay (Figure 2). The Port of Houston Authority (PHA) and the POG are the current non-Federal sponsors. The Bay and Bayou Reaches are the responsibility of the PHA and the Galveston Channel Reach is the responsibility of the POG. Responsibility for the Offshore Reach is shared by both the PHA and POG.

1.3 Purpose and Need

Deepening and widening of the Offshore (48-foot) and Bay and Bayou Reaches (46-foot) of the HGNC Project was completed in 2005; deepening of the Galveston Channel Reach was deferred as the City of Galveston, the non-Federal sponsor at that time, lacked matching funds to perform the work. Environmental restoration features associated with the project that have been completed or are under contract to be completed before the end of 2012 include the colonial water bird nesting island known as Evia Island and over 2,800 acres of tidal marsh that have been built through the beneficial use of new work and maintenance dredged material.

The Port of Galveston assumed the role of non-Federal sponsor from the City of Galveston in 2006 and requested that the deepening project be resumed. The Houston-Galveston Navigation Channels, Texas, Galveston Channel Project LRR, dated May 31, 2007, was prepared to update the economic analysis of the previously recommended and authorized plan. The LRR recommended that the Galveston Harbor Channel be deepened to 46 feet and widened between 650 and 1,133 feet between Bolivar Roads and Pier 38 (Galveston Harbor Channel Sta. 0+000 to 20+000). Deepening of the Galveston Channel was completed in January 2011. The terminal 2,571 foot-long section of Galveston Harbor Channel referred to in this document as the Galveston Harbor Channel Extension was not recommended for deepening in the 1995 LRR project/HGNC Project; the depth of this section remains at -41 feet Mean Lower Low Water (MLLW). At the time of the 1996 WRDA authorization, this remaining 2,571 feet had been evaluated for deepening to 46 feet in the 1995 LRR but was determined to be not economically justified at the time since no portside facilities were in place. In the intervening years, conditions changed and beginning in 2006 portside service facilities began operating and utilizing the 41 foot channel.

1.4 Recommended Plan

The Galveston Harbor Channel portion of the HGNC Project is authorized to a project depth of -46 feet deep MLLW from Station 0+000 to Station 20+000 (generally from Bolivar Roads to the vicinity of POG Pier-38) and -41 feet MLLW from Station 20+000 to Station 22+571

(vicinity of POG Pier-38 west to vicinity of Pelican Island Bridge) (see Table 1); additional dredging below these depths for advance maintenance and allowable over-depth is 3 feet and

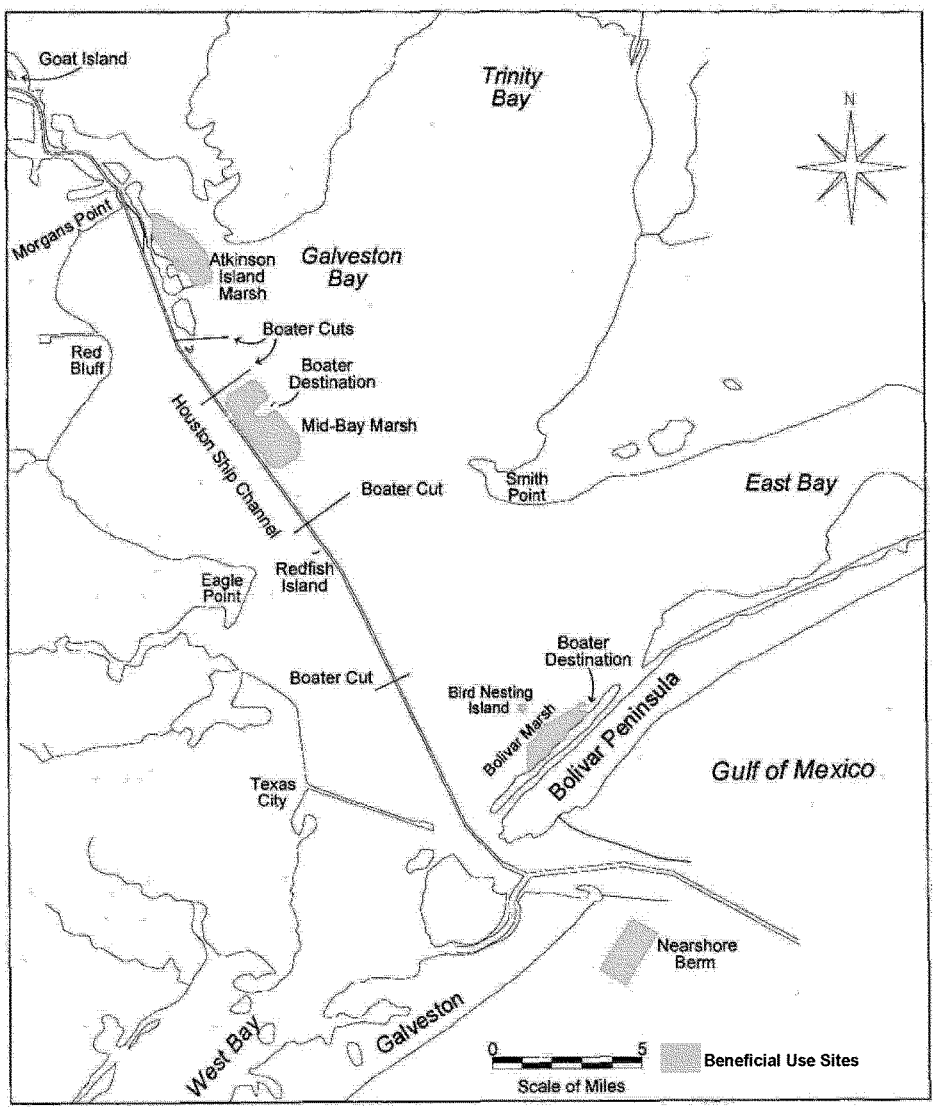

FIGURE 2: Houston-Galveston Navigation Channels Authorized Beneficial Use Sites

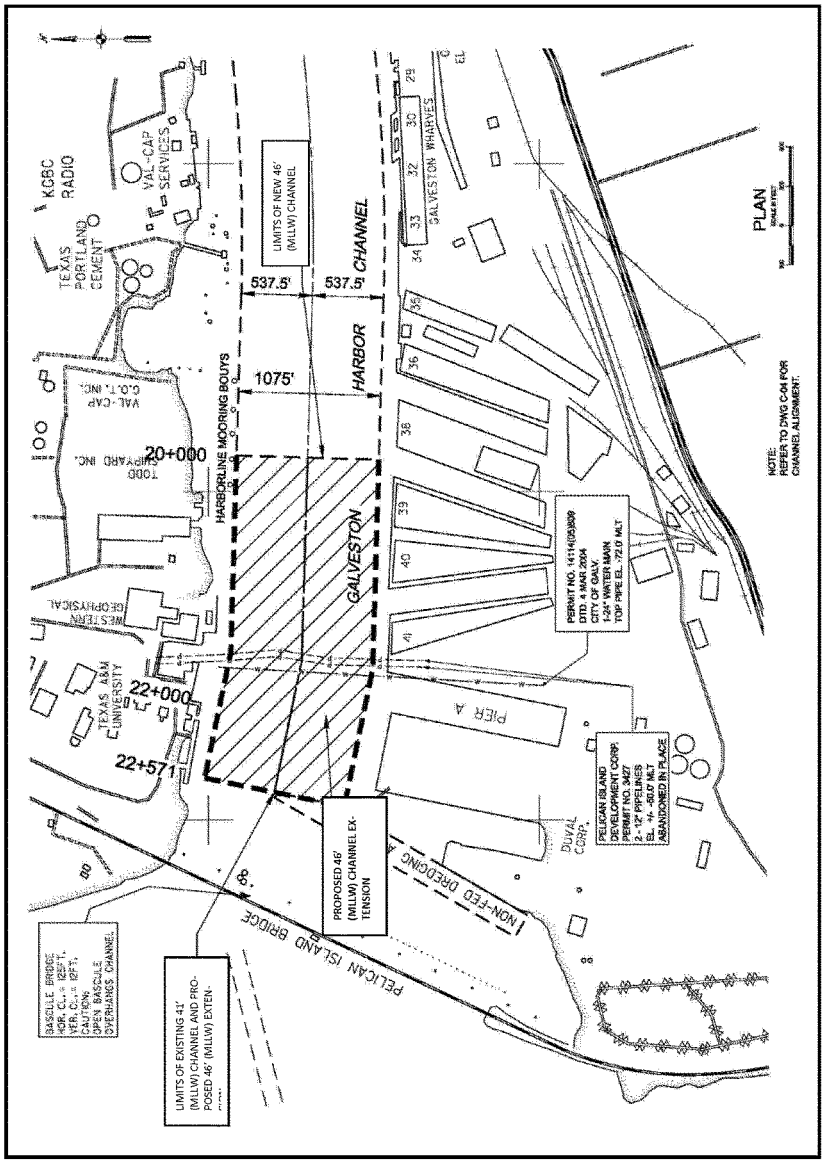

FIGURE 3: Footprint of the Recommended 46-foot Depth Extension of the Galveston Harbor Channel

Channel improvements would be constructed using a cutter head, hydraulic pipeline dredge, from its existing depth of -41-foot MLLW to a depth of -46 feet MLLW to be consistent with the rest of the channel (Figure 4). Advanced maintenance and allowable over-depth would remain at the current requirement of 3 feet and 2 feet, respectively, such that the maximum channel depth following periodic maintenance would not exceed -50 feet MLLW. Side slopes would be constructed at a slope of 1V:3H (1 foot vertical to 3 foot horizontal) and maintained at 1V:2H, which is consistent with maintenance of the remainder of the existing -46-foot MLLW project.

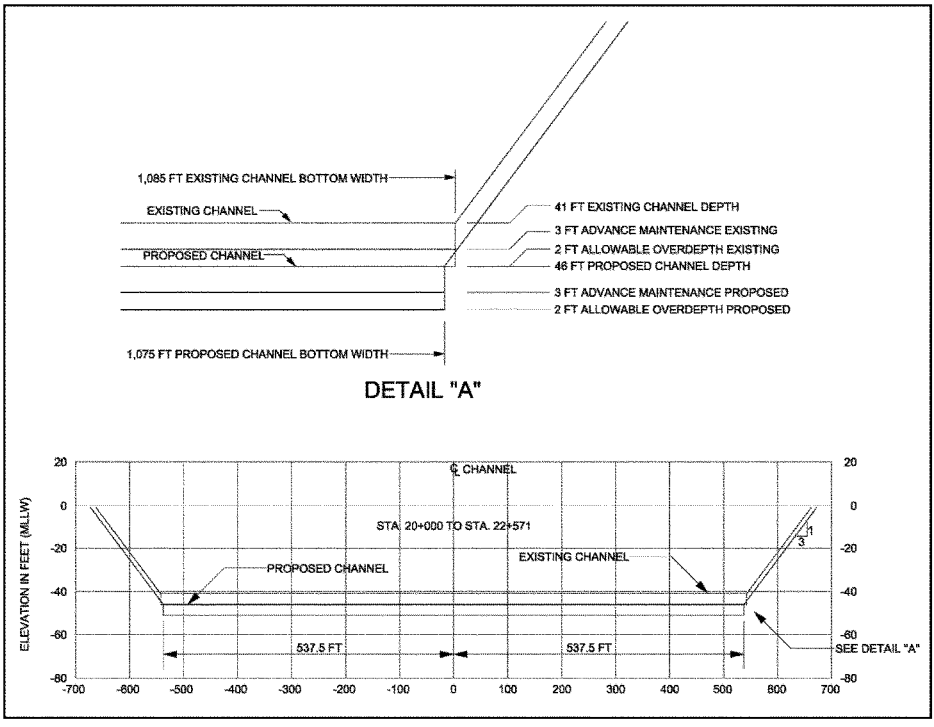

FIGURE 4: Typical Cross Section of Recommended 46-foot Depth Extension within Galveston Harbor Channel

Channel dredging to construct the -46-foot MLLW project would generate 513,800 cubic yards (cy) of new work material, consisting of primarily firm to stiff clays of high plasticity. The dredged material would be placed in the upland confined Pelican Island Placement Area (PA) (Figure 5).

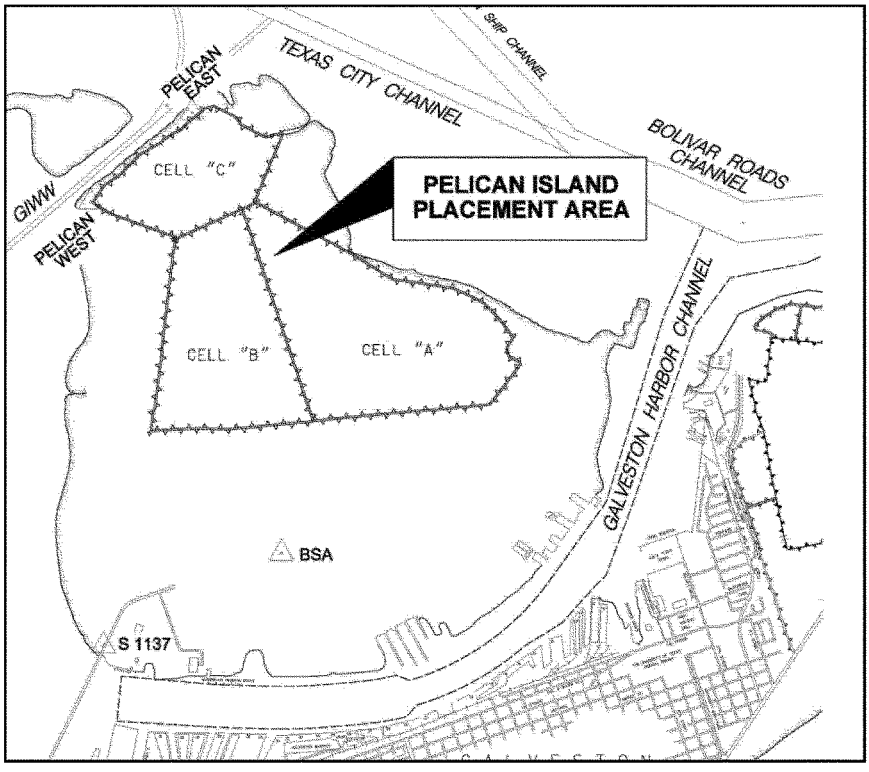

FIGURE 5: Pelican Island Placement Area

Maintenance quantity and frequency from constructing the proposed -46-foot MLLW Galveston Harbor Channel Extension project would be 648,000 cy of material about every four years, which is the same as for the existing -41-foot MLLW portion of the Galveston Harbor Channel. Maintenance material from the channel is primarily stiff clays and silts with lesser amounts of sands. All maintenance material would be placed in the existing upland confined Pelican Island PA, consistent with current practices. Opportunities for beneficial use of dredged material similar to those pursued for the Houston Ship Channel portion of the HGNC Project were considered (see Section 1.1). However, beneficial use was not determined economically feasible for the Galveston Harbor Channel Extension Project because of the high cost and the lack of a non-Federal cost-sharing partner. Therefore, beneficial use will not be implemented. No ocean disposal would be performed for new work dredged material placement.

The construction period for the new work dredging and placement would be approximately 6 months, which includes three months to prepare the PA for placement (i.e. provides for one month of work to prepare the PA and two months for soil settlement) followed by three months to dredge the channel extension and place the material in the PA.

Impacts resulting from project construction would involve only minor temporary impacts to bay bottom comparable in type and magnitude to those experienced during routine maintenance that occurs for the existing channel template. No mitigation would be required for the Recommended Plan.

2.0 ALTERNATIVES CONSIDERED

Both non-structural and structural alternatives were formulated and evaluated to identify the Recommended Plan in accordance with the following planning objectives and constraints:

Planning Objectives:

- Identify an environmentally acceptable project;
- Increase deep-draft navigation efficiency for Galveston Harbor Channel over the 50-year period of analysis; and ,
- Maximize benefits over costs for the period of analysis.

Planning Constraints:

- The study process and plans must comply with Federal and State laws and policies;
- Fish and wildlife habitat affected by a project should be minimized as much as possible and preserved, if possible;
- Alternative plans that resolve problems in one area should not create or amplify problems in other areas; and,
- Project depths in excess of the existing adjacent 46 feet are not necessary or practical.

The following project alternatives, including the No-Action Alternative, were considered for addressing project need and planning objectives:

1. No-Action Alternative (i.e. Future Without-Project Condition)
2. Non-Structural Alternatives
3. Structural Alternatives

The No-Action Alternative is synonymous with the Future Without-Project Condition described in the GHCE PACR and is developed for comparison with all other alternatives. For the structural plans, a variety of channel depths and dredged material placement alternatives were developed, evaluated and screened. A discussion of each alternative is presented in more detail in the following sections.

2.1 No-Action Alternative

The No-Action Alternative is the continued maintenance of the existing 41-foot deep by 1085-foot wide channel segment extending a distance of 2,571 feet between Station 20+000 and Station 22+571. Maintenance dredging of this section is typically performed every four years, to maintain project depth. During each four-year maintenance cycle, approximately 648,000 cy of material is dredged and placed in the existing designated upland confined Pelican Island PA.

Under the No-Action Alternative, deeper draft vessels seeking access to the bulk cargo facilities at the far west end of the channel would continue to be constrained by channel depth, and would continue current practices of light-loading to access and depart these facilities.

2.2 Non-Structural Alternatives

Light-loading of vessels is the only viable non-structural alternative. This alternative is already in use as the No-Action Alternative. Each alternative also assumes some amount of light loading continues to occur.

2.3 Structural Alternatives

The following Structural Alternatives were considered:

1. 43-foot Deep Channel;
2. 44-foot Deep Channel;
3. 45-foot Deep Channel, and
4. 46-foot Deep Channel.

Construction of the 42-, 43-, 44- and 46-foot deep MLLW channel alternatives would involve dredging the bottom width of the existing channel only. The existing channel width is 1,085 feet, whereas, the new bottom widths under each of the deepening scenarios would be smaller, with the minimum bottom width of 1,075 feet occurring under the 46-foot deep MLLW alternative. Project design elements (e.g. channel width, side slopes, advanced maintenance and allowable overdepth), annual maintenance quantities and impacts for all channel deepening alternatives being considered are the same or assumed to be similar. Only the initial dredged quantities generated from the construction of each of the alternatives would vary (Table 2).

TABLE 2: Initial Estimated Construction Dredged Quantities Generated from the Project Alternatives

Channel Alternative	Total Estimated New Work Volume *(cubic yards)*	New Work Federal Channel Dredge Volume *(cubic yards)*	Third-Party Facilities *(cubic yards)*
43-foot Deep Channel Project	255,100	200,400	54,700
44-foot Deep Channel Project	373,233	304,867	68,367
45-foot Deep Channel Project	491,367	409,333	82,033
46-foot Deep Channel Project	609,500	513,800	95,700

For all channel project alternatives considered, deepening of the channel and future maintenance would be performed using a hydraulic pipeline dredge. Side slopes would be constructed 1V:3H (1 foot vertical to 3 foot horizontal) and maintained 1V:2H, which is consistent with maintenance of the remainder of the existing -46-foot MLLW project. The channel bottom widths for all proposed depths would be maintained less than the existing 1085-foot project bottom width. Since shoaling rates at the project location are assumed to be the same as the No-Action Alternative for any of the proposed channel depths, estimated maintenance dredging for each of the proposed channel alternatives would be 648,000 cy every 4 years.

Impacts resulting from implementation of any of the proposed channel deepening alternatives would involve negligible impacts to bay bottom comparable in type and magnitude to those experienced during routine maintenance that occurs for the existing channel template. Based on cross sections of the existing channel template, deepening the project to 46 feet MLLW would result in a channel bottom width of 1,075 feet which would be consistent with the dimensions of the remainder of the authorized Galveston Harbor Channel. Most of the new work dredging would occur across the bottom width channel and toe slope; the maximum increase of the top width on each side would be 7 feet. This increase in top width translates to around 0.8 acre of impact to bay bottom. However, given variations in conditions of channel and elevations of the top of slope dredging will likely widen the side slopes between 4 and 7 feet, or between 0.5 and 0.8 acre. In addition, the current dock owners along the channel routinely dredge their berths, thus the bay bottom adjacent to the channel is also undergoing routine disturbance from channel maintenance and ship traffic as well as maintenance activities to keep the adjacent private berths at required depths. Therefore, any impacts to bay bottom as a result of construction would not be "new", but would be among the cyclical recurring impacts that occur during maintenance of the channel and adjacent berths.

Impacts from the deepening of the Houston Ship Channel to -46-feet MLLW and widening to 460 feet, as well as deepening of the Galveston Harbor Channel to -46-feet MLLW (no widening) have

been described in the 1995 SEIS and 2007 LRR. These reports for the now completed projects included documentation of National Environmental Policy Act (NEPA) compliance; the NEPA documentation concluded that impacts to bay bottom (benthic habitat) that did not support oyster reef were negligible and required no mitigation. The Galveston Harbor Channel Extension involves deepening of only 2,571 feet linear feet of channel to be consistent with the bottom depth of the recently constructed -46-foot MLLW project depth of the Galveston Harbor Channel. The total area of impact for the Galveston Harbor Channel Extension is less than 1 percent of the entire HGNC impact footprint, and no oyster reef is present in this extension. Furthermore, no mitigation was recommended by the U.S. Fish and Wildlife Service (USFWS) in the 2011 Planning Aid Letter (PAL) for this project (included in Appendix B). Therefore, based on past NEPA documentation and coordination, no mitigation would be required for any of the proposed channel deepening alternatives.

2.4 Dredged Material Placement Alternatives

Several dredged material placement alternatives were considered for placing the new work dredged material from the proposed project, including the existing upland confined PA (i.e., Pelican Island PA), a new upland confined PA on Pelican Island, and a new beneficial use site (marsh) located off the west end of Pelican Island (Figure 6).

2.4.1 Upland Confined Placement Alternative – Pelican Island PA

For upland placement, new work material would be placed in the Pelican Island PA, and would be used for raising and repairing levees. Maintenance material from this extension would continue to be placed in the Pelican Island PA.

2.4.2 New Upland PA on Pelican Island

An 81.76-acre tract, located on the north edge of the Galveston Harbor Channel was explored for consideration as a new dredged material upland confined PA. This placement alternative was dropped from consideration due to the high cost to develop the site compared to the relative small placement capacity of the completed PA.

2.4.3 Beneficial Use of Dredged Material Alternatives

Beneficially used new work dredged material would be placed on the west side of Pelican Island for open water marsh creation. Depending on the channel depth alternative considered, between

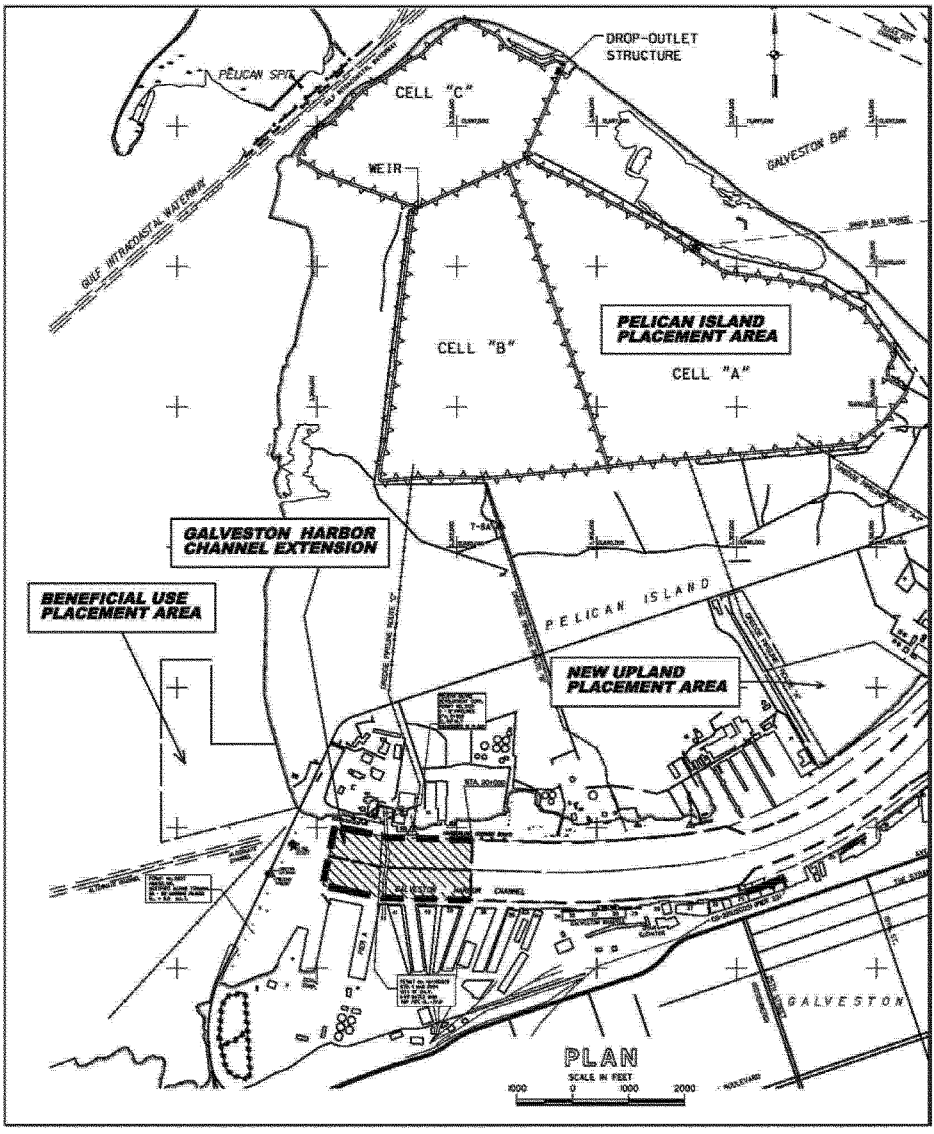

FIGURE 6: Dredged Material Placement Alternatives Considered

200,400 and 513,800 cy of new work dredged material would be generated from project construction and used to create an estimated 48 to 103 acres of open water marsh (Table 3). Maintenance material from the 46-foot deep project channel would continue to be placed in the Pelican Island PA consistent with current practice.

The construction process and design for marsh creation is similar regardless of beneficial use quantity and corresponding marsh size. Marsh construction would entail hydraulically placing new work dredged material from channel deepening to construct a perimeter levee around the north, west and south borders of the beneficial use site to an elevation of +7 feet above the water level at low tide, assuming the average depth to bay bottom along the west side of Pelican Island is around -5 feet MLLW. Construction of a perimeter levee along the east shoreline of the BU site would not be necessary as the site would tie into the existing Pelican Island shoreline. Prior to hydraulically placing material for levee construction, a small quantity of borrow material from bay bottom adjacent to the proposed levee would be excavated to construct the initial levee lift to replace unsuitable soft foundation soils in the levee footprint. Once placed, the perimeter levee slopes would be armored using a combination of geotextile, blanket stone and riprap shoreline protection. This was included in the design of the BU placement alternatives under consideration as the location of the beneficial use marsh has considerable fetch length and water depth which, based on experience with other BU projects in Galveston Bay, would increase erosion potential and threaten success of a newly constructed marsh if shoreline protection was not included. The new work material from the construction of the channel deepening project would be pumped into the marsh site and amphibious equipment would be used to guide the dredge discharge for fairly even placement across the site. Future maintenance material would be added as needed, to manage the target elevations of the marsh design. As a follow up measure, 5-foot deep circulation channels would be constructed inside the marsh cell. Excavated material from construction of the circulation channels would be placed in the eastern area of the marsh near the Pelican Island shoreline. Outlet structures would also be put into place to facilitate dewatering of the site; once target elevations were met, these structures would be removed to establish tidal flow and circulation within the site.

2.5 Screening of Channel and Placement Alternatives

The following screening criteria were identified as important in the formulation and evaluation of possible project alternatives. The Recommended Plan should:

- Identify an environmentally acceptable project;
- Increase deep-draft navigation efficiency for the Galveston Harbor Channel over the 50-year period of analysis; and ; and,
- Maximize benefits over costs for the 50-year period of analysis.

Each alternative was evaluated with respect to meeting the aforementioned screening criteria (Table 4).

The No-Action Alternative is considered environmentally acceptable since it would continue to involve only minor temporary impacts to bay bottom experienced during routine maintenance activities. However, deeper draft vessels attempting ingress and egress to the bulk cargo facilities at the far west end of the channel would continue to be constrained by existing channel depth, and would continue current practices of light-loading to access and depart the bulk cargo facilities. Because of these practices, navigation efficiency and shipping economies of scale would continue to be hampered by insufficient channel depth.

TABLE 3: Construction Elements and Dredged Material Quantities for Beneficial Use Alternatives

Beneficial Use Alternative Marsh Size (acres)	Corresponding Channel Alternative	New Work Dredge Quantity (cy)	Perimeter Levee Borrow Material (cy)	Levee Armoring			5-foot Deep Circulation Channels				Outlet Structure(s)
				Geotextile (square yards)	Blanket Stone (tons)	Rip Rap (tons)	20-foot Bottom Width (lf)	60-foot Bottom Width (lf)	90-foot Bottom Width (lf)	Excavated Volume (cy)	
48	43-foot Deep Channel Project	200,400	121,000	27,000	13,000	35,000	2,600	700	700	50,000	2
66	44-foot Deep Channel Project	304,867	163,438	33,888	16,238	43,066	3,575	960	960	68,750	2
86	45-foot Deep Channel Project	409,333	208,219	40,944	19,619	52,033	4,660	1250	1250	89,600	3
103	46-foot Deep Channel	513,800	253,000	48,000	23,000	61,000	5,200	1,400	1,400	100,000	3

TABLE 4: Alternatives Screening Matrix

Screening Criteria / Channel Alternative[1]	Increase deep-draft navigation efficiency	Be environmentally acceptable	Maximize benefits (BCR)
No-Action Alternative (41-foot Deep Channel)		✓	
43-foot Deep Channel Alternative	✓	✓	
44-foot Deep Channel Alternative	✓	✓	
45-foot Deep Channel Alternative	✓	✓	
46-foot Deep Channel Alternative (NED/ Recommended Plan)	✓	✓	✓

[1] The channel width for all alternatives, including the No-Action Alternative, is the existing authorized width of 1,085 feet associated with the currently authorized -41 feet MLLW depth of this channel segment.

Impacts resulting from any of the proposed channel deepening alternatives would involve only minor temporary impacts to bay bottom habitat comparable in type and magnitude to those experienced in the project footprint during routine maintenance that occurs under the No-Action Alternative to maintain the existing channel template. Therefore, all proposed channel alternatives are considered environmentally acceptable and no mitigation would be required for any of the alternatives.

All channel deepening alternatives would increase navigation efficiency since deeper channels allow larger volumes of goods to be transported with each vessel movement, as light-loaded vessels can be more fully loaded or smaller vessels can be replaced with larger, deeper-draft vessels. However, only the 46-foot Deep Channel Alternative would accommodate fully-loaded deep draft vessel ingress and egress of the Port's bulk terminal facilities located at the end of the channel.

Upon examination of project costs and benefits, it was determined that it would be more cost effective to pump the material to Pelican Island PA than to construct an open water marsh, unless USACE could feasibly cost share marsh creation with the local sponsor or other interested entity. Because pumping to Pelican Island PA is the least cost option, beneficial use of the material will not be pursued unless cost-sharing is feasible. The46-foot channel with the utilization of the existing Pelican Island PA reasonably maximizes economic benefits with the planning objectives and constraints, and is environmentally acceptable; as such it is the NED. From an environmental perspective, the types of impacts and the footprint would essentially remain the same for any of the structural alternatives considered during screening. Therefore the impact analysis in Section 4 of this EA is limited to two alternatives – the No Action and Recommended Plans – as the impacts associated with the smaller plans have been addressed in the analysis of the 46-foot plan.

3.0 AFFECTED ENVIRONMENT

3.1 Description of the Project Area

The project area includes the eastern end of Galveston Island and Pelican Island. Galveston Island is a low-lying barrier island two miles off the Texas coast, approximately 50 miles southeast of Houston, Texas. It was formed as an offshore bar at the beginning of the present sea-level stand, and grew by accretion of sand from littoral drift. Pelican Island was a natural sand-spit that has been expanded substantially by years of disposal of dredged material from the Galveston Harbor and Texas City Channels continuing to the present. The Galveston Harbor Channel is a very active shipping lane providing deep draft vessel access to the POG, an important Texas deepwater port. The channel, including the portion that would be deepened, is lined with various wharfs, docks and commercial and industrial facilities associated with POG operations and other users. Texas City, an important Gulf port city and producer of refined petroleum products, is located approximately seven miles from the project area. The Galveston community has a diversified income base, but jobs are predominantly dependent upon tourism, the POG, commercial fishing, the University of Texas Medical Branch (UTMB), and the American National Insurance Company.

3.2 Climate

The climate of the study area is humid subtropical with warm to hot summers and mild winters. The average annual high temperature is about 76 degrees Fahrenheit, with an average summer high of about 88 degrees for the months of June, July, and August, and an average annual winter low temperature of 66 degrees. Periods of freezing temperatures are infrequent and rainfall averages about 44 inches annually (National Weather Service, 2010). Severe weather occurs periodically in the form of thunderstorms, tornadoes, tropical storms and hurricanes.

3.3 Sea Level Change

3.3.1 Local (Relative) Sea Level Change

Current USACE guidance was used to assess relative sea level change (RSLC) for this GHCE Feasibility Report. USACE guidance (ER 1100-2-8162, December 2014 and Engineer Technical Letter (ETL) 1100-2-1, June 2014) specify the procedures for evaluating and incorporating climate change and relative sea level change into USACE planning studies and engineering design projects.

USACE guidance recommend that projects be evaluated using three different projections of future sea level change, i.e., "low, intermediate, and high," as follows:

- Low – Use the historic rate of local mean sea level change as the "low" rate. The guidance further states that historic rates of sea level change are best determined by local tide records (preferably with at least a 40 year data record).
- Intermediate – Estimate the "intermediate" rate of local mean sea level change using the modified NRC Curve I. The modified curve corrects for the local rate of vertical land movement.
- High – Estimate the "high" rate of local mean sea level change using the modified NRC Curve III. The modified curve corrects for the local rate of vertical land movement.

Additionally, USACE guidance also recommend that RSLC be evaluated at planning horizons other than the one used in the economic analysis, recommending at a minimum, RSLC analysis at 20, 50 and 100 years post-construction.

The recent historic rate of local sea level change can be obtained from local tide records. The tide gage nearest the GCHE is located at Pier 21 in Galveston, Texas (NOAA gage 8771450). The NOAA mean sea level trend at this site (from 1908 to 2013) is equal to 6.35 millimeters (mm)/year with a 95 percent confidence interval of ± 0.25 mm/year. This equates to a rise of 0.42 feet in 20 years. If the estimated historic eustatic (global) rate equals that given for the Modified NRC curves (1.7 mm/year), this results in an observed subsidence rate of 6.35 – 1.7 = 4.65 mm/year.

Utilizing the online sea level calculator referenced in ER 1100-2-8162, estimates of future RSLC were determined. The computed future rates of RSLC in the table below give the predicted low, intermediate, and high estimates of sea level change at the 20-, 50- and 100-year planning horizons.

TABLE 5: Estimated Change in Relative Sea Level over the 100-year (2016-2116) period of analysis for the Low, Intermediate and High Rate Scenarios

Scenario	Year 2036	2066	2116
	Sea Level Rise in feet		
Low Rate	0.42	1.05	2.10
Intermediate Rate	0.54	1.48	3.41
High Rate	0.00	2.86	7.58

3.4 Tides and Salinity

The normal daily mean tidal range in the channel is about 1.4 feet, with larger variations dependent upon the wind. During winter, weather fronts out of the northwest are usually accompanied by strong winds that may depress the water surface as much as 4 feet below mean sea level. At other times of the year, predominantly southerly winds, when coupled with higher than normal tides (i.e. spring tides), may occasionally and temporarily raise surface water elevations of the bay; this effect. Large fluctuations in water surface elevation may also occur during tropical storms and hurricanes (USACE, 1975).

Salinities in the project area averages about 25.5 parts per thousand (ppt), compared to 25 to 30 ppt near Bolivar Roads, which is located approximately 3.5 miles due east of the project area near the Galveston Entrance Channel.

3.5 Vegetation

The project area is located in the Gulf Coast Prairies and Marshes Region that borders the Gulf of Mexico from the Sabine River to Corpus Christi Bay (Gould, 1975). The existing Galveston Harbor Channel reach and the Pelican Island disposal area are located in highly disturbed areas, associated with previous and ongoing maintenance and construction activities related to the existing authorized project.

Because of human disturbance over many decades, habitat types in the project area have been disturbed to the point where original species composition and diversity found prior to major development and industrialization, no longer exist. The channel portion of the project footprint is part of a very active shipping lane that supports numerous industrial and commercial activities, and is devoid of vegetation.

Although the Pelican Island PA is an active confined upland PA, scattered terrestrial vegetation assemblages exist in the vicinity. Typical species include hackberry (*Celtis laevigata*), Bermuda grass (*Cynodon dactylon*), red mulberry (*Morus rubra L.*), palm trees (*Sabal Mexicana, S. texana*), and honey suckle (*Lonicera albiflora*). Invasive species such as Chinese tallow trees (*Sapium sabiferum*), Brazilian pepper (*Schinus terebinthifolius*), salt cedar (*Tamarisk sp.*), and giant reed (*Phragmites communis*) also occur in the vicinity of the PA. However, the current frequency of dredged material placement and related maintenance activities on Pelican Island PA deter the successful establishment and proliferation of these invasive species in the PA.

3.6 Aquatic Nuisance Species

Ballast water discharged from ships may contribute to the introduction and spread of aquatic nuisance species (ANS) from distant ports of call into U.S. waters. ANS are invasive, non-native or exotic species that may displace native species, degrade native habitats, spread disease, and disrupt human social and economic activities that depend on water resources (U.S. Coast Guard (USCG), 2011a). ANS that are known to occur within the study area that may have been introduced as a result of ballast water discharge or boat hull fouling include the Australian jellyfish (*Phylloriza punctata*), the Pacific white shrimp (*Litopenaeus vannamei*), the white crust tunicate (*Didenum perlicidum*), and sauerkraut grass (*Zoobotryon vertcillatum*). Additional information on these ANS species as well as other species of concern for Galveston Bay may be found at http://www.galvbayinvasives.org (Galveston Bay Estuary Program, 2010).

In response to national concerns, the National Invasive Species Act of 1996 (NISA) was reauthorized and amended the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA). Initially a voluntary program beginning in 1998, the USCG established a national mandatory ballast water management program in 2004 to comply with the NISA to prevent the introduction of ANS. The implementing regulations for the program may be found at 33 Code of Federal Regulations (CFR) 151 Subparts C and D. (USCG, 2011b).

The program applies to all vessels equipped with ballast water tanks and requires mandatory ballast water management plans and practices for all vessels that operate in U.S. waters or are bound for ports or places in the United States. Ballast water management practices may include conducting mid-ocean ballast water exchanges, retaining ballast water onboard, or using an alternative environmentally sound ballast water management method approved by the USCG. The program also established requirements for vessels to keep records on all ballasting operations and provide reports records pertaining to ballast water management to the USCG. (USCG, 2011a)

The USCG officer designated as the Captain of the Port (COTP), or a person designated by that officer, for the Port Zone of Houston-Galveston is responsible for ensuring compliance monitoring under the ballast water management program for vessels calling on the POG. To assess compliance of any vessel subject to the ballast water regulations, the COPT may take samples of ballast water and sediment, examine documents, and make other appropriate inquiries. In addition, the master, owner, operator, or person in charge of a vessel, is required to make available to the COTP, upon request, all records pertaining to ballast water management as required by the regulation.

3.7 Wetlands and Aquatic Resources

3.7.1 Wetland Resources

No wetlands or submerged aquatic vegetation occur within the existing footprint of Galveston Harbor Channel, which is a very active shipping lane that supports the POG and its numerous industrial and commercial activities. The Pelican Island PA is an existing active upland confined PA. As a result of the consistent periodic placement of maintenance dredged material into the PA as well as other maintenance activities associated with management of the PA, no persistent stands of wetlands or submerged aquatic vegetation occur within the cells of the PA.

The immediate shoreline located outside of the channel footprint is highly developed with the Texas A&M University at Galveston (TAMUG) campus, commercial dock facilities, and the Pelican Island Bridge surrounding it to the north, south and west. Because of this extensive

commercial development, only a small remnant tidal salt marsh wetland occurs well outside the project footprint, along the northwestern edge of the project area between the Pelican Island Bridge and TAMUG. This small, approximately 4-acre wetland occurs behind a berm of shell hash along the shoreline, but is connected to bay waters through a small tidal inlet channel. The wetland is dominated by saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*), saltwort (*Batis maritima*), sea-ox eye daisy (*Borrichia frutescens*), big leaf sumpweed (*Iva frutescens*) and gulf cordgrass (*S. spartinae*).

3.7.2 Marine Aquatic Resources

Benthic marine organisms are an ecologically important component of the marine resources, serving as a major source of food for many species of fish and shellfish of commercial and recreational importance. Benthic organisms are also primary consumers, feeding on micro-algae and plant detritus, providing an important link in the marine food chain. The most abundant benthic organisms in the project area include annelid worms (polychaetes and oligochaetes), peracarid crustaceans (amphipods and tanaidaceans), and mollusks (bivalves and gastropods) (GBNEP, 1992). Although oyster habitat can be found in the adjacent Galveston Bay estuary, no oyster reef habitat is present in the project footprint. The quality and productivity of the benthic marine habitat within and immediately adjacent to the Galveston Harbor is considered low compared to the overall bay system since the benthic substrate along the channel is highly disturbed due to the frequency of maintenance dredging and the effects of ship traffic (USACE, 1975; USACE 1987). Small free-swimming and benthic marine organisms in the immediate vicinity of maintenance dredging work are caught by the dredge cutter head or pulled into the pipeline by the pump and removed. Recolonization of the benthic community between maintenance cycles is dependent on salinity and temperature as well as the nature of the channel substrate and other environmental parameters related to sediment distribution (Sanders, 1958; Purdy, 1964; White et al. 1985). Since sediment quality does not differ greatly between maintenance cycles, recolonization of the benthic habitat within the channel is more likely due to overall environmental parameters within the bay.

While seagrasses have typically historically flourished in the Galveston Bay System, seagrass beds have nearly disappeared entirely from the area due to human disturbances, hurricane activity, and their limited tolerances to turbidity, deep water, and wave energy. The only remaining natural seagrass beds in the Galveston Bay system occur in Christmas Bay, located over 20 miles west of the project (Sheridan, 2002).

3.8 Wildlife

The project area is located in the Texan Biotic Province (Blair, 1950), and provides some food and shelter for wintering and migrating grassland songbirds. Birds occasionally found in the area include a variety of waterfowl, shorebirds and wading birds, a variety of gulls and terns (*Laridae* family), and herons and egrets (*Ardeidae* family). Other birds that may be found in the area include the brown pelican (*Pelecanus occidentalis)*, white-faced ibis (*Plegadis chihi*), black rail (*Laterallus jamaicensis)*, red-winged blackbird (*Agelaius phoeniceus*), and the marsh hawk (*Circus cyaneus*) (The Nature Conservancy of Texas, 2009).

In addition, Little Pelican Island, which is separated from Pelican Island by the Gulf Intracoastal Waterway (GIWW), has colonial water bird nesting sites that are used by as many as 12 to 15 species of birds, including the brown pelican (CEC Environmental Exchange, 2004). Piping plover (*Charadrius melodus*) are also known to winter along the Texas Gulf Coast on beaches and bayside mud or sand flats.

Mammals potentially found within terrestrial areas in and adjacent to the project area include the hispid cotton rat (*Siomodon hispidus*), the eastern cottontail (*Svlvilaous floridanus*), opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), and feral dogs and cats (The Nature Conservancy of Texas, 2009). The common bottlenose dolphin (*Tursiops truncatus)* is the most abundant, year-round marine mammal inhabiting the waters of project area.

The most common marine reptiles inhabiting bay waters of the project area are the Kemp's ridley sea turtle (*Lepidochelys kempii)* and loggerhead sea turtles (*Caretta caretta*).

3.9 Fisheries and Essential Fish Habitat

In the Gulf of Mexico, essential fish habitat (EFH) consists of those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity of species that are federally managed by the Gulf of Mexico Fishery Management Council (GMFMC) and by the National Marine Fisheries Service (NMFS), pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). By definition, EFH includes those waters and substrate necessary for fish and shellfish spawning, breeding, feeding, and growth through maturity. "Waters" include aquatic areas and associated physical, chemical, and biological properties currently or historically utilized by the fisheries. "Substrate" includes any sediment, hard bottom, structures underlying the waters, and associated biological communities (U.S. Department of Commerce 2007). Those activities potentially impacting EFH may result in either direct (e.g.,

physical disruption) or indirect (e.g., loss of prey species) effects, and can be site-specific, habitat-wide, cumulative, and/or synergistic effects.

The project area is located in Ecoregion 4 and includes EFH designated by the GMFMC for red drum (*Sciaenops ocellatus*), white shrimp (*Litopenaeus setiferus)*, brown shrimp (*Farfantepenaeus aztecus,)* and Spanish mackerel (*Scomberomorus maculatus*). Details regarding specific habitat requirements for each of these species follow in Table 4. The project area also includes EFH for highly migratory species managed by NMFS including: scalloped hammerhead sharks, blacktip sharks (*Carcharhinus limbatus*), bull sharks (*Carcharhinus leucas*), lemon sharks (*Negaprion brevirostris*), spinner sharks (*Carcharhinus brevipinna*), bonnethead sharks (*Sphyrna tiburo*), Atlantic sharpnose sharks (*Rizoprionodon terraenovae*), and finetooth sharks (*Carcharhinus isodon*). EFH in the project vicinity includes estuarine emergent marsh, estuarine mud, sand and shell substrates, and the estuarine water column.

TABLE 6: Habitat Requirements of Species with EFH in the Project Study Area

Species	Location/Distribution
Red Drum	Red drum commonly occur in all of the Gulf's estuaries, but also occur in a variety of habitats, ranging from depths of about 130 feet offshore to very shallow estuarine waters; the GMRMC considers all estuaries to be EFH for the red drum. Estuaries are important for both habitat requirements and for dependence on prey species which include shrimp, blue crab, striped mullet, and pinfish. Schools are common in the deep Gulf waters, with spawning occurring in deeper water near the mouths of bays and inlets and on the Gulf side of the barrier islands. Red drum are associated with a variety of substrate types including sand, mud, and oyster reefs. (GMFMC 2010).
Brown Shrimp	Brown shrimp are most abundant in central and western Gulf of Mexico and found in estuaries and offshore waters to 360 feet with the post-larval individuals typically occurring within estuaries. Post-larval individuals and juveniles are associated with shallow vegetated habitats, but are also found over silty-sand; non-vegetated mud bottoms are preferred. Adults typically occur outside of bay areas in marine waters extending from mean low tide to the edge of the continental shelf and areas associated with silt, sand, and sandy substrates. (GMFMC 2010).
Spanish Mackerel	Pelagic species are found in neritic waters and along coastal areas, inhabiting the estuarine areas; especially higher salinity areas, during seasonal migrations. Spanish mackerel are rare and infrequent inhabitants of Gulf estuaries, where spawning occurs offshore from May to October. Nursery areas are in estuaries and coastal waters year-round. Larvae are found offshore over the inner continental shelf, most commonly in water depths less than 150 feet. Juveniles are found offshore, in beach surf, and occasionally in estuarine habitat; juveniles prefer marine salinity and clean sand substrate. (GMFMC 2010).
White Shrimp	White shrimp are offshore and estuarine dwellers; pelagic or demersal depending on their life stage. Eggs are demersal and larval stages are planktonic, and both occur in nearshore marine waters. Post-larvae become benthic upon reaching the nursery areas of estuaries, seeking shallow water with muddy sand bottoms that are high in organic detritus. Juveniles move from the estuarine areas to coastal waters as they mature. The adults are demersal and generally inhabit nearshore Gulf of Mexico waters in depths less than 100 feet on soft mud or silty bottoms. (GMFMC 2010).
Scalloped Hammerhead Sharks,	Common, large, schooling sharks of warmer waters, migrating seasonally north-south along the eastern coastal and offshore waters of the United States, including the Gulf of Mexico. Neonates may occur in nearshore coastal waters, bays and estuaries of the Gulf of Mexico from Texas to the southern west coast of Florida; Juveniles can be found in coastal areas in the Gulf of Mexico from southern mid-coast of Texas, eastern Louisiana to the southern west coast of Florida and the Florida Keys, and in offshore waters from the mid-coast of Texas to eastern Louisiana. Adults may occur in Coastal areas in the Gulf of Mexico along the southern Texas coast, and eastern Louisiana through the Florida Keys, as well as offshore from southern Texas to eastern Louisiana.
Blacktip Sharks	Blacktips are fast-moving sharks, occurring in shallow waters and offshore surface waters of the continental shelf. Blacktips are viviparous, and young are born in bay systems in late May and early

Species	Location/Distribution
	June after a year-long gestation period. The reproductive cycle occurs every 2 years. Juveniles are found in all Texas bay systems in a variety of habitats and shallow coastal waters from the shore to the 82 foot isobath (NMFS, 2006a). They feed mainly on pelagic and benthic fishes, cephalopods and crustaceans, and small rays and sharks (Froese and Pauly, 2012). Juvenile blacktip sharks occur in the Gulf and estuarine portions of the study area and adults in the Gulf portions of the study area.
Bull Sharks	Bull sharks are coastal and freshwater sharks that inhabit shallow waters, especially in bays, estuaries, rivers, and lakes. They frequently move between fresh and brackish water and are capable of covering great distances. Adults are often found near estuaries and freshwater inflows to the sea (Froese and Pauly, 2012). Bull sharks are viviparous, have a gestation period of a little less than 1 year, and it is assumed the reproductive cycle occurs every 2 years. Juveniles are found in waters less than 82 feet deep in shallow coastal waters, inlets, and estuaries (NMFS, 2006a). They feed on bony fishes, sharks, rays, shrimp, crabs, squid, sea urchins, and sea turtles (Froese and Pauly, 2012). Juvenile bull sharks occur in the Gulf and estuarine portions of the study area.
Lemon Sharks	Feeds mainly on fish but also takes crustaceans and mollusks. (Froese and Pauly, 2012). Occurs on continental and insular shelves, frequenting mangrove fringes, coral keys, docks, sand or coral mud bottoms, saline creeks, enclosed bays or sounds, and river mouths. May enter fresh water. Occasionally moves into the open ocean, near or at the surface, apparently for purposes of migration.
Spinner Sharks	Found on the continental and insular shelves from close inshore to offshore. Makes vertical spinning leaps out of the water as a feeding technique in which the sharks spins through a school of small fish with an open mouth and then breaks the surface. Feeds mainly on pelagic bony fishes, also small sharks, cuttlefish, squids, and octopi. Viviparous. Forms schools. Highly migratory off Florida and Louisiana and in the Gulf of Mexico.
Bonnethead Sharks	Bonnethead sharks can be found on sand or mud bottoms in shallow coastal waters. The bonnethead shark is viviparous, reaching sexual maturity at about 30 inches. The pups are born in late summer and early fall, measuring 12 to 13 inches (Froese and Pauly, 2012). Both juveniles and adults inhabit shallow coastal waters up to 82 feet deep, inlets, and estuaries over sand and mud bottoms (Froese and Pauly, 2012; NMFS, 2006a). They feed mainly on small fish, bivalves, crustaceans, and octopi (Froese and Pauly, 2012). Juveniles and adults occur year-round in the Gulf and estuarine portion of the study area.
Atlantic Sharpnose Sharks	Atlantic sharpnose shark inhabits intertidal to deeper waters, often in the surf zone off sandy beaches, bays, estuaries, and river mouths (Froese and Pauly, 2012). They are viviparous, and mating occurs in June, with a gestation period of about a year (NMFS, 2006a). They feed on fish, shrimp, crab, mollusks, and segmented worms (Froese and Pauly, 2012). Juvenile Atlantic sharpnose shark occur in the Gulf and estuarine portions of the study area.

The MSFCMA established procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. Any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to the consultation provisions of the above-mentioned Act. This EA serves to initiate EFH consultation under the MSFCMA.

The Gulf of Mexico and Galveston Bay also support extensive commercial and recreational fisheries. The Gulf waters in the vicinity of the project support a variety of species of commercial and recreational importance that are typically found within Galveston Bay. Leading commercial fisheries include gulf menhaden (*Brevoortia patronus*), and shrimp, and shellfish fisheries. Galveston Bay is the state's largest estuarine source of seafood, and is one of the major oyster producing areas in the country (GBEP, 2008).

Other commercial and recreational species in the project vicinity may include Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), southern flounder (*Paralichtys*

lethostigma), spot (*Leiostomus xanthurus*), sea trout (*Cynoscion nebulosus*), sand trout (*Cynoscion arenerius*) and striped mullet (*Mugil cephalus*). These species are ubiquitous along the Texas coast with seasonal differences in abundance.

3.10 Threatened and Endangered Species

The USFWS and the NMFS identified the threatened or endangered species in Table 8 as possibly occurring in Galveston County. The bald eagle has been recently delisted but the protections provided by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act remain in effect.

A Biological Assessment (BA) has been prepared that includes information on the distribution and habitat requirements of these species, as well as their occurrence within the project area (see Appendix C). This BA also addresses the proposed project's potential impact on federally listed threatened and endangered species and species of concern. Of these species listed in Table 9, only the brown pelican and the Kemp's ridley and loggerhead sea turtles are known to occur in the project area; however, no nesting sites for brown pelicans or sea turtles are located in the project area. Other species listed in Table 9 that are known to occur in Galveston County are not likely to occur in the vicinity of the project due to lack of suitable habitat or known range limits. There is no designated critical habitat for any of the listed species within the project area.

While suitable habitat for piping plover and red knot occurs along the sandy beach shorelines of the Gulf of Mexico and some dredged material islands along the GIWW in Galveston County, these species are not likely to occur in the vicinity of the project due to lack of suitable habitat. The shorelines along the Galveston Harbor Channel in the vicinity of the proposed deepening of the Galveston Harbor Channel Extension predominantly consist of bulkheads and dock facilities; very small, short stretches of shorelines having shell hash substrates occur to a lesser extent in the project area in areas such as that found at TAMUG Clipper dock area. These areas are continuously disturbed by ongoing maintenance dredging activities, commercial shipping and recreational vessel traffic and other human activities making these areas unsuitable for piping plover.

Table 7
Federally-Listed Threatened and Endangered Species for Galveston County, Texas

Common Name	Scientific Name	Listing Status[1]	
		USFWS[2]	NMFS[3]
INVERTEBRATES			
elkhorn coral	*Acropora palmata*	NA	T
lobed star coral	*Orbicella annularis*	NA	T
mountainous star coral	*Orbicella faveolata*	NA	T
boulder star coral	*Orbicella franksi*	NA	T
REPTILES			
green sea turtle	*Chelonia mydas*	T	T
hawksbill sea turtle	*Eretmochelys imbricata*	E	E
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	E
leatherback sea turtle	*Dermochelys coriacea*	E	E
loggerhead sea turtle	*Caretta caretta*	T	T
BIRDS			
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	NA
red knot	*Calidris canutus rufa*	T	NA
piping plover	*Charadrius melodus*	T w/ CH	NA
MAMMALS			
West Indian manatee	*Trichechus manatus*	E w/ CH	NA
finback whale	*Balaenoptera physalus*	NA	E
humpback whale	*Megaptera novaengliae*	NA	E
sei whale	*Balaenoptera borealis*	NA	E
sperm whale	*Physeter macrocephalus*	NA	E

[1]E = Endangered; T = Threatened; w/ CH = with Federally Designated Critical Habitat; NA = Not Applicable

[2]USFWS, 2016. http://ecos.fws.gov/tess_public/reports/species-by-current-range-county?fips=48167

[3]NOAA/NMFS, 2016. http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/Documents/texas.pdf

3.11 Cultural Resources

The channel deepening portion of the project was previously surveyed as described in the report titled *Underwater Investigations, Houston-Galveston Navigation Channels, Texas Project; Galveston, Harris, Liberty, and Chambers Counties, Texas,* prepared by Espey, Huston, and Associates, and dated 1992. This survey did not identify any significant anomalies within the area of potential effect for this project. Furthermore, the dredging and maintenance of the 41-foot channel depth would have resulted in the destruction of any cultural resource had they been present. The upland PA occurs in an area that was created in modern times. The area of potential effect for the proposed project does not include any cultural resources listed on, eligible for listing on, or currently unevaluated for listing on the National Register of Historic Places.

3.12 Air Quality and Noise

3.12.1 Air Quality

To comply with the 1970 Clean Air Act (CAA) and the 1990 Amendments, the U.S. Environmental Protection Agency (EPA) has promulgated National Ambient Air Quality Standards (NAAQS) for the protection of the public health and welfare with the allowance of an adequate margin of safety. The EPA has set NAAQS for six criteria pollutants: lead, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and particulate matter. Achieving and maintaining compliance with the NAAQS incorporates the effects of population and industrial growth, technology changes, and national or statewide control measures, including state implementation plans (SIP) for complying with NAAQS.

The project area is located within Galveston County, Texas, and is part of an area designated as the Houston-Galveston-Brazoria (HGB) Intrastate Air Control Region (EPA 2007). The HGB was classified as a "severe" nonattainment area for the 1-hour and 8-hour NAAQS for ozone, with an attainment deadline of 2019, and a conformity determination threshold level of 25 tons per year (tpy) for either nitrogen oxides (NO_X) or volatile organic compounds (VOC), which are precursors to ozone formation.

With the promulgation of a new 8-hour ozone standard in 2012, the HGB is designated a "marginal" nonattainment area. Under the new 8-hour ozone standard, a General Conformity Determination would be required for projects emitting more than 100 tpy for NO_X or VOC.

A preliminary air conformity analysis to determine the proposed project's conformity with current air quality standards analysis is provided in Appendix D. The results are summarized in Section 4.12.1.2 of this document.

3.12.2 Noise

Federal and local governments have established noise guidelines and regulations for the purpose of protecting citizens from potential hearing damage and from various other adverse physiological, psychological, and social effects associated with noise. The Federal Interagency Committee on Urban Noise developed land-use compatibility guidelines for noise in terms of day-night average sound level (DNL) (U.S. Department of Transportation, 1980). It is recommended that no residential uses, such as homes, multifamily dwellings, dormitories, hotels, and mobile home parks, be located where the noise is expected to exceed a DNL of 65 decibels (dBA). The DNL is the energy average A-weighted acoustical level for a 24-hour period with a 10-decible upward industrial uses area considered acceptable where the noise level exceeds DNL of 65 dBA. For outdoor activities, the EPA recommends DNL of 55 dBA as the sound level below which there is no reason to suspect that the general population would be at risk from any of the effects of noise (EPA, 1974). Noise-sensitive receptors are facilities or areas where excessive noise may disrupt normal activity, cause annoyance, or loss of business. Land uses such as residential, religious, educational, recreational, and medical facilities are more sensitive to increased noise levels than are commercial and industrial land uses. Noise levels in the study area are elevated, ranging between 58-66 dBA compared to undeveloped areas along the coast, and are affected by bulk facility operations, vessel navigation, and vehicular traffic in the Galveston and Pelican Island areas.

Sensitive receptors within approximately one mile of the project area include TAMUG, Central Middle School, and various churches, businesses (including hotels), and residential neighborhoods.

3.13 Water and Sediment Quality

3.13.1 Water Quality

The Galveston Harbor Channel is situated in West Galveston Bay, which is a classified water body designated Segment 2424 in the Bays and Estuaries category. Water body uses of this segment are: High Aquatic Life Use; Contact Recreation Use; General Use; Fish Consumption Use, and Oyster Waters Use. Inventory data from 2008 indicate the quality of water in the vicinity of the project is generally considered to be good; Aquatic Life Use, Fish Consumption Use, Contact Recreation Use and General Use are fully supported or of no concern for the West Galveston Bay water segment (Texas Commission on Environmental Quality (TCEQ) 2008a). Only Oyster Waters Use was non-supporting as a result of high levels of bacteria (TCEQ, 2008a), which were also attributed to non-point sources associated with urban runoff and storm sewers (TCEQ 2008b), resulting in restrictions on shellfish harvesting in an area adjacent to the Texas City Ship Channel and Moses Lake. (DSHS, 2010 a and b).

Due to concerns regarding the presence of dioxin and polychlorinated biphenyls (PCBs) in fish sampled in Trinity Bay and Upper and Lower Galveston Bays in Chambers, Galveston and Harris Counties, at concentrations exceeding established health assessment guidelines, the Texas Department of State Health Services (DSHS) issued an advisory in July 2008 regarding the consumption of catfish species and spotted seatrout from Galveston Bay, which includes the project area (DSHS, 2008). The DSHS advisory recommends that adults should limit consumption of all catfish species and spotted seatrout caught from these waters to no more than one 8-ounce meal per month; women who are nursing, pregnant, or who may become pregnant and children should not consume catfish or spotted seatrout from these waters.

The most recent USACE water quality data were obtained on samples collected from the Galveston Harbor Channel in the vicinity of the proposed extension in December 2006. Chemical analyses were conducted for a variety of metals, pesticides, polycyclic aromatic hydrocarbons, and other organic compounds. These data indicate that, in general, the water quality is good. The 2006 data show that detected contaminant levels in all ambient water samples were below applicable EPA Water Quality Criteria, and Texas Surface Water Quality Standards (PBS&J, 2007).

A review of the National Response Center web page (NRC, 2009) was also conducted. Records for the past three years did not reveal any reports of significant chemical or petroleum spills in the project vicinity. But there were several incidences of minor spills of hydraulic oil, diesel fuel, drilling mud, or unknown sheens. These releases were either secured or left to dissipate, as appropriate.

Elutriate data were also acquired in 2006. The elutriate test was designed to simulate the process of hydraulic dredging and is used to predict any potential for resuspension of contaminants (e.g. heavy metals, polycyclic aromatic hydrocarbons, PCBs, pesticides and other organics) into the water column during dredging. The elutriate is prepared by creating a slurry, which is then agitated to determine if contaminants associated with the sediment particles are re-suspended into the water column. These data show that detected contaminant levels in elutriate samples were below all applicable Texas Surface Water Quality Standards and EPA Water Quality Criteria.

3.13.2 Sediment Quality

The most recent USACE sediment quality data were obtained on samples collected from the Galveston Harbor Channel in the vicinity of the proposed extension in December 2006. The sediment quality data are based on analyses of composite samples comprised of subsamples collected perpendicular to the centerline of the channel. There are no EPA quality criteria for

sediments, so comparisons with sediment quality screening guidelines (Buchman, 1999) were made. Based on these comparisons, the channel sediments in the Galveston Harbor Channel are considered to be non-hazardous. Additionally, suspended particulate phase bioassays, solid phase bioassays, and bioaccumulation assessments were conducted on these sediments. This testing confirms that there is no reason to believe that contaminant issues would arise because of sediment quality (PBS&J, 2007).

Sediments that collect in the Galveston Harbor Channel Project between dredging cycles have been regularly sampled for grain-size characteristics since the early 1990's. The historical average sediment grain size is given in Table 10 below. The sediments in these channel reaches are primarily stiff to hard plasticity clays and silts with a small sand fraction. The D_{50}, which gives the median grain size, indicates an overall particle size characteristic of medium silt.

TABLE 8: Sediment and Grain Size Analysis

Project Segment	Average Composition (%)			D_{50} (mm)
	Sand	Silt	Clay	
Galveston Harbor Channel	14.4	42.6	43.0	0.029

3.14 Hazardous, Toxic, and Radioactive Waste

A Hazardous, Toxic, and Radioactive Waste (HTRW) assessment of lands and water resources in and adjacent to the project area was performed by USACE Galveston District in June, 2010. The objective of this assessment was to identify the existence of potentially hazardous sites or facilities, hazardous contamination, and materials of concern that could impact or be impacted by the proposed project. The HTRW assessment was conducted in general accordance with procedures described in the USACE guidance document ER 1165-2-132, "Water Resources Policies and Authorities-Hazardous, Toxic and Radioactive Waste Guidance for Civil Works Projects", ASTM E 1527-05 Standard Practice for Environmental Site Assessments: Phase I ESA Process, and EPA Standards and Practices for All Appropriate Inquires, 2005. Findings and recommendations presented in this assessment are based on field reconnaissance, interviews, a regulatory agency review, historic archives, and a review of site history through examination of historic aerial photographs. Aerial photographs show project area changes such as: shifting and filling in of docks, numerous finger-pier additions and removals, modifications to Port access roads, all consistent with a growing Port industrial complex. One of the most

notable changes within the project area was the construction of Pelican Island PA, and its changing configurations. Aerial photographs did not reveal any additional sites of interest, beyond those identified by the regulatory agency review.

As part of this assessment, a site visit was conducted within the project area. No visual signs of environmental contamination or recognized environmental conditions, including spills or illegal waste disposal, were observed during the site inspection.

The regulatory agency review examined the following databases: National Priority List (NPL); Comprehensive Environmental Response Compensation, and Liability Information System (CERCLIS); No Further Remedial Action Planned (NFRAP); Resource Conservation and Recovery Information System - Treatment, Storage and Disposal Facilities (RCRA TSD); Resource Conservation and Recovery Information System – Corrective Action Sites (RCRA COR); Resource Conservation and Recovery Information System - Large and Small Quantity Generators (RCRA GEN); Emergency Response Notification System (ERNS); State Sites (e.g., Texas Commission on Environmental Quality Voluntary Cleanup Program Site Listing [TXVOL], Innocent Owner/Operator Program [IOP] and State Superfund Sites); City/County Solid Waste Landfills (SWL); Texas Spills Incident Information System (TXSPILL); Texas Industrial Hazardous Waste Notice of Registration (IHW NOR); Registered Above Ground/Underground Storage Tanks (AST/UST); and, Leaking Underground Storage Tanks (LUST).

A supplemental regulatory agency review was conducted by the Galveston District, which examined the following databases: Texas National Resource Information System (TNRIS), which includes oil/gas well and pipeline data from the Texas Railroad Commission, EPA's Envirofacts Data Warehouse, and other in-house data archives from the USACE Information Management Office. Although the assessment of oil/gas wells and associated pipelines are not required by USACE guidance (ER 1165-2-132), these sites were investigated in exercising due diligence and prudence regarding potential environmental impacts, relocation issues, or impacts to engineering design and construction activities. The regulatory review identified the following sites and environmental incidents, within the project area vicinity.

Regulatory records indicated 85 ERNS incidents (or spills) had occurred within a 0.25-mile of TAMUG, Galveston Terminals Inc, and other marine terminals and marina facilities along or within the vicinity of the Galveston Harbor Channel. These releases ranged from known and unknown sheens, a cup of paint, petroleum spills up to 30 barrels, and individual releases of fogging agents approaching 25 gallons. Media affected by these releases included air, land, and harbor and waterway areas.

One LUST, which previously stored unspecified petroleum products at Magcobar Minerals Division; two LUSTs for gasoline storage currently removed from the ground at TAMUG; and two ASTs, one that stored gasoline and the other diesel were identified. These sites were located within 0.43, 0.25, and 0.25 miles, respectively, of the project area. Releases from the ASTs were captured by concrete secondary containment structures and no media was impacted.

Eight TXSPILL releases were identified within 0.25 mile of the project area. Six of these incidents are associated with Vulcan Machine and Boiler Works (Vulcan). Vulcan released 0.5 gallons of hydraulic fluid and one gallon of diesel fuel to the water, 50 gallons of fogging spray to land and water media, and produced an oil sheen. All releases except the hydraulic fluid, fogging agent, and sheen were reported as having a completed cleanup status. The remaining two releases occurred at the Galveston Terminals. The terminals spilled five gallons of diesel and 30 barrels of #5-fuel oil to the water. The cleanup for all spills has been completed.

No oil/gas wells or petroleum pipelines were identified in the project area. However, one water and one sewer pipeline line were identified in the vicinity of Stations 21+500 and 21+550. No other sites of concern were identified by the regulatory review.

3.15 Socioeconomics

The City of Galveston's economy is characterized by a predominance of jobs in the retail and service sectors, a large in-commuting population, and an important tourism industry. Although Hurricane Ike took a heavy toll on Galveston in 2008, economic activities for the City of Galveston are still highly dependent on the POG, the University of Texas Medical Branch (UTMB), American National Insurance Company Headquarters, Federal agencies, and the tourist industry. Interest in tourism activities is still a growing trend in the Galveston area (Galveston Chamber of Commerce, 2010). Over the last two decades the tourism industry has seen the largest increase from 7 percent in 1990 to 20 percent in 2008 (CDM, 2010).

The POG is equipped with facilities to handle various cargo types including containers, dry and liquid bulk, break bulk, RO/RO (roll-on/roll-off of cargo), refrigerated and project cargoes. The principal cargoes at the POG are agricultural products such as grains, vegetables, fruit, and commercial cargoes to include sulfur, timber, and various other building materials. The Port also has a cruise-liner passenger terminal, and is the year-round homeport to two Carnival Cruise Line vessels.

Prior to Hurricane Ike in 2008, U.S. Census estimates showed the City's population was around 52,821 people, though more current data from the 2008 Texas State Demographer shows the population was around 59,000 (CDM, 2010). As a result of the storm, as much as 20 percent of

the population was displaced reducing the number of persons living in the City to an estimated 48,410 people. The City had been growing at a slow annual rate of 0.4 percent from 2000 to 2008; however, this growth has been largely outpaced by the rest of Galveston County whose annual growth rate was 5.5 times greater during the same period. There are 22,695 households living in the City of Galveston. The City's average household size is 2.2 and the average family size is 2.9. These are slightly lower than the average household and family sizes of Galveston County, which are 2.6 and 3.2, respectively. The 2008 median age of persons living in the City of Galveston and Galveston County was 36.5 and 36.2 years, respectively, compared to a median household income of $46,846 and $69,016.

In the months preceding Hurricane Ike the unemployment rate had been steadily increasing due to broader economic conditions. Immediately following the storm, unemployment spiked to 9.7 percent. The damage forced many businesses to close and some employers have not returned to pre-storm capacity. As of February 2010, 24,210 persons living in the City of Galveston were employed, which is an employment gain of 470 persons since 2005. Despite this, an increasing unemployment rate, currently around 8.1 percent, persists due to the labor force increasing faster than employment. In addition, the City of Galveston currently supports an estimated 35,000 jobs indicating that a significant number of jobs are being filled by people who do not live in the City.

3.16 Environmental Justice (EJ)

In compliance with Executive Order (EO) 12898, Federal Action to Address Environmental Justice in Minority and Low-Income Populations, an analysis was performed to determine whether the proposed project would have a disproportionately adverse impact on minority or low-income population groups in the vicinity of the project area. Low-income persons are defined as "a person whose household income is at or below the Department of Health and Human Services (HHS) poverty guidelines." The 2008 HHS poverty guideline for a family of three is $17,163. This analysis consisted of determining characteristics of residential populations in the project area.

The socio-economic characteristics of the City of Galveston compared to Galveston County are presented in Table 11. Prior to Hurricane Ike in 2008, the City of Galveston had a population of 52,821 living in 22,695 households. The racial makeup of the city was 67.5 percent White, 20.3 percent African American, 0.9 percent Native American, 3.1 percent Asian, 6.1 percent other, and 2.1 percent from two or more races. Of the total population, 28.0 percent were of Hispanic or Latino origin. With the 2008 poverty threshold for a family of three at $17,163, the median family income in the City was 2.65 times the poverty threshold while in the County

was four times the poverty threshold. Approximately 18 percent of families in the City live below the poverty line compared to 10 percent in the County (CDM, 2010).

TABLE 9: Socio-Economic Characteristics in the City of Galveston and Galveston County from 1990 to 2008

	City of Galveston			Galveston County		
	1990	2000	2006-2008	1990	2000	2006-2008
Population	59,070	57,247	52,281	158,329	192,911	230,541
Median Age	---	35.5	36.5	---	35.9	36.2
Households	24,157	23,842	22,695	57,294	70,941	84,225
Average Household Size	2.4	2.3	2.2	2.6	2.6	2.6
Median Family Income	$25,559	$34,049	$46,485	$35,413	$51,435	$69,016
Families Below Poverty Level	20.0%	17.8%	18.4%	12.5%	10.1%	9.8%
High School Graduate	9,448	9,249	9,143	29,127	33,389	41,042
Bachelor's Degree	4,331	4,897	5,518	12,670	18,827	25,849

Source: CDM (2010)

3.17 Prime and Unique Farmlands

Prime farmland soils are defined by the Secretary of Agriculture in 7 CFR, Part 657 (Federal Register, Vol. 43, No. 21) as those soils that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. The soil quality, growing season, and moisture supply are available to economically produce sustained high yield of crops when treated and managed, including water management, according to acceptable farming methods. Some soils are considered prime farmland in their native state, and others are considered prime farmland only if they are drained or watered well enough to grow the main crops in the area.

The project area consists of a deep-water navigation channel and adjacent marine industrial and commercial industries. The proposed footprint of the channel deepening project does not include land or soil suitable for agricultural activities. Based on the Soil Survey of Galveston County, Texas (Soil Conservation Service, 1988), soils within the Pelican Island PA are classified in the Ijam soil series, which consists of soils formed in materials dredged from bay and canals. According Soil Survey Geographic Database (SSURGO) information acquired from the Natural Resources Conservation Service (NRCS) (2011), soils within the Ijam series are not considered prime farmlands. Furthermore, Ijam soils are not suitable for crop production or pasture due to salinity (Soil Conservation Service, 1988).

3.18 Recreational Resources

Tourism is a major contributor to the project area economy. Development of the area as a recreational area relates to its proximity to the population of the Houston-Galveston metropolitan area, its many miles of beaches, and favorable climate. Fishing and boating are the most important recreational activities in the project area. Other forms of recreation common to the area are water and jet skiing, surfing, bird watching, swimming, and beach combing (among others). Many charter vessels are available along the docks in Galveston for those desiring deep sea or bay fishing, and several private and public marinas, boat launching ramps, bait camps, and yacht and sailing clubs are located in the vicinity of the project area. Major public recreational facilities include county parks, public beaches, Galveston Island State Park, and Seawolf Park on Pelican Island. In 2007 alone, an estimated 5.4 million tourists visited the City of Galveston. Through purchases on such travel-related expenses as lodging, dining, and entertainment, tourists were directly responsible for spending more than $561 million in the City of Galveston in 2007, and tourism was directly responsible for approximately 9,300 jobs in the city (Angelou Economics, 2008).

3.19 Roadways and Traffic

Major roadways within the project area include State Highway 87 (SH-87) and Highway 275, which directly service the POG. SH-87 is a major local artery providing mainland access to the POG, the State Marine Highway Ferry system, and to communities such as Bolivar, Anauhac, and Beaumont via the ferry system. Both roadways are used by commercial, tourist, and local traffic, and connect to Interstate Highway-46, a major corridor connecting Galveston Island directly to the City of Houston some 50 miles to the north, and to the Interstate system.

Vehicular traffic consists of a mixture of local area and urban residents, commercial and industrial vehicles associated with the Port industries, and tourism. Various railway connections also serve the POG and the City of Galveston.

3.20 Aircraft Wildlife Strikes

A Memorandum of Agreement (MOA) was executed among the Federal Aviation Administration (FAA), the U.S. Air Force, the U.S. Army, EPA, USFWS, and the U.S. Department of Agriculture (USDA) to address the potential for aircraft-wildlife strikes throughout the United States, when considering proposed projects that may become an attractant to wildlife deemed hazardous to aircraft. In accordance with the FAA Advisory Circular 150/5200-33B and the MOA with the FAA to address aircraft-wildlife strikes, the USACE must take into account whether features of a proposed project (e.g. dredged material placement, BU features, or mitigation) could increase these wildlife hazards. The FAA recommends minimum separation criteria for land-use practices that attract hazardous wildlife to the vicinity of airports. These criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or air operations area (AOA).

These separation criteria include:

Perimeter A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest AOA.

Perimeter B: For airport serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest AOA.

Perimeter C: Five-mile range to protect approach, departure and circling airspace.

The only airport in the near vicinity of the study area is the Scholes International Airport. The study area and the existing Pelican Island PA meet the standard minimum separation criteria for Perimeters A and B surrounding the AOA of Scholes International Airport. However, the study area and Pelican Island PA are both located within the 5-mile radius of the Scholes International Airport approach, departure and circling airspace (Perimeter C). While the Pelican

Island PA could pose potential attractant to wildlife deemed hazardous to aircraft (i.e. waterfowl), it has been a long-time existing active upland confined PA used on a reoccurring basis for the placement of dredged material during routine maintenance dredging of the existing Galveston Harbor Channel.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Project Area

This section provides a discussion of the environmental impacts associated with both the No-Action and the Recommended Plan. From an economic perspective, there are differences among the channel depths considered in the economic analysis in terms of the amount of material to be placed. However, from an environmental perspective, the types of impacts and the footprint would essentially remain the same. Therefore, the impact analysis is limited to two alternatives, as all of the impacts are covered by the analysis of the 46-foot plan (the preferred plan).

4.1.1 No-Action Alternative

No construction activities would be associated with the No-Action Alternative. The No-Action Alternative is the continued maintenance of the existing -41-foot MLLW by 1085-foot wide channel segment extending between Station 20+000 and Station 22+571. Maintenance dredging would continue to be approximately 648,000 cy about every 4 years. Maintenance material would continue to be placed in the existing, designated upland confined Pelican Island PA.

Under the No-Action Alternative, deeper draft vessels seeking access to the bulk cargo facilities at the far west end of the channel would continue to be constrained by channel depth, and would continue current practices of light-loading to access and depart these facilities.

4.1.2 Recommended Plan

The Recommended Plan would involve deepening of the -41-foot MLLW portion of the currently authorized Galveston Harbor Channel between Station 20+000 and 22+571 to a depth of -46-feet MLLW plus two-feet of allowable over-depth and three-feet of advanced maintenance; all material will be placed into the Pelican Island PA. The bottom width of the proposed channel extension would be reduced to 1,075 feet, consistent with the remainder of the existing -46-foot MLLW portion of the Galveston Harbor Channel. The estimated maintenance dredging for the Recommended Plan would be the same as the No-Action Alternative (i.e. 648,000 cy every 4 years) since shoaling rates at the project location are assumed to be the same.

Under the Recommended Plan, deeper draft vessels accessing bulk cargo facilities at the far west end of the channel would not be constrained by channel depth; as such the vessels could be more fully-loaded. Thus, the Recommended Plan would provide for more efficient movement of deep-draft vessels transporting commodities along the waterway to and from these facilities.

4.2 Sea Level Rise

Current USACE guidance was used to assess relative sea level change (RSLC) for this GHCE Feasibility Report. USACE guidance (ER 1100-2-8162, December 2014 and Engineer Technical Letter (ETL) 1100-2-1, June 2014) specify the procedures for evaluating and incorporating climate change and relative sea level change into USACE planning studies and engineering design projects. Utilizing the online sea level calculator referenced in ER 1100-2-8162, estimates of future RSLC were determined (Table 6, section 3.3.1).

4.2.1 No-Action Alternative

The affects of RSLC (relative sea level change) would occur nearly uniformly throughout the bay, as the average sea level rise would be the same at various locations. However, tidal amplitude would be altered, increasing over existing conditions in the upper reaches of Galveston Bay. This is likely due to the decrease in energy lost to bottom friction caused by the increased water depth in the bay as sea level rises.

If the highest rate of sea level rise occurs, much of the shoreline habitat of Galveston Bay may be altered. Some of the potential impacts may include:

- Present wetland areas would be largely inundated;
- New wetlands would only occur in areas where the shoreline is unaltered by bulkheads or development;
- Increased tidal amplitude may result in increased current velocities, resulting in increased erosion at the shoreline fringe;
- The increased depth may reduce the wind-wave shear at the bay bottom, and hence reduce the re-suspension of fine sediment.

Thus, under conditions of the highest rates of predicted RSLC, there would likely be considerable impacts to the bay-wide environment. However, if the eustatic rate of sea level rise is lower than the highest predicted rate, or if the rate of subsidence is decelerating relative to the historic rates observed at the tide gage, then many of the potential effects of RSLC discussed here would likely be mitigated.

Although the bay environment may be affected, RSLC will not contribute any significant impacts on the actual project. Potential impacts include increased currents within the navigation channel and less re-suspension of sediment which could increase shoaling within the channel. However, these impacts will be minimal and there will be no significant difference between the No Action and the Recommended Plan.

4.2.2 Recommended Plan

No difference in water levels between the No Action and Recommended Plans is likely. Thus, the impacts of RSLC would be similar in nature and scope to those described for the No Action Plan. RCLC is not expected to have a significant impact on dredging frequency, shoaling or ship handling.

4.3 Tides and Salinity

4.3.1 No-Action Alternative

Under the No-Action alternative, tidal amplitude may increase in the bay as a result of increase overall water depth associated with RSLC (refer to Section 4.1). With respect to salinity, hydrodynamic salinity studies show that the water column within the project area is well mixed, indicating that any salinity variation that may occur due to channel deepening is likely to be relatively small.

4.3.2 Recommended Plan

As stated under conditions of RSLC (Section 4.2.2), there would be relatively no difference in water levels between the No Action and Recommended Plans. Thus, tidal amplitude would remain unchanged under the Recommended Plan. With respect to salinity, hydrodynamic salinity studies show that the water column within the project area is well mixed, indicating that any salinity variation that may occur due to channel deepening is likely to be relatively small.

4.4 Vegetation

4.4.1 No-Action Alternative

Pelican Island Cell B is part of an active upland confined PA, While terrestrial plants, including invasive species like Chinese tallow and Brazilian pepper, tend to occur on disturbed lands such as PAs, the high salinity of dredged material sediments and the frequency of dredged material

placement on Pelican Island PA and related maintenance activities are deterrents to successful establishment of terrestrial vegetation.

4.4.2 Recommended Plan

No changes in the nature of dredged material, the frequency of dredged material placement, and the related maintenance activities will result from the implementation of the Recommended Plan. Therefore, no impacts to terrestrial vegetation are anticipated.

4.5 Aquatic Nuisance Species

4.5.1 No-Action Alternative

Vessel ballast water discharges or exchanges in coastal waters have the potential to introduce ANS. To minimize this potential threat, all vessels calling on the POG must comply with established USCG regulations that: (1) require mandatory ballast water management practices for all vessels that operate in U.S. waters, (2) establish additional practices for vessels entering U.S. waters after operating beyond the extraterritorial economic zone, and (3) require the reporting and recordkeeping of ballasting operations by all vessels.

4.5.2 Recommended Plan

Deepening the existing channel would not result in an increase in the number of vessels, but would allow vessel operators and shippers already using the channel to fully realize the economies of scale of fully loaded vessels instead of light-loading cargo in response to channel depth constraints. Therefore, the threat of introducing invasive aquatic species as a result of the channel deepening project is minimal.

4.6 Wetlands and Aquatic Resources

No wetlands or submerged aquatic vegetation exists in the project area. Therefore, these resources would not be impacted.

4.6.1 No-Action Alternative

No wetlands or submerged aquatic vegetation exists within the existing Galveston Harbor Channel. The Pelican Island PA is an existing active upland confined PA. As a result of the consistent periodic placement of maintenance dredged material into the PA as well as other maintenance activities associated with management of the PA, no persistent stands of wetlands or submerged aquatic vegetation occur or are expected to establish within the cells of the PA.

4.6.2 Recommended Plan

The No wetlands or submerged aquatic vegetation exists within the footprint of the propose Alternative. The frequency of dredged material placement and the related maintenance activities for the Recommended Plan would be the same as under the No Action Alternative. Therefore, no impacts to wetlands or aquatic resources are anticipated.

4.7 Marine Aquatic Resources

4.7.1 No-Action Alternative

Maintenance dredging of the existing -41-foot MLLW portion of the Galveston Harbor Channel routinely displaces approximately 81 acres of marine benthic channel bottom. The benthic habitat within and adjacent to the channel is highly disturbed due to the frequency of maintenance dredging operations and ship traffic. Therefore, it is expected that productivity of bottom dwelling organisms in this area is quite low compared to the overall bay system (USACE, 1975; USACE 1987), as maintenance activities may disturb and remove small free-swimming and benthic marine organisms in the immediate vicinity of the dredging work that are caught by the dredge cutter head or pulled into the pipeline by the pump. Most free-swimming organisms will not be impacted, since they are able to avoid the slow moving cutter head. Limited recolonization of the benthic community between maintenance cycles is expected to occur since the substrate and other environmental parameters related to sediment distribution that in turn affect invertebrate distribution do not differ greatly between maintenance cycles. As such, impacts to the existing low quality marine benthic population that occurs during maintenance dredging is minor and temporary.

4.7.2 Recommended Plan

Based on cross sections of the existing channel template, deepening the project by 5 feet to a maximum depth of 46 feet MLLW would result in a reduction in the channel bottom width to 1,075 feet, consistent with the remainder of the authorized channel project. Most of the new work dredging would occur at the toe of the channel slope and would only increase the top width on each side by a maximum of 7 feet. This increase in top width translates to around 0.8 acre of impact to bay bottom. However, given variations in conditions of channel and elevations of the top of slope dredging will likely widen the side slopes between 4 and 7 feet, or between 0.5 and 0.8 acre. In addition, the current dock owners along the channel routinely dredge the berths adjacent to the channels, thus the bay bottom adjacent to the channel is also undergoing routine disturbance from channel maintenance and ship traffic as well as maintenance activities to keep the adjacent private berths at required depths. Thus any impacts to bay bottom as a result of construction would not be "new", but would be among the cyclical recurring impacts that occur during maintenance of the channel and adjacent berths under the No-Action scenario.

Since, no new permanent effects to invertebrates and benthos would occur as a result of the project, no mitigation would be required for this alternative.

4.8 Wildlife

4.8.1 No-Action Alternative

The existing navigation channel is located in a highly disturbed commercial port. Maintenance dredging of the existing channel results in temporary, minor disturbances to wildlife that may occur in the project area. Channel deepening would occur within the footprint of the existing project, which undergoes periodic maintenance dredging activities. Maintenance dredging produces disturbances similar to those expected from the work being proposed. Any temporarily displaced wildlife would have suitable habitat immediately available to them in the project vicinity. For these reasons, the proposed action is not expected to adversely affect wildlife.

4.8.2 Recommended Plan

Proposed dredging to deepen the channel would be undertaken in a highly disturbed commercial area of an existing navigation channel. The proposed project would result in temporary, minor disturbances to wildlife in the project area during construction. The channel deepening would occur within the footprint of the existing project, which undergoes periodic maintenance dredging, and would produce disturbances similar to wildlife resources similar to those incurred by wildlife during maintenance dredging activities. Temporarily displaced wildlife would relocate to available suitable habitat located immediately in the project vicinity as they do during routine maintenance dredging of the existing channel. For these reasons, the proposed action is not expected to adversely affect wildlife.

4.9 Fisheries and Essential Fish Habitat

4.9.1 No-Action Alternative

Fish within the project vicinity would continue to avoid direct dredging impacts from continued maintenance dredging of the exiting channel by swimming away from the disturbance. While maintenance dredging would periodically increase turbidity levels in the estuarine water column, these impacts would be minor in nature and of short duration, resulting in no adverse effects to EFH or fisheries.

4.9.2 Recommended Plan

The impacts of construction dredging on fish would be similar to those experienced under the No-Action Alternative. Fish within the project vicinity would swim out of the area avoid direct dredging impacts. Construction dredging to deepen the channel would result in temporarily increases in turbidity levels in the estuarine water column similar to levels experience during routine maintenance dredging. These impacts would be minor in nature and of short duration, resulting in no adverse effects to EFH or fisheries.

4.10 Threatened and Endangered Species

4.10.1 No-Action Alternative

Under the No-Action Alternative, no construction activities would occur and threatened and endangered species would not be affected. Routine channel maintenance activities and placement of dredged maintenance material within the existing active upland confined Pelican Island PA would continue to be where no suitable habitat exists for potential nesting sea turtles and piping plover. Brown pelicans feeding or resting in or near the vicinity of the project are highly mobile and would relocate to nearby areas to avoid disturbance from maintenance activities.

4.10.2 Recommended Plan

Construction and placement activities for the proposed channel extension project are short-term (approximately 4 months) and would occur within the footprint of the existing channel project, which undergoes routine maintenance dredging and placement. The routine maintenance activities produce disturbances similar to those expected from the construction dredging and placement being proposed. Construction dredging would be accomplished by hydraulic pipeline dredge, as opposed to hopper dredges that have the potential to impact sea turtles. Placement of dredged material would continue to be within the existing active upland confined Pelican Island PA. Brown pelicans feeding or resting in or near the vicinity of the project are highly mobile and would be able to relocate to nearby areas to avoid disturbance from construction activities.

For these reasons, the Recommended Plan is not expected to impact any listed species or their critical habitat. Therefore, no effect on any of the federally-listed species or their critical habitat is anticipated.

4.11 Cultural Resources

The proposed work was coordinated with the Texas State Historic Preservation Officer (SHPO). The SHPO concurred that the proposed channel deepening portion of the project would have

no effect on historic properties and that the proposed upland PA has no potential to effect historic properties. The construction contractor shall immediately stop all work in that area and notify the USACE Staff Archeologist should any cultural resources be discovered during construction. The USACE Staff Archeologist will coordinate any unanticipated discoveries with the SHPO, as necessary.

4.12 Air Quality and Noise

4.12.1 Air Quality

4.12.1.1 No-Action Alternative

No construction or new operating emission sources are associated with the No-Action Alternative.

4.12.1.2 Recommended Plan

Since the project is within an area classified as a "marginal" non-attainment area for ozone, an analysis was conducted based on the established criteria to determine if a formal air conformity analysis would be required. The analysis focused on short-term direct emission impacts resulting from project construction.

The analysis results indicate that short-term project construction emissions of both ozone precursors, NO_X and VOC, would amount to 106.4 and 1.62 tons per year, respectively. Emissions of VOC from the proposed project construction are below the 100 ton per year *de minimis* emissions threshold and are thus exempt from a General Conformity Determination. However, the NO_X emissions generated from project construction would exceed the applicable *de minimis* threshold level of 100 tons per year. As such, a Draft General Conformity Determination for NO_X emissions has been prepared pursuant to General Conformity Rule (41 CFR 93, Subpart B) to demonstrate that the proposed Galveston Harbor Channel Extension Project would comply with the requirements of the General Conformity Rule and would be in conformity with the SIP (Appendix D). The General Conformity Determination will be completed during Preconstruction Engineering and Design (PED) when the timing and design of the project is known.

It is estimated that emissions from dredging and material placement activities would produce short-term impacts to air quality in the immediate vicinity of the project. The duration of construction activities, including dredging and placement of dredged material, would not exceed 4 months. For comparison to the SIP Area Source Emissions budget, the annual NO_X emission rates estimated for the Galveston Harbor Channel Extension Project may be summarized in terms of tons per day and compared to the SIP emissions budget. The daily NO_X emissions for the Galveston Harbor Channel Extension Project non-road mobile equipment emissions would

be 1.2 tons per day, which represents less than two percent of the 64.53 tons per day SIP 2007 daily Non-road Emissions Budget for NO_X.

Based on an evaluation of the proposed Galveston Harbor Channel Extension Project emissions, it is believed that the total emissions of NO_X would result in a level of emissions that are well within the 2007 Non-road Mobile Emissions Budget in the most recently approved SIP revision. As the Galveston Harbor Channel Extension Project is not unusual in scope for an area like the HGB, it is anticipated that emissions from the project would be less than an increase of 10 percent of the VOC and NO_X emissions inventories for the entire HGB nonattainment area. Therefore, emissions from the activities subject to the USACE action are not considered regionally significant for purposes of General Conformity. Because of this, it is expected that emissions from the project construction would not:

- Cause or contribute to new violation of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or,
- Delay timely attainment of any NAAQS or interim emission reductions or other milestones in any area.

4.12.2 Noise

4.12.2.1 No-Action Alternative

Under the No-Action Alternative, impacts related to noise would continue to be associated with periodic maintenance dredging and placement activities for the existing channel, primarily from the use of a cutterhead dredge (68 dBA). These impacts would continue to be short term, lasting only the duration of the maintenance dredging event.

4.12.2.2 Recommended Plan

Noise impacts associated with proposed dredging and placement activities are expected to be short term and would be very similar to noise levels during current maintenance dredging by cutterhead dredge (68 dBA) for the existing channel. No adverse impacts are anticipated for sensitive receptors in the project area vicinity.

4.13 WATER AND SEDIMENT QUALITY

4.13.1 Water Quality

4.13.1.1 No-Action Alternative

Under the No-Action Alternative, periodic maintenance dredging and placement activities for the existing Galveston Harbor Channel Project may result in elevated levels of suspended solids (TSS). However these levels are expected to be similar to levels experienced at times in Galveston Bay, which is often naturally turbid due to wind-induced re-suspension of bay sediments. Consequently, aquatic organisms are adapted to this type of disturbance. Therefore, any such impacts from continued dredged material placement operations are expected to be minor and would be temporary, occurring only during the dredging period, which occurs about every four years for the existing project. These impacts would continue to be short term, lasting only the duration of the maintenance dredging event.

Elutriate data do not indicate that re-suspension of contaminants (e.g. heavy metals, polycyclic aromatic hydrocarbons, PCBs, pesticides and other organics) into the water column would result in water quality problems during maintenance dredging operations of the existing channel.

4.13.1.2 Recommended Plan

Dredged material from the proposed extension would be placed in Pelican Island, an upland confined PA. The PA effluent would be decanted over a drop outlet structure, thereby controlling the release of suspended solids. Discharge operations may result in elevated levels of TSS; however these levels are expected to be similar to levels experienced under the No-Action Alternative during routine maintenance dredging of existing Galveston Harbor Channel Project. Any impacts from dredged material placement operations during project construction are expected to be minor and temporary, occurring only during the dredging period, which is expected to be about three months for the proposed project.

As with the No-Action Alternative, any re-suspension of contaminants (e.g. heavy metals, polycyclic aromatic hydrocarbons, PCBs, pesticides and other organics) into the water column would not result in water quality problems during dredging operations in this project.

The proposed dredged material placement plan has been evaluated with regard to the requirements of Section 404(b)(1) of the Clean Water Act (CWA)(Appendix F). Water quality certification was requested and was received in a letter from the TCEQ in a letter dated 9 July 2013 (Appendix B).

4.13.2 Sediment Quality

A comparison of sediment quality data with sediment quality screening guidelines together with toxicity and bioaccumulation assessments indicate that the sediments in the project vicinity have been and continue to remain suitable for discharge. Furthermore, the dredged material would be discharged into an upland confined PA. Therefore, unacceptable adverse

impacts on sediment quality are not expected to result from dredged material discharge operations.

4.14 Hazardous, Toxic, and Radioactive Waste

Based on the findings of the HTRW survey, the probability of encountering contaminated sites or toxic substances during project construction is considered low. Information compiled by this assessment indicates additional investigations are not warranted at this time.

4.15 Socioeconomics

4.15.1 No-Action Alternative

Activities associated with the proposed project have the potential to create additional waterborne commerce and temporary construction jobs, and jobs in related industries. Benefits associated with job creation could be manifested in increased economic output, and could increase revenues for supplementing the local tax base within the City.

4.15.2 Recommended Plan

Proposed deepening of this Galveston Harbor Channel Extension to 46-feet to be consistent with the dimensions of the remainder of the channel would allow the POG to more efficiently serve its tenants and customers by allowing the same number of existing vessels calling on the port facilities along the extension to be more efficiently (fully) loaded with cargo. However, since only a few commodities are affected (e.g. barite and cement) no increase in infrastructure and cargo handling facilities is anticipated.

4.16 Environmental Justice (EJ)

The minority and low-income populations living within the project area vicinity would not likely experience any adverse changes to the demographic, economic, or community cohesion characteristics within their neighborhoods, as a result of the proposed project. Increased spending in the area generated by construction and related activities could temporarily boost the local economy, resulting in temporary job creation or preservation of jobs in the construction and service sectors. Any newly created jobs would potentially be distributed among all groups equally.

Therefore, proposed project activities are not expected to present a disproportionately adverse effect on EJ populations within the study area vicinity. It is possible that proposed activities could positively impact EJ populations and other residents by increasing employment opportunities.

4.17 Prime and Unique Farmlands

Prime or unique farmlands are not present in the project area; therefore, no impacts would occur to these resources.

4.18 Recreational Resources

Tourism and recreation, both large contributors to the economy, would not be impacted by the proposed channel deepening. However, small recreational fishing vessels may be temporarily impacted due to temporary increases in turbidity levels and the presence of the dredge platform in the channel.

4.19 Roadways And Traffic

4.19.1 No-Action Alternative

Under the No-Action Alternative, roadway and railway infrastructure servicing the existing POG facilities is not planned, although period maintenance will likely occur. Vehicular traffic would continue to consist of a mixture of local area and urban residents, commercial and industrial vehicles associated with the Port industries, and tourists.

4.19.2 Recommended Plan

Temporary increases in vehicular traffic resulting from commuting construction workers could occur. These effects would be minor in nature. No other infrastructure improvements related to roadways or traffic are planned as a result of the proposed project.

4.20 Aircraft Wildlife Strikes

The Pelican Island PA was evaluated to determine if the proposed action could increase wildlife hazards to aircraft using Galveston Scholes Field International Airport, which is the only public use airport with a five-mile approach, departure, and circling radius of the project study area.

Though the Pelican Island PA is a designated upland confined PA, at times during placement activities during the maintenance dredging cycle may provide shallow open water habitat for birds and wildlife species that pose a strike hazard to aircraft. Proposed project would involve the use of Pelican Island PA for the one-time placement of construction material and the continued placement of maintenance dredged material from the Galveston Harbor Channel Extension, which would not result in a change in land use of the PA. Therefore, the proposed

action is not expected to increase wildlife hazards to aircraft using the Galveston Scholes Field International Airport

5.0 MITIGATION

No impacts are expected to occur to natural resources or cultural resources as a result of the proposed project. Therefore, no mitigation is needed for the proposed project activities. This determination is consistent with the recommendations of the January 14, 2011 USFWS PAL for the Galveston Harbor Channel Extension (Appendix B).

Impacts resulting from implementation of the Recommended Plan (i.e. -46-foot MLLW channel) would involve negligible impacts to very low quality bay bottom habitat comparable in type and magnitude to those experienced during routine maintenance that occurs for the existing channel template. Based on cross sections of the existing channel template, deepening the project to -46 feet MLLW would result in a reduced channel bottom width of 1,075 feet that is consistent with the remainder of the authorized Galveston Harbor Channel, which is currently at -46 feet MLLW. Most of the new work dredging would occur across the bottom width channel and toe slope; the maximum increase the top width on each side would be 7 feet. This increase in top width translates to around 0.8 acre of impact to bay bottom. However, given variations in conditions of channel and elevations of the top of slope dredging will likely widen the side slopes between 4 and 7 feet, or between 0.5 and 0.8 acre. In addition, the current dock owners along the channel routinely dredge their berths, thus the bay bottom adjacent to the channel is also undergoing routine disturbance from channel maintenance and ship traffic as well as maintenance activities to keep the adjacent private berths at required depths. Therefore, any impacts to bay bottom as a result of construction would not be "new", but would be among the cyclical recurring impacts that occur during maintenance of the channel and adjacent berths.

Similar impacts from the deepening of the Houston Ship Channel to 46-feet MLLW and widening to 460 feet, as well as deepening of the Galveston Harbor Channel to 46-feet MLLW (no widening) were discussed in the 1995 SEIS and 2007 LRR. The NEPA documents for the now completed projects recognized that the bay bottom substrates (benthic habitat) within the footprint of the existing maintained channels that did not support oyster reef was of very low quality compared to natural bay bottom; as such, impacts to bay bottom within the existing channels were determined to be negligible and required no mitigation. The Galveston Harbor Channel Extension involves deepening of only 2,571 feet linear feet of channel to be consistent with the bottom depth and dimensions of the recently constructed 46-foot MLLW project depth of the Galveston Harbor Channel. The total area of impact for the Galveston Harbor Channel Extension is less than percent of the entire HGNC impact footprint, and no oyster reef is present in this extension.

6.0 CUMULATIVE IMPACTS

Cumulative impacts are those impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or persons undertake such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Impacts include both direct effects (caused by the action and occurring at the same time and place as the action), and indirect effects (caused by the action but removed in distance and later in time, and reasonably foreseeable).

The economy of port city of Galveston, Texas, is deeply rooted in tourism, commercial fishing, and marine commerce. As a result of a long history of continuing urbanization, industrialization, and commercialization, both land and water resources in the project vicinity have been extensively altered. Past and present projects involving alterations of land and water within the vicinity Galveston Harbor Channel Project include extensive development and ongoing modification of private, commercial and POG docking facilities, rail yards and shipyards; development of cruise terminal facilities; construction and expansion of Texas A&M University at Galveston; and improvements to numerous restaurant and retail businesses along the waterfront. Past alterations of the bay environment include the original construction and subsequent deepening of the Galveston Harbor Channel (Bolivar Roads to POG Pier 38) to -46-feet MLLW as well as the construction, modification and maintenance of the nearby GIWW and Texas City and Houston Ship Channels.

Reasonably foreseeable future projects in the vicinity of the project include improvements to infrastructure and the existing navigation channel, as well as expansion of commercial and industrial facilities along the navigation channel. A few representative projects are listed below.

1) Galveston Harbor Channel Extension
2) POG Dock Improvements (fill in slips at Pier 12 and 14 (Year 2011)
3) Containership Terminal on Pelican Island
4) Pelican Island Storage Terminal Expansion (Year 2011)
5) Texas City Shoal Point Container Facility
6) GIWW maintenance and modifications

As a result of past and present activities, the proposed project template is within previously disturbed areas of the authorized Galveston Harbor Channel project and associated docks. From a NEPA standpoint, proposed project improvements would occur within an area that has undergone

extensive channel construction and maintenance dredging in the past as well as urban, industrial and commercial development. As such, the area is considered a disturbed area with little to no vegetated shoreline and poor quality benthic and open water habitats compared to other areas of the open bay.

Dredged material generated from the construction and maintenance of the Galveston Harbor Channel Extension project would be placed in the Pelican Island PA (see Figure 5), an existing upland confined placement area, and would not involve impacts to terrestrial and aquatic resources. Maintenance dredging frequency and volume requirements for the project remain unchanged from the existing authorized project. Any impacts associated with the proposed Galveston Harbor Channel Extension would involve only minor, temporary or short-term impacts during the duration of project construction as discussed in Section 4.0 of this EA.

The effects described are similar in nature and magnitude to the effects these resources have experienced during the recent deepening of 3.8 miles (Sta. 0+000 to 20+000) of the Galveston Harbor Channel from -41 feet MLLW to -46 feet MLLW, and to the effects they routinely experience and will continue to experience in association with ongoing routine maintenance dredging of the authorized Galveston Harbor Channel project and adjacent dock facilities. The project would temporarily displace fish and wildlife species and marine benthic organisms during construction activities. Mobile fish and wildlife species would relocate to nearby suitable habitat. Much of the benthic substrate in the project footprint is poor quality disturbed habitat due to the construction and recurring maintenance dredging of the exiting Galveston Harbor Channel and docking facilities and ship traffic. As such, impacts to the benthic population from construction of the project are considered negligible.

The water column and water quality would be temporarily affected by turbidity during construction activities, but no more than has occurred during construction of the existing -46-foot MLLW channel or its periodic maintenance. While emissions from construction activities would exceed air quality standards, they are expected to conform to the SIP for air quality compliance (see Appendix D). The Galveston Harbor Channel Extension would have long-term beneficial impacts on the socioeconomics of tenants and customers in the project area by increasing cargo loading efficiency of the existing vessels calling on the port facilities along the extension.

In conclusion, the anticipated adverse impacts of the proposed project to human health and the environment are minimal and would not significantly contribute to the cumulative effects of past, present and future projects within the project vicinity. The result of the project would benefit the POG and its tenants and customers by increasing cargo loading efficiency of the existing vessels calling on the port facilities along the waterway.

7.0 COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

This EA has been prepared to satisfy the requirements of all applicable environmental laws and regulations, and has been prepared in accordance with the Council on Environmental Quality's (CEQ) implementing regulations for the National Environmental Policy Act, 41 CFR Parts 1500 – 1508, and USACE Regulation ER 200-2-2, *Environmental Quality: Procedures for Implementing NEPA*. Following is a list of applicable environmental laws and regulations that were considered in the planning of this project and the status of compliance with each:

7.1 National Environmental Policy Act

This EA has been prepared in accordance with CEQ regulations for implementing NEPA. The environmental and social consequences of the recommended plan have been analyzed in accordance with NEPA and disclosed in this document.

7.2 Fish and Wildlife Coordination Act of 1958, as Amended

The Recommended Plan is being coordinated with the USFWS and the Texas Parks and Wildlife Department. During the coordination process, the agencies provided information on fish and wildlife resources and planning input that was considered in the development of the project. In accordance with the Fish and Wildlife Coordination Act, the USFWS provided comments and recommendations on the Recommended Plan in a Planning Aid Letter dated January 14, 2011 (Appendix B), which the District considered in formulating plans for avoiding and minimizing impacts to fish and wildlife.

7.3 National Historic Preservation Act of 1966, as Amended

Compliance with the National Historic Preservation Act of 1966, as amended, requires identification of all National Register of Historic Places (NRHP)-listed or NRHP-eligible properties/resources in the project area and development of mitigation measures for those adversely affected in coordination with the SHPO and the Advisory Council on Historic Preservation. This Recommended Plan was determined to be of such limited nature that it does not have the potential to cause effect on historic properties. The SHPO concurred with this determination by letter dated April 16, 2008 (Appendix B). This project is in compliance with the National Historic Preservation Act pursuant to 36 CFR 800.3(a).

7.4 Coastal Barrier Improvement Act of 1990

The Coastal Barrier Resources Act of 1982 established the John H. Chaffee Coastal Barrier Resources System to minimize the loss of human life, wasteful Federal expenditures, and damage to fish, wildlife, and other natural resources associated with coastal barriers. The Coast Barrier Improvement Act of 1990 was enacted to reauthorize the Coastal Barrier Resources Act (CRBA) of 1982. The act defines coastal barriers as "bay barriers, barrier islands, and other geological features composed of sediment that protect landward aquatic habitats from direct wind and waves." As part of the program, the Federal government discourages development on designated undeveloped coastal barriers by restricting certain Federal financial assistance, including USACE development projects. The nearest CBRA zones are TX-03A and TX03AP located on Bolivar Peninsula approximately 3 miles southeast of the southern limit of the HSC, and TX-04 located on the mainland shoreline of Galveston Bay between the Texas City Dike and the Galveston Island Causeway. The Recommended Plan is in compliance with the Coastal Barrier Improvement Act of 1990 as the project would not encourage coastal barrier development and would only support previously existing development in areas outside of these designated resource areas.

7.5 Magnuson-Stevens Fishery Conservation Management Act (MSFCMA)

Congress enacted amendments to the MSFCMA in 1996 that established procedures for identifying EFH and required interagency coordination to further the conservation of federally-managed fisheries. Rules published by the NMFS (50 CFR 600.805 through 600.930) specify that any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund or undertake an activity that could adversely affect EFH be subject to the consultation provisions of the MSFCMA. No significant impacts to living marine resources or EFH would occur as a result of implementing the Recommended Plan, therefore no mitigation is required.

7.6 Coastal Zone Management Act of 1972 (CZMA)

The CZMA requires that all land-use changes in the project area be conducted in accordance with approved state coastal zone management programs. Any project that is located in, or that may affect land and water resources in the Texas coastal zone and that requires a Federal license or permit, or is a direct activity of a Federal agency, or is federally funded must be reviewed for consistency with the Texas Coastal Management Program (TCMP). The proposed action is within the coastal boundary defined by the TCMP. The District has determined that the proposed project would not adversely impact these resource areas and that the proposed activities are consistent with the goals and policies of the TCMP to the maximum extent practicable. The District's consistency review is included in Appendix G.

7.7 Endangered Species Act of 1973, as Amended

The District coordinated this project with the USFWS and the NMFS under Section 7 of the ESA, regarding federally-listed threatened and endangered species or their habitat, of potential occurrence in the project area. In the PAL dated January 14, 2011 (see Appendix B), the USFWS recommended that presence/absence surveys be conducted in suitable areas adjacent to Pelican Island and any necessary consultation procedures initiated with the USFWS pursuant to Section 7 of the ESA to ensure that Piping plover are not inadvertently disturbed or harassed.

The shorelines along the ship channel in the vicinity of the proposed deepening of the Galveston Harbor Channel Extension project are predominantly bulk-headed and used by dock facilities short stretches of shorelines having shell hash substrates occur to a lesser extent in the project area in areas such as that found at TAMUG Clipper dock area. These areas are continuously disturbed by ongoing maintenance dredging activities, commercial shipping and recreational vessel traffic and other human activities making these areas unsuitable for piping plover. Any disturbance to the channel shorelines caused by the proposed deepening of the Galveston Harbor Channel Extension project would be of the same type and magnitude as experienced with the periodic maintenance dredging and placement into the Pelican Island PA associated with the authorized Federal project. Therefore, the USACE has determined that proposed project will have no effect on piping plover and presence/absence surveys will not be necessary.

Available information, investigations, and informal consultation with USFWS and NMFS have determined that the proposed project would not result in adverse impacts to any federally listed threatened or endangered species and no critical habitat is present in the project area. A Biological Assessment (BA) was prepared describing potential impacts on these listed species (attached as Appendix C). The BA was coordinated with the USFWS and the NMFS for concurrence with the USACE finding that proposed project activities will have no effect on any federally-listed threatened or endangered species, or critical habitat.

7.8 Clean Air Act of 1972, as Amended

As required by the CAA, the EPA has promulgated the General Conformity Rule, which requires that Federal agencies consult with State and local air quality regions to inform them of expected impacts of a Federal action and associated effects on their SIP emissions budget. The project is located in Galveston County, Texas, which is a severe non-attainment area for the 8-hour ozone standard. An analysis was conducted to determine if a formal air conformity analysis would be required. The results indicated that short-term construction emissions of both ozone precursors, NO_X and VOC, would amount to 106.4 and 1.62 tons per year, respectively.

This indicates that NO_X emissions exceed the threshold level of 25 tons per year. As such, a Draft General Conformity Determination for NO_X emissions has been prepared pursuant to General Conformity Rule (41 CFR 51.855) to demonstrate that the proposed Galveston Harbor Channel Extension Project would comply with the requirements of the General Conformity Rule and would be in conformity with the SIP (Appendix D). A Final General Conformity Determination will be completed during PED when project timing and design are known.

7.9 Clean Water Act of 1977, as Amended (CWA)

The District evaluated the proposed action pursuant to Section 404(b)(1) of the CWA and this analysis is included in Appendix F. A Joint Public Notice was issued with the TCEQ (Appendix B). The TCEQ is the state agency for issuing state water quality certifications pursuant to Section 401 of the CWA. A copy of the state water quality certification is included in Appendix B.

7.10 Executive Order 11990 – Protection of Wetlands

The proposed action has been analyzed for compliance with EO 11990. The project area does not contain wetlands, nor would wetlands outside the project area be affected by the project. Therefore, the proposed project is in compliance with this EO.

7.11 Executive Order 12898 – Environmental Justice

This Order directs Federal agencies to achieve EJ to the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review. Agencies are required to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The proposed project would not have a disproportionate adverse impact on minority or low-income population groups within the project area.

7.12 CEQ Memorandum Dated August 11, 1980 – Prime or Unique Farmlands

Prime or Unique farmlands are not present in this project area.

7.13 Executive Order 11988 Floodplain Management

EO 11988 directs Federal agencies to evaluate the potential effects of proposed actions on floodplains. Such actions should not be undertaken that directly or indirectly induce growth in the floodplain unless there is no practical alternative. The recommended plan would not induce

increased flooding in developed areas and would not contribute to increased future flood damages, and would not induce further development.

7.14 Migratory Bird Treaty Act (MBTA)

This EO directs Federal agencies to increase their efforts under the MBTA, Bald and Golden Eagle Protection Acts, the Fish and Wildlife Coordination Act, the ESA of 1973, NEPA of 1969 and other pertinent statutes as they pertain to migratory birds to avoid measurably negative take of migratory bird populations. Channel deepening and placement activities would not impact migratory bird populations.

7.15 Memorandum of Agreement Between the Federal Aviation Administration - Aircraft Wildlife Strikes

A MOA was executed among the FAA, the U.S. Air Force, the U.S. Army, EPA, USFWS, and the USDA, with the intention to minimize wildlife risks to aviation and human safety, while protecting the Nation's valuable environmental resources. Pursuant to this MOA, Agencies should not construct projects within a specified distance of airports that may become an attractant to wildlife deemed hazardous to aircraft. Scholes International Airport on Galveston Island is located within a 5-mile radius of the proposed project area. However, channel deepening and placement activities would not become an attractant to wildlife or migratory bird populations that would impact aircraft.

7.16 Invasive Species, Executive Order 13112

EO 13112 directs Federal Agencies to, within Administration budgetary limits, prevent the introduction of invasive species; detect and respond rapidly to and control populations of such species in a cost-effective manner; monitor invasive species populations accurately and reliably; provide for restoration of native species and habitat condition in ecosystems that have been invaded; conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and promote public education on invasive species and the means to address them. Because of the frequency of dredged material placement on Pelican Island PA and the containment and treatment of ship's ballast water, the threat of proliferating the introduction or establishment of invasive species in land or water areas of the project vicinity is minimal.

8.0 CONCLUSIONS

The proposed project would not result in significant impacts to the human environment; therefore, preparation of an EIS is not required. The following specific conclusions summarize the findings of the EA, as detailed in the environmental analyses in Section 4.0:

- Aquatic habitat would be temporarily affected during the construction activities; these impacts represent minor impacts to the environment.
- No terrestrial habitats would be affected by the recommended modifications to the channel, though terrestrial areas within the confined upland PA would be affected.
- Fish and invertebrates may be affected locally in the project area during construction activities, but the impacts would be minor and temporary.
- The project would have no effect on threatened or endangered species.
- Historic properties or recorded archeological sites would not be affected by the proposed action.
- Emissions from construction activities exceed air quality standards but are expected to conform to the SIP for air quality compliance.
- Implementation of the proposed action would not result in any permanent noise impacts; noise levels produced during construction would be similar to those experienced during regular channel maintenance.
- There would be no long-term impacts to water quality from the proposed activities.
- There would be no hazardous and/or toxic waste impacts from the proposed action.
- There would be minor, temporary impacts to recreational resources during the construction period, but no long-term impacts.
- No significant or adverse impacts to environmental resources are expected to occur as a result of implementation of the proposed project. No adverse cumulative impacts to environmental resources are expected as a result of project implementation.
- The USACE finds that the proposed action is in compliance with the TCMP.

9.0 PUBLIC INVOLVEMENT, REVIEW, AND COORDINATION

A Notice of Availability (NOA) for the Environmental Assessment, Galveston Harbor Channel Extension, Post-Authorization Change Report was released on 10 May, 2013. This public notice was made available to solicit public views and concerns regarding the tentatively recommended channel improvements and the Draft General Conformity Determination (DGCD). Documents were made available for review and comment for a period of 30 days from 10 May to 10 June, 2013. The PACR was never finalized due to the Houston-Galveston Navigation Channel 902 limit exceedance. However, in February 2016 a new Federal Cost

Share Agreement (FCSA) was signed and the study was resumed under Section 216 of the Flood Control Act (FCA) of 1970. Comments on the DEA were used to evaluate the impacts of alterna-tives and to identify a plan that is socially and environmentally acceptable.

The Environmental Assessment (EA) was coordinated with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and other Federal, state, and local agencies. A list of agencies with whom activities were coordinated is provided in the NOA in Appendix E. Comments were received only from EPA, NMFS, and TPWD. Agency correspondence and USACE response to comments is found in Appendix B. The Galveston Harbor Channel Extension Project is very limited in scope, non-controversial, and affects only a previously deepened and regularly maintained channel. No further public review is planned.

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Appendix A

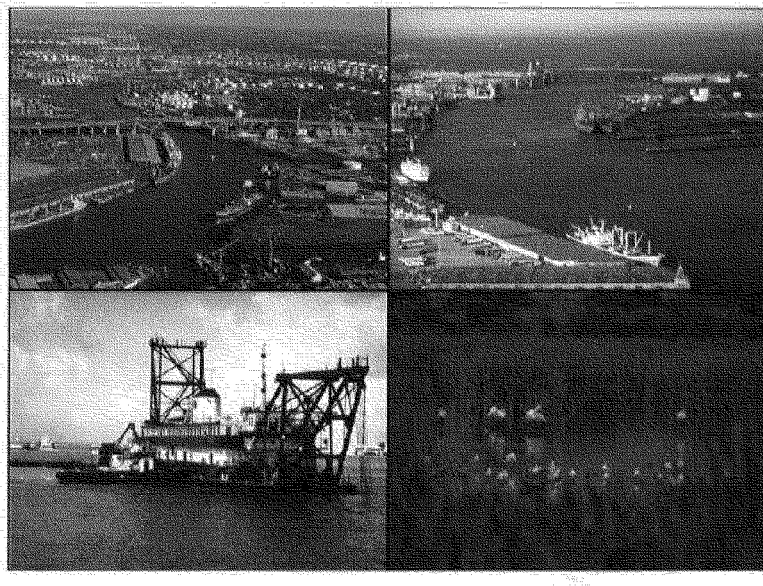
Houston-Galveston Navigation Channels Supplemental Environmental Impact Statement Record of Decision

US Army Corps
of Engineers

Galveston District
Southwestern Division

Houston-Galveston Navigation Channels, Texas

Limited Reevaluation Report
and
Final Supplemental Environmental Impact Statement



November 1995

RECORD OF DECISION

HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS

This Record of Decision to the Supplemental Environmental Impact Statement (SEIS), presents the basis for my decision to recommend deepening the channel entrance from its present depth of 42 feet to 47 feet, deepening and widening the Houston Ship Channel from 40 feet deep by 400 feet wide to 45 feet deep by 530 feet wide for most of it length, and deepening the Galveston Channel from 40 feet to 45 feet. The project includes an Environmental Restoration Plan that incorporates environmental navigation design measures and the beneficial use of dredged material to initially construct 690 acres of marsh habitat (wetlands) and a 12-acre colonial waterbird nesting island using new work dredged material, incrementally develop an additional 3,560 acres of marsh over a 50-year period using maintenance dredged material, and construct other island restoration features using the initial and future maintenance dredged material. The project is economically and environmentally justified, and in the public interest.

A wide array of structural and nonstructural alternatives was evaluated in the Environmental Impact Statement for the Galveston Bay Area Navigation Study that was completed in July 1988. The alternatives are described and discussed on pages 60 through 85 in the Galveston Bay Area Navigation Study Final Feasibility Report and Environmental Impact Statement, Volume 1, Main Report, and are hereby incorporated by reference. Although the Galveston Bay Area Navigation Study developed a well defined plan that sufficiently addressed National Economic Development benefits, the adequacy and the assessment of project impacts were questioned by state and Federal resources agencies. Due to the environmental concerns, a Limited Reevaluation Report and the SEIS were prepared to reevaluate the project and assess the environmental aspects with a focus on optimizing environmental channel design features and beneficial uses of dredged material to form the Environmental Restoration Plan. Alternatives considered in the SEIS included no action, upland disposal, ocean disposal, open bay disposal, and navigation improvements (enlargement of channels). The recommended plan, navigation improvements incorporating the Environmental Restoration Plan, is the environmentally preferable plan.

The findings of the SEIS are based on numerous environmental and engineering studies recommended by an Interagency Coordination Team. The Interagency Coordination Team was composed of the U.S. Army Corps of Engineers, the project sponsors, and several state and Federal environmental agencies. As a result of this unparalleled coordination and cooperation, the recommended plan is considered the environmentally preferable plan. The only mitigation necessary for this enormous dredging project is the construction of 118 acres of artificial oyster reef to replace direct losses of natural reef. After completion of project construction, the Port of Houston Authority, one of the project sponsors, has agreed to monitor and maintain all beneficial use sites at no expense to the Federal government.

Technical and economic criteria specified in the Water Resources Council's Principles and Guidelines were used to formulate alternative channel designs. All applicable laws, executive orders, and regulations were considered in evaluating design alternatives. All practicable means to avoid or minimize environmental damage by the selected alternative have been adopted.

I have reviewed and evaluated all documents concerning the Galveston District Engineer's recommendation, including the views of other interested agencies and the general public, and have considered prevailing administrative policies, and the resolutions by the Committee on Public Works of the United States House of Representatives, dated October 19, 1967, and December 9, 1975. Based upon these factors, I find that the plan recommended in the Final Limited Revaluation Report and SEIS, and authorized by Congress in Public Law 104-303, Section 101(a)(30), is suitable for implementation for navigation improvements and environmental restoration. I further conclude that the Houston-Galveston Navigation Channels project should be implemented as soon as practicable.

Based on the conditions set forth in the Galveston District Engineer's finding and the added conditions set forth herein, I conclude that the public interest is best served by the decisions as set forth herein.

RUSSELL L. FUHRMAN
Major General, USA
Director of Civil Works

29 Jan 98
DATE

APPENDIX B

Agency Coordination

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

May 7, 2013

Mr. Rusty Swafford
National Marine Fisheries Service
Environmental Assessment Branch
4700 Avenue U
Galveston, TX 77550

Dear Mr. Swafford:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is explained in the attached Notice of Availability and described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

Sections 3.9 and 4.9 of the Draft EA include discussions of marine fisheries and Essential Fish Habit (EFH) in the project area, as well as the proposed project's potential impacts on these resources. The District has determined that the proposed project would have minimal and temporary impacts on fisheries and EFH. Pursuant to regulations published by the National Marine Fisheries Service (50 CFR 600.805 through 600.930) under the Magnuson-Stevens Fishery Conservation and Management Act, we request initiation of EFH consultation and that the Service review the enclosed information and provide written comments and concurrence with this determination.

If you or your staff have any questions regarding this project, please contact Andrea Catanzaro at (409) 766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Encls

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

December 18, 2009

Mr. David M. Bernhart
Assistant RA for Protected Resources
Southeast Regional Office
National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, FL 33701

Dear Mr. Bernhart:

This letter is in regard to a proposed 2,571 foot extension of the Galveston Harbor Channel. The Galveston Harbor Channel branches off the Galveston Bay Entrance Channel at the Bolivar Roads junction, and proceeds westerly between Galveston Island and Pelican Island, in Galveston County Texas (see enclosed figures).

The proposed project would improve navigation efficiency by deepening a portion of the existing 40-ft deep x 1,075-ft wide channel to 45 feet depth, starting near the Port of Galveston's Pier-38, and proceeding westward towards the Pelican Island Bridge (from Station 20+000 to Station 22+571), extending the existing channel an additional 2,571 feet. No widening is proposed and the existing bottom width of 1,075 feet would be retained, for both the existing and extended channel. Channel dredging would generate 609,500 cubic yards of new work dredged material which would be placed in the existing Pelican Island Placement Area (Cell "B").

To ensure compliance with the requirements of Section 7(a)(2) of the Endangered Species Act, a list is requested of any species which are listed or proposed to be listed, as well as any critical habitat that may be present in the area of the proposed action.

If you or your staff has any questions regarding this activity, please contact George Dabney at (409) 766-6345.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Enclosures

Identical letter sent to:
Mr. Steve Parris
Field Supervisor
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058-3051

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

December 18, 2009

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Field Supervisor
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058-3051

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Sincerely,

Carolyn Murphy
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Enclosures

Identical letter sent to:
Mr. David M. Bernhart
Assistant RA for Protected Resources
Southeast Regional Office
National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, FL 33701

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051

January 2010

Thank you for your request for threatened and endangered species information in the Clear Lake Ecological Services Field Office's area of responsibility. According to Section 7(a)(2) of the Endangered Species Act and the implementing regulations, it is the responsibility of each Federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any federally listed species.

Please note that while a Federal agency may designate a non-Federal representative to conduct informal consultation or prepare a biological assessment, the Federal agency must notify the U.S. Fish and Wildlife Service (Service) in writing of such designation. The Federal agency shall also independently review and evaluate the scope and contents of a biological assessment prepared by their designated non-Federal representative before that document is submitted to the Service.

A county by county listing of federally listed threatened and endangered species that occur within this office's work area can be found at http://www.fws.gov/southwest/es/EndangeredSpecies/lists/ListSpecies.cfm. You should use the county by county listing and other current species information to determine whether suitable habitat for a listed species is present at your project site. If suitable habitat is present, a qualified individual should conduct surveys to determine whether a listed species is present.

After completing a habitat evaluation and/or any necessary surveys, you should evaluate the project for potential effects to listed species and make one of the following determinations:

- **No effect** – the proposed action will not affect federally listed species or critical habitat (i.e., suitable habitat for the species occurring in the project county is not present in or adjacent to the action area). No coordination or contact with the Service is necessary. However, if the project changes or additional information on the distribution of listed or proposed species becomes available, the project should be reanalyzed for effects not previously considered.

- **Is not likely to adversely affect** – the project may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial. Certain avoidance and minimization measures may need to be implemented in order to reach this level of effects. The Federal agency or the designated non-Federal representative should seek written concurrence from the Service that adverse effects have been eliminated. Be sure to include all of the information and documentation used to reach your decision with your request for concurrence. The Service must have this documentation before issuing a concurrence.

TAKE PRIDE IN AMERICA

- **Is likely to adversely affect** – adverse effects to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial. If the overall effect of the proposed action is beneficial to the listed species but also is likely to cause some adverse effects to individuals of that species, then the proposed action "is likely to adversely affect" the listed species. An "is likely to adversely affect" determination requires the Federal action agency to initiate formal Section 7 consultation with this office.

Regardless of your determination, the Service recommends that you maintain a complete record of the evaluation, including steps leading to the determination of affect, the qualified personnel conducting the evaluation, habitat conditions, site photographs, and any other related articles.

The Service's Consultation Handbook is available online to assist you with further information on definitions, process, and fulfilling Endangered Species Act requirements for your projects at http://endangered.fws.gov/consultations/s7hndbk/s7hndbk.htm.

If we can further assist you in understanding a federal agency's obligations under the Endangered Species Act, please contact Moni Belton, David Hoth, Charrish Stevens, Arturo Vale or Catherine Yeargan at 281/286-8282.

Sincerely,

Stephen D. Parris

Stephen D. Parris
Field Supervisor, Clear Lake Field Office

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

May 7, 2013

Ms. Edith Erfling
Field Supervisor
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058

Dear Ms. Erfling:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is explained in the enclosed Notice of Availability and described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

The District is requesting that the U. S. Fish and Wildlife Department review the enclosed Draft EA and provide any comments your agency may have regarding this proposed project pursuant to the Fish and Wildlife Coordination Act. We are also requesting your concurrence with the enclosed Biological Assessment (BA), which is included as Appendix D of the EA. The BA addresses the project's potential to affect federally-listed threatened and endangered species and species of concern. The overall conclusion of the BA is that the project will have no effect on federally-listed threatened or endangered species, nor will it impact critical habitat.

We appreciate your continued cooperation in coordinating the proposed project. If you or your staff has any questions regarding this project, please contact Andrea Catanzaro at (409) 766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Encls

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 FAX: 281/488-5882

January 14, 2011

Colonel Christopher Sallese
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Colonel Sallese:

This planning aid letter serves to provide the U.S. Fish and Wildlife Service's (Service) comments and recommendations regarding the U.S. Army Corps of Engineers, Galveston District (Corps) Houston-Galveston Navigation Channels (HGNC), Texas, Galveston Channel (Channel) Extension Project. The proposed Channel project will extend the length of the existing 40-foot deep by 1075 foot wide channel by an additional 2,571 feet, beginning at approximately Pier 38 (Station 20+000) and proceeding westward toward the Pelican Island Bridge (Station 22+571). This extension requires the Channel to be deepened to a depth of 45 feet resulting in the placement of an estimated 609,500 cubic yards of dredged material and future dredge maintenance material (160,000 cubic yards/year) in the existing Pelican Island Placement Area (PA).

Through this planning aid letter, the Service identifies and describes existing fish and wildlife resources within the proposed project area; evaluates and compares proposed alternatives; identifies potentially significant impacts; identifies modifications or alternatives which address fish and wildlife related problems, opportunities, or planning objectives; and recommends measures for resource protection early in the project planning process. Our comments are provided in accordance with the Fish and Wildlife Coordination Act (16 U.S.C. 661-667(e)), with the provisions of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), and the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.), and are intended to assist in the preparation of any further project assessments. This information does not represent a final report of the Secretary of the Interior within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act.

Project Background

Galveston Bay, the largest inland bay on the Texas coast, is a relatively shallow estuary that connects with the Gulf of Mexico. Several deep-water channels traverse Galveston Bay to provide access to the deepwater ports of Houston, Texas City, Bayport, and Galveston (Figure 1). The 1987 Galveston Bay Area Navigation Study is a feasibility study for improving the Houston and Galveston ship channels, which recommended that Galveston Harbor and Channel

be deepened to 50 feet and widened to 450 feet to provide access for larger ships in the Gulf of Mexico. The project, reviewed by the Assistant Secretary of the Army, resulted in a limited reevaluation report (LRR). The LRR was completed in November 1995 and recommended the Channel be deepened to 45 feet and widened to between 650 and 1,112 feet. However, the City of Galveston (the non-federal sponsor) lacked the funds to complete the project and subsequently transferred project responsibilities to the Port of Galveston (POG) in 2006.

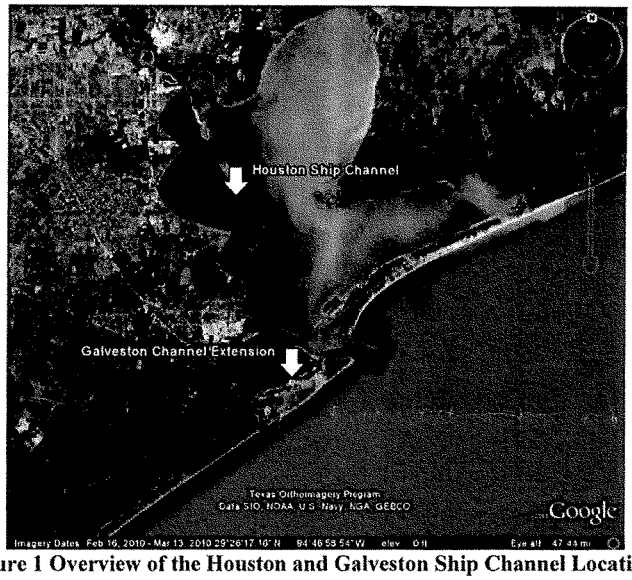

Figure 1 Overview of the Houston and Galveston Ship Channel Locations

Due to the recent availability of funds, the POG requested that the Corps deepen and maintain the Channel at a depth of 45 feet. Dredging continues today with the majority of the Channel depth at 45 feet except for the portion outlined in this planning aid letter. The entire Channel includes the off-shores reach and the area between Bolivar Peninsula and Pelican Island through Galveston Harbor to the Gulf Intracoastal Waterway (Figures 2 and 3).

In 1825, the Congress of Mexico established the Port of Galveston, which later served as the capital for the Republic of Texas. By the end of the 19th century, Galveston was one of the largest cotton ports in the nation rivaling New Orleans; however, the City was devastated by a hurricane in 1900. Unfortunately, Galveston never fully returned to its previous levels of national importance or prosperity despite attempts to draw new investment after the hurricane. Development was also hindered by the construction of the Houston Ship Channel, which brought the Port of Houston into direct competition with the natural harbor of the Port of Galveston for sea traffic.

Today, the POG facilities include more than 850 acres and supports commercial and recreational ships. The POG facilities handle various types of cargo including container, dry and liquid bulk, break-bulk, refrigerated, project cargos, and cruise passengers. The bay portion of the Channel is approximately 4.27 miles long and is maintenance dredged every 4 years. The entire Channel has a shoaling rate of 1,425,500 cubic yards per year; however, the 2,571-foot extension will contribute 160,000 cubic yards of maintenance material annually. The PA is located north of the Channel, is approximately 1,100 acres in size and is divided into three cells.

Alternatives Under Consideration

No Action Alternative

This Alternative presumes there would not be an extension or deepening of the Channel. Under this alternative, the Channel would retain the 40-foot depth, the 1,150 foot width and could limit the efficient movement of commodities by vessels traveling the waterway.

Preferred Alternative

Under this alternative, the Corps proposes to extend the Channel from approximately Pier 38 2,571 feet westward towards the Pelican Island Bridge (Station 20+000 to 22+571). Additionally, the proposed depth of the channel extension is 45 feet. No widening is proposed at this time and the channel top-of-cut will remain within the waterway. The Corps prefers to place the estimated 609,000 cubic yards of new work dredge material and future dredge maintenance material (estimated 160,000 cubic yards yearly) in upland confinement at the existing PA. The new work dredge material is expected to consist of firm clay of low plasticity. Existing levees at the PA will be mechanically raised to allow sufficient capacity to contain both new work and maintenance dredge materials. The Preferred Alternative best meets the goals and objectives of the POG and the 1995 LRR.

The Corps does not expect an increase in sedimentation as a result of this project and no changes are proposed to the existing maintenance dredging cycle to accommodate the Preferred Alternative.

Project Impacts on Fish and Wildlife Resources

Galveston Bay has some of the most productive marsh habitat along the Gulf Coast, providing habitat for many important commercial and recreational fish species. In addition, marsh sites provide nesting areas for over 20 different colonial waterbird species. Historically, marshes were abundant along southern reaches of Galveston Bay; however, increases in ship wakes, subsidence, and increased salinity have affected marsh habitat over the last 40 years at Pelican Island. Pelican Island has supported fringe marsh habitat, however development, erosion, intense weather events, and sea level rise have contributed to the diminishing marsh habitat available for fish and wildlife. However, fish and wildlife utilize these remaining marshes for foraging, nesting, and breeding and some species are year round residents.

The Supplemental Fish and Wildlife Coordination Act Report – Houston-Galveston Ship Channels (Service 1995), the Supplemental Fish and Wildlife Coordination Act Report – Houston Galveston Ship Channels Barge Lane Widening (Service 2002) and the Houston-Galveston Navigation Channels Texas Galveston Channel Project (Corps 2007) detail the important natural resource communities (oysters, marshes, bay bottom, colonial waterbirds and other wildlife) of Galveston Bay and estimate the negative and positive environmental impacts of HGNC deepening and widening projects.

Habitat Types

The Service used Geographic Information System (GIS) technology and aerial photos to identify habitat cover-types in and around the project area. The following habitats types were identified:

Open Bay - This cover type consists of open water with a muddy substrate and submerged aquatic vegetation. Open bay habitat supports a variety of aquatic species such as brown shrimp (*Farfantepenaeus aztecus)*, white shrimp *(Litopenaeus setiferus)*, spotted sea trout (*Cynoscion nebulosus)*, red drum (*Sciaenops ocellatus*), and menhaden (*Brevoortia patronus*). In addition to aquatic species, the open bay provides foraging opportunities for colonial waterbirds such as the brown pelican (*Pelecanus occidentalis*), great egret (*Ardea alba*), and great blue heron (*Ardea Herodias*). Impacts of dredge activities can be referenced in Service documents mentioned above.

Oyster Reef - Living oyster reefs are made up of fish, plants, invertebrates and can be a good indicator of the overall health of a system. Oyster reefs are very productive estuarine habitat and are used by different species of fish and decapod crustaceans compared to salt marsh (Zimmerman et. al 1989). Oysters provide a basic ecological function of filtering the bay water in which they live and filter rates range from 5 to 30 quarts of water per hour of feeding time (Hoffstetter 1990). Review of historic documentation reveals the presence of oyster reefs adjacent to the Galveston Channel. In addition, recent communications with Texas Parks and Wildlife biologists (2010) indicate that historic consolidate reefs and scattered shell substrates are located outside of the project area (Figure 4). No oyster reef impacts are anticipated with this project.

Fisheries

Sport fish potentially occurring within the open bays of the project area include red drum, spotted seatrout, black drum (*Pogonias cromis*), southern flounder (*Paralichthys lethostigma*), star drum (*Stellifer lanceolatus*) and spot (*Leiostomus xanthurus*). Other common fishes include gafftopsial catfish (*Bagre marinus*), striped mullet (*Mugil cephalus*), sheepshead (*Archosargus probatocephalus*), Atlantic croaker (*Micropogonia undulates*), hardhead catfish (*Arius felis*) and bay anchovy (*Anchoa mitchilli*). Shellfish include blue crab (*Callinectes sapidus*), American oyster (*Crassostrea virginica*) and several shrimp species. Dredging activities cause suspension of sediments and increased turbidity in the water column, and can cause temporary impacts to fish that inhabit the area. Changes in feeding, avoidance, territoriality, and homing behaviors can all be affected by increased suspended sediments and turbid waters. Wilber and Clarke



Figure 4 Galveston Channel Extension and historic oyster reefs in Galveston Bay

(2001) noted that changes in fish cough reflex, erratic swimming, and pronounced gill flaring can occur due to suspended sediments. These impacts are usually temporary, as fish have the capability to leave the area and return when impacts have subsided.

Essential Fish Habitat

Fish require healthy surroundings to survive and reproduce. Impacts from certain fishing practices as well as coastal and marine development threaten to alter, damage, or destroy fish habitats. Through the Magnuson-Stevens Fishery Conservation and Management Act, as amended through 1996, the National Ocean and Atmospheric Administration (NOAA), the regional fishery management council, and other federal agencies work together to minimize these threats and identify essential habitat for every life stage of each federally managed species. Essential fish habitat (EFH) includes all types of aquatic habitat—wetlands, coral reefs, seagrasses, rivers—where fish spawn, breed, feed, or grow to maturity. Productive commercial and recreational fisheries are inextricably linked to healthy marine habitats; protecting and restoring them will help support fishing communities now and for generations to come.

The muddy substrate and aquatic vegetation found in and along the Channel and shoreline of Pelican Island provide EFH for all life stages of shrimp, stoney crab, and red drum. The Channel bay bottom surface, while subject to recurrent dredging activities, provides the necessary habitats for these commercial and recreational important species. Physical disturbance to existing natural bay bottoms from the dredging process was previously addressed in detail during the original HGNC studies. The Galveston NOAA office has extensively studied the causes of salt-water intrusion, marsh erosion, the effects of marsh creation using dredge material on fisheries production, and overall productivity of wetlands in Galveston Bay.

Colonel Christopher Sallese 7

Threatened and Endangered Species

Our records indicate that the following delisted (DL), endangered (E), threatened (T) are species known to occur in Galveston County:

Brown pelican *(Pelecanus occidentalis)* – DL
Green sea turtle (*Chelonia mydas)* - E and T
Hawksbill sea turtle (*Eretmochelys imbricata*) - E
Kemp's Ridley sea turtle (*Lepidochelys kempii*) - E
Leatherback sea turtle (*Dermochelys coriacea*) - E
Loggerhead sea turtle (*Caretta caretta*) – T
Piping Plover (*Charadrius melodus*) - E and T

Brown Pelican

The brown pelican, listed in 1970, recovered and was removed from the federal endangered species list in November 2009. The brown pelican is a year round resident of the Gulf of Mexico, feeds in Galveston Bay, adjacent ship channels and bayous and is expected to occur in the project area. Although removed from the protection of the Endangered Species Act, the brown pelican remains protected under the Migratory Bird Treaty Act and populations are monitored by federal and state agencies to ensure recovery status.

Sea Turtles

Five species of sea turtles are found in U.S. waters and nest on U.S. beaches: leatherback, hawksbill, loggerhead, green, and Kemp's ridley. The leatherback, hawksbill and green sea turtles rarely nest in the southeastern U.S., however offshore waters are important feeding, resting, and migratory corridors. All are known to nest in Texas, however the Kemps's ridley and loggerhead turtles are more common along the Texas coast. The Texas sea turtle nesting season begins March 15 and ends October 1 each year and there is no designation of critical habitat for sea turtles in Texas. Sea turtles are not expected to be nesting within the project area; however, turtles may be encountered in the Channel during deepening and routine maintenance dredging.

Piping Plover

The piping plover was federally listed as endangered in the Great Lakes watershed and as threatened elsewhere in its range on January 10, 1986 (50 FR 50726). The piping plover is a regular winter resident along the upper Texas coast (Haig and Oring 1985, Haig and Plissner 1993). They arrive in July, with some late-nesting birds arriving in September. A few individuals can be found throughout the year but sightings are rare in late May, June, and early July. The wintering grounds along the Texas coast support populations from the Great Lakes, Northern Great Plains, Atlantic Coast and Canada, and play a crucial role in supporting the survival of this species. While the Galveston Ship Channel itself does not provide the habitat necessary to support wintering piping plovers, plovers may use the exposed sandy beaches and mud flat areas along the shoreline of the adjacent Pelican Island.

Critical habitat on the wintering grounds was designated July 10, 2001 (66 FR 36038). That designation included 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas to provide sufficient wintering habitat to support the piping plover at the population level and geographic distribution necessary for recovery of that species. A total of approximately 165,211 acres (66,881 hectares) and/or 1,798.3 miles (2,891.7 kilometers) were designated. There were 37 critical habitat units [approximately 62,454 acres (25,285 hectares), 797.3 miles (1,283.8 kilometers)] designated in Texas. These areas were believed to contain the essential physical and biological elements for the conservation of wintering piping plovers, and the physical features necessary for maintaining the natural processes that provide appropriate foraging, roosting, and sheltering habitat components. However, there is no designated critical habitat within the project area.

Cumulative Impacts

A cumulative impact analysis was completed and presented in the HGNC Final Environmental Impact Statement (FEIS). Impacts related to this project remain unchanged from those reported in the FEIS.

Summary and Recommendations

The Corps and the POG propose to extend the Channel 2,571 feet westward toward the Pelican Island Bridge and dredge this area to a depth of 45 feet to be consistent with the configuration of the existing of the Channel. New work dredge material and future dredge maintenance material from the project area are proposed to be placed in upland confinement in the Pelican Island Placement Area.

Review of the Corps' project documentation, aerial photographs and Service files indicate the project area is heavily altered by ship traffic (commercial and recreational) and dredging activities. The Service believes the Preferred Alternative will have minimal impacts on fish and wildlife resources in the immediate project area. Although no mitigation is proposed due to the temporary nature of the impacts, the Service recommends the beneficial use of dredge material over the upland confinement at Pelican Island. As identified in the *Galveston Bay Habitat Conservation Blueprint, Sites, A Plan to restore the Habitats and Heritage of Galveston Bay* (1998), both east and west shorelines and marshes of Pelican Island as well as the Pelican Spit (Little Pelican Island) have experienced significant erosion due to increased ship wakes and recent storm events. Both Pelican and Little Pelican Islands have supported a variety of wildlife and were considered large bird rookeries for Galveston Bay. Little Pelican Island supported large numbers of brown pelicans, gulls and terns until 2006 and Pelican Island had 3300 nesting laughing gulls (*Larus atricilla*) in 2005; however, human disturbance and predation may explain the lack of nesting activity at either island. Current restoration efforts are focused along the eroding western shoreline of Pelican Island north of the Pelican Island Causeway. At this location, local partners propose to construct a breakwater structure, pump dredge material behind the structure, and plant the area to create a beneficial marsh project. Likewise, the new work and future maintenance dredge material from the proposed Galveston Channel Extension project could be used beneficially to provide erosion protection from increased ship wakes, sea level rise and high water storm events to both sides of Pelican Island. Should the Corps decide to utilize

the dredged material beneficially, the Service can provide assistance in identifying suitable areas for the placement of that material.

While sea turtles are not expected to nest in the project area, they do feed in the bay system and may be encountered during dredging activities. Therefore, the National Oceanic and Atmospheric Administration, Protected Resource Division (David Bernhart, 727/551-5767) should be contacted for additional information on listed marine species under their jurisdiction.

No critical habitat for the piping plover is found within the project area, however; the birds can be located throughout the bay system on tidally exposed mud and sand flats. The Service recommends that presence/absence surveys be conducted in suitable areas adjacent to Pelican Island and any necessary consultation procedures initiated with the Service pursuant to Section 7 of the Endangered Species Act to ensure that the birds are not inadvertently disturbed or harassed.

Should the scope of the project change, impacts to fish and wildlife resources should be re-evaluated and coordination with the Service re-initiated. We appreciate the opportunity to participate in the planning of the Houston-Galveston Navigation Channels, Texas, Galveston Channel Extension Project. If you have any questions or comments concerning this planning aid letter, please contact staff biologist Donna Anderson at 281/286-8282.

Sincerely,

Edith Erfling

Edith Erfling
Field Supervisor

cc:
Carolyn Murphy, U.S. Army Corps of Engineers, Galveston, TX
Jaime Schubert, Texas Parks and Wildlife Department, Dickinson, TX
Jeanene Peckham, U.S. Environmental Protection Agency, Dallas, TX
Rusty Swafford, National Marine Fisheries Service, Galveston, TX
Ray Newby, Texas General land Office, Austin, TX
Scott Alford, National Resource Conservation Service, Baytown, Texas

REFERENCES

Galveston Bay Foundation. Galveston Bay Habitat Conservation Blueprint, A Plan to Restore the Habitats and Heritage of Galveston Bay.n.p., 1998. 118-119.

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Zimmerman, R., T. J. Minello, T. Baumer, and M. Castiglione. 1989. Oyster reef as habitat for estuarine macrofauna. NOAA Tech. Memo. NMFS-SEFC-249. 16 p.

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

May 7, 2013

Ms. Rebecca Hensley
Texas Parks & Wildlife Department
1502 FM 517 East
Dickinson, TX 77539

Dear Ms. Hensley:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is explained in the enclosed Notice of Availability and described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

Under the Fish and Wildlife Coordination Act, we are required to consider potential impacts to fish and wildlife resources in planning civil works projects and coordinate with the Texas Parks & Wildlife Department (TPWD). Pursuant to the Act, the District is requesting that TPWD review the enclosed Draft EA and provide any comments your agency may have regarding the proposed project. We appreciate your continued cooperation in allowing us to fulfill our obligations under the Act.

If you or your staff have any questions regarding this project, please contact Andrea Catanzaro at (409) 766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Encls

TEXAS PARKS & WILDLIFE

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Fort Worth

Carter P. Smith
Executive Director

June 10, 2013

District Engineer
U.S. Army Engineer District, Galveston
ATTN: CESWG-PE-PR
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Public Notice No. HGNC-13-01
Draft Environmental Assessment for Galveston Harbor Channel Extension

Texas Parks and Wildlife Department (TPWD) has reviewed the Draft Environmental Assessment (DEA) for the extension of the currently authorized 45-foot deep Galveston Harbor Channel for a distance of 2,571 feet, located adjacent to Pelican Island in Galveston County, Texas. The project area is currently authorized and maintained at a depth of 40 feet. The proposed dredging would deepen the channel an additional five feet to be consistent with the Houston-Galveston Navigation Channels. Approximately 514,000 cubic yards of new work dredged material is proposed to be placed at the Pelican Island placement area (PA). The channel extension would generate 648,000 cubic yards of maintenance material every four years to be placed at the Pelican Island PA.

Section 2.3.2 of the DEA explains that a beneficial use site along the west side of Pelican Island was identified as an alternative for material placement. This alternative included construction of a perimeter levee to +7 feet mean low tide. The levee would be constructed through excavating on-site borrow material adjacent to the levee alignment. The new work dredged material from the extension of the channel would then be placed within the perimeter levee at marsh elevations. The DEA states that this beneficial use alternative would not be implemented due to cost of construction. However, TPWD recommends that the U.S. Army Corps of Engineers further investigate the beneficial use alternative with a different project design that may reduce costs to beneficially utilize the dredge material. The new work dredge material is composed of mostly clays; therefore, the perimeter levees at the beneficial use site could be constructed with the new work dredge material from the channel instead of constructing perimeter levees with on-site borrow material. Future maintenance dredge material could be placed at the beneficial use site within the constructed perimeter levees. This alternate beneficial use site plan could reduce project costs and result in a project that would assist in restoring marsh habitat that supports fish and wildlife species. Additional analysis would ensure that all alternatives for beneficially utilizing material have been thoroughly explored.

Questions can be directed to Ms. Ashley Thompson at (281) 534-0139 in the Dickinson Marine Lab.

Sincerely,

Rebecca Hensley

Rebecca Hensley
Regional Director, Ecosystem Resources Program
Coastal Fisheries Division

RH:WD:AT

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Ms. Rebecca Hensley
Texas Parks & Wildlife Department
1502 FM 517 East
Dickinson, TX 77539

RESPONSE TO COMMENTS

Comment No.	Response
1	The Beneficial Use (BU) construction alternative described in the Draft Environmental Assessment was bed on an initial design evaluated during early plan formulation. The description will be corrected to describe the most recent construction methods illustrated in the Engineering Appendix to the main Post-Authorization Change Report. Only a small quantity of borrow material from bay bottom adjacent to the proposed levee would be excavated to replace unsuitable soft foundation soils in the levee footprint. The levee would then be constructed from hydraulically placed new work material from proposed channel deepening.
2	The major cost difference, by far, between placing the new work material within the upland confined Pelican Island placement area and constructing a new BU site is the added cost of shore protection, new outlet box, and the requirement to remove and replace unsuitable foundation soils beneath the new levee template prior to building the levee. Shoreline protection was included in the design of the BU placement alternatives under consideration as it was determined to be a critical design component. The proposed location of the site selected for design and analysis of the BU alternatives has considerable fetch length which would increase erosion potential and threaten success of a newly constructed marsh if shoreline protection was not included.

TEXAS HISTORICAL COMMISSION
The State Agency for Historic Preservation

RICK PERRY, GOVERNOR
JOHN L. NAU, III, CHAIRMAN
F. LAWERENCE OAKS, EXECUTIVE DIRECTOR

April 16, 2008

Ms. Carolyn Murphy
Chief, Environmental Section
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, TX 77553-1229

RE: Project review under Section 106 of the National Historic Preservation Act of 1966 and the Antiquities Code of Texas
Deepening of the Galveston Ship Channel, stations 20+000 to 22+571, and development of upland placement area on Pelican Island, Galveston County, Texas.
COE-VD

Dear Ms. Murphy:

Thank you for your correspondence describing the above referenced project. This letter serves as comment from the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission. As the state agency responsible for administering the Antiquities Code of Texas, these comments also provide recommendations on compliance with state antiquities laws and regulations.

You have requested that we concur with your determination of no historic properties affected for the section of the Galveston Ship Channel proposed for modification because this area was surveyed in 1991 by EH&A under Texas Antiquities Permit #1128. Reviewing the publication on that work dated April 1992, we note that 1) the survey was conducted at a lane spacing of 47 meters which is not acceptable under more recent survey standards requiring a maximum 30 meter lane spacing, 2) the survey in that area, by design, was conducted only south of the channel centerline, and 3) much of the area designated for survey in that section was not surveyed for reasons not stated by the author (we suspect obstructions present at the time prevented full access to the survey area).

We further note that 1) the proposed project design involves only deepening the existing channel from 40 feet to 45 feet with no corresponding widening and 2) this area has been dredged many times in the past to achieve and maintain this depth. We are also aware that the area is heavily developed along both shores of the ship channel, which precludes the effective magnetometer survey along the periphery of the existing channel, the area most likely to contained preserved historic resources. For these reasons, we feel that additional archeological survey for the proposed channel deepening would be unproductive and do not recommend such survey.

Additionally, we concur that the proposed upland containment area, for the reasons stated by you, has no potential to effect historic resources.

We look forward to further consultation with your office and hope to maintain a partnership that will foster effective historic preservation. Thank you for your cooperation in this federal and state review process, and for your efforts to preserve the irreplaceable heritage of Texas. **If you have any questions concerning our review or if we can be of further assistance, please contact Steve Hoyt at 512/463-7188.**

Sincerely,

Steven D. Hoyt

for F. Lawerence Oaks, State Historic Preservation Officer

State Historic Preservation Officer
Texas Historical Commission
P.O. Box 12276
Austin, TX 78711-2276

RESPONSE TO COMMENTS

Comment No.	Response
1	Thank you for your comment.

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

May 7, 2013

REPLY TO THE ATTENTION OF
Environmental Section

Mr. Mike Jansky
U.S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Mail Code 6 ENXP
Dallas, Texas 75202-2733

Dear Mr. Jansky:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is explained in the enclosed Notice of Availability and described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

This Draft EA was prepared in accordance with the National Environmental Policy Act of 1969, as amended, and as implemented by the Council on Environmental Quality (40 CFR Parts 1500-1508). The results of your review are requested by October 24, 2012.

I would appreciate your timely review of these documents. If you have any questions, or if you would like additional copies, please contact Ms. Andrea Catanzaro at the letterhead address, by telephone at 409-766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Encls

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

May 7, 2013

REPLY TO THE ATTENTION OF
Environmental Section

Susana M. Hildebrande, P.E.
Texas Commission on Environmental Quality
P.O. Box 13087, Mail Code 168
Austin, Texas 78711-3087

Dear Ms. Hildebrande:

Enclosed please find a copy of the Draft Post-Authorization Change Report (PACR) and Draft Environmental Assessment (EA) for the Galveston Harbor Channel Extension Project, Galveston County, Texas. This draft report is provided for your agency review of the Draft General Conformity Determination (GCD) in accordance with the Clean Air Act. The Draft GCD and air emission estimates are provided in Appendix E of the Draft EA.

A Notice of Availability for the Draft PACR, Draft EA and Draft GCD (enclosed) has been issued to the public for review and comment. The U.S. Army Corps of Engineers, Galveston District will accept written public comments on the Draft EA and the Draft GCD from April 4, 2013 through May 6, 2013.

The results of your review are requested by May 6, 2013. I would appreciate your timely review of these documents. If you have any questions, or if you would like additional copies, please contact Ms. Andrea Catanzaro at the letterhead address, by telephone at 409-766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Encls

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

May 7, 2013

REPLY TO THE ATTENTION OF
Environmental Section

Ms. Barbara Keeler
U.S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Dear Ms. Keeler:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is explained in the enclosed Notice of Availability and described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

This Draft EA was prepared in accordance with the National Environmental Policy Act of 1969, as amended, and as implemented by the Council on Environmental Quality (40 CFR Parts 1500-1508). The results of your review are requested by October 24, 2012.

I would appreciate your timely review of these documents. If you have any questions, or if you would like additional copies, please contact Ms. Andrea Catanzaro at the letterhead address, by telephone at 409-766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Encls

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

May 7, 2013

REPLY TO THE ATTENTION OF

Environmental Section

Ms. Karen McCormick
U.S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200

Dallas, Texas 75202-2733

Dear Ms. McCormick:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is explained in the enclosed Notice of Availability and described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

This Draft EA was prepared in accordance with the National Environmental Policy Act of 1969, as amended, and as implemented by the Council on Environmental Quality (40 CFR Parts 1500-1508). The results of your review are requested by October 24, 2012.

I would appreciate your timely review of these documents. If you have any questions, or if you would like additional copies, please contact Ms. Andrea Catanzaro at the letterhead address, by telephone at 409-766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy
Chief, Environmental Section

Encls

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

June 10, 2013

District Engineer
U.S. Army Engineer District, Galveston
Attn: CESWG-PE-PR
P.O. Box 1229
Galveston, TX 77553-1229

In accordance with our responsibilities under Section 309 of the Clean Air Act (CAA) and the National Environmental Policy Act (NEPA), the U.S. Environmental Protection Agency (EPA) Region 6 has reviewed the Draft Environmental Assessment (EA) for the Galveston Harbor Channel Extension Post-Authorization Change Report (Galveston Harbor) in Galveston County, Texas. The proposed action will deepen the Galveston Harbor Ship Channel from a current depth of 40 to a depth of 45 feet; for a distance of 2,571 feet. This will allow more heavily loaded barges to dock at the far end of the Galveston Harbor and result in increased navigational efficiency. Attached are specific comments for your consideration in preparation of the Final EA.

We appreciate the opportunity to provide comments for the Draft EA. Please send the Final EA to my attention. Should you have any questions or concerns regarding this letter, do not hesitate to call me at 214-665-8006, or contact Keith Hayden of my staff, at 214-665-2133 or hayden.keith@epa.gov for assistance.

Sincerely,

Rhonda Smith
Chief, Office of Planning
and Coordination

2.0 Alternatives Considered; Page 10

The EA states implementation of the tentatively proposed action alternative would result in a change in bottom width from 1,085 feet to 1,075 feet. The side slopes would have a constructed 1V:3H slope, and will be maintained at a 1V:2H slope. With a 5-foot increase in depth from 40 feet to 45 feet the 1V:3H slope would result in a total decrease in channel width of 30 feet at the channel bottom. The maintenance slope of 1V:2H would result in a decrease in channel width of 20 feet. This would reduce the overall channel width to 1,055 feet for the 1:3 slopes and 1,065 feet for the 1:2 slopes.

Recommendation:

- Clarify if any changes to project dimensions will occur to account for the discrepancy in bottom width. If no changes are to take place, please describe how the bottom widths were derived using the stated slopes.

2.3.2 Beneficial Use of Dredged Material Alternatives; Page 14

Marsh Construction Levee

The EA states the open water marsh creation alternative would construct a levee and armor it with a mixture of riprap, geotextile, and blanket stone.

Recommendation:

- Clarify if the entire extent of the marsh creation levee will be armored. If so, describe what analysis or modeling was performed, or what conditions exist in proximity of the potential beneficial use area to demonstrate a need to armor the entire levee.

Tidal Connectivity

Given the relative permanence of the suggested containment option, tidal connectivity may quickly become an issue with regards to maintaining marsh health and overall ecological function. However, the incorporation of circulation channels and outlet structures indicate that an effort will be made to restore this connectivity within the constructed marsh.

Recommendation:

- Once de-watering and consolidation has taken place, EPA recommends that the follow-up measures mentioned in the EA, outlet structures in particular, be implemented at the maximum extent practicable to maximize tidal connectivity.

Placement of Dredged Material

There is wide variation in projected amounts of dredge material to be used in marsh creation depending on the final depth of channel dredging. It is also unclear if beneficial use of

Recommendation:

- Clarify if these construction-related emissions did occur during 2012, or if the timeframe for project implementation has changed.

General Air Quality Concerns

Because of the air quality concerns of significant population centers within the EA study area, EPA recommends that in order to reduce potential short-term air quality impacts associated with construction activities, the agencies responsible for the project should include a Construction Emissions Mitigation Plan and adopt this plan in the Record of Decision (ROD). In addition to all applicable local, state, or federal requirements, the EPA recommends that the following mitigation measures be included in the Construction Emissions Mitigation Plan in order to reduce impacts associated with emissions of NOx, CO, PM, SO_2, and other pollutants from construction-related activities:

Fugitive Dust Source Controls:

- Stabilize open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate at active and inactive sites during workdays, weekends, holidays, and windy conditions;
- Install wind fencing and phase grading operations where appropriate, and operate water trucks for stabilization of surfaces under windy conditions; and
- Prevent spillage when hauling material and operating non-earthmoving equipment and limit speeds to 15 miles per hour. Limit speed of earth-moving equipment to 10 mph.

Mobile and Stationary Source Controls:

- Plan construction scheduling to minimize vehicle trips;
- Limit idling of heavy equipment to less than 5 minutes and verify through unscheduled inspections;
- Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, prevent tampering, and conduct unscheduled inspections to ensure these measures are followed;
- Consider use of construction equipment meeting EPA's Tier 4 engine standards. However, lacking availability of such non-road construction equipment that meets these standards, we would suggest use of EPA-verified particulate traps, oxidation catalysts and other appropriate controls where suitable to reduce emissions of diesel particulate matter and other pollutants at the construction site; and
- Consider alternative fuels and energy sources such as natural gas and electricity (plug-in or battery).

7.7 Endangered Species Act Consultation; Page 60

In the Planning and Aid Letter (PAL) dated January 14, 2011, the USFWS recommended that presence/absence surveys be conducted in suitable areas adjacent to Pelican Island and any

Ms. Rhonda Smith
Chief, Office of Planning and Coordination
Environmental Protection Agency, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RESPONSE TO COMMENTS

Comment No.	Response
1	Figure 2 will be updated to reflect the discontinuance of the nearshore berm as a beneficial use (BU) placement site.
2	As indicated in the last paragraph on page 11 (Section 2.3), project dimensions would change. At the deepest depth of 45 feet MLT, the bottom width of the channel would decrease by 10 feet in width (from 1,085 feet to 1,075 feet). The top of cut, however could increase by as much as 7 feet on each side, depending upon the existing depth of the bay bottom in a given location. This is shown in Figure 4 on page 7. The EA will refer the reader back to Figure 4 for added clarity.
3	The EA will clarify that the conceptual BU alternatives were evaluated during plan formulation, but were not selected due to costs. The EA will further clarify that the conceptual BU alternatives evaluated included armoring of the perimeter levees occurring along the north, west and south sides of the BU site. Since the Pelican Island shoreline occurs to the east of the BU site evaluated, no levees would be require to be built on that side of the site. Armoring of the levees would be necessary as site conditions in proximity of proposed BU alternatives include extensive fetch (distance traveled by wind and waves with no obstruction) and water depth that, based on experience with other projects, would lead to shoreline erosion of the site if proper levee protection was not included in the conceptual designs.
4	The discussion of the assumptions for construction of the BU alternatives considered during plan formulation will be clarified. Circulations channels and out let structures are discussed in the last paragraph of Section 2.3 of the EA. The wording will be clarified to state that the "5-foot deep circulation channels would be constructed inside the marsh cell to facilitate tidal flow through the site". In addition, the last sentence of the paragraph will be changed to indicate that once target elevations at the BU site are met, the outlet structures would be removed provide unrestricted tidal flow and circulation within the site.
5	The beginning of the last paragraph in Section 2.3 of the EA explains the various BU alternatives considered during plan formulation would have been constructed using new work material from channel deepening. The third from the last sentence of the last paragraph in Section 2.3 will be reworded to clarify the potential future use of maintenance material as follows: "Future maintenance material would be added, as needed, to meet and/or manage the target elevations of the marsh design."
6	For the various BU placement alternatives considered during plan formulation, new work material would be used to construct the site and fill the marsh to achieve target elevation. The third from the last sentence of the last paragraph in Section 2.3 will be reworded to clarify the potential future use of maintenance material as follows: "Future maintenance material would be added, as needed, to meet and/or manage the target elevations of the marsh design."
7	Subsequent to the initial preparation of the Draft EA, additional sediment testing of the Galveston Harbor Channel was perform and analyzed in February 2012. This will be indicated in the Final EA. This testing confirmed that the sediments were non-hazardous. The EA will reiterate that all dredged material generated from the proposed project would be placed in the upland confined Pelican Island Placement Area. For these reasons, there is no reason to believe that contaminant issues would arise because of sediment quality

Ms. Rhonda Smith
Chief, Office of Planning and Coordination
Environmental Protection Agency, Region 6
(continued)

Comment No.	Response
8	By letter dated June 12, 2013, the Texas Commission on Environmental Quality (TCEQ) provided general conformity concurrence that emission from the Galveston Harbor Channel Extension Project will not exceed the emissions budgets in the most recent state implementation plan revision approved on March 29, 2010 by the EPA. A copy of TCEQ's concurrence letter is included in the Final EA.
9	Construction-related emissions would occur during 2014.
10	EPA recommends that the following mitigation measures be included in the Construction Emissions Mitigation Plan in order to reduce impacts associated with emissions of NOx, CO, PM, S02, and other pollutants from construction-related activities: Fugitive Dust Source Controls: • Stabilize open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate at active and inactive sites during workdays, weekends, holidays, and windy conditions; • Install wind fencing and phase grading operations where appropriate, and operate water trucks for stabilization of surfaces under windy conditions; and • Prevent spillage when hauling material and operating non-earthmoving equipment and limit speeds to 15 miles per hour. Limit speed of earth-moving equipment to 10 mph. Mobile and Stationary Source Controls: • Plan construction scheduling to minimize vehicle trips; • Limit idling of heavy equipment to less than 5 minutes and verify through unscheduled inspections; • Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, prevent tampering, and conduct unscheduled inspections to ensure these measures are followed; • Consider use of construction equipment meeting EPA's Tier 4 engine standards. However, lacking availability of such non-road construction equipment that meets these standards, we would suggest use of EPA-verified particulate traps, oxidation catalysts and other appropriate controls where suitable to reduce emissions of diesel particulate matter and other pollutants at the construction site; and • Consider alternative fuels and energy sources such as natural gas and electricity (plug-in or battery).
11	Presence/absence surveys for piping plover are unnecessary for this project. The project area is continuously disturbed by ongoing maintenance dredging activities, commercial shipping and recreational vessel traffic and other human activities making these areas unsuitable for piping plover. The proposed action of deepening the channel from 40 feet to 45 feet Mean Low Tide would have the same affects as the on-going maintenance dredging of this section of channel; the dredging would likely be timed to occur during a regularly scheduled maintenance cycle for the channel. The shorelines along the existing Galveston Harbor Channel in the vicinity of the proposed deepening of the Galveston Harbor Channel Extension predominantly consist of bulkheads and dock facilities; very small, short stretches of shorelines having shell hash substrates occur to a lesser extent in the project area in areas such as that found at TAMUG Clipper dock area. These areas are continuously disturbed by ongoing maintenance dredging activities, commercial shipping and recreational vessel traffic and other human activities making these areas highly unsuitable for piping plover. While suitable habitat for piping plover occurs along the sandy beach shorelines of the Gulf of Mexico and some dredged material islands along the GIWW in Galveston County, these species are not likely to occur in the vicinity of the project due to lack of suitable or preferred habitat.

Ms. Rhonda Smith
Chief, Office of Planning and Coordination
Environmental Protection Agency, Region 6
(continued)

12	Documentation of required consultation and issued certifications for the proposed GHCE project will be cited in relevant locations in the text and included in the appropriate sections and/or appendices of the Final EA.

Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein, *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 12, 2013

District Engineer
U.S. Army Engineer District, Galveston
ATTN: CESWG-PE-PR
P.O. Box 1229
Galveston, Texas 77553-1229

Re: United States Army Corps of Engineers' (USACE) Galveston Harbor Channel Extension Project Post-Authorization Change Report; Draft General Conformity Determination

To Whom it My Concern:

This letter provides general conformity concurrence for the Galveston Harbor Channel Extension Project Post-Authorization Change Report; Draft General Conformity Determination. The Texas Commission on Environmental Quality (TCEQ) reviewed the project in accordance with Title 40 Code of Federal Regulations Part 93. The proposed project is located in the Houston-Galveston-Brazoria (HGB) area, which is classified as severe nonattainment for the 1997 eight-hour ozone standard. Emissions are expected to be above the 25 tons per year *de minimis* threshold; therefore, a general conformity analysis is required.

The TCEQ has determined that emissions from the proposed project will not exceed the emissions budgets specified in the most recent state implementation plan (SIP) revision approved by the United States Environmental Protection Agency (EPA). The most recently approved SIP revision, the HGB Reasonable Further Progress SIP adopted by the Commission on May 23, 2007, was approved by the EPA on March 29, 2010.

In support of the ozone National Ambient Air Quality Standard, the TCEQ suggests the USACE adopt pollution prevention and/or reduction measures in conjunction with this and future projects, such as the following:

- encourage construction contractors to apply for Texas Emission Reduction Plan grants;
- establish bidding conditions that give preference to clean contractors;
- direct construction contractors to exercise air quality best management practices;
- direct contractors that will use tugboats during construction to use clean fuels;
- direct operators of the assist tugboats used in maneuvering dredge vessels to use clean fuels;
- select assist tugs based on lowest nitrogen oxides (NO_X) emissions instead of lowest price; and/or
- purchase and permanently retire surplus NO_X offsets prior to commencement of operations.

Thank you for providing the necessary information and staff assistance for our review. We would also appreciate updates, as appropriate, as this project moves forward. I look forward to working with you in the future on any upcoming projects you may have that affect air quality in your district. If you require further assistance on this matter, please contact Holly Ferguson at (512) 239-4905 or holly.ferguson@tceq.texas.gov.

Sincerely,

David Brymer, Director
Air Quality Division
Texas Commission on Environmental Quality

DB/HB/kb

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

May 7, 2013

Mr. Charles Maguire
Water Quality Director
Texas Commission on Environmental Quality
TCEQ-MC150
2100 Park 35 Circle
Austin, TX 78753

Dear Mr. Maguire:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

Under the Clean Water Act (CWA) of 1977, a State Water Quality Certificate for the discharge activity is required prior to construction. A Joint Public Notice for the proposed project is enclosed. A CWA Section 404(b)(1) evaluation is included in Appendix G of the Draft EA. Our analysis of relevant data determined that Texas Surface Water Quality Standards will not be exceeded by the proposed action.

The District is requesting that the Texas Commission on Environmental Quality review the enclosed information and take appropriate action regarding the issuance of a State Water Quality Certificate for the proposed action. If you or your staff have any questions regarding this project, please contact Andrea Catanzaro at (409) 766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

Encl

Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein, *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

July 9, 2013

Ms. Andrea Catanzaro
Galveston District CESWG-PE-RE
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229

Re: Galveston Harbor Channel Extension, HGNC-13-01

Dear Ms. Catanzaro:

This letter is in response to the U.S. Army Corps of Engineers (Corps) Draft Environmental Assessment (DEA) dated March 2013 for the Galveston Harbor Channel Extension. The DEA was provided to the Texas Commission on Environmental Quality (TCEQ) on May 13, 2013. The project is described in the Joint Public Notice HGNC-13-01 issued on May 10, 2013. The extension project is located within the Galveston Harbor Channel in Galveston County, Texas.

The proposed work would deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep MLT. The proposed work would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The dredged material from the proposed extension would be placed in the upland confined Pelican Island Placement Area.

The TCEQ has reviewed the DEA. Based on our evaluation of the information contained in these documents, the TCEQ certifies that there is reasonable assurance that the project will be conducted in a way that will not violate water quality standards.

No review of property rights, location of property lines, nor the distinction between public and private ownership has been made, and this certification may not be used in any way with regard to questions of ownership.

If you require additional information or further assistance, please contact Mr. John Trevino, Water Quality Assessment Section, Water Quality Division (MC-150), by email at John.Trevino@tceq.texas.gov, or by phone at (512) 239-4600.

Sincerely,

David W. Galindo
Water Quality Division Director
Texas Commission on Environmental Quality

DWG/JT/gg

Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

May 21, 2013

District Engineer
U.S. Army Engineer District, Galveston
ATTN: CESWG-PE-PR
P.O. Box 1229
Galveston, Texas 77553

Re: TCEQ Grant and Texas Review and Comment System (TRACS) #2013-274, Galveston County, Project Harbor Channel Extenstion

To Whom it May Concern:

The Texas Commission on Environmental Quality (TCEQ) has reviewed the above-referenced project and offers the following comments:

We have no comment on this project.

Thank you for the opportunity to review this project. If you have any questions, please contact Ms. Melanie Trimble at (512) 239-1622 or melanie.trimble@tceq.texas.gov.

Sincerely,

Minor B. Hibbs, P.E.
Special Assistant to Chief Engineer

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF

Environmental Section

May 7, 2013

Ms. Sheri Land
Coastal Coordination Council
P.O. Box 12873
Austin, Texas 78711-2873

Dear Ms. Land:

The Galveston District is developing plans to deepen the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) from 40 feet mean low tide (MLT) to 45 feet deep (MLT). The proposed project, referred to as the Galveston Harbor Channel Extension, is located in Galveston County, Texas.

The proposed channel modifications would be consistent with the newly deepened -45 feet MLT Galveston Harbor Channel dimensions and would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel. The proposed work is explained in the enclosed Notice of Availability and described in detail in Section 1.4 of the enclosed Draft Environmental Assessment (EA).

Under the Coastal Zone Management Act (CZMA) of 1972, Federal actions are required to be consistent, to the extent practicable, with approved state coastal management plans. The District' s consistency determination is included in Appendix H of the Draft EA. The District is requests that you review the enclosed information to ensure that the proposed project is consistent with the Texas Coastal Management Plan.

If you or your staff have any questions regarding this project, please contact Andrea Catanzaro at (409) 766-6346, or by email at andrea.catanzaro@usace.army.mil.

Sincerely,

Carolyn Murphy

Carolyn Murphy
Chief, Environmental Section

Encls

APPENDIX C

Biological Assessment

BIOLOGICAL ASSESSMENT
FOR
GALVESTON HARBOR CHANNEL EXTENSION
FEASIBILITY STUDY
HOUSTON-GALVESTON NAVIGATION
CHANNELS, TEXAS

U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
GALVESTON, TEXAS

JUNE 2016

1.0 INTRODUCTION

1.1 PURPOSE OF THE BIOLOGICAL ASSESSMENT

This Biological Assessment (BA) has been prepared to fulfill the U.S. Army Corps of Engineers' (USACE), Galveston District requirements as outlined under Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended. The Federal action requiring this assessment is the proposed deepening improvements to the Galveston Harbor Channel, Galveston County, Texas. The Galveston Channel Navigation Project was part of an earlier study for improving the deep-draft navigation channels within the Galveston Bay area, authorized by a resolution of the House Committee on Public Works in October, 1967. The project sponsor is the Port of Galveston.

This BA evaluates the potential impacts of proposed deepening improvements to federally-listed threatened and endangered species identified by NMFS and the USFWS. Species included in this BA (Table 1) were identified from lists obtained from databases managed by the USFWS and NMFS (USFWS, 2016; NMFS, 2016). Additional protected species are listed by the Texas Parks and Wildlife Department as potentially occurring in Galveston County. However, these additional species are not covered in this BA as they are not federally-listed species.

The bald eagle was removed from the Federal list of threatened and endangered species. However, this species maintains Federal protection under the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act (64 Federal Register [FR] 164:46542–46558; 72 FR 130:37346– 37372). The brown pelican was also delisted (50 CFR 1759443-59472) and is protected under the Migratory Bird Treaty Act and the Lacey Act.

1.2 DESCRIPTION OF THE PROPOSED PROJECT AND HABITATS

The Galveston Channel Navigation Project is located on the upper Texas coast at the mouth of Galveston Bay in Galveston County, Texas. Galveston Channel is part of a complex of navigation channels running from offshore through Galveston Bay known as the Houston Galveston Navigation Channels (HGNC). Major channels include the Galveston Bay Entrance Channel from offshore, Bolivar Roads between Bolivar Peninsula and Galveston Island, the Houston Ship, Texas City, and Galveston Harbor Channels, and the Gulf Intracoastal Waterway. The Galveston Harbor Channel branches off the Galveston Bay Entrance Channel providing entry to the Port of Galveston. It extends in an east-west direction from Bolivar Roads between Galveston and Pelican Islands for about four miles (Figure 1). The project area includes the eastern end of Galveston Island and Pelican Island adjacent to the channel. Galveston Island is a low-lying barrier island two miles off the Texas coast, approximately 50 miles southeast of Houston, Texas.

The current depth of the terminal 2,571 feet of the Galveston Harbor Channel is -41 feet mean low tide (MLLW), and its width is 1,085 feet. Proposed channel improvements to this terminal section of the channel would consist of deepening the channel to a depth of 46-feet MLLW; channel side slopes would continue remain at the existing to be 1V:3H (1 foot vertical and 3 feet horizontal) so that the associated width of the terminal section of the channel would be reduced to 1,075 feet (Figures 2 and 3). The proposed modifications to this terminal segment of the channel would then be consistent existing dimensions of the remainder of the Galveston Harbor Channel, which was recently deepened to -46 feet MLLW in early 2011. The deepening would originate near Port of Galveston Pier-38 at Station 20+000, continuing westward towards Pelican island Bridge and ending at Station 22+571. Advanced maintenance and allowable over-depth would remain at the current requirement of 3 feet and 2 feet, respectively, such that the maximum channel depth following periodic maintenance would not exceed -51 feet MLLW.

Channel dredging to 46 feet deep would generate 513,800 cubic yards of new work material, consisting of primarily firm to stiff clays of high plasticity, which would be placed along the north perimeter of Cell B of the existing upland, confined Pelican Island placement area (PA). The potential for beneficial use was examined but it was not the least cost placement option, compared to upland placement. Therefore, it was not considered economically feasible and will not be utilized.

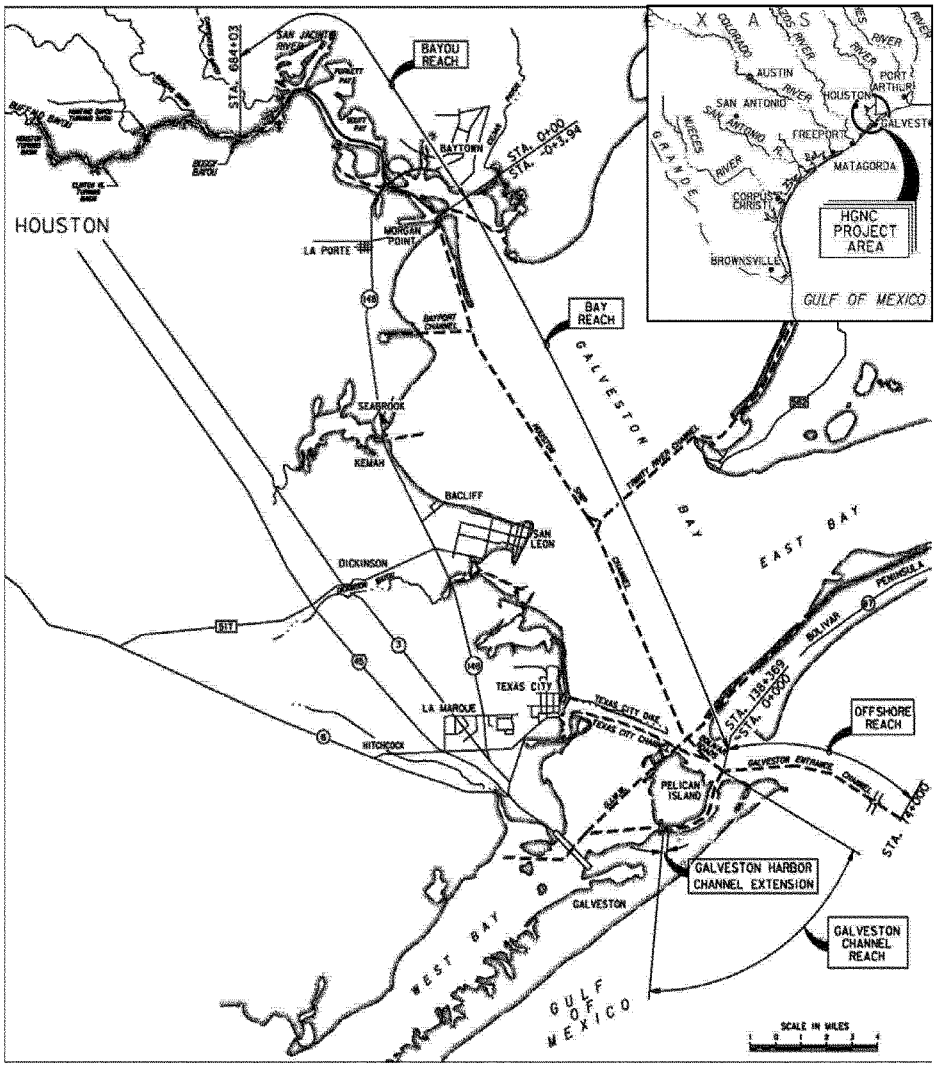


FIGURE 1: Houston-Galveston Navigation Channels Reach Designations and Project Area.

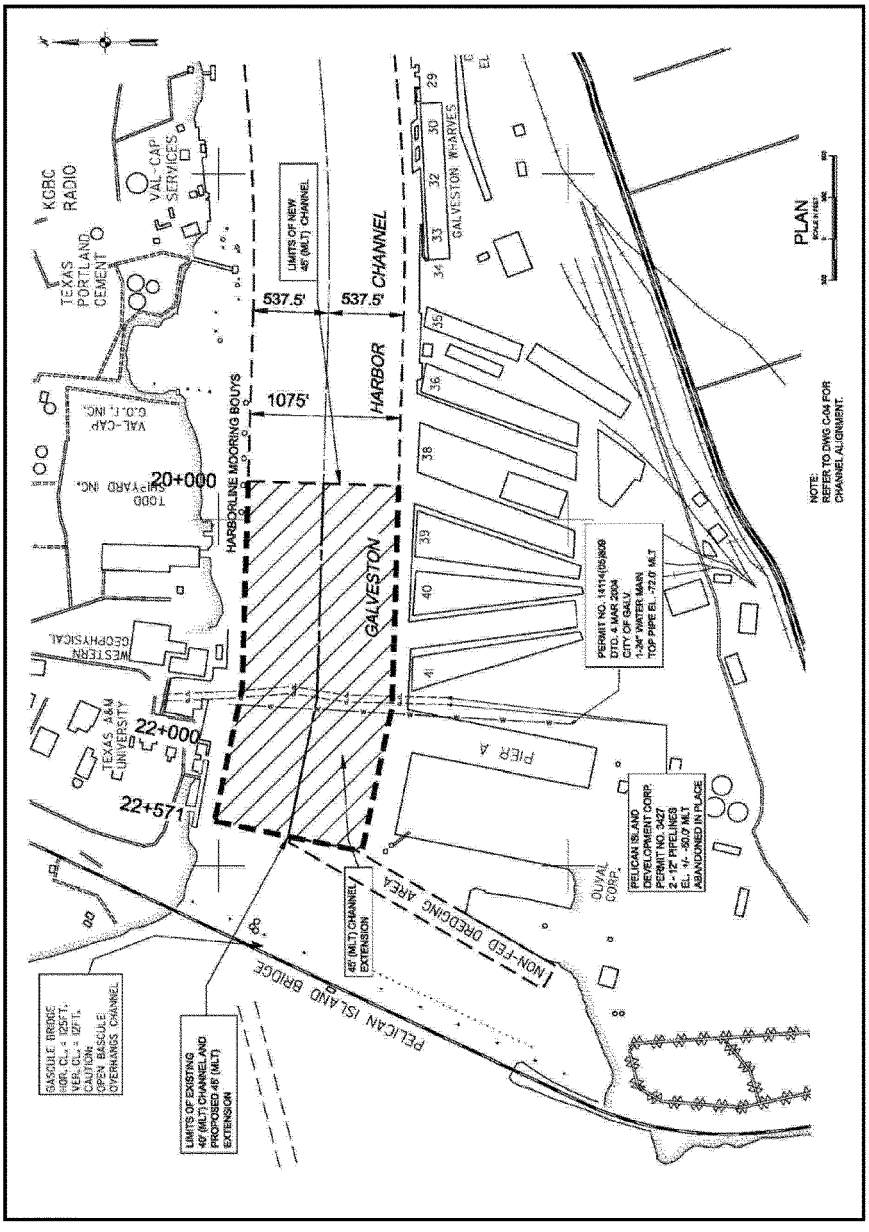


FIGURE 2: Footprint of the Recommended 46-foot Depth Extension of the Galveston Harbor Channel

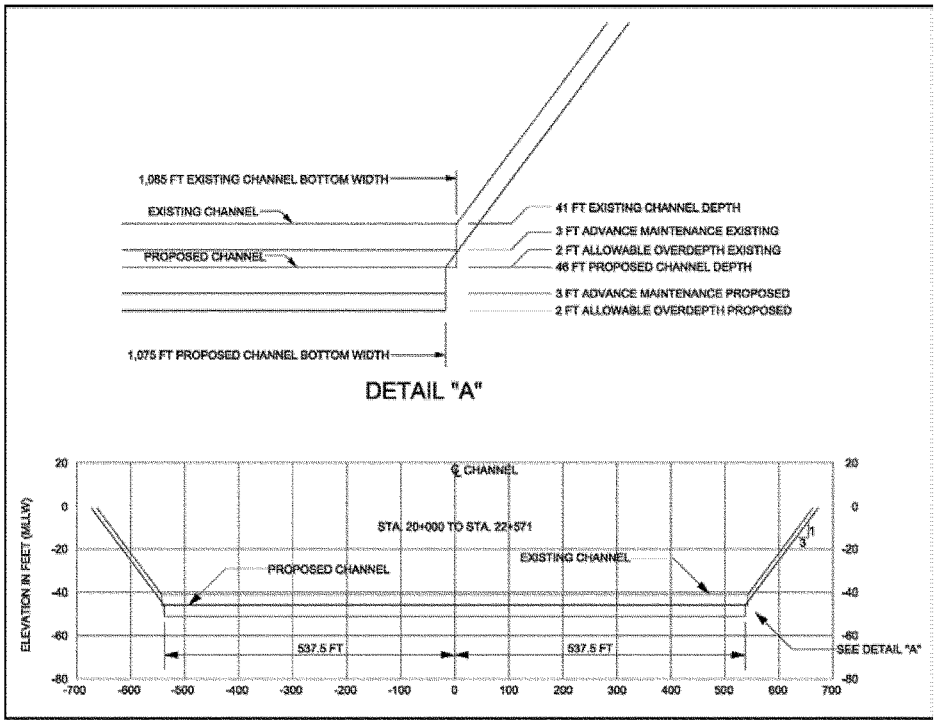


FIGURE 3: Typical Cross Section of Recommended 46-foot Depth Extension within Galveston Harbor Channel.

No ocean disposal is proposed for new work dredged material placement. Future maintenance material from the proposed project would also be placed in the existing Pelican Island PA. The construction period for the new work dredging and placement would be approximately 4 months.

2.0 SPECIES DESCRIPTIONS

Of the species listed in Table 1, only the brown pelican, and the loggerhead and Kemp's Ridley sea turtles are likely to occur in the vicinity of, or in areas adjacent to, the project. While suitable habitat for piping plover and red knot occurs along the sandy beach shore-

lines of the Gulf of Mexico and some dredged material islands along the GIWW in Galveston County, these species are not likely to occur in the vicinity of the project due to lack of suitable habitat. The shorelines along the Galveston Harbor Channel in the vicinity of the proposed deepening of the Galveston Harbor Channel Extension project predominantly consist of bulkheads and dock facilities; very small, short stretches of shorelines having shell hash substrates occur to a lesser extent in the project area in areas such as that found at TAMUG Clipper dock area. These areas are continuously disturbed by ongoing maintenance dredging activities, commercial shipping and recreational vessel traffic and other human activities making these areas unsuitable for piping plover and red knot. Any disturbance to the channel shorelines caused by the proposed deepening of the Galveston Harbor Channel Extension project would be of the same type and magnitude as experienced with the periodic maintenance dredging and placement into the Pelican Island PA associated with the authorized Federal project. Other species listed on Table 1 are not likely to occur in the vicinity of the project due to lack of suitable habitat or known range limits. There is no designated critical habitat for any of the listed species within the project area. Of the protected species, only the brown pelican is known to have regular occurrence in the project area vicinity. Species descriptions follow below.

2.1 BROWN PELICAN

The brown pelican is a common bird of Texas coastal and near-shore areas and they occur in the project area. Foraging or resting area in bay waters in the vicinity of the project may become less attractive during construction because of increased noise and human activity, but the habitat would not be destroyed.

2.2 SEA TURTLES

Green sea turtle. The green sea turtle was historically the most abundant sea turtle in Texas. Over harvesting and destruction of nesting habitat brought about a rapid decline, although this species can still be found on the seagrass meadows of the lower Laguna Madre. This species is most likely to occur in the southern bays of Texas where clear water and seagrass and algal beds are more abundant. It is not likely to occur along the upper Texas coast or in the project area.

Hawksbill sea turtle. This turtle is extremely rare in Texas coastal waters and is not expected to be present in the project area.

Kemp's ridley sea turtle. The Kemp's ridley sea turtle migrates along the coast of Texas and is probably the most common sea turtle in Texas bays. It frequently enters bays to feed on shrimp, crab, and other invertebrates. This species is found in Galveston Bay and may be present in waters in the vicinity of the project.

Leatherback sea turtle. The leatherback turtle is rare along the Texas coast. It is a pelagic species that tends to keep to deeper offshore waters where it feeds primarily on jellyfish. There are no known aggregation sites or feeding areas in the project area and the species is not expected to be present.

Loggerhead sea turtle. The loggerhead sea turtle frequents the temperate waters of the continental shelf along the Atlantic coast and Gulf of Mexico, where it forages around rocks, coral reefs, and shellfish beds. Sub-adults also commonly enter Texas bays, lagoons, and estuaries. This species may be present in bay waters in the vicinity of the project.

3.0 EFFECTS OF THE PROPOSED ACTION ON LISTED SPECIES

The following sections provide the findings of Galveston District and species-specific avoidance, minimization, and conservation measures that support the effect determinations presented. Effect determinations are presented using the language of the ESA:

- *No effect* - the proposed action will not affect a federally-listed species or critical habitat;

- *May effect, but not likely to adversely affect* - the project may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial; or

- *Likely to adversely affect* - adverse effects to listed species and/or critical habitat may occur as a direct result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or completely beneficial. Under this determination, an additional determination is made whether the action is likely to jeopardize the continued survival and eventual recovery of the species.

Table 1
Federally-Listed Threatened and Endangered Species for Galveston County, Texas

Common Name	Scientific Name	Listing Status[1]	
		USFWS[2]	NMFS[3]
INVERTEBRATES			
elkhorn coral	*Acropora palmata*	NA	T
lobed star coral	*Orbicella annularis*	NA	T
mountainous star coral	*Orbicella faveolata*	NA	T
boulder star coral	*Orbicella franksi*	NA	T
REPTILES			
green sea turtle	*Chelonia mydas*	T	T
hawksbill sea turtle	*Eretmochelys imbricata*	E	E
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	E
leatherback sea turtle	*Dermochelys coriacea*	E	E
loggerhead sea turtle	*Caretta caretta*	T	T
BIRDS			
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	NA
red knot	*Calidris canutus rufa*	T	NA
piping plover	*Charadrius melodus*	T w/ CH	NA
MAMMALS			
West Indian manatee	*Trichechus manatus*	E w/ CH	NA
finback whale	*Balaenoptera physalus*	NA	E
humpback whale	*Megaptera novaengliae*	NA	E
sei whale	*Balaenoptera borealis*	NA	E
sperm whale	*Physeter macrocephalus*	NA	E

[1]E = Endangered; T = Threatened; w/ CH = with Federally Designated Critical Habitat; NA = Not Applicable

[2]USFWS, 2016. http://ecos.fws.gov/tess_public/reports/species-by-current-range-county?fips=48167

[3]NOAA/NMFS, 2016. http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/Documents/texas.pdf

3.1 BROWN PELICAN

Foraging brown pelicans are common along the Texas coast and may be found in the project area. However, no nesting sites are located in the project area. Although the waters surrounding the project area may be used by pelicans for feeding or resting, these birds are highly mobile and are able to relocate to avoid disturbance from construction activities. Although there may be disturbance of feeding and displacement during construction, these are localized activities that would not negatively affect this species' feeding, nesting, or resting activities overall. We conclude that the project will have no effect on the brown pelican.

3.2 SEA TURTLES

It is unlikely that leatherback and hawksbill sea turtles would occur in the project area due to their scarcity. Green sea turtles most likely occur in the southern bays of Texas where clear water and seagrass and algal beds are more abundant. Turtles that may occur in bay waters near the project area include the Kemp's ridley and loggerhead sea turtles. The proposed project involves dredging activities within the Galveston Harbor Channel. However, these activities would be accomplished by hydraulic pipeline dredge, as opposed to hopper dredges that may impact sea turtles. Placement of dredged material would be in an existing upland confined PA where no suitable habitat exists for potential nesting turtles. Therefore, the project will have no effect on sea turtles.

4.0 COORDINATION

Information provided on fish and wildlife resources has been considered in the development of the project, through a USFWS Planning Aid Letter (PAL) dated January 14, 2011 (Appendix B). In the PAL, the USFWS recommended that presence/absence surveys be conducted in suitable areas adjacent to Pelican Island and any necessary consultation procedures initiated with the Service pursuant to Section 7 of the Endangered Species Act to ensure that Piping plover are not inadvertently disturbed or harassed.

The shorelines along the ship channel in the vicinity of the proposed deepening of the Galveston Harbor Channel Extension project are predominantly bulk-headed and used by dock facilities, though they may occur to a lesser extent as shell hash substrates in a few areas such as that found at TAMUG Clipper dock area. These areas are continuously disturbed by ongoing maintenance dredging activities, commercial shipping and recreational vessel traffic and other human activities making these areas unsuitable for piping plover. Any disturbance to the channel shorelines caused by the proposed deepening of the Galveston Harbor Channel Extension project would be of the same type and magnitude as experienced with the periodic maintenance dredging and placement into the Pelican Island PA associated with the authorized Federal project. Therefore, the USACE has determined that proposed project will have no effect on piping plover and presence/absence surveys will not be necessary.

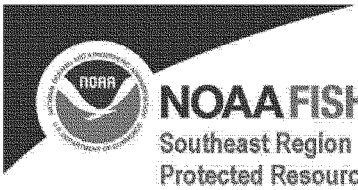
5.0 CONCLUSIONS

Construction and placement activities for the proposed channel extension project are short-term (approximately 4 months) and would occur within the footprint of the existing channel project, which undergoes routine maintenance dredging and placement. The routine maintenance activities produce disturbances similar to those expected from the construction dredging and placement being proposed. For these reasons, the proposed action is not expected to impact any listed species or their critical habitat identified in this BA. Therefore, no effect on any of the federally-listed species or their critical habitat is anticipated.

6.0 LITERATURE CITED

National Marine Fisheries Service. 2016. NOAA Fisheries Southeast Region Protected Resources Division, Texas' Threatened and Endangered Species and Critical Habitat Designations. http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/Documents/texas.pdf. Accessed 22 June, 2016.

U.S. Fish and Wildlife Service. 2016. U.S. Fish and Wildlife Service Endangered Species List – Galveston County, Texas. IPaC Trust Resources Report. https://ecos.fws.gov/ipac/project/HR6NP24EJNBIRJRA3OJIBFZCBU/overview Accessed 13 June, 2016.



NOAA FISHERIES
Southeast Region
Protected Resources Division

Texas' Threatened and Endangered Species

For more information on listed species please visit:
http://www.nmfs.noaa.gov/pr/species/esa/listed.htm
http://sero.nmfs.noaa.gov/protected_resources/index.html

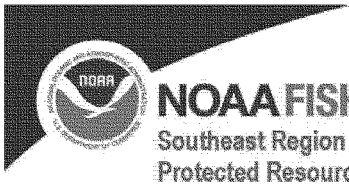
Marine Mammal Species	Scientific Name	Status
fin whale	*Balaenoptera physalus*	Endangered
humpback whale	*Megaptera novaeangliae*	Endangered
sei whale	*Balaenoptera borealis*	Endangered
sperm whale	*Physeter macrocephalus*	Endangered
Sea Turtle Species		
green sea turtle	*Chelonia mydas*	Threatened[1]
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
leatherback sea turtle	*Dermochelys coriacea*	Endangered
loggerhead sea turtle	*Caretta caretta*	Threatened[2]
Invertebrate Species		
lobed star coral	*Orbicella annularis*	Threatened
mountainous star coral	*Orbicella faveolata*	Threatened
boulder star coral	*Orbicella franksi*	Threatened
elkhorn coral	*Acropora palmata*	Threatened[3]

Critical Habitat Designations

For final rules, maps, and GIS data please visit:
http://sero.nmfs.noaa.gov/maps_gis_data/protected_resources/critical_habitat/index.html

Loggerhead sea turtle: There are 38 designated marine areas that occur throughout the Southeast Region.

[1] Florida's breeding population is listed as endangered.
[2] Northwest Atlantic distinct population segment.
[3] Colonies located at Flower Garden Banks National Marine Sanctuary.



Species Proposed for Listing Under the Endangered Species Act

Federal action agencies are encouraged to include species proposed for listing under the Endangered Species Act (ESA) in their Section 7 consultation requests. Species that are proposed for listing are those which have been found to warrant federal protection under the ESA, but a final rule formally listing the species has not yet published. By including these species in your Section 7 consultation, reinitiating consultation after the ESA listing is finalized may not be necessary.

For more information on species proposed for listing under the ESA, please visit: http://www.nmfs.noaa.gov/pr/species/esa/candidate.htm#proposed

U.S. Fish & Wildlife Service

IPaC Trust Resources Report

NAME

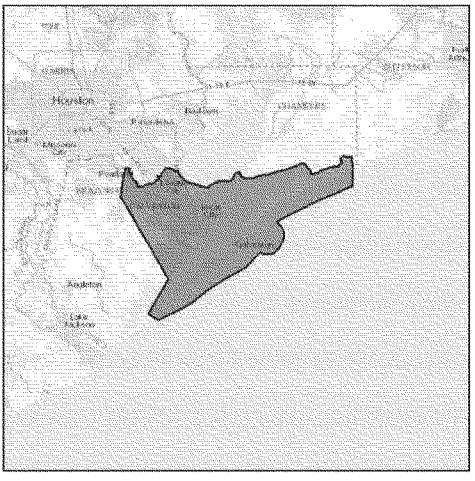
GHCE

LOCATION

Galveston County, Texas

IPAC LINK

https://ecos.fws.gov/ipac/project/CSLQP-KBZYN-FCHMI-CM7A7-PG44ZQ



U.S. Fish & Wildlife Service Contact Information

Trust resources in this location are managed by:

Texas Coastal Ecological Services Field Office

Endangered Species

Proposed, candidate, threatened, and endangered species are managed by the Endangered Species Program of the U.S. Fish & Wildlife Service.

This USFWS trust resource report is for informational purposes only and should not be used for planning or analyzing project level impacts.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list from the Regulatory Documents section.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency.

A letter from the local office and a species list which fulfills this requirement can only be obtained by requesting an official species list either from the Regulatory Documents section in IPaC or from the local field office directly.

The list of species below are those that may occur or could potentially be affected by activities in this location:

Birds

Attwater's Greater Prairie-chicken Tympanuchus cupido attwateri Endangered

CRITICALHABITAT

No critical habitat has been designated for this species. http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B00O

Piping Plover Charadrius melodus Threatened

CRITICALHABITAT

There is **final** critical habitat designated for this species.
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B079

Red Knot Calidris canutus rufa Threatened

CRITICALHABITAT

No critical habitat has been designated for this species.
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0DM

Mammals

West Indian Manatee Trichechus manatus — Endangered

CRITICAL HABITAT

There is **final** critical habitat designated for this species. http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=A007

Reptiles

Hawksbill Sea Turtle Eretmochelys imbricate — Endangered

CRITICAL HABITAT

There is **final** critical habitat designated for this species. http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=C00E

Kemp's Ridley Sea Turtle Lepidochelys kempii — Endangered

CRITICAL HABITAT

No critical habitat has been designated for this species. http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=C00O

Leatherback Sea Turtle Dermochelys coriacea — Endangered

CRITICAL HABITAT

There is **final** critical habitat designated for this species. http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=C00F

Loggerhead Sea Turtle Caretta caretta — Threatened

CRITICAL HABITAT

There are both **final** and **proposed** critical habitat designated for this species.

http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=C00U

Critical Habitats

This location overlaps all or part of the critical habitat for the following species:

Piping Plover Charadrius melodus

Final designated critical habitat http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B079#crithab

APPENDIX D

Draft General Air Conformity Determination

Draft
General Conformity Determination
Galveston Harbor Channel Extension
Post Authorization Change Report
Galveston County, Texas

DRAFT
GENERAL CONFORMITY DETERMINATION
GALVESTON HARBOR CHANNEL EXTENSION
POST AUTHORIZATION CHANGE REPORT
GALVESTON COUNTY, TEXAS

Prepared for:

U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Prepared by:

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March 2013

ATKINS
TBPE REG. #F-474

Printed on recycled paper

PROFESSIONAL ENGINEER STATEMENT

This Draft General Conformity Determination Document and estimate of air contaminant emissions (attachment) is released on _____ __, 2013, under the authority of Ruben I. Velasquez, P.E., Registration No. 69126, for the purpose of evaluation and discussion. This preliminary document is not to be used for construction, bidding, or permitting purposes.

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Attachment:

Tabular Summaries of Estimated Air Emissions

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Acronyms and Abbreviations

CAA	Federal Clean Air Act
CFR	Code of Federal Regulations
CO	carbon monoxide
CY	cubic yards
DEIS	Draft Environmental Impact Statement
DOT	U.S. Department of Transportation
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
GRP	General Reevaluation Plan
HGB	Houston/Galveston/Brazoria
MPO	Metropolitan Planning Organization
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_x	nitrogen oxides
PM_{10}	particulate matter with an aerodynamic diameter equal to or less than 10 microns
PACR	Post Authorization Change Report
SIP	Texas State Implementation Plan
SO_2	sulfur oxides
TCEQ	Texas Commission on Environmental Quality
tpy	tons per year
U.S.	United States
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1.0 INTRODUCTION

The Galveston Harbor Channel Extension Project is located on the upper Texas coast at the mouth of Galveston Bay in Galveston County, Texas. The project includes the Offshore Reach (the common Entrance Channel) and the area between the Bolivar Peninsula and Pelican Island through Galveston Harbor to the Gulf Intracoastal Waterway. Galveston Harbor Channel is the separable channel branching off the Houston Ship Channel, providing entry to the Port of Galveston, Texas. The Galveston Harbor Channel extends in an east-west direction from Bolivar Roads between Galveston and Pelican Islands for about four miles (Figure 1).

The U.S. Army Corps of Engineers (USACE) has prepared a Draft Environmental Assessment (EA) to describe the environmental impacts associated with deepening a portion of the existing Galveston Harbor Channel from 40 feet to 45 feet mean low tide. This channel improvement would increase navigation efficiently for deep draft vessels enabling maximum loading, and would allow users at the far end of Galveston Harbor Channel to take advantage of fully loaded vessels alleviating the current practices of light-loading. The project sponsor is the Port of Galveston.

This project, as a Federal action, is subject to the General Conformity Rule promulgated by the U.S. Environmental Protection Agency (EPA) pursuant to the Clean Air Act (CAA), Section 176(c)(1). The rule mandates that the Federal government not engage in, support, or provide financial assistance for licensing or permitting, or approving any activity not conforming to an approved state implementation plan. In Texas, the applicable plan is the Texas State Implementation Plan (SIP), an EPA-approved plan for the regulation and enforcement of the National Ambient Air Quality Standards (NAAQS) in each air quality region within the state.

This document represents the Draft General Conformity Determination prepared on behalf of the USACE, Galveston District, to assess whether air contaminant emissions that would result from the proposed Galveston Harbor Channel Extension Project are in conformity with the SIP for the Houston/Galveston/Brazoria (HGB) ozone nonattainment area.

Figure 1, Project Study Area

2.0 REGULATORY BACKGROUND – GENERAL CONFORMITY

General Conformity refers to the process of evaluating plans, programs, and projects to determine and demonstrate they meet the requirements of the CAA and the SIP. The General Conformity Rule establishes conformity in coordination with and as part of the NEPA process. The General Conformity Rule is promulgated by the EPA and mandates that the Federal government not engage in, support, or provide financial assistance for licensing or permitting, or approving any activity not conforming to an approved SIP. In Texas, the applicable plan is the Texas SIP, an EPA-approved plan for the regulation and enforcement of the NAAQS in each air quality region within the state.

The purpose of this General Conformity requirement is to ensure Federal agencies consult with state and local air quality districts so they become aware of the project and its expected air emissions and would consider these expected emissions in their SIP emissions budget. The General Conformity Rule is codified at Title 40 Code of Federal Regulations (CFR) Part 51, Subpart W, and Title 40 CFR Part 93, "Determining Conformity of Federal Actions to State or Federal Implementation Plans."

The CAA defines conformity to an implementation plan as the upholding of "an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards and achieving expeditious attainment of such standards." Conforming activities or actions should not, through additional air pollutant emissions, result in the following:

- Cause or contribute to new violation of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or
- Delay timely attainment of any NAAQS or interim emission reductions or other milestones in any area.

Pursuant to the General Conformity Rule, a Federal agency; e.g., the USACE, must make a General Conformity Determination for all Federal actions in nonattainment areas where the total emissions of a nonattainment pollutant or its precursors exceeds levels established by the regulations. For the HGB nonattainment area, the threshold level is 100 tons per year (tpy) for either NO_x or VOC. In addition, even if the total emissions of VOC or NO_x do not exceed the 100 tpy threshold levels, when the total emissions of any pollutant from the Federal action represents 10 percent or more of a nonattainment or maintenance area's total emissions of those pollutants, then the action is defined as a regionally significant action and a conformity determination would be still be applicable. Only those air emissions of NO_x and VOC related to the Federal action; i.e., those considered to be implemented by the USACE, should be considered in this General Conformity Determination.

3.0 APPLICABILITY

The proposed Galveston Harbor Channel Extension Project will be located in Galveston County, Texas. This county is included in the eight county HGB ozone nonattainment area which is classified as "marginal" in terms of its degree of compliance with the current 8-hour ozone standard. This classification affects facilities that generate the ozone precursors, oxides of NO_x, and VOC. As such, the project is subject to the General Conformity Rule which applies to all nonattainment and maintenance areas.

The proposed Galveston Harbor Channel Extension Project was evaluated based on the anticipated equipment to be used and identification of expected air contaminants and estimated emission rates for this project. The emissions inventory included emissions associated with dredging of the channel and from land-based mobile sources that will be used during excavation of the dredged material placement area, including off-road earth-moving equipment and on-road construction equipment. Air contaminant emissions associated with this equipment will be primarily combustion products from fuel burned in the engines powering this equipment.

Based on this evaluation, it has been determined that a General Conformity Determination for NO_x emissions would be required for this project as emissions of NO_x are estimated to exceed the 100 tons per year applicability threshold for general conformity. Emissions of VOC from the proposed project are exempt from a General Conformity Determination because they are below the 100 ton per year emissions threshold requiring such an analysis.

4.0 AIR EMISSIONS INVENTORY

For the General Conformity Determination, an air emissions inventory was prepared for project-related activities for the Galveston Harbor Channel Extension Project based on the schedule and other assumptions as developed by the USACE. Air emissions estimates were calculated using techniques appropriate for a specific emissions generating activity or source. The basis, emission factors, and summary of emissions are attached to this document.

4.1 Project Emissions

It is anticipated that the project construction activities will begin and be completed in 2012. Project air contaminant emissions were estimated based on projected equipment use and scheduling of on-shore and near-shore construction activities. The project air emissions inventory included emissions associated with dredging vessels and equipment, nonroad construction equipment, and on-road mobile sources, as follows:

- Dredging vessels and equipment – included dredges and support marine vessels
- Nonroad construction equipment – included dozers, dragline, excavators, etc.
- On-road mobile sources – included employee commuter vehicles

Air contaminant emissions were estimated in tons per year for each piece of equipment based on the equipment horsepower, fuel type, and expected operating hours in 2012. Detailed emission calculations are attached to this document.

4.1.1 Dredging Vessels and Equipment

Dredging emissions included those that would be expected to result from the use of tug boats and miscellaneous marine vessels in support of the dredging activities. Air emissions directly related with the dredging equipment were calculated on an annual basis based on the anticipated type of engine, activity, horsepower, and anticipated hours of operation. Estimated emissions were based on the emission factor algorithms referenced from EPA's technical report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data," EPA 420-R-00-002, February 2000. This technical report is a compilation of engine and fuel usage test data from various types of marine vessels including bulk carriers, container ships, dredges, tankers, and tugboats. Emission factors were determined based on an emission factor algorithm used to calculated air contaminant emission rates for these emission sources. The emission factor algorithm is applicable to all engine sizes since, according to the EPA's document, the emissions data showed no statistically significant difference across engine sizes.

4.1.2 Nonroad Construction Equipment

Air contaminant emissions from nonroad construction equipment used for on-shore excavation were estimated based on the anticipated type of equipment, activity, horsepower, and anticipated hours of operation. The estimated nonroad construction emissions included those that would be expected to result from equipment used for onshore activities; i.e., filling, working, and compacting of dredged material. The operation of construction vehicles (e.g., dozer, dragline, excavator, etc.) would generate air emissions typical of vehicles powered by diesel-fueled internal combustion engines. The estimate of emissions for this equipment was based on emission factors generated using the EPA's NONROAD2005. This computer model may be used to calculate emissions for many nonroad equipment types, categorizing them by horsepower rating and fuel type available for specific years, for a specific geographic area, state, or county.

4.1.3 On-road Mobile Sources

Mobile source emissions associated with the Galveston Harbor Channel Extension Project construction would be generated from employee commuter vehicles. Mobile on-road emissions associated with employee vehicles were calculated using EPA MOBILE6, a mobile source emissions model. A mix of light duty gasoline vehicles and light duty gasoline trucks was assumed for the makeup of the employee vehicles. An average commute of 25 miles each way was assumed for each vehicle. The total number of miles traveled equaled the number of miles per trip multiplied by the total number of days of construction activity times the number of vehicles.

4.2 GALVESTON HARBOR CHANNEL EXTENSION PROJECT – SUMMARY OF NO_X AND VOC EMISSIONS

For comparison with the thresholds defined in the General Conformity Rule, the estimated annual emissions of NO_x and VOC for the Galveston Harbor Channel Extension Project are summarized in Table 1. Emissions of carbon monoxide, sulfur dioxide, and particulate matter are not considered in the General Conformity evaluation as this area is in attainment with the NAAQS for each of those pollutants.

TABLE 1
GALVESTON HARBOR CHANNEL EXTENSION PROJECT
SUMMARY OF NO_X AND VOC EMISSIONS
(tons per year)

	2012
NO_x	106.4
VOC	1.62

The estimate of VOC emissions for the Galveston Harbor Channel Extension Project would not exceed the conformity threshold of 100 tpy for either of these years. Therefore, a General Conformity Determination for VOC emissions would not be required for this project.

The estimate of NO_X emissions for the Galveston Harbor Channel Extension Project would exceed General Conformity threshold (100 tpy) in 2012 and would require a General Conformity Determination.

4.3 MAINTENANCE DREDGING

After the extension of the channel is completed, the USACE anticipates the need to perform maintenance dredging of the channel to remove any shoaling that has occurred after the construction period. It is anticipated that there will be no increase in the maintenance quantities from the existing amounts; the maintenance quantity is estimated to be about 648,000 cubic yards every 4 years based on dredging of about 162,000 cubic yards per year.

A summary of the estimated emissions in tons per year resulting from the additional maintenance dredging equipment is shown on Table 2. A detailed summary of emissions can be found in the attached emission summary tables.

TABLE 2
MAINTENANCE DREDGING – TOTAL ESTIMATED EMISSIONS

Air Contaminant	Dredging Equipment Emissions (tons/year)
CO	0.90
NO_X	7.90
$PM_{2.5}$	0.18
PM_{10}	0.19
SO_2	1.31
VOC	0.09

The General Conformity rules specifically exclude from applicability maintenance dredging where no new depths are required, applicable permits are secured, and disposal will be at an approved disposal site. Therefore, a General Conformity Determination for this project would not include emissions from the anticipated maintenance dredging activities.

5.0 PRELIMINARY GENERAL CONFORMITY DETERMINATION

The proposed Galveston Harbor Channel Extension Project would conform to the applicable SIP if, for each pollutant that exceeds the threshold rates (100 tpy of NO_x or VOC), the total emissions from the action is in compliance or consistent with all relevant requirements and milestones contained in the applicable SIP. Under 40 CFR Part 93, Subpart B, "Determining Conformity of General Federal Actions to State or Federal Implementation Plans," a Federal action required to have a conformity determination for a specific pollutant would be determined to conform to the SIP if it meets one of several requirements in 40 CFR §93.158, "Criteria for Determining Conformity of General Federal Actions."

Based on evaluation of the proposed project description and the estimated air quality emissions, it is believed that project emissions can meet the requirements of 40 CFR §93.158(a)(5)(i)(A). This section of the Federal General Conformity Rule applies to an ozone nonattainment area, where the EPA has approved a revision to an area's attainment demonstration after 1990, and the state makes a determination that "the total of direct and indirect emissions from the action, or portion thereof, is determined by the State agency responsible for the applicable SIP to result in a level of emissions which, together with all other emissions in the nonattainment area, would not exceed the emissions budgets specified in the SIP."

The emissions budget for General Conformity purposes is defined in 40 CFR §93.152. In summary, the emissions budget is that portion of the total allowable emissions used as a basis for the latest approved revision of the SIP that is allocated to mobile sources; any stationary source or class of stationary sources; to any federal action or class of actions; to any class of area sources; or to any subcategory of the emissions inventory.

The General Conformity Determination is based on the 8-hour ozone standard and the corresponding attainment dates and de minimis levels. For the HGB nonattainment area, the most recently approved SIP revision is the 2004 Mid-Course Review SIP (TCEQ, 2004), based on attainment of the 1-hour ozone standard, and associated emissions trading programs approved by the EPA on 6 September 2006 (EPA, 2006). In this SIP, the emissions budgets for NO_x and VOC are based on emissions inventories for 1999 updated for the year 2000, where appropriate, and projected to 2007.

As discussed in the 2004 SIP revision, nonroad mobile sources include a very broad category of nonroad equipment that includes engines mounted on construction equipment. The Nonroad Mobile emissions weekday budget for 2007 is 64.53 tons per day of NO_x and 50.62 tons per day of VOC (TCEQ, 2004). The Nonroad Mobile emissions inventory includes emissions from equipment associated with agricultural, aircraft, commercial, construction, ground support (airport), industrial, lawn and garden, railroad maintenance, logging, locomotives, oil and gas, recreational, and recreational marine equipment.

5.1 GALVESTON HARBOR CHANNEL EXTENSION PROJECT EMISSIONS COMPARED TO SIP EMISSIONS BUDGETS

For comparison to the SIP Area Source Emissions budget, the annual NO_x emission rates estimated for the Galveston Harbor Channel Extension Project may be summarized in terms of tons per day and compared to the SIP emissions budget as shown on Table 3.

TABLE 2
GALVESTON HARBOR CHANNEL EXTENSION PROJECT – NO_X EMISSIONS COMPARED TO SIP 2007
WEEKDAY NONROAD MOBILE SOURCE EMISSIONS BUDGET[1]

	2012
Tons per Year	106.4
Tons per Day	1.2
% of Nonroad Mobile Emissions Budget (64.53 tons per day)	1.9%

[1]TCEQ, 2004.

As shown on Table 2, NO_x emissions for the Galveston Harbor Channel Extension Project non-road mobile equipment emissions would represent less than two percent of the SIP 2007 Non-road Emissions Budget for NO_x.

5.2 PRELIMINARY GENERAL CONFORMITY DETERMINATION

Based on an evaluation of the proposed Galveston Harbor Channel Extension Project emissions, it is believed that the total emissions of NO_x would result in a level of emissions that are well within the 2007 Non-road Mobile Emissions Budget in the most recently approved SIP revision. As the Galveston Harbor Channel Extension Project is not unusual in scope for an area like the HGB, it is anticipated that emissions from the project will be less than an increase of 10 percent of the VOC and NO_x emissions inventories for the entire HGB nonattainment area. Therefore, emissions from the activities subject to the USACE action are not considered regionally significant for purposes of General Conformity. Because of this, it is expected that emissions from the project construction will not:

- Cause or contribute to new violation of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or
- Delay timely attainment of any NAAQS or interim emission reductions or other milestones in any area.

Pursuant to the General Conformity Rule (40 CFR Part 93, Subpart B), this Draft General Conformity Determination is being provided to demonstrate that the proposed Galveston Harbor Channel Extension Project will comply with the requirements of the General Conformity Rule and will be in conformity with

the SIP. As specified in the Federal General Conformity Rules, 40 CFR §93.158(a)(5)(i)(A), the state must make a determination that the total emissions of NO_x or VOC from the action, or portion thereof, would result in a level of emissions which, together with all other emissions in the HGB nonattainment area, would not exceed the emissions budgets specified in the SIP. Therefore, it is requested that the TCEQ review this draft and provide a formal determination and confirmation. Once written confirmation is received, this information will be relied upon by the USACE as a basis for making a Final General Conformity Determination for the proposed Galveston Harbor Channel Extension Project.

6.0 REFERENCES

40 Code of Federal Regulations (CFR) Part 93, Subpart B, "Determining Conformity of General Federal Actions to State and Federal Implementation Plans."

———. 2004. "Revisions to the State Implementation Plan (SIP) for the Control of Ozone Air Pollution, Houston/Galveston/Brazoria Ozone Nonattainment Area," Adopted 1 December 2004.

U.S. Environmental Protection Agency (EPA). 2000. "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data," EPA320-R-00-002, February 2000.

———. 2004 "Nonroad Emissions Model Draft NONROAD 2002 Support Document, "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling," April 2004.

———. 2006. "Approval and Promulgation of Air Quality Implementation Plans; Texas; Revisions to the Ozone Attainment Plan for the Houston/Galveston/Brazoria Nonattainment Area," 6 September 2006. *Federal Register*, Volume 71, No. 172, Page 52670.

Attachment

Tabular Summaries of Estimated Air Emissions

APPENDIX A

List of Tables
Galveston Channel Extension Project

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Table B-2. Dredge Equipment Engine Horsepower and Hours of Operation
Galveston Channel Extension Project

Contract No.	Reach	Dredge Type	Horsepower (hp)												
			Engine Type					Survey Boat		Trawler		Floating Booster	Tug	Spill Barge	Crew Boat
			Total	Propulsion	Pump	Generator	Generator at Idling	Main Engine	Idling	Main Engine	Idling	Pumping	Propulsion	Main Engine	Propulsion
1	Dredge 45 Ft Channel - New Extension	30" Dredge	9,600				3,000						500	165	400

	Operating Hours												
	Dredge					Survey Boat		Trawler		Floating Booster	Tug	Spill Barge	Crew Boat
Dredge Type	Total Dredging	Propelling	Pumping	Power Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling
30" Dredge	1,800				579						3,600	300	300

Dredging time is based on 600,000 cubic yards of dredged material.

Table B-3. Maintenance Dredge Equipment Engine Horsepower and Hours of Operation
Galveston Channel Extension Project

Contract No.	Reach	Dredge Type	Horsepower (hp)												
			Engine Type					Survey Boat		Trawler		Floating Booster	Tug	Spill Barge	Crew Boat
			Total	Propulsion	Pump	Generator	Generator at Idling	Main Engine	Idling	Main Engine	Idling	Pumping	Propulsion	Main Engine	Propulsion
1	45 Ft Channel - Maintenance Dredging	30" Dredge	9,600				3,000						500	165	400

	Operating Hours												
	Dredge					Survey Boat		Trawler		Floating Booster	Tug	Spill Barge	Crew Boat
Dredge Type	Total Dredging	Propelling	Pumping	Power Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling
30" Dredge	113				51						375	23	23

Dredging time is based on 192,000 cubic yards per year of maintenance dredging at a rate of 1,440 cubic yards per hour.

Table C-1. Marine Engine Emission Factors and Fuel Consumption Algorithms
(in g/kW-hr, for all marine engines)
Galveston Channel Extension Project

Statistical Parameter	Exponent (x)	Intercept (b)	Coefficient (a)
CO	1	0	0.8378
NO_X	1.5	10.4496	0.1255
PM	1.5	0.2551	0.0059
PM2.5	1.5	0.2551	0.0059
PM10	1.5	0.2551	0.0059
SO_X	n/a	0	2.3735
VOC (HC)	1.5	0	0.0667

Notes:

1.) All regressions but SO_2 are in the form of:

Emissions Rate (g/hp-hr) = (a*(Fractional Load)^x + b) * 0.7457
where the conversion factor of 0.7457 kW/hp is used to calculate the emission factor in g/hp-hr

2.) Fractional Load is equal to actual engine output divided by rated engine output.

3.) The SO_2 regression is the form of:

Emissions Rate (g/hp-hr) = a*(Fuel Sulfur Flow in g/hp-hr) + b
where Fuel Sulfur Flow is the Fuel Consumption times the sulfur content of the fuel;
The sulfur content for the fuel consumption regression was set to 3300 parts per million (0.33 wt%)

4.) **Fuel Consumption (g/hp-hr) = (14.12 / (Fractional Load) + 205.717) * 0.7457**

5.) n/a is not applicable, n/s is not statistically significant.

6.) All information shown above is detailed in Table 5-1 of the EPA technical report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data", EPA 420-R-00-002, February 2000.

Table C-2. Marine Equipment Load Factors and Emission Factors
Galveston Channel Extension Project

	Dredge					Crew Boat		Trawler		Floating Booster	Tug	Spill Barge	Crew Boat
Operating Mode	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling
Load Factor	0.8	0.8	0.8	0.8	0.2	0.4	0.2	0.4	0.2	0.8	0.4	0.4	0.4
EF (Gram/hp-hr)													
CO	0.780934	0.780934	0.780934	0.780934	3.123737	1.561868	3.123737	1.561868	3.123737	0.780934	1.561868	1.561868	1.561868
NO_X	7.923056	7.923056	7.923056	7.923056	8.838583	8.162195	8.838583	8.162195	8.838583	7.923056	8.162195	8.162195	8.162195
PM	0.199377	0.199377	0.199377	0.199377	0.239417	0.207619	0.239417	0.207619	0.239417	0.199377	0.207619	0.207619	0.207619
PM2.5	0.178703	0.178703	0.178703	0.178703	0.217870	0.188933	0.217870	0.188933	0.217870	0.178703	0.188933	0.188933	0.188933
PM10	0.186522	0.186522	0.186522	0.186522	0.226841	0.199314	0.226841	0.199314	0.226841	0.186522	0.199314	0.199314	0.199314
SO_X	1.304627	1.304627	1.304627	1.304627	1.613694	1.407716	1.613694	1.407716	1.613694	1.304627	1.407716	1.407716	1.407716
VOC (HC)	0.099511	0.099511	0.099511	0.099511	0.556090	0.196607	0.556090	0.196607	0.556090	0.099511	0.196607	0.196607	0.196607

Notes:

1.) The dredge type, engine type, horsepower, and fuel type were based on information provided by project sponsors.

2.) The engine load factors for the dredges and support equipment were determined from Table 5-2 of the EPA Report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data", February 2000.
A survey of dredge engine sizes along with input from project sponsors was used to determine which operating mode and hence which load factor applied to each engine. The following assumptions applied to the load factor determination:
A.) The main engines on the dredges were assumed to operate at full power (e.g. 0.8 "cruise" load factor from Table 5-2 of EPA report) for all hours of operation.
B.) The generators on the dredges were assumed to operate at 0.2 load factor during idling.
C.) The main engines or propulsion engines on the support equipment were assumed to operate at intermittent times during the dredging operations and were also determined to operate at the 0.4 "slow cruise" load factor.
D.) The auxiliary engines, if any, on the support equipment were assumed to operate sparingly during idling and were determined to operate at the 0.2 "maneuvering" load factor.

3.) The emission factors were calculated according to the algorithm table and formulas detailed on page 5-3 of the EPA report. The emissions Rate formula and algorithm table are also shown on Table A-4, "Marine Engine Emission Factor and Fuel Consumption Data", February 2000.

4.) The Emission Rate in tons/hr is based on the following formula: Emission Rate = hp*LF*EF*(0.0022046 lbs/gram)*(1 ton/2000 lbs).

Table C-3. Dredgin Equipment Emissions
Galveston Channel Extension Project

CO (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: Dredge 45 Ft Channel - New Extension	30" Dredge													
1	9.39				1.39						1.24	0.03	0.01	12.06

NO_x (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: Dredge 45 Ft Channel - New Extension	30" Dredge													
1	94.82				3.95						6.46	0.19	0.10	105.36

PM (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: Dredge 45 Ft Channel - New Extension	30" Dredge													
1	2.08				0.13						0.16	0.00	0.01	2.60

$PM_{2.5}$ (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: Dredge 45 Ft Channel - New Extension	30" Dredge													
1	2.19				0.12						0.15	0.00	0.01	2.39

PM_{10} (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: Dredge 45 Ft Channel - New Extension	30" Dredge													
1	2.24				0.13						0.15	0.00	0.01	2.52

SO_2 (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: Dredge 45 Ft Channel - New Extension	30" Dredge													
1	15.55				0.12						1.12	0.03	0.01	17.47

VOC (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: Dredge 45 Ft Channel - New Extension	30" Dredge													
1	0.89				0.05						0.10	0.00	0.01	1.05

Table C-4. Dredging Equipment Emissions - Maintenance Dredging
Galveston Channel Extension Project

CO (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: 45 Ft Channel - Maintenance Dredging	30" Dredge													
1	6.15				0.19						0.08	0.01	0.01	0.90

NO_x (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: 45 Ft Channel - Maintenance Dredging	30" Dredge													
1	7.07				0.39						0.49	0.01	0.03	7.90

PM (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: 45 Ft Channel - Maintenance Dredging	30" Dredge													
1	0.15				0.01						0.01	0.00	0.00	0.20

$PM_{2.5}$ (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: 45 Ft Channel - Maintenance Dredging	30" Dredge													
1	0.14				0.02						0.01	0.00	0.00	0.18

PM_{10} (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: 45 Ft Channel - Maintenance Dredging	30" Dredge													
1	0.47				0.01						0.01	0.00	0.00	0.59

SO_2 (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: 45 Ft Channel - Maintenance Dredging	30" Dredge													
1	0.96				0.05						0.09	0.00	0.00	1.21

VOC (tpy)	Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	
YEAR 2012	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	TOTALS
Contract No. / Reach: 45 Ft Channel - Maintenance Dredging	30" Dredge													
1	0.08				0.02						0.01	0.00	0.00	0.09

Table D-1. NONROAD Equipment Emission Factors
Galveston Channel Extension Project

(grams per horsepower-hour)

Range	HP	SCC	EQUIP	CLASSIFICATION	Engine Type	Fuel Type	VOC exhaust	PM10 exhaust	PM25 exhaust	VOCCrankcase	CO exhaust	NOx exhaust	CO2 exhaust	SO2 exhaust	PM exhaust
50 < HP <= 75	75	2270002069	Crawler Tractor/Dozers	Construction and Mining Equipment	Diesel	Diesel	0.326752193	0.362138748	0.351274566	0.054451253	3.17107704	3.853668713	595.1703367	0.010942471	0.362138748
75 < HP <= 100	100	2270002036	Excavators	Construction and Mining Equipment	Diesel	Diesel	0.296413069	0.449967272	0.436467853	0.035588387	3.422761787	3.561676083	595.2533569	0.017511957	0.449967272
100 < HP <= 175	175	2270002066	Tractors/Loaders/Backhoes	Construction and Mining Equipment	Diesel	Diesel	0.903349629	0.636718042	0.617716501	0.017897181	3.519113791	5.564566038	623.6072566	0.011226021	0.636718042
100 < HP <= 175	175	2270002069	Crawler Tractor/Dozers	Construction and Mining Equipment	Diesel	Diesel	0.259446516	0.299421689	0.290439039	0.004862096	1.291914601	3.143197471	596.043865	0.009513759	0.299421689
100 < HP <= 175	175	2270002061	Other Construction Equipment	Construction and Mining Equipment	Diesel	Diesel	0.314721577	0.320570142	0.310953038	0.006052945	1.462964998	2.877125229	535.8775577	0.009615971	0.320570142
175 < HP <= 300	300	2270002036	Excavators	Construction and Mining Equipment	Diesel	Diesel	0.215051539	0.186731945	0.181126987	0.02355418	0.84443003	2.673155395	536.1795103	0.009068437	0.186731945
175 < HP <= 300	300	2270002045	Cranes	Construction and Mining Equipment	Diesel	Diesel	0.247285385	0.152470041	0.14786594	0.004413209	0.708243025	3.354177736	590.2940128	0.009212668	0.152470041
175 < HP <= 300	300	2270002069	Crawler Tractor/Dozers	Construction and Mining Equipment	Diesel	Diesel	0.226406014	0.193139868	0.187345501	0.003913546	0.977415354	2.867401234	596.1390772	0.009618718	0.193139868
300 < HP <= 600	600	2270002045	Cranes	Construction and Mining Equipment	Diesel	Diesel	0.239473899	0.177535945	0.17220877	0.004396364	1.096357572	4.219697795	590.3205954	0.009366338	0.177535945
300 < HP <= 600	600	2270002061	Other Construction Equipment	Construction and Mining Equipment	Diesel	Diesel	0.306230491	0.293727458	0.284915815	0.005792435	2.132603394	4.572203408	595.9032139	0.009515511	0.293727458

Table D-2. Load Factors For Equipment Using Diesel or Gasoline

SCC Code	Equipment	Load Factor[1] Diesel	Gasoline
22xx003010	Aerial Lifts	21%	46%
22xx005015	Agricultural Tractor	59%	62%
22xx006015	Air Compressors	43%	56%
22xx001030	All Terrain Vehicles	42%	100%
22xx002033	Bore/Drill Rigs	43%	79%
22xx002042	Cement & Motar Mixers	43%	59%
22xx004066	Chippers/Stump Grinders	43%	78%
22xx002039	Concrete/Industrial Saws	59%	78%
22xx002045	Cranes	43%	47%
22xx002066	Crawler Dozers/Tractor	59%	80%
22xx002054	Crushing/Procesing Equipment	43%	85%
22xx002078	Dumpers/Tenders	21%	41%
22xx002036	Excavators	59%	53%
22xx007015	Fellers/Bunchers/Skidders	59%	70%
22xx003020	Forklifts	59%	30%
22xx006020	Gas Compressors	43%	85%
22xx006005	Generator Sets	43%	68%
22xx002048	Graders	59%	64%
22xx005050	Hydro Power Units	43%	56%
22xx004056	Lawn and Garden Tractor	43%	44%
22xx002051	Off-Highway Truck	59%	80%
22xx002075	Off-Highway Tractor	59%	70%
22xx004056	Other Agricultural Equipment	59%	55%
22xx002081	Other Construction Equipment	59%	48%
22xx003040	Other General Industrial	43%	54%
22xx003050	Other Material Handling	21%	53%
22xx002003	Pavers	59%	66%
22xx002021	Paving Equipment	59%	59%
22xx002009	Plate Compactors	43%	55%
22xx006030	Pressure Washer	43%	85%
22xx006010	Pumps	43%	69%
22xx003060	Refrigeration/AC	43%	46%
22xx002015	Rollers	59%	62%
22xx002057	Rough Terrain Forklifts	59%	63%
22xx002063	Rubber Tire Dozer	59%	75%
22xx002060	Rubber Tire Loader	59%	71%
22xx002018	Scrapers	59%	70%
22xx002072	Skid Steer Loader	21%	58%
22xx001060	Specialty Vehicle/Carts	21%	58%
22xx002024	Surfacing Equipment	59%	49%
22xx003030	Sweepers/Scrubbers	43%	71%
22xx002006	Tampers/Rammers	43%	55%
22xx003070	Terminal Tractors	59%	78%
22xx005040	Tillers > 6 hp	59%	71%
22xx004026	Timmer/Edger/Brush Cutter	43%	91%
22xx002066	Tractor/Loader/Backhoe	21%	48%
22xx002030	Trenchers	59%	66%
22xx006025	Welders	21%	68%

1. Load Factors from Appendix A of *Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling*,EPA Office of Air and Radiation Report Number NR-005b, December 2002

Table D-3. Construction Equipment Emissions
Galveston Channel Extension Project

Equipment Type	Description	Fuel Type	HP	Typical Load Factor	Hours of Operation	Emission Factors (grams/horsepower-hour)								Estimated Emission Rates (tpy)							
						VOC	PM10	PM2.5	CO	NOx	CO2	SO2	Pb	VOC	PM_{10}	PM2.5	CO	NOx	CO2	SO_2	Pb
EP 6295J037 SKT,ORANGE PEEL, 1 CY HVY DTY	BUCKET	-			1									0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EP W1606R0 MARINE EQUIPMENT, BOATS & LAUNCHES, TRUCKABLE WORKBOAT W/PILOT HOUSE & PUSH KNEES, 26'BOAT, 25.25' X 8' X 3'	WORKBOAT	DIESEL	140	59%	9	0.33676482	0.32257914	0.31396244	1.482986	3.67712525	526.877977	0.04961997	0.32657014	0.0001	0.0001	0.0001	0.0004	0.0011	0.1484	0.0000	0.0001
EP T4890015 TRUCK TRAILER, LOWBOY, 40 TON, 3 AXLE (ADD TOWING TRUCK)	TRUCK TRAILER	-			1									0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EP T6070H18 TRK,HWY, 43,000 GVW, 4X4, 3 AXLE	HIGHWAY TRUCK	DIESEL	205	59%	2	2.9			15.5	2.5			0.1	0.0003	0.0002	0.0002	0.0016	0.0013	0.0000	0.0000	0.0000
EP T6500H20 TRK,HWY, 16,000GVW,4X4, 1T PICKUP	HIGHWAY TRUCK	DIESEL	180	40%	1	0.5			15.5	2.5			0.1	0.0001	0.0000	0.0000	0.0025	0.0004	0.0000	0.0000	0.0000
EP T6500H21 TRUCK, HIGHWAY, CREW, 2x4 1CY PICKUP, 4X4	HIGHWAY TRUCK	GASOLINE	180	50%	34	0.5			14.4	2.5				0.0027	0.0023	0.0020	0.0777	0.0135	0.0000	0.0000	0.0000
GEN T1502400 TRACTOR, CRAWLER (DOZER), 101-175 HP (75-130 KW), POWERSHIFT, W/ UNIVERSAL BLADE	CRAWLER DOZER/TRACTOR	DIESEL	138	57%	81	0.25473668	0.23842169	0.23043904	1.2913148	3.4231747	556.642935	0.06561378	0.29842169	0.0012	0.0013	0.0013	0.0057	0.0142	2.4083	0.0000	0.0013
GEN T1502500 TRACTOR, CRAWLER (DOZER), 191-250 HP (105-186 KW), POWERSHIFT, W/ UNIVERSAL BLADE	CRAWLER DOZER/TRACTOR	DIESEL	255	56%	244	0.23251836	0.1951397	0.19734551	0.972475135	2.68740123	535.139977	0.06618719	0.1951397	0.0062	0.0072	0.0074	0.0368	0.1134	21.2689	0.0004	0.0077
GEN T4521016 TRUCK OPTION, FLAT BED, 8' (2.4 M) x 24' (7.3 M), (AUG-25,000 LB (11,340 KG) GVW TRUCK)	TRUCK BED	-			7									0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GEN T4521030 TRUCK OPTION, HOIST, 5 TON (4.28 MT), 15'-24' (4.9 M-7.3 M) BOOM (ADD 26,000 LB (11,340 KG) GVW TRUCK & FLAT BED)	HOIST	-			1									0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TRUCK, HIGHWAY, 26,000 LBS GVWR, 2 AXLE, 4X2 (CHASSIS ONLY-ADD OPTIONS)	HIGHWAY TRUCK	GASOLINE	210	59%	2	0.5			37.1	2.5				0.0001	0.0000	0.0000	0.0101	0.0007	0.0000	0.0000	0.0000
GEN X0639720 TUG BOAT, 1350-400 HP (1'12,298 KW)	TUG BOAT	DIESEL	400	59%	1	0.21302290	0.20972174	0.20340156	0.1328034	4.8722034	535.900231	0.0595139	0.2937274	0.0001	0.0001	0.0001	0.0004	0.0012	0.1394	0.0000	0.0002
MAP E6HH03A BUCKET, DRAGLINE, 5.5 CY, MEDIUM WEIGHT	BUCKET DRAGLINE	-			167									0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
MAP F2HM0R0A CRANE,CRAWLER, 4.5CY / 90'BOOM	CRANE	DIESEL	300	43%	1	0.26116066	0.16247	0.14736956	0.7792243	3.3841777	530.28401	0.0092126	0.16247	0.0000	0.0000	0.0000	0.0001	0.0005	0.0764	0.0000	0.0000
MAP F2HM0R0A CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, CRUSHLINE/LANPHUL, 3.5 CY, 80' BOOM (ADD MAGNET)	CRANE	DIESEL	366	43%	167	0.24268672	0.2228474	0.2054739	1.0983576	4.2188998	530.3205	0.0092126	0.1775359	0.0037	0.0032	0.0030	0.0304	0.1169	14.6635	0.0003	0.0049
MAP H2SR0000 HYDRAULIC EXCAVATOR, ATTACHMENT, MATERIAL HANDLING, 3.25 CY BUCKET, W/TIPS (ADD 20,000-75,000 LB HYDRAULIC EXCAVATOR)	HYDRAULIC EXCAVATOR ATTACHMENT	-			1									0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
MAP H2SC4Z00 HYDRAULIC EXCAVATOR, CRAWLER, 24,840 LBS, 0.60 CY BUCKET, 16'5" MAX DIGGING DEPTH	EXCAVATOR	DIESEL	75	59%	1	0.3049645	0.4499573	0.4364677	2.4227616	3.9216761	595.25936	0.0105139	0.4499573	0.0000	0.0000	0.0000	0.0002	0.0002	0.0269	0.0000	0.0000
MAP L5SC0000 LOADER, FRONT END, CRAWLER, 2.25 CY BUCKET	TRACTOR/LOADER/BACKHOE	DIESEL	121	21%	1	0.8211467	0.636718	0.6176166	3.5191136	5.564498	523.80779	0.0112681	0.636718	0.0000	0.0000	0.0000	0.0001	0.0002	0.0175	0.0000	0.0000
MAP T7SC4000 TRACTOR, CRAWLER (DOZER), 75 HP, LOW GROUND PRESSURE, W/2.6 CY SEMI-U BLADE (ADD ATTACHMENTS)	CRAWLER DOZER/TRACTOR	DIESEL	75	59%	1	0.33630945	0.3621387	0.35127748	3.1771077	3.8536587	595.17054	0.0105425	0.3621387	0.0000	0.0000	0.0000	0.0001	0.0002	0.0271	0.0000	0.0000
MAP T7SC4Z04 TRACTOR, CRAWLER (DOZER), 240 HP, LOW GROUND PRESSURE, W/7.79 CY STRAIGHT BLADE (ADD ATTACHMENTS)	CRAWLER DOZER/TRACTOR	DIESEL	240	59%	72	0.29231535	0.1951397	0.18734551	0.972475135	2.68740123	595.139977	0.0061719	0.1951397	0.0025	0.0022	0.0021	0.0109	0.0322	6.0253	0.0001	0.0022
MAP T8SP0000 TRK,HWY, 8,600GVW, 4X2, SUT-PKUP	HIGHWAY TRUCK	GASOLINE	150	50%	34	0.5			14.4	2.5				0.0018	0.0000	0.0000	0.0501	0.0087	0.0000	0.0000	0.0000
MAP T8SP0001 TRK, FUEL & LUBE, 6X4, 3 AXLE	HIGHWAY TRUCK	DIESEL	325	50%	1	0.5			15.5	2.5			0.1	0.0001	0.0000	0.0000	0.0042	0.0007	0.0000	0.0000	0.0000
SKL CC6250K8 Mustang 12 CY, 1 mi round trip	HIGHWAY TRUCK	DIESEL	250	59%	611	0.5			15.5	2.5			0.1	0.0527	0.0000	0.0000	1.6322	0.2633	0.0000	0.0000	0.0105
SKL HD6H8120 Excav & load 6t truck loader	EXCAVATOR	DIESEL	256	59%	531	0.21460636	0.1907319	0.19113	0.944443	2.6731954	535.17961	0.0093984	0.19073319	0.7110	0.6320	0.6349	3.1276	8.8782	1776.1	0.0307	0.6320

Table D-3. Construction Equipment Emissions
Galveston Channel Extension Project

Equipment Type	Description	Fuel Type	HP	Typical Load Factor	Hours of Operation	Emission Factors (grams/horsepower-hour)								Estimated Emission Rates (tpy)							
						VOC	PM10	PM2.5	CO	NOx	CO2	SO2	PB	VOC	PM_{10}	PM2.5	CO	NOx	CO2	SO_2	PB
Gross Contractor																					
2024 TASE7350 TRUCK,TRAILER, WATER TANKER, 5,000 GAL (18,927 L) (NDS 10,000 LB (22,680 KG) GVW TRUCK)	TRUCK,TRAILER,WATER TANKER	-			5									0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2024 TSE7350 TRUCK, HIGHWAY, 56,000 LB (24,948 KG) GVW, 6X4, 3 AXLE (NDS ACCESSORIES)	HIGHWAY TRUCK	DIESEL	310	59%	5	0.9			15.5	2.5			0.1	0.0095	0.0000	0.0000	0.0158	0.0025	0.0000	0.0000	0.0001
SMAP 15SC2001 LOADER / BACKHOE, WHEEL, 2.50 CY FRONT IDG BUCKET, 24" DIP, 4.5 CF, 12' DIGGING DEPTH, 4X4	TRACTOR/LOADER/BACKHOE	DIESEL	121	21%	2	0.6211497	0.535718	0.517.9165	3.5191139	5.594469	533.99773	0.0112581	0.539718	0.0031	0.0000	0.0000	0.0052	0.0023	0.2349	0.0000	0.0000
SMAP XME2002D HELICOPTER, 1290 LB. LIFT CAP. VERTER INSTRUMENTATION, DT & CHEP	HELICOPTER	Aviation Fuel	1490	50%	2	0.3	0.4	0	2.4	3.1	0	0.3	0	0.0005	0.0010	0.0000	0.0062	0.0080	0.0000	0.0006	0.0000
													TOTALS	0.0972	0.0346	0.0326	1.9750	0.8004	88.9291	0.0023	0.0424

Table E-1. Crew Size per Equipment
Galveston County Extension Project

	Cutterhead Dredge		
	Cutterhead Dredge Crew	Shore Crew	Other Construction Equipment
Employees	46	6	29

Table E-2. Emission Factors for Employee Vehicles
Galveston County Extension Project

County	Type of Vehicle	EPA Category[1]	Emisson Factor (g/mile)		
			CO[2]	NOx[2]	VOC[2]
Galveston	Cars	LDGV	6.17	0.395	0.486
	Pickups	LDGT1	6.65	0.506	0.504

Notes:
1. LDGV=light duty gasoline-fueled vehicles designated for transport of up to 12 people
LDGT1=light duty gasoline-fueled trucks with a gross vehicle weight (GVW) rating of 6000 pounds or less
2. Emission factors for CO, NOx, and VOC are from MOBILE6.2 run using Galveston County input file, "09gl830a.in", which can be found on the TCEQ FTP site:
ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/Mobile_EI/HGB/m62/2009/

Table E-3. Summary of Employee Vehicles Emissions
Galveston County Extension Project
NED Alternative

Project Year	Type of Vehicle	EPA Category	Daily Vehicles (/day)	Total (VMT)	Travel Days (days/yr)	Annual Travel (VMT/yr)	Annual Emissions (tpy)		
							CO	NO_x	VOC
2012	Cars	LDGV	26	50.0	196	254,800	1.7329	0.1109	0.1365
	Pickups	LDGT1	26	50.0	196	254,800	1.8677	0.1421	0.1416
						Totals	3.6007	0.2531	0.2781

Notes:
1. Total VMT is assumed to be 50 miles/day round trip.
2. Annual travel = Daily vehicles * Total VMT * Travel days/yr.
3. Annual emissions = Emission factor * Annual travel * 1lb/453.6 grams * 1ton/2000lb

Table A-1. Annual Project Emissions Summary
Galveston Channel Extension Project

Year 2012	TONS PER YEAR					
	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC
Dredge & Support Equipment	12.05	105.36	2.39	2.52	17.47	1.25
Construction Equipment	1.98	0.80	0.03	0.03	0.0023	0.097
Employee Vehicles	3.60	0.25	-	-	-	0.28
TOTAL	**17.63**	**106.41**	**2.42**	**2.55**	**17.48**	**1.62**

Annual Maintenance Dredging

Year 2012	TONS PER YEAR					
	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC
Dredge & Support Equipment	0.90	7.90	0.18	0.19	1.31	0.09

Table A-2. Summary of Project Emissions Compared to 2002 Emissions Inventory
Galveston Channel Extension Project

2002 EMISSION INVENTORY	TONS PER YEAR					
	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC
HGA	1,101,693	357,353	59,155	325,353	152,017	214,128
Brazoria County	61,140	51,453	5,020	16,351	16,314	17,591
ANNUAL PROJECT EMISSIONS	CO	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC
Year 2012	17.63	106.41	2.42	2.55	17.48	1.62
% of HGA	0.002%	0.03%	0.004%	0.001%	0.01%	0.001%
% of Brazoria County	0.03%	0.21%	0.05%	0.02%	0.11%	0.01%

Table A-3. General Conformity Emissions By Source
Galveston Channel Extension Project

Year	NO_x (tpy)				VOC (tpy)			
	Dredge & Support Equipment	Construction Equipment	Employee Vehicles	NO_x Total	Dredge & Support Equipment	Construction Equipment	Employee Vehicles	VOC Total
2012	105.36	0.80	0.25	106.41	1.25	0.10	0.28	1.62

Table B-1. Dredging Contract Schedule - Days per Year
Galveston Channel Extension Project

Contract No.	Reach	Dredging Duration Months	Dredging Duration Days	Contract Start	Contract Finish	Year 2012 days
1	Dredge 45 Ft Channel - New Extension	3	90	1/1/2012	10/1/2012	196
					TOTAL	196

APPENDIX E

Notice of Availability for the Environmental Assessment, Galveston Harbor Channel Extension, Post-Authorization Change Report, Galveston County, Texas

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

May 10, 2013

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Notice of Availability for the Environmental Assessment, Galveston Harbor Channel Extension, Post-Authorization Change Report, Galveston County, Texas

AGENCY: Department of the Army, U.S. Army Corps of Engineers, Department of Defense; Texas Commission on Environmental Quality

ACTION: Notice of Availability and Joint Public Notice

SUMMARY: The U.S. Army Corps of Engineers (USACE), Galveston District announces the release of the Draft Post-Authorization Change Report (DPACR), the Draft Environmental Assessment (DEA), and the Draft General Conformity Determination (DGCD), and their public comment periods, for the Galveston Harbor Channel Extension Project, Post-Authorization Change Report.

PURPOSE: This public notice is to inform interested parties that the U.S. Army Corps of Engineers (USACE), Galveston District (the District) has prepared a Draft Environmental Assessment (DEA) in accordance with the National Environmental Policy Act (NEPA), Public Law 91-190, and regulations for implementing the Procedural Provisions of the NEPA, 40 Code of Federal Regulations 1500-1508. This notice is being distributed to interested State, Federal, and local agencies, private organizations, and individuals in order to assist in collecting facts and recommendations concerning the tentatively recommended channel improvements to extend the limits of the existing authorized 45-foot deep Galveston Harbor Channel for a distance of 2,571 feet to reach the end of the limits of the authorized and currently maintained 40-foot portion of the channel.

PROJECT LOCATION: The approximately 4-mile-long Galveston Harbor Channel is included in the Galveston Channel Reach of the Houston-Galveston Navigation Channels (HGNC), Texas, Project, and provides entry to the Port of Galveston located on the upper Texas coast near the mouth of Galveston Bay in Galveston County, Texas.

PROJECT DESCRIPTION: Tentatively recommended channel improvements would deepen the 40-foot deep by 1,085-foot wide segment of the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) to a 45-foot deep by 1,075-foot wide channel. The proposed project, referred to as the Galveston Harbor Channel Extension, would be consistent with the newly deepened -45 feet mean low tide (MLT) Galveston Harbor Channel dimensions. The channel modifications would increase efficient movement of deep-draft vessels transporting commodities to dock facilities located along this terminal section of the Galveston Harbor Channel.

NEED FOR WORK: The tentatively recommended channel improvement would address the navigation inefficiency that exists within last 2,571 feet of the Galveston Harbor Channel by deepening the -40 foot MLT section of channel to be consistent with the rest of the existing -45 feet MLT Galveston Harbor Channel. Deepening the channel would allow vessel operators and shippers to fully realize the economies of scale of fully loaded vessels that are currently light-loaded inbound and outbound due to channel depth constraints. Vessel operators and shippers would be able to transport larger volumes of goods on more fully loaded or deeper draft vessels, which would improve shipping productivity by moving cargo faster, safer, and more efficiently with less energy expended and producing less pollution.

PROPOSED WORK: The Tentatively Recommended Plan consists of channel improvements to deepen the 40-foot deep by 1085-foot wide segment of the Galveston Harbor Channel from Station 20+000 (near POG Pier 38) to Station 22+571 (near the Pelican Island Bridge) to a 45-foot deep by 1,075-foot wide channel(Figure 3). Channel improvements would be constructed using a cutter head, hydraulic pipeline dredge, from its existing depth of -40-foot MLT to a depth of -45 feet MLT to be consistent with the rest of the channel. Advanced maintenance and allowable over-depth would remain at the current requirement of 3 feet and 2 feet, respectively, such that the maximum channel depth following periodic maintenance would not exceed -50 feet MLT. Side slopes would be constructed at a slope of 1V:3H (1 foot vertical to 3 foot horizontal) and maintained at 1V:2H, which is consistent with maintenance of the remainder of the existing -45-foot MLT project. Channel dredging to construct the -45-foot MLT project would generate 513,800 cubic yards (cy) of new work material, consisting of primarily firm to stiff clays of high plasticity. The dredged material would be placed in the upland confined Pelican Island Placement Area (PA).

COMPLIANCE WITH LAWS AND REGULATIONS: This proposed plan is being coordinated with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and other Federal, state, and local agencies. Informal consultation procedures have begun with the USFWS and NMFS in compliance with the Endangered Species Act, as amended. Our initial determination is that the proposed action will not have any adverse impacts on threatened or endangered species.

Essential Fish Habitat: This notice initiates Essential Fish Habitat consultation requirements of the Magnuson-Stevens Fishery Conservation and Management Act. Our initial determination is that the proposed action will not have a substantial adverse impact on Essential Fish Habitat or federally-managed fisheries in the Gulf of Mexico. Our final determination relative to project impacts and the need for mitigation measures is subject to review by and coordination with the NMFS.

Texas Council on Environmental Quality (TCEQ) Water Quality Certification: The proposed dredged material placement plan will also be evaluated with regard to the requirements of Section 404(b)(1) of the Clean Water Act. Water quality certification has been requested from the Texas Commission on Environmental Quality (TCEQ).

Draft General Conformity: As required by the Clean Air Act, the Environmental Protection Agency (EPA) has promulgated rules to ensure that Federal actions conform to the appropriate State Implementation Plan (SIP). The General Conformity Rule (40 CFR Part 51, Subpart W)

applies to Federal actions, within maintenance or nonattainment areas. Pursuant to Section 176 of the Clean Air Act Amendments of 1990, the USACE has prepared a document entitled, "Draft General Conformity Determination, Galveston Harbor Channel Extension, Post Authorization Change Report, Galveston, Texas" (Appendix E of the DEA). This document is hereby noticed for public comment and will be submitted by the USACE to the TCEQ and EPA concurrently with this DEA. As part of the General Conformity process, the USACE is making this document available to the public for review and comment for a period of 30 days. During this time, the USACE will consult with the TCEQ and the EPA seeking concurrence that emissions from the Tentatively Recommended Plan are conformant with the SIP for the Houston-Galveston-Brazoria ozone nonattainment area. Once written confirmation is received from the TCEQ and the EPA, the USACE will prepare a Final General Conformity Determination for the proposed project. The Tentatively Recommended Plan is expected to increase air emissions in the Houston-Galveston Air Quality Control Region, which is currently classified as a marginal nonattainment area for ozone. An analysis of estimated emissions associated with the proposed project indicates that there may be short-term impacts on air quality in the immediate vicinity of the project area, but no long-term impacts are expected. However, the estimated project emissions of nitrous oxides (NOx) are expected to exceed the conformity threshold of 100 tons per year.

Other Agency Authorizations: It is also our preliminary determination that the proposed action is consistent with the Texas Coastal Management Program (TCMP) to the maximum extent practicable. The proposed work was coordinated with the Texas State Historic Preservation Officer (SHPO). The SHPO concurred that the proposed channel deepening portion of the project would have no effect on historic properties and that the proposed upland PA has no potential to effect historic properties.

The following is a list of Federal, State, and local agencies with which these activities are being coordinated:

U.S. Environmental Protection Agency, Region 6
U.S. Department of Commerce
U.S. Department of the Interior
Eighth Coast Guard District
Budget and Planning Office, Office of the Governor of Texas
Texas Historical Commission
Texas Parks and Wildlife Department
Texas Commission on Environmental Quality
Texas General Land Office
The Texas Office of State-Federal Relations
Texas Department of Transportation
Texas Water Development Board
Port of Galveston

STATE WATER QUALITY CERTIFICATION: TCEQ certification is required. The TCEQ is reviewing the proposed project under Section 401 of the Clean Water Act and in accordance with Title 31, Texas Administrative Code Section 279.1-13 to determine if the work would comply with State water quality standards. By virtue of an agreement between the U.S. Army

known interested persons that there is pending before the TCEQ a decision on water quality certification under such act. Any comments concerning this work may be submitted to the Texas Commission on Environmental Quality, Attention: Water Quality Division, MC-150, P.O. Box 13087, Austin, Texas 78711-3087. The public comment period extends 30 days from the date of publication of this notice. A copy of the public notice with a description of work is made available for review in the TCEQ's Austin office.

The TCEQ may conduct a public meeting to consider all comments concerning water quality if requested in writing. A request for a public meeting must contain the following information: the name, mailing address, and telephone number of the person making the request; a brief description of the interest of the requester, or of persons represented by the requester; and a brief description of how the project would adversely affect such interest.

EVALUATION FACTORS: The decision whether to proceed with the proposed action will be based on an evaluation of the probable impact of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources as well as public and environmental safety and economic concerns.

ENVIRONMENTAL DOCUMENTATION: The work described in this notice represents a change to the existing project. A preliminary review of this proposed plan indicates that an Environmental Impact Statement (EIS) is not required. This preliminary determination of EIS requirement will be changed if information brought forth in the coordination process is of a significant nature. Based on this determination, a DEA has been prepared. The DEA assesses potential impacts to the human and natural environment that would result from the proposed project. The document is available online at http://www.swg.usace.army.mil/BusinessWithUs/PlanningEnvironmentalBranch/DocumentsforPublicReview.aspx.

PUBLIC COMMENT: The USACE is soliciting comments from the public, Federal, state, and local agencies and officials, Indian tribes, and other interested parties in order to consider and evaluate the impacts of this proposed activity. Comments will be considered in the evaluation of impacts on endangered species, historic properties, water quality, general environmental effects, and other public interest factors. Comments will be used in preparation of the Final EA pursuant to NEPA. Comments are also used to determine the overall public interest of the proposed activity.

Persons desiring to express their views or provide information to be considered in evaluating the impact of this work and the future maintenance operations are requested to mail their comments to:

District Engineer
U.S. Army Engineer District, Galveston
ATTN: CESWG-PE-PR
P.O. Box 1229
Galveston, Texas 77553-1229

The comments should make specific reference to Public Notice No. HGNC-13-01. The USACE, Galveston District will accept written public comments on the DEA and the DGCD from May 10, 2013 through June 10, 2013. Comments on the DEA and the DGCD must be postmarked by June 10, 2013.

Any person who has an interest that may be affected by this action may request a public hearing. The request must be submitted in writing within 30 days of the date of this notice and must clearly set forth the interest that may be affected and the manner in which the interest may be affected by this activity.

FOR FURTHER INFORMATION CONTACT: Questions about the proposed action and the DEA may be referred to Ms. Andrea Catanzaro at (409) 766-6346, or by email at andrea.catanzaro@usacc.army.mil.

Dolan Dunn
Chief, Planning, Environmental
and Regulatory Division
Galveston District

APPENDIX F

Evaluation of Section 404(b)(1) Guidelines

EVALUATION OF SECTION 404(b)(1) GUIDELINES (SHORT FORM)

PROPOSED PROJECT: Galveston Harbor Channel Extension Project, Feasibility Study, Galveston County, Texas.

	Yes	No*
1. Review of Compliance (230.10(a)-(d))		
A review of the proposed project indicates that:		
a. The placement represents the least environmentally damaging practicable alternative and, if in a special aquatic site, the activity associated with the placement must have direct access or proximity to, or be located in the aquatic ecosystem, to fulfill its basic purpose (if no, see section 2 and information gathered for EA alternative).	X	
b. The activity does not appear to:		
1) Violate applicable state water quality standards or effluent standards prohibited under Section 307 of the Clean Water Act;	X	
2) Jeopardize the existence of federally-listed endangered or threatened species or their habitat; and	X	
3) Violate requirements of any federally-designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies).	X	
c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, an economic values (if no, see values, Section 2)	X	
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (if no, see Section 5)	X	

	Not Applicable	Not Significant	Significant*
2. Technical Evaluation Factors (Subparts C-F) (where a 'Significant' category is checked, add explanation below.)			
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)			
1) Substrate impacts		X	
2) Suspended particulates/turbidity impacts		X	
3) Water column impacts		X	
4) Alteration of current patterns and water circulation		X	
5) Alteration of normal water fluctuation/hydroperiod		X	
6) Alteration of salinity gradients		X	
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D)			
1) Effect on threatened/endangered species and their habitat		X	
2) Effect on the aquatic food web		X	
3) Effect on other wildlife (mammals, birds, reptiles and amphibians)		X	

	Not Applicable	Not Significant	Significant*
2. Technical Evaluation Factors (Subparts C-F) (where a 'Significant' category is checked, add explanation below.)			
c. Special Aquatic Sites (Subpart E)			
1) Sanctuaries and refuges	X		
2) Wetlands	X		
3) Mud flats	X		
4) Vegetated shallows	X		
5) Coral reefs	X		
6) Riffle and pool complexes	X		
d. Human Use Characteristics (Subpart F)			
1) Effects on municipal and private water supplies	X		
2) Recreational and Commercial fisheries impacts		X	
3) Effects on water-related recreation		X	
4) Aesthetic impacts		X	
5) Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves	X		

3. Evaluation of Dredged or Fill Material (Subpart G)	
a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material (check only those appropriate):	
1) Physical characteristics	X
2) Hydrography in relation to known or anticipated sources of contaminants	
3) Results from previous testing of the material or similar material in the vicinity of the project	X
4) Known, significant sources of persistent pesticides from land runoff or percolation	
5) Spill records for petroleum products or designated (Section 311 of Clean Water Act) hazardous substances	X
6) Other public records of significant introduction of contaminants from industries, municipalities or other sources	X
7) Known existence of substantial material deposits of substances that could be released in harmful quantities to the aquatic environment by man-induced discharge activities	X
8) The material to be placed in the water consists of sand and rock. The material is considered to be exempt from contaminant testing.	

List appropriate references:

	Yes	No
b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and placement sites and not likely to degrade the placement sites, or the material meets the testing exclusion criteria.	X	

4. Placement Site Delineation (230.11(f))	
a. The following factors as appropriate, have been considered in evaluating the placement site (check only those appropriate):	
1) Depth of water at placement site	
2) Current velocity, direction, and variability at placement site	
3) Degree of turbulence	
4) Water column stratification	
5) Discharge vessel speed and direction	
6) Rate of discharge	X
7) Fill material characteristics (constituents, amount, and type of material, settling velocities)	X
8) Number of discharges per unit of time	X
9) Other factors affecting rates and patterns of mixing (specify)	

List appropriate references:

1) not applicable

	Yes	No
b. An evaluation of the appropriate factors in 4a above indicates that the placement site and/or size of mixing zone are acceptable.	X	

	Yes	No
5. Actions to Minimize Adverse Effects (Subpart H)		
All appropriate and practicable steps have been taken, through application of recommendations of 230.70-230.77 to ensure minimal adverse effects of the proposed discharge.	X	

List actions taken:

1) The placement area (PA) to be used is an existing upland confined PA disposal site that has been used previously for dredged material discharge for the Galveston Harbor Channel.

	Yes	No*
6. Factual Determination (230.11)		
A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:		
a. Physical substrate at the placement site (review Sections 2a. 3, 4, and 5 above)	X	
b. Water circulation, fluctuation and salinity (review Sections 2a. 3, 4, and 5)	X	
c. Suspended particulates/turbidity (review Sections 2a. 3, 4, and 5)	X	
d. Contaminant availability (review Sections 2a. 3, and 4)	X	
e. Aquatic ecosystem structure and function (review Sections 2b and c, 3, and 5)	X	
f. Placement site (review Sections 2, 4, and 5)	X	
g. Cumulative impacts on the aquatic ecosystem	X	
h. Secondary impacts on the aquatic ecosystem	X	

7. Evaluation Responsibility	
a. This evaluation was prepared by:	Andrea Catanzaro
Position:	Environmental Lead/Biologist

8. **Findings** (check only those appropriate)	
a. The proposed placement site for discharge of or fill material complies with the Section 404(b)(1) Guidelines.	X
b. The proposed placement site for discharge of dredged or fill material complies with the Section 404(b)(1) Guidelines with the inclusion of the following conditions:	

List of conditions:

1) **Not Applicable**

c. The proposed placement site for discharge of dredged or fill material does not comply with the Section 404(b)(1) Guidelines for the following reason(s):	
1) There is a less damaging practicable alternative	
2) The proposed discharge will result in significant degradation of the aquatic ecosystem	
3) The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem	

13 Sept 2013 Date	Carolyn Murphy CAROLYN MURPHY Chief, Environmental Section

NOTES:

* A negative, significant, or unknown response indicates that the permit application may not be in compliance with the Section 404(b)(1) Guidelines.

Negative responses to three or more of the compliance criteria at the preliminary stage indicate that the proposed projects may not be evaluated using this "short form" procedure. Care should be used in assessing pertinent portions of the technical information of items 2a-e before completing the final review of compliance.

Negative response to one of the compliance criteria at the final stage indicates that the proposed project does not comply with the Guidelines. If the economics

APPENDIX G

Texas Coastal Management Program Consistency Determination

COMPLIANCE WITH GOALS AND POLICIES - SECTION 501.25(a)-(f)
DREDGING AND DREDGED MATERIAL DISPOSAL AND PLACEMENT

GALVESTON HARBOR CHANNEL EXTENSION
GALVESTON COUNTY, TEXAS

Section 501.25 Dredging and Dredged Material Disposal and Placement

(a) Dredging and the disposal and placement of dredged material shall avoid and otherwise minimize adverse effects to coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches to the greatest extent practicable. The policies of this subsection are supplemental to any further restrictions or requirements relating to the beach access and use rights of the public. In implementing this subsection, cumulative and secondary adverse effects of dredging and the disposal and placement of dredged material and the unique characteristics of affected sites shall be considered.

Compliance: Material dredged from the Galveston Harbor Channel Extension will be taken from the existing channel footprint. Dredged material will be pumped by pipeline and hydraulic pipeline dredge to Pelican Island Placement Area (PA), an existing confined, upland PA. All critical areas, shore areas, and Gulf beaches are avoided.

(1) Dredging and dredged material disposal and placement shall not cause or contribute, after consideration of dilution and dispersions, to violation of any applicable surface water quality standards established under subsection (f) of this section.

Compliance: There are no contaminants in the project area based analysis of water and sediment quality data as presented in Sections 3.13 and 4.8 of the Environmental Assessment for this project. No water quality standards will be violated by this project.

(2) Except as otherwise provided in subparagraph (D) of this paragraph, adverse effects on critical areas from dredging and dredged material disposal or placement shall be avoided and otherwise minimized, and appropriate and practicable compensatory mitigation shall be required, in accordance with subsection (h) of this section.

Compliance: Material dredged from the Galveston Harbor Channel Extension will be performed within the existing channel footprint. Dredged material will be pumped by pipeline and hydraulic pipeline dredge to Pelican Island PA, an existing confined, upland PA. All critical areas will be avoided.

(3) Except as provided in subparagraph (D) of this paragraph, dredging and the disposal and placement of dredged material shall not be authorized if:

(A) there is a practicable alternative that would have fewer adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches, so long as that alternative does not have other significant adverse effects;

Compliance: All channel deepening alternatives fall within the existing federally-maintained channel footprint, and, thus, involve the same degree of minor temporary impacts to affected resources. Placement alternatives involving beneficial use (BU) of dredged material to create tidal marsh were considered, but costs for implementing BU alternatives were several times in excess of the base placement plan.

(B) all appropriate and practicable steps have not been taken to minimize adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches; or

Compliance: All practicable steps, including upland placement to the extent practicable, utilization of existing PAs, and minimum channel footprint to meet the project needs have been taken to minimize adverse affects on these resources.

(C) significant degradation of critical areas under subsection (h)(1)(G)(v) of this section would result.

Compliance: Critical areas are avoided and degradation of such areas is not anticipated as a result of the proposed project.

(4) A dredging or dredged material disposal or placement project that would be prohibited solely by application of subparagraph (C) of this paragraph may be allowed if it is determined to be of overriding importance to the public and national interest in light of economic impacts on navigation and maintenance of commercially navigable waterways.

Compliance: Dredging and placement is not precluded by paragraph (C), as noted above.

(b) Adverse effects from dredging and dredged material disposal and placement shall be minimized as required in paragraph (1) of this subsection. Adverse effects can be minimized by employing the techniques in this paragraph where appropriate and practicable.

Compliance: Adverse effects of dredging and dredged material placement as described in this EA have been minimized as described under "Compliance" for paragraph (1) of this subsection. The project has been cited and sized to optimize plan performance while minimizing environmental impacts and cost.

(1) Adverse effects from dredging and dredged material disposal and placement can be minimized by controlling the location and dimensions of the activity. Some of the ways to accomplish this include:

(A) locating and confining discharges to minimize smothering of organisms;

(B) locating and designing projects to avoid adverse disruption of water inundation patterns, water circulation, erosion and accretion processes, and other hydrodynamic processes;

(C) using existing or natural channels and basins instead of dredging new channels or basins, and discharging materials in areas that have been previously disturbed or used for disposal or placement of dredged material;

(D) limiting the dimensions of channels, basins, and disposal and placement sites to the minimum reasonably required to serve the project purpose, including allowing for reasonable overdredging of channels and basins, and taking into account the need for capacity to accommodate future expansion without causing additional adverse effects;

(E) discharging materials at sites where the substrate is composed of material similar to that being discharged;

(F) locating and designing discharges to minimize the extent of any plume and otherwise control dispersion of material; and

(G)avoiding the impoundment or drainage of critical areas.

Compliance: Construction and maintenance dredging for the deepening project will be performed within the existing footprint of the federally-maintained channel. All construction and maintenance material will be discharged directly into the Pelican Island PA, which is an existing confined, upland PA used for maintenance dredging of the existing project. Impacts to benthic marine organisms during construction and maintenance will be minor and temporary. No impoundment or drainage of critical areas will occur. No new channel are required to access the existing PA.

(2) Dredging and disposal and placement of material to be dredged shall comply with applicable standards for sediment toxicity. Adverse effects from constituents contained in materials discharged can be minimized by treatment of or limitations on the material itself. Some ways to accomplish this include:

(A) disposal or placement of dredged material in a manner that maintains physicochemical conditions at discharge sites and limits or reduces the potency and availability of pollutants;

(B) limiting the solid, liquid, and gaseous components of material discharged;

(C) adding treatment substances to the discharged material; and

(D) adding chemical flocculants to enhance the deposition of suspended particulates in confined disposal areas,

Compliance: There are no contaminants in the project area based analysis of water and sediment quality data as presented in Sections 3.13 and 4.8 of the Environmental Assessment for this project.

(3) Adverse effects from dredging and dredged material disposal or placement can be minimized through control of the materials discharged. Some ways of accomplishing this include:

(A) use of containment levees and sediment basins designed, constructed, and maintained to resist breaches, erosion, slumping, or leaching;

(B) use of lined containment areas to reduce leaching where leaching of chemical constituents from the material is expected to be a problem;

(C) capping in-place contaminated material or, selectively discharging the most contaminated material first and then capping it with the remaining material;

(D) properly containing discharged material and maintaining discharge sites to prevent point and nonpoint pollution; and

(E) timing the discharge to minimize adverse effects from unusually high water flows, wind, wave, and tidal actions.

Compliance: Dredged material will be placed in an existing confined upland PA (Pelican Island PA) with properly maintained levees, that is currently used for maintenance material placement for the existing Federal project.

(4) Adverse effects from dredging and dredged material disposal or placement can be minimized by controlling the manner in which material is dispersed. Some ways of accomplishing this include:

(A) where environmentally desirable, distributing the material in a thin layer;

(B) orienting material to minimize undesirable obstruction of the water current or circulation patterns;

(C) using silt screens or other appropriate methods to confine suspended particulates or turbidity to a small area where settling or removal can occur;

(D) using currents and circulation patterns to mix, disperse, dilute, or otherwise control the discharge;

(E) minimizing turbidity by using a diffuser system or releasing material near the bottom;

(F) selecting sites or managing discharges to confine and minimize the release of suspended particulates and turbidity and maintain light penetration for organisms; and

(G) setting limits on the amount of material to be discharged per unit of time or volume of receiving waters.

Compliance: Dredged material will be placed in an existing confined upland PA (Pelican Island PA) with properly maintained levees, that is currently used for maintenance material placement for the existing Federal project. Any effluent from Pelican Island PA will be controlled to minimize the introduction of Total Suspended Solids (TSS) into the receiving water.

(5) Adverse effects from dredging and dredged material disposal or placement operations can be minimized by adopting technology to the needs of each site. Some ways of accomplishing this include:

(A) using appropriate equipment, machinery, and operating techniques for access to sites and transport of material, including those designed to reduce damage to critical areas;

(B) having personnel on site adequately trained in avoidance and minimization techniques and requirements; and

(C) designing temporary and permanent access roads and channel spanning structures using culverts, open channels, and diversions that will pass both low and high water flows, accommodate fluctuating water levels, and maintain circulation and faunal movement.

Compliance: All dredging will be accomplished by a hydraulic pipeline dredge from the water. Dredged material will be placed in the Pelican Island PA, an existing confined upland PA with properly maintained levees that is currently used for maintenance material placement for the existing Federal project. The Pelican Island PA can be accessed by land-based equipment without damaging critical areas.

(6) Adverse effects on plant and animal populations from dredging and dredged material disposal or placement can be minimized by:

(A) avoiding changes in water current and circulation patterns that would interfere with the movement of animals;

(B) selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species that have a competitive edge ecologically over indigenous plants or animals;

(C) avoiding sites having unique habitat or other values including habitat of endangered species;

(D) using planning and construction practices to institute habitat development and restoration to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics;

(E) using techniques that have been demonstrated to be effective in circumstances similar to those under consideration whenever possible and, when proposed development and restoration techniques have not yet advanced to the pilot demonstration stage, initiating their use on a small scale to allow corrective action if unanticipated adverse effects occur;

(F) timing dredging and dredged material disposal or placement activities to avoid spawning or migration seasons and other biologically critical time periods; and

(G) avoiding the destruction of remnant natural sites within areas already affected by development.

Compliance: Construction and maintenance dredging for the deepening project will be performed within the existing footprint of the federally-maintained channel. All construction and maintenance material will be discharged directly into the Pelican Island PA, which is an existing confined, upland PA used for maintenance dredging of the existing Federal project. Coordination with the U.S. Fish and Wildlife Service (USFWS) under the Fish and Wildlife Coordination Act, and the USFWS and the National Marine Fisheries Service, under the requirements of the Endangered Species Act, was implemented. No impacts to endangered species or their critical habitats are anticipated. Impacts to benthic marine organisms during construction and maintenance will be minor and temporary.

(7) Adverse effects on human use potential from dredging and dredged material disposal or placement can be minimized by:

(A) selecting sites and following procedures to prevent or minimize any potential damage to the aesthetically pleasing features of the site, particularly with respect to water quality;

(B) selecting sites which are not valuable as natural aquatic areas;

(C) timing dredging and dredged material disposal or placement activities to avoid the seasons or periods when human recreational activity associated with the site is most important; and

(D) selecting sites that will not increase incompatible human activity or require frequent dredge or fill maintenance activity in remote fish and wildlife areas.

Compliance: No new PAs are proposed. All construction and maintenance material will be discharged directly into the Pelican Island PA, which is an existing confined, upland PA used for maintenance dredging of the existing Federal project.

(8) Adverse effects from new channels and basins can be minimized by locating them at sites:

(A) that ensure adequate flushing and avoid stagnant pockets; or

(B) that will create the fewest practicable adverse effects on CNRAs from additional infrastructure such as roads, bridges, causeways, piers, docks, wharves, transmission line crossings, and ancillary channels reasonably likely to be constructed as a result of the project; or

(C) with the least practicable risk that increased vessel traffic could result in navigation hazards, spills, or other forms of contamination which could adversely affect CNRAs;

(D) provided that, for any dredging of new channels or basins subject to the requirements of §501.15 of this title (relating to Policy for Major Actions), data and information on minimization of secondary adverse effects need not be produced or evaluated to comply with this subparagraph if such data and information is produced and evaluated in compliance with §501.15(b)(1) of this title (relating to Policy for Major Actions).

Compliance: Construction and maintenance dredging for the deepening project will be performed within the existing footprint of the federally-maintained channel. All construction and maintenance material will be discharged directly into the Pelican Island PA, which is an existing confined, upland PA used for maintenance dredging of the existing Federal project. No new PAs are being proposed.

(c) Disposal or placement of dredged material in existing contained dredge disposal sites identified and actively used as described in an environmental assessment or environmental impact statement issued prior to the effective date of this chapter shall be presumed to comply with the requirements of paragraph (a) of this subsection unless modified in design, size, use, or function.

Compliance: Pelican Island PA, which will receive dredged material from the project will not be modified in design, size, use, or function and, therefore, complies with the requirements of paragraph (a) of this subsection.

(d) Dredged material from dredging projects in commercially navigable waterways is a potentially reusable resource and must be used beneficially in accordance with this policy.

(1) If the costs of the beneficial use of dredged material are reasonably comparable to the costs of disposal in a non-beneficial manner, the material shall be used beneficially.

(2) If the costs of the beneficial use of dredged material are significantly greater than the costs of disposal in a non-beneficial manner, the material shall be used beneficially unless it is demonstrated that the costs of using the material beneficially are not reasonably proportionate to the costs of the project and benefits that will result. Factors that shall be considered in determining whether the costs of the beneficial use are not reasonably proportionate to the benefits include, but are not limited to:

(A) environmental benefits, recreational benefits, flood or storm protection benefits, erosion prevention benefits, and economic development benefits;
(B) the proximity of the beneficial use site to the dredge site; and
(C) the quantity and quality of the dredged material and its suitability for beneficial use.

(3) Examples of the beneficial use of dredged material include, but are not limited to:

(A) projects designed to reduce or minimize erosion or provide shoreline protection;
(B) projects designed to create or enhance public beaches or recreational areas;
(C) projects designed to benefit the sediment budget or littoral system;
(D) projects designed to improve or maintain terrestrial or aquatic wildlife habitat;
(E) projects designed to create new terrestrial or aquatic wildlife habitat, including the construction of marshlands, coastal wetlands, or other critical areas;
(F) projects designed and demonstrated to benefit benthic communities or aquatic vegetation;
(G) projects designed to create wildlife management areas, parks, airports, or other public facilities;
(H) projects designed to cap landfills or other waste disposal areas;
(I) projects designed to fill private property or upgrade agricultural land, if cost-effective public beneficial uses are not available; and
(J) projects designed to remediate past adverse impacts on the coastal zone.

Compliance: New work and future maintenance dredged material to be generated by the project consists predominantly of almost equal percentages (approximately 43 percent each) of silt and clay. Several BU alternatives were considered during project planning. These are discussed in Section 2.4 of this EA. The costs of implementing the BU alternatives considered were nearly as much as three times the cost of traditional

placement in the existing upland confined Pelican Island PA. As such, these BUs were considered cost prohibitive without the identification and assistance of an additional project cost-share sponsor.

(e) If dredged material cannot be used beneficially as provided in paragraph (4) (B) of this subsection, to avoid and otherwise minimize adverse effects as required in paragraph (1) of this subsection, preference will be given to the greatest extent practicable to disposal in:

(1) contained upland sites;

(2) other contained sites; and

(3) open water areas of relatively low productivity or low biological value.

Compliance: Pelican Island PA is fully confined and meets the requirements above.

(f) For new sites, dredged materials shall not be disposed of or placed directly on the boundaries of submerged lands or at such location so as to slump or migrate across the boundaries of submerged lands in the absence of an agreement between the affected public owner and the adjoining private owner or owners that defines the location of the boundary or boundaries affected by the deposition of the dredged material.

Compliance: All construction and maintenance material will be discharged directly into the Pelican Island PA, which is an existing confined, upland PA used for maintenance dredging of the existing Federal project. No new PAs are being proposed.

FINAL
STATEMENT OF FINDINGS
AND
FINDING OF NO SIGNIFICANT IMPACT

FOR

GALVESTON HARBOR CHANNEL EXTENSION
POST-AUTHORIZATION CHANGE REPORT

GALVESTON COUNTY, TEXAS

U.S. ARMY CORPS OF ENGINEERS, GALVESTON DISTRICT
GALVESTON, TEXAS

1. Purpose. This document addresses the proposed deepening of the Galveston Harbor Channel from -41 feet mean lower low water (MLLW) to -46 feet MLLW for a distance of 2,571 feet, beginning at the Port of Galveston (POG) Pier-38 (Station 20+000) and continuing westward ending near the Pelican Island Bridge (Station 22+571). The project is located in Galveston Bay between Pelican and Galveston Islands, in Galveston, Galveston County, Texas.

The Galveston Harbor Channel portion of the Houston-Galveston Navigation Channels (HGNC) Project is authorized to a project depth of 46 feet deep (plus 3 feet of advance maintenance and 2 feet of allowable overdepth) from Station 0+000 to Sta- tion 20+000 (generally from Bolivar Roads to the vicinity of POG Pier-38), and to a project depth of only 41 feet (plus 3 feet of advance maintenance and 2 feet of allowable overdepth) from Station 20+000 to Station 22+571 (vicinity of POG Pier-38 west to vicinity of Pelican Island Bridge). The last 41-foot deep portion of the Galveston Harbor Channel limits efficient movement of deep-draft vessels transporting commodities along the waterway.

Deep draft vessels transiting the 41-foot deep portion of the Galveston Harbor Channel must arrive and depart light-loaded in order to utilize bulk facilities docks handling cement, barite ore, bio-diesel, and coal, located along the far western end of the 41-foot channel segment. Deepening the channel would allow vessel operators and shippers to fully realize the economies of scale of fully loaded vessels that are currently light-loaded inbound and outbound due to channel depth constraints. This Environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) and Council on Environmental Quality (CEQ) regulations to document findings concerning the environmental impacts of the proposed action.

2. Proposed Action. Proposed channel improvements consist of deepening a segment of the existing 41-foot deep by 1075-foot wide channel from -41 feet MLLW to -46 feet MLLW, along a distance of 2,571 feet. The deepening will originate near POG Pier-38 at Station 20+000, continuing westward towards Pelican Island Bridge and ending at Station 22+571.

Channel deepening will be accomplished using a cutter head, hydraulic pipeline dredge. Advanced maintenance and allowable overdepth will remain at the current requirement of 3 feet and 2 feet, respectively, such that the maximum channel depth following periodic maintenance will not exceed -50 feet MLLW. No widening is proposed; the bottom width would remain at 1,075 feet or less and the channel top-of-cut will remain in the template of the existing project.

The project will generate 609,500 cubic yards (cy) of new work material (Federal and third party), consisting of primarily firm to stiff clays of low plasticity. The dredged material will be placed in the upland confined Pelican Island Placement Area (PA).

Maintenance quantity and frequency from the proposed 46-foot channel deepening project will remain at 648,000 cy every 4 years which currently dredged from the existing 41-foot deep channel project. No ocean disposal will be performed for new work dredged material placement. Beneficial use was not considered economically feasible and will not be implemented for this project. All maintenance material will be placed in the existing upland confined Pelican Island PA consistent with current practices.

The construction period for the new work dredging and placement would be approximately four months, including one month to prepare the placement area and three months to construct the channel extension and place the material.

3. Coordination. A Notice of Availability was issued to interested parties including Federal and state agencies on September 19, 2012, which described the proposed action and announced the availability of the Draft EA. Comments on the Notice of Availability and Draft EA and the District's responses, are included in Appendix E of the Final EA.

4. Environmental Effects. Galveston District has taken every reasonable measure to evaluate the environmental, social and economic impacts of the proposed project. Based on information provided in the EA and coordination with Federal, state, and local agencies, temporary and permanent effects resulting from the proposed project have been identified and can be found in Section 4 of the Final EA. The deepening of Galveston Harbor Extension would have negligible impacts to very low quality bay bottom habitat comparable in type and magnitude to those experienced during routine maintenance that occurs for the existing channel template. No special aquatic sites, including wetlands, would be impacted. Therefore, no mitigation would be required for this project. Only minor, temporary increases in turbidity, noise and navigation traffic are anticipated. However, such effects would not be "new", but would be among the cyclical recurring impacts that occur during maintenance of the channel. All affected resources are expected to recover to pre-project conditions after the work is completed. The proposed project is expected to contribute beneficially to navigation efficiency and is not expected to contribute negative cumulative impacts to the area.

The District has determined that the project is consistent with the Texas Coastal Management Plan and compliant with Essential Fish Habitat (EFH). A Section 404(b)(1) Evaluation (short form) of project impacts to water quality indicates the project will not adversely affect water quality. The District has received water quality certification from the Texas Commission on Environmental Quality and requested a consistency determination from the Texas General Land Office. It is the District's conclusion that the proposed project will not have a significant impact on the environment or to the surrounding human population.

5. Determinations. The analysis of the environmental impacts of the proposed project is based on the accompanying Final EA. Factors considered in the review were impacts to sea level rise, vegetation, wildlife, aquatic resources including EFH, threatened and endangered species and piping plover critical habitat, cultural resources, socioeconomic resources, Environmental Justice, Prime and Unique Farmlands, Hazardous, Toxic, and Radioactive Wastes, air, noise, water quality, as well as alternative courses of action and cumulative impacts. The proposed project was found to be compliant with the Endangered Species Act, Clean Air Act, Clean Water Act, EFH, and the Texas Coastal Management Plan (TCMP).

6. Findings. Based on my analysis of the Final EA and other information pertaining to the proposed project, I find that the Galveston Channel Extension Project will not have a significant effect on the quality of the human environment. Galveston District reviewed the project for consistency with the goals and policies of the TCMP. Based on this analysis, I find that the proposed plan is consistent with the goals and policies of the TCMP. After consideration of the information presented in the Final EA, I have determined that an environmental impact statement is not required under the provisions of NEPA, and other applicable regulations of the U.S. Army Corps of Engineers, and that the proposed project may be constructed.

6 Jun 18
(date)

Lars N. Zetterstrom, P.E.
Colonel, U.S. Army
Commanding