DRAFT ENVIRONMENTAL ASSESSMENT
for
33 U.S.C Section 408 Approval Request and Section 204(f) Assumption of Maintenance Report

Bayport Ship Channel Improvements

Harris and Chambers Counties, Texas

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

August 2013

DRAFT
STATEMENT OF FINDINGS
AND
FINDING OF NO SIGNIFICANT IMPACT
FOR
33 U.S.C SECTION 408 APPROVAL REQUEST
AND SECTION 204(f) ASSUMPTION OF MAINTENANCE REPORT

BAYPORT SHIP CHANNEL IMPROVEMENTS
HARRIS AND CHAMBERS COUNTIES, TEXAS

1. Purpose. This document addresses the potential environmental impacts of the proposed deepening and widening of the Bayport Ship Channel (BSC) by the Port of Houston Authority (PHA) from -40 feet mean low tide (MLT) to -45 feet MLT from Station 239+04, located at the intersection of the Houston Ship Channel (HSC) and BSC and known as the Bayport Flare, to the end of the BSC turning basin at Station 25+58. The project is located in Galveston Bay, in Harris and Chambers Counties, Texas. This documentation is presented for use in evaluation of the proposed project for purposes of 33 U.S.C. Section 408 approval and Section 204(f) Assumption of Maintenance.

Although this project references MLT, the U.S. Army Corps of Engineers, Galveston District (USACE) is in the process of converting all vertical datums used in navigation projects to reference Mean Lower Low Water (MLLW). The new MLLW reference is intended to indicate the average minimum tidal depth expected in the water bodies. While the District has not yet made determinations concerning the new reference elevations for Galveston Bay, project elevations will eventually need to be adjusted in accordance with the new standards. Although the reference datum change would change the labeled value of the project bottom elevation, it is not expected to change the physical elevation of the channel. The BSC is authorized to a project depth of -40 feet deep (plus 2 feet of advance maintenance and 2 feet of allowable overdepth). Deep draft vessels transiting the existing BSC must arrive and depart light-loaded in order to utilize container and bulk facilities berthing areas and docks located in the Bayport Channel Container Terminal and other docks and facilities on the BSC because of channel depth restrictions. Deepening the channel would allow vessel operators and shippers to realize the economies of scale of fully loaded vessels. 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, and for the purpose of demonstrating compliance with 33 USC Section 408 Modification of Federally Authorized Projects for proposed impacts to a Federal navigation channel. Upon completion of the Section 408 review and approval, the decision on the Department of the Army (DA) Section 10/404 permit (DA Permit Application No. SWG-2011-01183) can be made. Authorization under Sections 408 and 10/404 must be received for construction of this project by the PHA. It is the expressed intent of the PHA that, prior to initiation of construction of this channel improvement, a request will be submitted to USACE for Federal Assumption of Operation and Maintenance pursuant to Section 204(f) of the Water Resources Development Act (WRDA) of 1986, as amended in WRDA 1990, for the completed project.

2. Proposed Action. The BSC would be deepened with hydraulic pipeline dredges from -40-feet MLT to -45-feet MLT, with 2-feet of advanced maintenance and 2-feet of allowable overdepth, from the Flare at Station 239+04 through the turning basin (Station 25+58). The existing 300-foot channel bottom width would be widened to a bottom width of 400 feet by dredging the channel 100 feet to the north from the Flare at Station 221+00 to the land cut at Station 115+00. Within the land cut from Station 115+00 to the end of the turning basin at Station 25+58, the existing 300-foot bottom width channel would be widened to a proposed width of 350 feet by dredging the channel 50 feet to the north. The proposed channel side slopes would be dredged to a 3-foot horizontal:1-foot vertical ratio.

If approved, the project would generate 3.7 million cubic yards (MCY) of new work material from initial construction. The new work dredged material would be placed in the upland confined Placement Area (PA) 15, where 48% of the material would be used to increase the height of levees. The increased levee height at PA15 and resulting increased capacity of PA15 from new work levee raising would offset the decrease in overall system maintenance capacity that would otherwise result from this proposed project. The total maintenance quantity for the next 20 years would be approximately 23.6 MCY, which includes an increase of 4.2 MCY due to the incremental increase in channel depth and width beyond existing conditions. Maintenance materials would be placed in existing PAs 14 and 15, PA 14/15 connection, Mid Bay PA, and Marsh Cells M-7/8/9, M-10, M-11(when constructed), and Mid Bay. Proposed project construction would begin in January 2014, and the construction period for the new work dredging and placement would be approximately 11 months.

3. Coordination. A Notice of Availability was issued to interested parties including Federal and state agencies on August 28, 2013, 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 including placement of new work and maintenance dredged material have been identified and assessed and can be found in Sections 4 and 7 of the Final EA. The deepening and widening of the BSC will impact 4.6 acres of oyster reef and scattered oysters, and 13.9 acres of wetlands. The oysters will be mitigated by creating or restoring oyster loss at a 1acre:1acre ratio at Fisher's Reef, located in the northeastern region of the Galveston Bay System known as Trinity Bay. The Fisher's Reef mitigation site would restore oyster reef negatively impacted by siltation from Hurricane Ike in 2008. A total of 13.9 acres of mixed salt marsh wetlands would be impacted (9.23 acres permanently; 4.7 acres temporarily) on the bay side of PA 15 in Marsh Cells M-7/8/9 in order to create a PA15 stability berm to correct levee factor of safety deficiencies. The 9.23 acres of permanently impacted wetlands would be mitigated on a 1:1 functional ratio. Compensatory mitigation would consist of the creation of 8.25 acres of tidal fringe saltmarsh, dominated by smooth cordgrass and black mangrove at the Baytown Nature Center located off of Scott Bay in Baytown, Texas. Approximately 4.7 acres of mixed tidal marsh within the proposed 50-ft-wide stability berm construction corridor would be temporarily disturbed by construction equipment access. Construction mats would be used in the construction corridor to prevent uprooting of vegetation. Once construction is complete, the mats would be removed and the area would be restored to pre-project contours, replanted, and monitored to ensure full on-site marsh restoration. No other special aquatic sites would be impacted by the proposed project. Only minor, temporary increases in turbidity, noise and navigation traffic are anticipated during project construction. These 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 would not adversely affect water quality. The District will request water quality certification from the Texas Commission on Environmental Quality and a consistency determination from the Texas General Land Office through DA Permit Application No. SWG-2011-01183. For purposes of the Section 408 evaluation and 204(f) report, 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, 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, EFH, and the Texas Coastal Management Plan (TCMP). Clean Water Act compliance will be demonstrated through the evaluation of the DA Section 10/404 Permit Application No. SWG-2011-01183. Issuance of the DA permit and USACE approval of project plans and specifications will be required prior to project construction by the PHA.

6. Findings. Based on my analysis of the Final EA for Section 408 approval and 204(f) report and other information pertaining to the proposed project, I find that the BSC 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.

________________________ __________________________________

(date)

Richard Pannell
Colonel, U.S. Army Corps of Engineers,
District Engineer

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List of Acronyms

B.C.	Before Christ
BCT	Barbours Cut Terminal
BSC	Bayport Ship Channel
BSCCT	Bayport Ship Channel Container Terminal
BU	Beneficial Use
BUG	Beneficial Uses Group
CAA	Clean Air Act
CASP	Clean Air Strategy Plan
CY	Cubic Yard
dB	Decibels
dBA	Decibels, A-Weighted
DPP	Davis Petroleum Pipeline LLC
EA	Environmental Assessment
EFH	Essential Fish Habitat
EMS	Emergency Medical Service
EO	Executive Order
ERDC	U. S. Army Engineer Research and Development Center
FEIS	Final Environmental Impact Statement
FMP	Fishery Management Plan
GBEP	Galveston Bay Estuary Program
GIWW	Gulf Intracoastal Waterway
GMSL	Global Mean Sea Level

GMFMC	Gulf of Mexico Fisheries Management Council
HGAC	Houston-Galveston Area Council
HGB	Houston-Galveston-Brazoria area
HGNC	Houston-Galveston Navigation Channel Project
HPA	Houston Pilots Association
HSC	Houston Ship Channel
HUD	U.S. Department of Housing and Urban Development
HYC	Houston Yacht Club
IH 10	Interstate Highway 10
IH 45	Interstate Highway 45
Leq	Equivalent Continuous Noise Level
Ldn	Day-Night Average Sound Level
MCY	Million Cubic Yards
MLT	Mean Low Tide
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
NAA	Nonattainment Area
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxides
NRCS	Natural Resources Conservation Service
PA	Placement Area

PHA	Port of Houston Authority
ppb	parts per billion
ppt	parts per trillion
ppth	parts per thousand
RSLR	Relative Sea Level Rise
RV	Recreational Vehicle
SH	State Highway
SRCC	Southern Regional Climate Center
SSC	Seabrook Sailing Club
TB	Turning Basin
TCEQ	Texas Commission on Environmental Quality
TEU	Twenty-Foot Equivalent Unit
THC	Texas Historical Commission
tpd	Tons per Day
TPWD	Texas Parks and Wildlife Department
TRCC	Texas Railroad Commission
U. S.	United States of America
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOCs	Volatile Organic Compounds
WMA	Wildlife Management Area
WRDA	Water Resources Development Act

1.0 INTRODUCTION, PURPOSE AND NEED

1.1 INTRODUCTION

The Port of Houston Authority (PHA), Harris County, Texas (hereinafter referred to as "the Applicant") applied to the U.S. Army Corps of Engineers (USACE), Galveston District, for a Clean Water Act Section 404 permit, and a Rivers and Harbors Act Section 10 permit for dredge and fill activities related to the improvements of portions of the Bayport Ship Channel (BSC), hereinafter referred to as "the proposed project" or "the proposed action", on December 6, 2011 (reference Permit Application SWG-2011-01183). The proposed project requires dredging in navigable waters to deepen and widen portions of the BSC, and potential placement of fill in waters of the United States, both regulated activities under the jurisdiction of the USACE. In accordance with the National Environmental Policy Act (NEPA), this Environmental Assessment (EA) has been prepared to analyze and document the potential impacts of the proposed project and reasonable alternatives to the natural and human environment.

Additionally, the purpose of this EA is to support the requirements of 33 U.S.C 408 to get approval from the USACE prior to modification of an existing Federal project, and to support the USACE in the determination of the Federal interest in the Assumption of Maintenance (AOM) of non-federal sponsor (NFS) improvements to the BSC under Section 204(f) of WRDA 1986.

1.1.1 Proposed Action and Location

The proposed project is located at and near the BSC, in the northwest part of the upper Galveston Bay, within Harris and Chambers Counties, Texas (Exhibit 1.1.1-1). The BSC is currently maintained by the USACE to a depth of -40 feet (ft) mean low tide (MLT) plus 2 ft of advanced maintenance and 2 ft of allowable overdepth dredging at a width of approximately 300-ft and is approximately 4.1 miles in length from the Turning Basin (TB) to the intersection with the Houston Ship Channel (HSC). The BSC was mined for levee building materials to approximately -51 ft in 2003 for the segment located in Galveston Bay, as discussed in Section 1.1.2. The Bayport Flare (Flare), the wide channel turning segment connecting the BSC to the HSC, is currently maintained at a depth of -40 ft MLT plus 7 ft of advanced maintenance and 2 ft of allowable overdepth dredging from the confluence of the Flare and HSC to approximately Station 214+00. The advanced maintenance was set at 7 ft in an attempt to reduce the frequency of dredging to ensure the channel remains open at its intended authorized depth.

The Applicant proposes to deepen and widen portions of the BSC. The channel would be deepened from the Bayport TB at Station 25+58 through the Flare at the confluence of the BSC with the HSC at Station 239+04. The depth would be increased from -40 ft MLT to -45 ft MLT, plus 2 ft of advanced maintenance, and an allowance for 2 feet of standard practice overdepth dredging. The channel would be widened by 100-ft to the north, from Station 214+00 to the land cut at Station 115+00, and by 50 ft to the north from the land cut (Station 115+00) to the TB (Station 25+58). Maintenance dredged materials would be placed into existing placement areas during construction. New work dredged materials would be used beneficially to hydraulically raise the levees on PA 15. This form of BU[1] would not directly be beneficial ecologically, but would eliminate the need to mine new bay bottom to supply levee building clays. Maintenance materials would be placed in existing PAs 14 and 15, other Atkinson Island PA cells (PA 14/15 connection, Marsh Cells M7/8/9, M10 and M11 when it is constructed) and Mid Bay. The proposed project is illustrated in Exhibit 1.1.1-2.

[1] The context of beneficial use (BU) in this EA considers all the forms of BU listed in Engineer Manual (EM) 1110-2-5026, *Beneficial Uses of Dredged Material*, and listed in the U.S. Environmental Protection Agency (USEPA) – *USACE Identifying, Planning, and Financing Beneficial Use Projects Using Dredged Material Beneficial Use Planning Manual*, including reuse of materials for construction of levees, and ecological BU. "Beneficial Use" as used in this document may not have the same usage and context as environmental BU and can mean beneficial from an impact avoidance, efficiency or economic perspective.

Legend

- Existing Channel Limits
- Channel Centerline

0 5
Miles

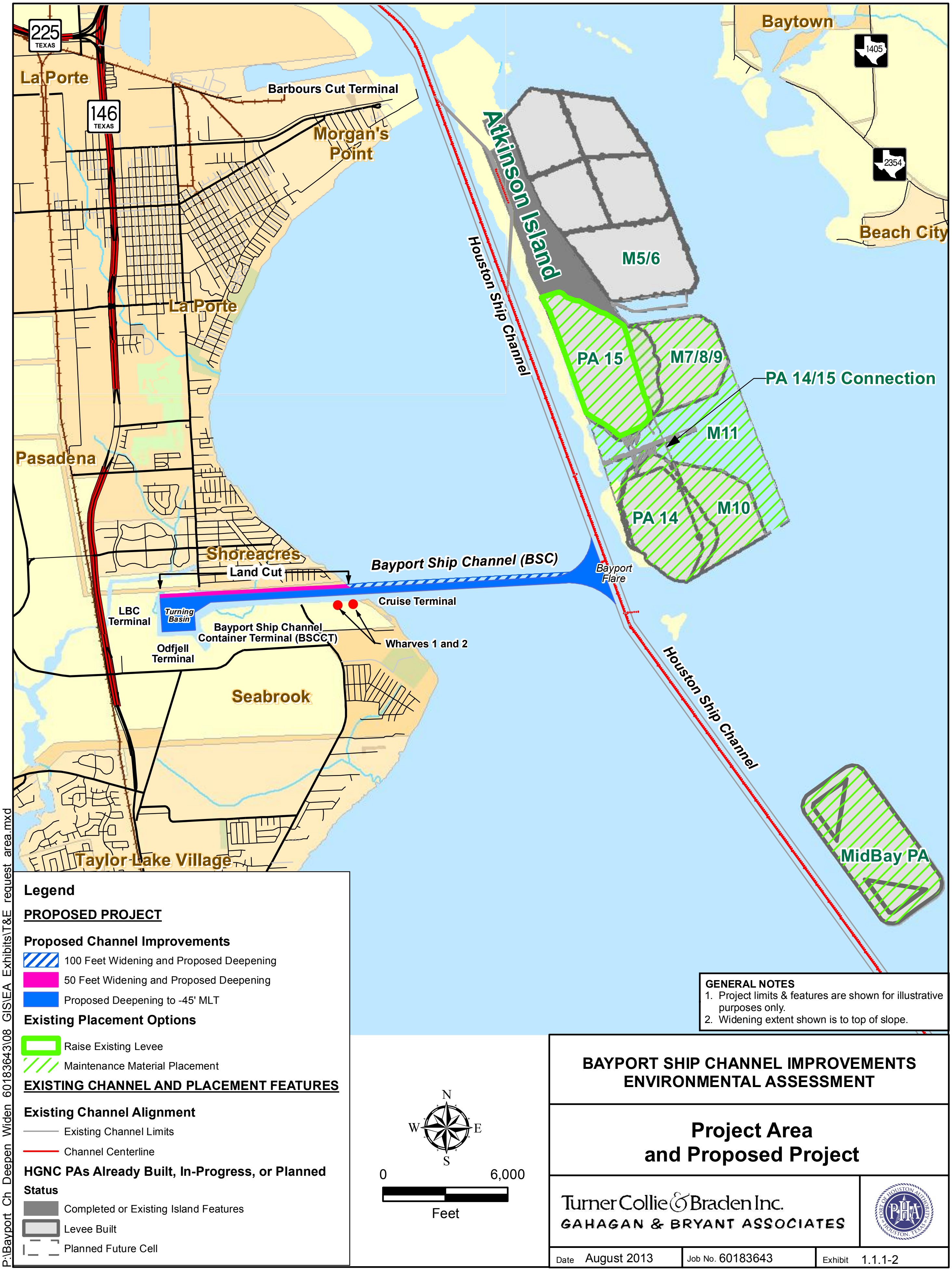
BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Vicinity Map

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date July 2013	Job No. 60183643	Exhibit 1.1.1-1

Path: P:_ENVP\Bayport_Ch_Deepen_Widen_60183643\08_GIS\EA_Exhibits\Revised_for_408-204_EA\Exh 1.1.1-1 Vicinity Map.mxd



BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Project Area and Proposed Project

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date August 2013 | Job No. 60183643 | Exhibit 1.1.1-2

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1.1.2 Project Background

The PHA (Applicant) is an autonomous governmental entity created in 1927 by a special act of the Texas Legislature (article III, section 52 of the Texas Constitution, Act of 1927, 40th Legislature, R.S., Chapter 97, § 1, 1927 Texas General Laws 256, 256-57), with a mission to provide, operate, and maintain waterways and cargo/passenger facilities. Its mission is also to promote trade and generate favorable economic effects upon, and contribute to, the economic development of the Applicant, the City of Houston (COH), and the communities of Harris County and the Texas Coastal Region. This mission is to be accomplished in a manner that provides sufficient funds to cover the Applicant's operational expenses and capital investments.

The Port of Houston is ranked first among U.S. ports in foreign waterborne tonnage (14 consecutive years); first in U.S. imports (19 consecutive years); second in U.S. export tonnage and second in the U.S. in total tonnage (19 consecutive years) (PHA, 2010). More than 220 million tons of cargo moved through the Port of Houston in 2009. More than 7,700 vessel calls were recorded at the Port of Houston in 2009 (PHA, 2010). The Port of Houston is home to the world's second largest petrochemical complex. The size of the refining industry plus the concentration of other energy sector services and industry (e.g., equipment manufacturing) in the area help position the Port of Houston as one of the few ports that exports more goods than it imports.

Based on container cargo processed through its facilities, the Port of Houston is the seventh largest container port in the U.S., and the leading container port on the Gulf Coast. It handles over 65 percent of the container traffic in the Gulf Coast region and over 94 percent of the container traffic in Texas (PHA, 2011). The Port of Houston is a 25-mile-long complex of diversified public and private port facilities located in southeastern Texas. These facilities include the HSC, its tributary channels and basins which extend from Morgan's Point to the HSC TB within the COH, Buffalo Bayou from the HSC TB to Main Street, and the BSC. The facilities include a container terminal at Barbours Cut Terminal (BCT) at Morgan's Point, and a container terminal at the Bayport Ship Channel Container Terminal (BSCCT) on the BSC. There are also two privately owned liquid cargo terminals to serve the petrochemical complex located next to the BSCCT. There are other smaller facilities along the HSC around the HSC TB that have been used to handle containerized cargo; however, these facilities serve smaller vessels, have insufficient shore-side handling and storage, are not designed for modernized container operations, and are not suited for this use. Therefore, the BCT and BSCCT have been the primary container terminals for the Port of Houston.

The BSC began with a series of agreements in 1964 between Humble Oil and Refining Company and the Harris County HSC Navigation District (now the PHA) to dredge a new side channel to connect to the HSC in the present-day location of the BSC. A 10-ft deep, 100-ft wide barge channel was completed in 1966, and later deepened to 12 ft in 1970 as the first phase of the project. The second phase began in 1972 and was completed in 1977, resulting in the Bayport TB, aids to navigation, dredged material disposal, drainage structures, access roads, and railroad modifications on the property on the south side of the channel within the land cut. The land cut is the portion of the channel that was created by cutting into the mainland. The channel was later deepened in 1974 to its current authorized depth of 40 ft in order to handle a design vessel drafting 36 ft, pursuant to Department of the Army permit number 6140. Federal maintenance of the BSC was authorized by an amendment to Section 819 of the Water Resources Development Act (WRDA) of 1986, Public Law 99-662. The USACE assumed maintenance of the channel in April 1993 with a Local Cooperation Agreement (LCA) authorized by the WRDA 1986 amendment. In 2003, the BSC was mined to -51 feet MLT plus 2 feet of standard overdepth dredging from approximately Station 150+00 to the HSC (which is most of the length of the segment in the Bay) by the USACE

SWG. The new work dredged material was beneficially utilized to construct levees at PAs 14 and 15 as well as the straightening of the front side of PA 15 under the Mid Bay contract.

A Twenty-foot Equivalent Unit (TEU) is a standard measure of cargo volume equal to the volume of a standardized 20-ft long shipping container. The Port of Houston handled 1,057,869 TEUs in 2001 with most of this (911,903 TEUs) handled at the BCT, the Applicant's then-primary facility. This exceeded the practical annual throughput capacity of that facility, and regional container vessel traffic was expected to increase. Container throughput in Houston had risen at an average growth of more than 10 percent per year since 1992, a rate among the highest in the world. Therefore, the Applicant sought to develop new container and cruise terminal facilities at the BSC to meet current and anticipated future needs. Planning for these facilities resulted in the *Final Environmental Impact Statement (FEIS) for Port of Houston Authority's Proposed Bayport Ship Channel Container/Cruise Terminal*, dated May 2003, hereafter referred to as the "Bayport Ship Channel Container/Cruise Terminal FEIS" (BSCCT FEIS). Construction started in 2004, with the first phase completed in January 2007, providing three of the seven planned container ship berths.

1.2 PURPOSE

The overall project purpose is to improve navigational efficiency of the BSC to alleviate the current transit restrictions and to allow passage of larger vessels including those expected upon expansion of the Panama Canal. At the time the channel was completed in 1974, the largest container ships could hold just over 2,000 TEUs (Port Bureau, 2011). Since then, container ship sizes have grown to more than 10,000 TEU. Ships approaching this size are already calling on the BSC, even before the completion of the Panama Canal expansion. The proposed project would increase the navigational efficiency of vessel traffic already utilizing the BSC and BSCCT, and would prepare the channel and terminal for more efficient operations when future increases in large vessel traffic occur. The navigational efficiency needs driving the project are explained in more detail in the following section.

1.3 NEED

The need for this project is driven by the following considerations, each explained in the following paragraphs:

- **Navigational Inefficiency** - Navigational inefficiency due to current channel depth and size for vessels currently calling on the BSCCT
- **Larger Vessel Traffic** - Expected increase in larger vessel traffic associated with current industrial trend and the phasing out of the current smaller sized vessels
- **Cargo Handling Capacity** - Continued and growing demand for container cargo handling capacity at the Port of Houston
- **Limited Capacity for Growth** - Limited capacity for growth at Barbours Cut Container Terminal, presence of modernized terminal facilities at BSCCT, and need for deeper draft service for existing petrochemical terminal users at the BSC.
- **Economic Development -** PHA's mission to contribute to economic development of the surrounding and regional communities.

Navigational Inefficiency

Currently, larger, more modern vessels than what the BSC was originally designed for, call on the BSCCT and the adjacent user facilities via the BSC, which currently has a depth of -40 ft MLT. These include both container vessels and bulk liquid petrochemical vessels. These vessels travel via the HSC, which has an authorized depth of -45 ft MLT. Therefore, some container vessels bound for the BSCCT and neighboring facilities have to be light-loaded before entering the BSC, and cannot carry the full tonnage afforded by the 45-ft depth of the HSC. Light-loading involves not loading the ship to its full capacity to reduce the ship's draft to enable entry to a harbor. This decreases the efficiency of operations, requiring increased labor, fuel use, and air emissions to deliver the same tonnage via multiple deliveries. In addition, the Houston Pilots Association, whose pilots guide ships through the channels in and out of the HSC and BSC, have indicated the current channel configurations of the BSC inhibit efficient navigation for the larger ships currently calling the BSCCT and have restricted vessel traffic to daylight hours with multiple tug assists. Access to the current navigation channel and the existing channel width also requires these larger vessels to be maneuvered into and out of the BSC facilities by multiple tugs. Currently, tugs are needed for larger ships to navigate the channel due to squat and certain wind and current conditions. Squat is a hydrodynamic effect experienced by vessels moving rapidly enough through water to create a low pressure zone that pulls the hull closer to the seabed, and may happen if the vessel has to increase speed to maintain maneuverability and avoid drifting. A wider channel would potentially allow fewer tugs to maneuver the vessels when traveling the channel, thus improving navigation efficiency. These factors drive the need for the project from a perspective of current demands.

Larger Vessel Traffic

The expansion of the Panama Canal is under construction and anticipated to be complete in 2014. The shipping industry has already begun to shift the maritime fleet operating at the Port of Houston in anticipation of the expansion. The term "Panamax" is a shipping industry term describing the maximum size vessel that can traverse the Panama Canal. Post-Panamax vessels denote ships larger than can travel through the existing Panama Canal. Post-Panamax vessels can currently make vessel calls to the BSCCT from ports of origin not requiring travel through the Panama Canal. When the Panama Canal expansion is completed, a new maximum vessel size (termed New Panamax) will be able to travel through the canal. Therefore, New Panamax and many Post-Panamax-sized vessels will be able to cross the Panama Canal, which would increase traffic of the largest vessel sizes going into the Gulf of Mexico. This would increase navigation issues along the BSC.

As discussed in Section 1.1.2, prior to construction of the BSCCT, the container vessel throughput in Houston had increased up to 10 percent annually since 1992. The BSCCT FEIS provides details of what these traffic increases have meant in terms of then-existing container facilities (primarily the BCT), and the need to develop new container facilities that have since been constructed and operated at the BSCCT. The container facilities, previously the primary limiting factor in accommodating increased container traffic, can accommodate current and projected future needs.

Cargo Handling Capacity

The continued demand for the container capacity at Bayport, and the associated channel traffic, is illustrated in a recent article by the Port Bureau, an independent ports industry trade organization with membership from numerous regional governments and private port services entities (Port Bureau, 2011). The article stated that 67 percent of the Gulf Coast-loaded TEUs are handled by the Port of Houston, much greater than the next highest figure of 12 percent by the Port of New Orleans. Part of the reason for this high percentage of container traffic is that Houston is a major intermodal/transmodal transportation hub, with a well-developed cargo rail hub system, with proximity to the Gulf Intracoastal Waterway (GIWW). Several of the largest logistics, global and bulk retailer companies, have distribution centers in Texas, including Siemens, Bayer, Exel, Home Depot, the Container Store, and Wal-Mart (Port Bureau, 2011). The latter four are located in the Houston area. Gulf Winds International, a third-party logistics company that provides transport, storage, and distribution to all types of commercial and industrial customers, maintains a 1.5 million square-feet warehouse, its largest, near the BCT (Port Bureau, 2011).

Limited Capacity for Growth

As discussed in the BSCCT FEIS, there are limited backlands (nearby shore-side land) and limited room for growth at the BCT. Moreover, the BSCCT has both ample backlands and modern equipment, which allow for the continued projected growth to handle containers. With the BCT already having reached capacity, and limited by available backland, the most practical solution to accommodate the expected and increasing containerized traffic is modernization of the BSC in order to maximize the most efficient use of the existing and planned capacity at BSCCT. From a future needs perspective, the factors that drive the need for the project are the forecasted container traffic, the need to accommodate deeper draft vessels of other BSC users including the petrochemical facilities, Houston's continued presence as the Gulf of Mexico's major multi-modal transport hub, the lack of capacity at the BCT, and the practicality of using the permitted terminal capacity at the BSCCT. The currently proposed channel improvements are part of the expansion captured in the BSCCT FEIS.

Economic Development

With respect to PHA's mission to contribute to economic development of the COH and the communities of Harris County and the Texas Coastal Region, the project would further the regional job growth already produced by the construction of the BSCCT. The BSCCT's economic impact has already exceeded the initial design predictions of tax revenue and jobs created (approximately 9,800) with the building of only half of the facilities planned (Port Bureau, 2011). Because limitations in navigation efficiency translate to higher shipping costs and can lead to a reduction in container traffic accommodated in a timely manner, the lack of a more efficient channel to match the capacity of the container facilities already constructed and planned would affect the future traffic at the facility. This could affect the existing job base and the continued job growth that would be realized by the BSCCT operating at full capacity, and would mean potential lost jobs. As the Port of Houston has a higher output of exported goods (primarily created in the local community) than imported, the inefficient handling and shipping of these exports also threatens the existing local jobs that create these goods for exports. The potential for further job growth generated by container facilities depends on a channel that provides efficient access to the BSCCT.

1.4 PROJECT DATUM

USACE-SWG is in the process of converting all vertical datums used in navigation projects to reference Mean Lower Low Water (MLLW). The new MLLW reference is intended to indicate the average minimum tidal depth expected in the water bodies. While the District has not yet made determinations concerning the new reference elevations for Galveston Bay, project elevations will eventually need to be adjusted in accordance with the new standards. Although the reference datum change would change the labeled value of the project bottom elevation, it is not expected to change the physical elevation of the channel.

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2.0 ALTERNATIVES ANALYSIS

2.1 INTRODUCTION

This section discusses the alternatives that were considered during the preparation of this EA, including those eliminated from further study, those analyzed in detail, and the No Action Alternative. Although the No Action Alternative does not meet the Purpose and Need of the proposed project, in accordance with NEPA, it always remains as an alternative to the Applicant's proposed action (i.e., deepening and widening of the BSC). This discussion is intended to form part of the basis for the USACE's Section 10/404 permit decision, and to satisfy the requirements of 33 U.S.C. 408, and Section 204(f) for Federal AOM. As a result of the decision process, the USACE may issue the permit, deny the permit, or issue the permit with modifications or conditions. The USACE may also consider AOM of the channel after the construction of the project by the Applicant pursuant to the terms of WRDA 1986 Section 204 (f) if the Federal government determines the project to be in the Federal interest. The No Action Alternative is considered to be the future without- project condition against which all other alternatives are compared.

Because the proposed action is improvement of an existing navigation channel, alternate sites for channel improvement are not practical or feasible and, therefore, were not considered. While alternate sites could be considered alternatives for some projects addressing a national or statewide need, this is not the case for the Applicant's proposed action. The existing BSC provides the only access to the BSCCT facilities and bulk liquid petrochemical facilities at the BSC. The BSCCT was built to expand the containerized cargo handling capacity in the Port of Houston because of limited or diminishing capacity at other existing facilities and continued containerized cargo growth at rates among the highest in the world. Because Houston has well-developed rail facilities, is located centrally with respect to overland routes to the U.S. interior, and is geographically situated for deep draft shipping, it is uniquely positioned to serve many shipping needs. The presence of a substantial portion of the U.S.'s refinery capacity in the area also makes Houston important to petrochemical shipping. In 2010, the Port of Houston was first among U.S. ports in foreign tonnage, second in total tonnage, and the seventh largest container port. The shipping and petrochemical industries are also important to the local economy. Considering this, it is not practical or cost effective to divert cargo and commodities currently shipped through the Port of Houston, to other facilities in the U.S. Therefore, the alternatives evaluated were channel improvements to the existing BSC and dredged material placement alternatives in the vicinity of the project location.

Two suites of alternatives are discussed in this section. The first suite considers alternatives for channel improvements to increase navigation efficiency. The second suite of alternatives considers the placement of dredged materials from the initial construction and operation, of the project, and maintenance of the channel improvements. These alternatives address the purpose and need of the proposed action. Besides the stated purpose of the proposed action, project costs and timelines are also legitimate and important considerations in the alternatives analysis. The proposed project and existing features referenced in this section are illustrated in Exhibit 1.1.1-2.

Formulation of alternative channel alignments and dredged material placement areas (PAs) included an evaluation and analysis of new dredging required to achieve the desired navigation improvements, operational concerns, and historical and projected shoaling rates. Channel widths were determined by ship simulations conducted by the Maritime Institute of Technology and Graduate Studies (MITAGS) based on information from the Applicant, Houston Pilots Association and the Engineer Research and Development Center (ERDC).

2.2 CHANNEL IMPROVEMENT ALTERNATIVES

The PHA and the Houston Pilots Association have expressed a strong interest in deepening and widening the BSC from the intersection of the HSC to the TB due to navigation concerns, associated vessel delays, and operational constraints resulting from the need for multiple tug assistance for the transit of vessels after the Flare to the BSCCT and neighboring facilities and from the BSCCT and neighboring facilities back to the Flare. Tug assistance is currently required within the existing BSC channel for the larger ships calling on the BSCCT due squat and maneuverability issues in the bay portion of the channel. The deepening and widening of the channel will allow for reduced tug assistance within the channel itself, as well as use of larger, more efficient, deeper draft vessels. Tug assistance required for the current Flare is not addressed by the channel improvements, and is being addressed by the USACE Bayport Flare Widening Project. The alternatives screened and selected consider the effectiveness of improving navigation efficiency by allowing the continued use of larger, more-efficient vessels and reducing delays. The following describes the process by which channel deepening alternatives were conceived, screened, and selected.

2.2.1 Initial Alternatives

The existing BSC is a 300-ft wide channel with a 40-ft depth. The BSC is a side channel connecting to the HSC, which has a 45-ft depth. Deepening the BSC to a depth less than 45 ft would not allow the applicant to take advantage of the full draft afforded by the main channel that the BSC connects with to provide ocean-going navigation. Part of the BSC is within a land cut constrained by existing residential development to the north and the BSCCT berths to the south. Therefore, options for widening the channel within the land cut in a cost effective manner are practically limited to expanding the existing one-way traffic shipping lane instead of providing for two-way traffic. The Applicant also discussed operational constraints with the Pilots to determine what channel improvements they desired to alleviate these constraints.

The initial alternatives included widening of the Flare, which was removed from consideration for the proposed action in the later stages of alternatives analysis. It should be noted that the Flare is being evaluated by the USACE Galveston District as a separate study and project under a Federal authority. Regardless, the initial range of alternatives included early evaluations of the Flare. Existing features around the channel referenced in the description of these alternatives can be seen in Exhibit 1.1.1-2 for reference to their location. All alternatives, below, assume increasing the Bayport Flare from the existing 3,000-ft radius to a 5,300-ft radius.

- **Option 1** – No Action. No channel improvements and maintaining the channel at its existing width and depth.

<u>Deepening Only</u>

- **Option 2** – Deepen only (no widening) to -45 ft MLT of the BSC from the Flare to the existing TB, plus widening the Flare to a 5,300-ft radius.

- **Option 3** – Deepen only (no widening) to -45 ft MLT from the Flare to Wharves 1 and 2 with a new TB at the Cruise Terminal**,** plus widening the Flare to a 5,300-ft radius.

Deepening/Widening to the Land Cut Options

- **Option 4** – Deepen to -45 ft MLT and widen by 50 ft to the north from the Flare to the Land Cut, deepen inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.
- **Option 5** – Deepen to -45 ft MLT and widen by 50 ft to the south from the Flare to the Land Cut, deepen inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.
- **Option 6** – Deepen to -45 ft MLT and Widen by 25 ft each side from the Flare to the Land Cut, deepen inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.
- **Option 7** – Deepen to -45 ft MLT and widen by 100 ft to the north from the Flare to the Land Cut, Deepen inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.
- **Option 8** – Deepen to -45 ft MLT and widen by 100 ft to the south from the Flare to the Land Cut, Deepen inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.
- **Option 9** – Deepen to -45 ft MLT and widen by 50 ft each side from the Flare to the Land Cut, deepen inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.

Deepening/Widening Entire Channel Length (Flare to TB)

- **Option 10 (Pilot Preferred 1)** – Deepen to -45 ft MLT and widen by 100 ft to the north from the Flare to the Land Cut, deepen to -45 ft MLT and widen by 50 ft to the north inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.
- **Option 11 (Pilot Preferred 2)** – Deepen to -45 ft MLT and widen by 150 ft to the north from the Flare to the Land Cut, deepen to -45 ft MLT and widen by 100 ft to the North inside the Land Cut to the TB, plus widening the Flare to a 5,300-ft radius.

Since the purpose of the proposed project is to improve navigation efficiency of the BSC, this would be the primary criterion used to evaluate alternatives. Doing so in a timely and cost effective manner was also considered important considering the needs underlying the purpose. Other criteria pertinent to the Applicant's mission and operating practices were also considered. The initial alternatives were screened using the following general criteria:

1) **Increase Navigation Efficiency** – In this initial stage of screening, key factors that affected navigability of vessels constrained by the current channel were considered. This included navigability along the entire BSC length, minimum widening identified by the Pilots to provide navigation efficiency, and effects of widening on the channel alignment.

2) **Cost Effectiveness** – Total project costs and cost effectiveness considerations were used for initial screening. Preliminary project construction costs were developed considering cost factors such as dredging, levee construction, engineering design, potential mitigation, and construction management. As environmental marine field surveys were performed, site-specific oyster habitat acreage data became available, and oyster mitigation costs associated with each option were developed and included in the

project costs. With regard to cost effectiveness, some options that proposed widening to one side were deemed more cost effective than other options proposing to achieve the same width by widening to both sides. This is due to the loss of effectiveness resulting from two separate smaller dredge cuts being necessary to widen two sides, increasing the time needed to complete the construction and thus costs. Consideration of total cost and cost effectiveness allowed comparison of alternatives that were otherwise similar.

3) **Constructability** – Various factors regarding the construction feasibility of the alternatives were considered. These included the ability to implement the project expediently, potential impacts on existing PHA and surrounding infrastructure, and dredging efficiency and practicality considerations such as the width of cut, multiple passes required, and vessel traffic.

4) **Minimize Environmental Impacts** – With the exception of the land cut portion, the BSC is located in the open waters of upper Galveston Bay. Therefore, environmental impacts would be limited to open water marine habitat and would not involve terrestrial, wetland, or near-shore (tidal flats, beach, dunes etc.) impacts. Environmental marine field surveys provided geospatial data useful to gauging the marine habitat impacts, and confirmed that oyster reef and unvegetated, featureless bay bottom would be impacted by channel widening. Therefore, oyster reef acreage impacts were the primary measure of environmental impact used in the screening. The geospatial data indicated that more acreage was located to the south of the BSC than the north. More detail on the nature of the oyster reef habitat and quantities can be found in Chapter 3, Affected Environment.

The initial alternatives were then screened using these four basic criteria with typically one or two given criteria providing a strong reason to eliminate certain options. The following discussion summarizes the screening process and provides reasoning as to why various alternatives were dismissed from further study.

- **Elimination of Options 2 and 3** - The Pilots indicated that navigation efficiency would not be substantially improved with only deepening of the channel. Many of the current restrictions to more efficient entry have to do with horizontal constraints, as vessels must crab under certain wind, current, and velocity conditions. Therefore, deepening-only options did not substantially meet the criteria to increase navigation efficiency, and were eliminated from further consideration, which eliminated Options 2 and 3.

- **Elimination of Options 5 and 8** - Although widening to the south has a dredge cost advantage over widening to the north for the same given width due to the existing bathymetry along the south of the BSC, there are other drawbacks to widening options going south. Channel widening to the south would force the channel alignment to shift south, which would move the centerline of the channel closer to the berthing facilities, which would diminish the ability of vessels to transition into the land cut while passing ships that are berthed at the BSCCT, reducing this aspect of navigability. Also, longer, more continuous oyster habitat acreage adjacent to the channel was found on the south side of the BSC compared to the north. Thus for the same widening, options widening to the south impact more oyster acreage than similar options widening to the north. Therefore, widening options solely to the south did not substantially meet the criteria to increase navigation efficiency or to minimize environmental impacts, and were eliminated, which eliminated Options 5 and 8.

- **Elimination of Option 6 -** Although widening to both sides preserves the current channel centerline which simplifies vessel entry compared to widening by the same width to one side, there are other drawbacks to widening on both sides. It is substantially less cost efficient due to the need to perform more dredge passes compared to widening to one side. Also, at narrower widths, dredging becomes more difficult to control to achieve a desired geometry and presents a constructability issue due to the size of the expected dredging equipment necessary to achieve the dredging and placement of materials in an efficient manner. Option 6, which proposes to widen 25 ft to each side would be inefficient compared to widening 50 ft to one side, and would be more difficult to maintain a consistent dredge width due to its narrow size. Furthermore, the amount of widening provides less navigability improvement compared to larger widths proposed. Therefore, Option 6 does not substantially meet criteria for cost efficiency or constructability, and would provide a smaller increase in navigation efficiency at a cost that was almost the same as Option 8, 100-ft widening to the south, and was almost midway between the costs for Options 4 and 7, involving 50-ft and 100-ft widening to the north, respectively. Therefore, compared to other remaining alternatives, Option 6 does not fulfill several criteria as well, and is therefore eliminated from further study.

- **Elimination of Option 11 -** Option 11, which includes widening by 100 ft to the north within the land cut, would substantially impact the existing riprap shore protection along the northern shore of the land cut. This could greatly increase the cost of this option compared to Option 10, which provides 50-ft widening within the land cut. The shore protection replacement costs were not estimated in detail, but based on preliminary calculations, could increase the cost of Option 11 by 5% to 10% which already is more than $30 Million more than Option 10. Therefore based on cost effectiveness, Option 11 was eliminated from further study.

- **Elimination of Option 7 -** Discussions with the Pilots indicated that improvements to navigation efficiency would be hampered if channel improvements did not extend inside the land cut. The remaining options were Options 1, 4, 7, 9, and 10. Of those, Option 10 is the same outside the land cut as Option 7, but provides 50-ft widening inside the land cut. Therefore, Option 7 was eliminated from further study.

At the end of the initial screening, the remaining action options were Options 1, 4, 9 and 10. The remaining action options that did not include widening inside the land cut (Options 4 and 9) were modified to include 50-ft widening inside the land cut for consideration in the next phase of alternative evaluation.

2.2.2 Screened Alternatives

The Applicant contracted with the Maritime Institute of Technology and Graduate Studies (MITAGS), Waterway Simulation Technology, Inc. (WST) in Baltimore, MD to perform computer-based simulations of vessel navigation in the BSC. The developer used proprietary Transas® database modeling software to import the electronic chart display information system (ECDIS) data. A simulation model was created that incorporated a visual image database of the channel and port facilities, shoreline structures, navigational aids and a radar database for generating simulated radar signatures. The model also incorporated hydrographic data, (bathymetry, currents, etc.) and terrain data, (landmass topography, coastline, piers, etc.). This model involved human participation, also known as “man-in-the-loop”. The Houston Pilots Association provided the human participation in the model simulations. The end result was a visually based simulation vessel navigation model that Pilots controlled from a mock-up control room.

Prior to this ship simulation study, the USACE ERDC conducted a navigability simulation study for the Flare widening being studied by the USACE Galveston District, and determined that 4,000 ft was a sufficient radius instead of the 5,300 ft radius initially considered. Additionally, ERDC recommended the incorporation of a 235-ft straightener on the east side of the HSC just south of the Flare. From the ERDC study, the Pilots decided to continue testing alternatives with the 4,000-ft radius Flare in place without any widening on the east side of the HSC, anticipating that this feature would be in place in the future, with any channel improvements being built by the Applicant. It should be noted that the USACE is currently evaluating the 4,000-ft radius Flare and a widening on the HSC as part of a separate project, that, if approved and funded, would be constructed around the completion time of the proposed action. Final dimensions and depths have not been established. The Flare widening is listed in the alternatives description above only to demonstrate what conditions and features were used in the simulations. Because the USACE may implement the Flare widening, it is not shown after this section as part of the Applicant's proposed action, or in describing the alternatives the Applicant would consider.

Simulations were conducted for multiple alternatives identified as Alternatives 0 through 5, described below. Please note that Alternative 0 was the previously screened Option 1 (No Action). Alternative 1 was added by the Pilots, Alternative 2 was previously screened as Option 2. Options 4, 9 and 10 were simulated and are renamed Alternatives 3, 4 and 5, respectively.

Simulations were conducted for multiple alternatives identified as Alternatives 0 through 5, described below. Please note that Alternative 0 was the previously screened Option 1 (No Action). Alternative 1 is new and was added by the Pilots to test the effects of only channel deepening without widening. Alternative 2 was previously screened as Option 2. Options 4, 9 and 10 were simulated and are renamed Alternatives 3, 4 and 5, respectively.

- **Alternative 0 –** No Action. (No channel improvements and maintaining the channel at its existing width and depth.)
- **Alternative 1 –** Deepen entire channel and TB to -45 ft MLT.
- **Alternative 2 -** Deepen entire channel and TB to -45 ft MLT, plus widening the Flare to a 4,000-ft radius.
- **Alternative 3 –** Deepen entire channel and TB to –45 ft MLT and widen by 50 ft to the north from the Flare to the TB, plus widening the Flare to a 4,000-ft radius.
- **Alternative 4 –** Deepen entire channel and TB to –45 ft MLT and widen by 50 ft each side from the Flare to the Land Cut, and by 50 ft to the north inside the Land Cut to the TB, plus widening the Flare to a 4,000-ft radius.
- **Alternative 5 –** Deepen entire channel and TB to –45 ft MLT and widen by 100 ft to the north from the Flare to the Land Cut and by 50 ft to the north inside the Land Cut to the TB, plus widening the Flare to a 4,000-ft radius.

Additional measures were taken to test the efficiency of the various alternatives' channel geometry under a variety of operating conditions. These included Pilot-defined extreme wind and flood/ebb current conditions and execution of vessel/tug simulations. The simulation vessels used were container ships ranging from 9,000 TEU to 15,000 TEU loaded to 44 ft draft, and a Panamax bulk carrier and Suezmax tanker loaded to a 40-ft draft.

2.2.2.1. Performance of Alternatives

The six screened alternatives were then evaluated using the same four criteria used in the initial screening phase, except that "Increasing Navigation Efficiency" now included success in MITAGS simulation runs. Opinions of probable construction costs were developed for each alternative that considered the same cost factors as before with the addition of specific oyster mitigation costs, since oyster survey data became available during this phase. Table 2.2.2-1 summarizes the performance of each alternative with respect to the criteria. The MITAGS report, included in Appendix 6 of the Section 408 Report, gives a full description of how the model was developed and run, along with the results of each run as well as evaluations conducted by the Houston Pilots who participated in the runs. A brief synopsis of the results and the performance of the alternative in relation to the evaluation criteria is described below.

- **Performance of Alternative 0 and Alternative 1 -** The existing BSC alignment, width and flares at the existing depth were unanimously agreed to be unsafe for all tested post-Panamax containerships. The "No Action" alternative provides no increase in navigation efficiency, which is the project's primary purpose. It is carried forward in this EA solely to comply with NEPA and to contrast the impacts of the other action alternatives as the future without-project condition. Alternative 1 was eliminated from further study because it does not meet the main purpose of the project of increasing navigation efficiency.

- **Performance of Alternative 1 -** The existing BSC alignment, width and Flare deepened to –45 ft MLT were unanimously agreed to be unsafe for all tested post-Panamax containerships. Alternative 1 provides no increase in navigation efficiency, which is the project's primary purpose and is therefore, eliminated.

- **Performance of Alternative 2 –** The existing BSC deepened to a depth of -45 ft MLT with a 4,000-ft entrance Flare on the south bank was also unanimously agreed to be unsafe for all tested Post-Panamax containerships under the conditions run. This alternative provides no increase in navigation efficiency, which is the project's primary purpose and was therefore, eliminated.
- **Performance of Alternative 3 –** The alternative to increase the width of the BSC by 50 ft to the north in the bay section of the waterway, deepening to -45 ft MLT, and adding a 4,000 ft Flare on the south side of the entrance to the BSC was more efficient than the 300 ft width but the large containerships continued to be difficult to handle within the confines of this size channel and resulted in operational delays too much of the time. Because this alternative does not fulfill the primary criterion of navigation efficiency to a substantial degree, it was eliminated from further study.
- **Performance of Alternative 4 –** Widening the BSC 50 ft on both the north and south sides of the waterway to establish a 400-ft wide channel in the bay section of the waterway, deepening to -45 ft MLT and adding a 4,000-ft radius Flare at the entrance to the BSC from the HSC was found to be acceptable for normal operations. This alternative would impact approximately 11.1 acres of oyster habitat versus 4.3 acres impacted with Alternative 5. Also, due to widening both sides, greater dredging costs could be assumed due to requiring two smaller cuts instead of one larger cut, decreasing efficiency. Costs of Alternative 4 are approximately $1.4 million more than Alternative 5.
- **Performance of Alternative 5 –** The widening of the BSC 100 ft to the north to obtain a 400 ft wide channel in the bay section of the waterway and a 350 ft wide channel in the land cut, deepening to -45 ft MLT, and adding a 4,000 ft radius Flare to the south side of the entrance to the BSC from the HSC was found to be acceptable for normal operations. However, in the pilot recommendations and surveys, all unanimously agreed that the widening should be to the north. Alternative 5 can thus be considered to provide a substantial

increase in navigation efficiency. Because this alternative involves only widening to the north, the least amount of oyster habitat is impacted. Also, widening to only one side increases the dredging efficiency for the reasons mentioned earlier. Therefore, this alternative is the preferred alternative.

2.2.2.2. Comparison of Alternatives

The alternatives remaining for comparison are Alternative 0 (No Action), Alternative 4 (Deepen and Widen 50 ft Both Sides), and Alternative 5 (Deepen and Widen 100 ft North). The following summarizes a comparison of the remaining alternatives.

- Alternative 0, No Action, provides no increase in navigation efficiency, but is carried forward for NEPA purposes. However, this alternative is not practicable because it does not meet the needs of the project.

- Alternative 4 increases the navigational efficiency the most and is the second least costly action alternative. However, it impacts twice as much oyster habitat as Alternative 5 and, with widening to both sides, would be less cost effective for dredging costs and may be subject to more dredge delays compared to Alternative 5. Therefore, this alternative is not not the least environmentally damaging practicable alternative.

- Alternative 5 provides a substantial increase in navigation efficiency, and of the action alternatives, minimizes environmental impacts the most by impacting the least amount of oyster acreage and costs the least. Also, Alternative 5 was identified the most times as the preferred plan by Pilots in the MITAGS study comments. Because it is practicable and has the least environmental impact of the remaining alternatives, it is the least environmentally damaging practicable alternative.

Considering that of the action alternatives, Alternative 5 provides a substantial increase in navigation efficiency, fulfills the cost effectiveness criterion the best as it is least costly and is dredge efficient, fulfills the constructability criterion better by not being potentially subject to more dredge delays by widening only to one side, and minimizes environmental impacts the most by impacting the least oyster acreage, on the balance of these criteria, Alternative 5 is selected as the preferred channel improvement alternative.

Table 2.2.2-1 Summary of Screened Channel Alternatives Evaluation

Alternative	New Work Dredge Quantity	Performance for Following Criteria: Increase Navigation Efficiency	Cost Effectiveness	Constructability	Minimize Environmental Impact
Alternative 0 – No Action	0 MCY	• No increase.	• No capital construction costs	• No constructability issues	• No oyster impacts
Alternative 3 – Deepen to -45 ft, Widen **50 ft North** from Flare to TB	3.3 MCY	• Insufficient increase. • 5 of 11 MITAGS runs successful • All but 1 run for smallest (9K TEU) & largest (15K TEU) container vessels were unsuccessful	• Not estimated. Eliminated from further study due to insufficient navigability improvement	• Eliminated from further study due to insufficient navigability improvement	• Eliminated from further study due to insufficient navigability improvement
Alternative 4 – Deepen to -45 ft, Widen **50 ft Each Side** from Flare to Land Cut & **50 ft North** Land Cut to TB	3.6 MCY	• Greatest increase • 9 of 9 MITAGS runs successful • All runs (9 & 14K TEU) were successful	• Cost[1] = $80.8 Million • Less cost effective for dredge costs due to widening on both sides	• Potential to have more dredge delays compared to one-side widening	• 11.1 acres oyster habitat would be impacted
Alternative 5 – Deepen to -45 ft, Widen **100 ft North** from Flare to Land Cut & **50 ft North** Land Cut to TB	3.7 MCY	• Substantial increase. • 8 of 11 MITAGS runs successful • All 14K TEU runs successful except one (pilot error), & all but two of five 15K TEU runs successful • All tanker & bulk carrier runs successful • Of 6 pilots, had most (3) recommendations as safe plan of choice	• Cost[1] = $79.4 Million	• No constructability issues	• 4.6 acres oyster habitat would be impacted

1. Cost = Channel construction cost assuming placement at existing PAs 15,

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2.2.3 Channel Improvement Alternatives Advanced in this EA

As a result of the initial screening process and the alternatives evaluation, the channel improvement alternatives described in the following subsections are carried forward for further evaluation in this EA.

2.2.3.1. No Action

The No Action Alternative involves no channel improvements and consists of leaving the channel at its existing width and depth. Periodic maintenance of the existing channel depth and width would continue.

2.2.3.2. Applicant's Preferred Alternative

The preferred channel improvement alternative is Alternative 5. Improvements to the BSC would consist of the following features (shown in Exhibit 2.2.3-1):

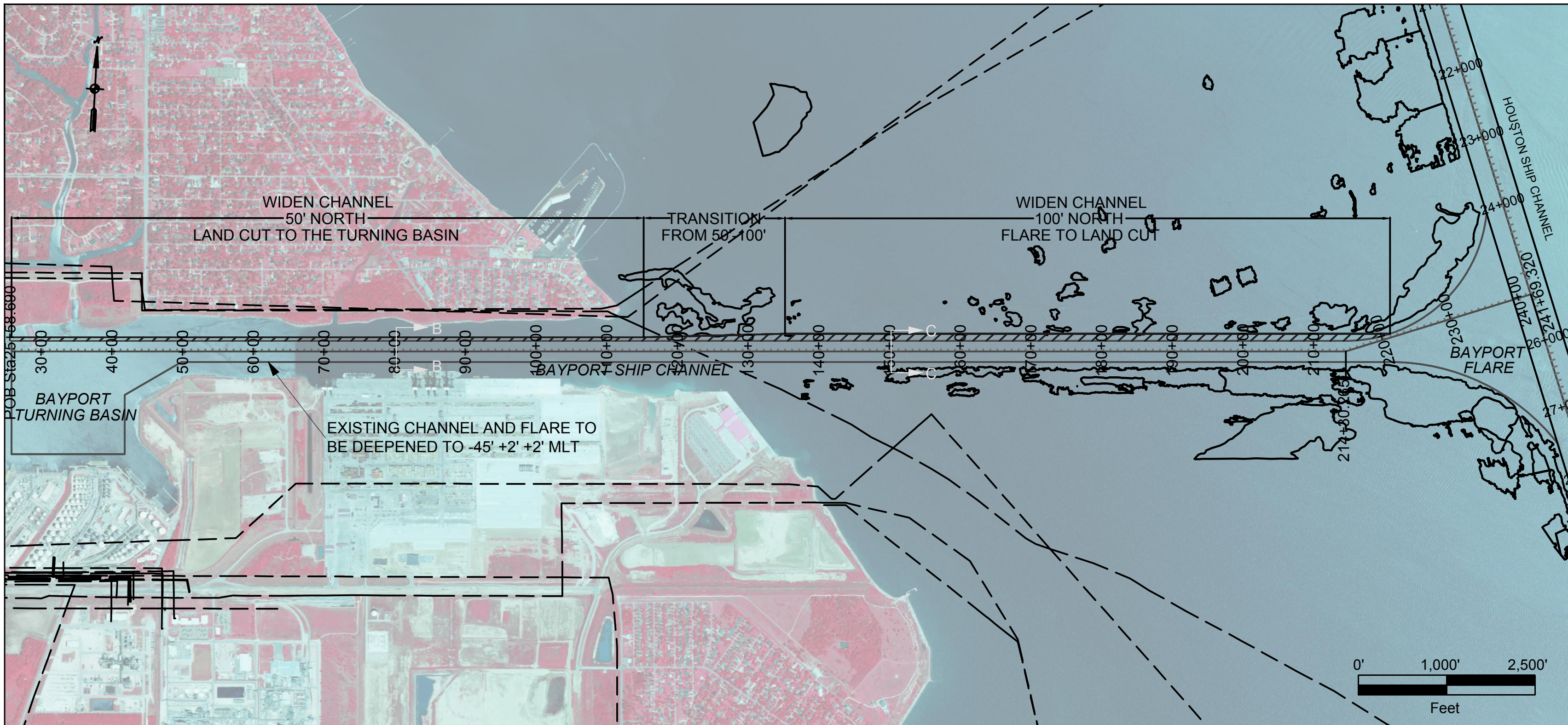
- Deepening the channel from –40 ft MLT to –45 ft MLT, with 2 ft of advanced maintenance and 2 ft of allowable overdepth, from the start of the Flare at Station 239+04, all the way through the TB.

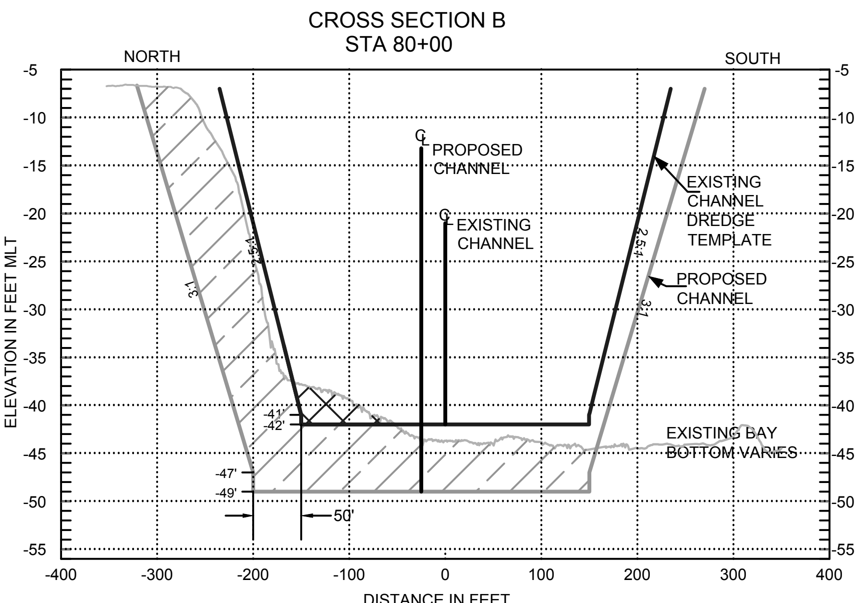
- The BSC would be widened from its existing toe-to-toe width of 300 ft to a proposed width of 400 ft (Exhibit 2.2.3-1) by dredging the channel 100 ft to the north, from the start of the Flare at Station 214+00 to the land cut, at approximately Station 115+00. The channel side slope would be dredged to a 3-ft horizontal: 1-ft vertical ratio. The widening would require some minor dredging east of the start of the northern Flare beginning at approximate station 221+00 to blend in the widened side slope on the north side of the channel to approximate station 214+00.

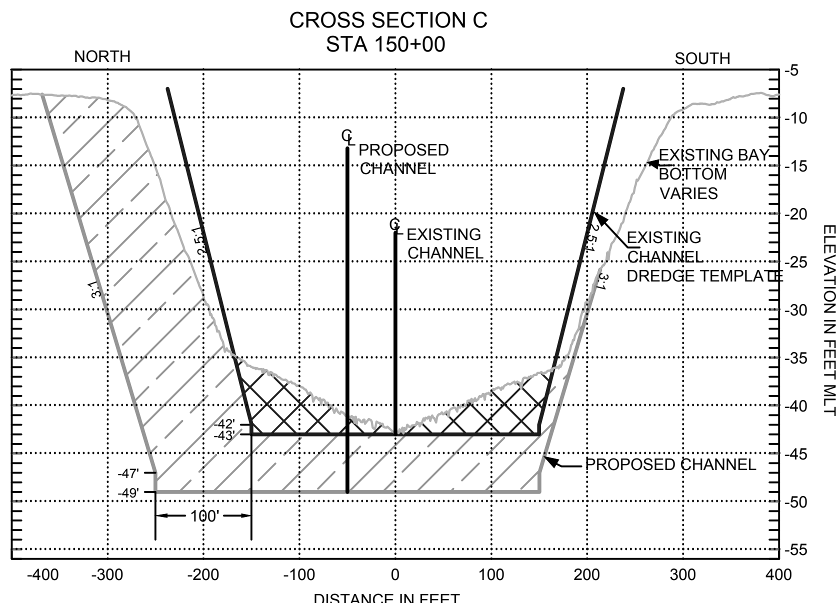
- The BSC would be widened inside of the land cut from its existing toe-to-toe width of 300 ft to a proposed width of 350 ft (Exhibit 2.2.3-1) by dredging the channel 50 ft to the north, approximately from Station 115+00 to the end of the TB at Station 25+58.

Near the entrance of the land cut, at approximate Station 135+00, the widening would transition from 100 ft to 50 ft until the eastern end of the land cut at approximate Station 115+00. The USACE is evaluating plans to ease the Flare as a separate project to an approximate radius of 4,000 ft to the depths of the HSC and BSC. A Discretionary Authority Report for the Bayport Flare Easing Project is in development. The final width and depth of the Flare have not been determined. If approved for construction, the Bayport Flare Easing Project would be constructed by the USACE. As stated previously, the Bayport Flare Easing Project is a separate project and will not be evaluated as part of the AOM or 33 U.S.C. 408 process.

Approximately 3.7 million cubic yards (MCY) of new work material would be generated from initial construction, and approximately 4.2 MCY of additional (incremental) maintenance material over the current Federal maintenance responsibility for the authorized BCS would be generated over a period of 20 years after construction of this alternative. A report detailing the methodology, data and estimated shoaling quantities is available upon request.







CROSS SECTION LEGEND:

- MAINTENANCE MATERIAL
- AREA TO BE DREDGED FOR NEW WORK

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

PREFERRED CHANNEL ALTERNATIVE
AND CROSS SECTIONS

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

Exhibit 2.2.3-1

Job No. 60183643

Date August 2013

LEGEND

- OYSTERS
- PREFERRED CHANNEL ALTERNATIVE
- CONTOURS (FT MLT), JAN. 25-31, 2011
- PIPELINES

NOTE:
1. NO OYSTER IMPACTS WOULD BE CAUSED BY THIS DEEPENING.

File Name: 2013.07.18 - BayportPermitUpdate.dwg

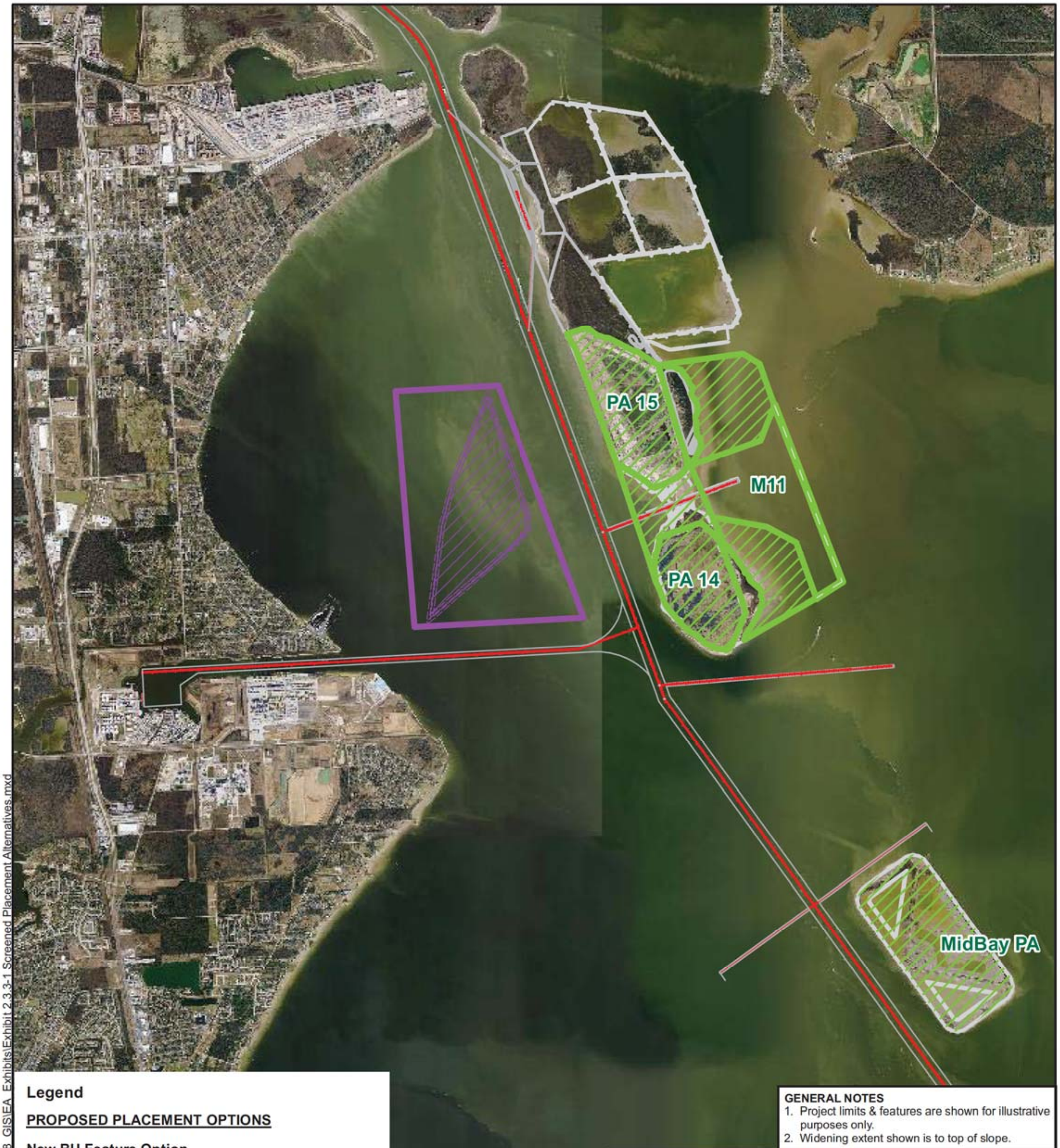
2.3 DREDGED MATERIAL PLACEMENT ALTERNATIVES

The proposed action described in Section 1.1 involves deepening and widening the BSC, which would generate approximately 3.7 MCY of new work dredged material. Based on review of existing borings, approximately 2.4 MCY of the new work material would consist of clay material, 520,000 cubic yards (CY) would consist of silty sands, 320,000 CY would consist of sandy silts, and 460,000 CY would consists of other unconsolidated silty material. Requirements for placement of maintenance dredging material are also considered in the screening and evaluation of alternatives. The incremental maintenance material resulting from the operation and maintenance of the proposed action over a 20-year period is estimated to be 4.2 MCY. The existing channel maintenance is estimated at 19.4 MCY over the 20-year period. A report detailing the methodology, data and estimated shoaling quantities is available upon request. The proposed action requires placement of new work and maintenance dredged material in an environmentally acceptable and economically feasible manner. The following subsections describe the process used for conceiving, screening, and evaluating placement alternatives for the proposed action.

2.3.1 Development of Placement Alternatives

In order to determine the most effective means of placement of the new work and maintenance materials generated by the proposed channel improvements, prospective placement alternatives were developed by first investigating an area within a three and five mile radius from the center of the existing BSC project area. A five mile limit was established for the placement of new work materials resulting from the proposed project, that considered previous experience with the clay materials to be dredged, potential beneficial uses (both ecological and other), environmental considerations, and cost effectiveness. Existing information such as existing facilities, existing placement areas, oyster reef mapping, and pipeline information were plotted on a map (reference Exhibit 2.3.1-1) to help facilitate the development of an array of alternatives for the placement of materials from the proposed project.

Review of existing information shows that there are several existing dredged material PAs within the five mile radius of the project footprint: PA 14, PA 15, the PA 14/15 connection, Atkinson Marsh Cells NW – M10, and Mid Bay. Atkinson Marsh Cells NW-M4 have been filled and M5/6 would be filled prior to the planned schedule for construction of the proposed project. Atkinson Marsh Cells M7/8/9 and M10 are currently under construction. The capacities of the existing PAs projected to the time of the planned schedule of construction of the proposed action are shown in Table 2.3.1-1 below. Capacities were determined using the most recent LIDAR data provided by the USACE dated May 5, 2011. Site capacities were determined using Terramodel software from a digital terrain model of the USACE data. Once the current capacities were calculated, the expected maintenance materials to be placed into the sites between the time of the survey and the planned construction schedule were subtracted. Maintenance materials have been dredged from the Upper Bay reach of the HSC between the time of the LIDAR survey and September 2011 and placed in PA 15. Maintenance materials were dredged from the Mid Bay reach of the HSC and placed in the Mid Bay PA in early 2012. These quantities have been subtracted from the estimated capacities computed from the May 2011 LIDAR surveys. The resulting remaining neat line capacity (or the volume available before volume reduction during the consolidation process) expected at the time of the construction of the proposed action is shown in the table below. Capacity gains due to consolidation and active site management through ditching, drying, and draining could increase the site capacities up to 34.6 MCY of channel cut yards.



Legend

PROPOSED PLACEMENT OPTIONS

New BU Feature Option

- Marsh Levee
- Proposed New BU Marsh Permit Area
- Maintenance Material Placement

EXISTING CHANNEL AND PLACEMENT FEATURES

Existing Placement Options

- Levee Raising
- Maintenance Material Placement

Existing Channel Alignment

- Existing Channel Limits
- Channel Centerline

N
W E
S

0 6,000
Feet

GENERAL NOTES
1. Project limits & features are shown for illustrative purposes only.
2. Widening extent shown is to top of slope.

BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Screened Placement Options

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date May 2013	Job No. 60183643	Exhibit 2.3.3-1

Path: P:\Bayport_Ch_Deepen_Widen_60183643\08_GIS\EA_Exhibits\Exhibit 2.3.3-1 Screened Placement Alternatives.mxd

Table 2.3.1-1 Existing Facility Capacities

Placement Area	Top of Levee	Fill Elevation	Capacity	Units
14	25 ft MLT	21 ft MLT	2,900,000	CY
15	25 ft MLT	21 ft MLT	5,000,000	CY
Mid Bay	20 ft MLT	16 ft MLT	6,900,000	CY
M7/8/9	6 ft MLT	4 ft MLT	3,200,000	CY
M10	6 ft MLT	4 ft MLT	2,400,000	CY
	Total Capacity		**20,400,000**	**CY**

Additionally, the USACE is conducting a study to widen the Flare and conduct maintenance dredging. Based on the most recent schedule from the USACE, this work is expected to occur in late 2015 or early 2016, dependent upon approval and funding. The Applicant's schedule for construction is estimated to begin January 2014 upon approval of the 408 Request and AOM Report. Although the Flare Project has not been finalized or approved, the approximate dredged material placement needs were considered when developing placement Alternatives for the Proposed Action. It is estimated that the USACE would dredge approximately 1.9 MCY of new work materials from widening the Flare and approximately 1.8 MCY of maintenance materials from the entire existing BSC and Flare. Their placement plan is currently under evaluation. The total amount of materials to be dredged for the BSC by both the USACE and for the proposed project from 2014 through 2016 is approximately 7.5 MCY. Therefore, approximately 12.9 MCY of neat line capacity would remain in the existing facilities after 2016 unless additional improvements, such as levee raising, were made to the existing facilities or a new PA was constructed.

As stated above, the existing upland placement facilities have sufficient capacity for the placement of new work materials from the proposed action without any improvements. However, this would potentially deplete a large portion of the existing capacity for maintenance material placement not only for the BSC and its proposed channel improvements, but for the Houston-Galveston-Navigation Channel Project (HGNC) as well. Therefore, the Applicant sought to explore solutions that would create additional capacity through either improvement of existing facilities by using the new work materials to raise the levees on existing PAs or to create a new PA that provides upland placement or potentially, a beneficial use marsh.

In addition to looking at existing Galveston Bay PAs to the east of the BSC, potential tracts of open land to the west of the land cut side of the BSC were considered for the development of a terrestrial new dredged material placement area. The land cut portion of the BSC is surrounded by residential development to the north, petrochemical terminals to the west, and petrochemical terminals and the BSCCT to the south. Much of the undeveloped land adjacent to the BSC is either pipeline easement or designated for dredged material placement for the petrochemical terminals. There is no available undeveloped land greater than 10 acres directly adjacent to the BSC. A desirable upland placement area of sufficient size to accommodate large-scale dredging equipment is on the order of 300 to 500 acres. Accessing larger nearby tracts would require crossing numerous existing infrastructure including roads, bulk petrochemical terminal and refinery facilities, and residential development. Undeveloped acreage north of Shoreacres would require dredge pipe placement (in lieu of more expensive and less efficient overland haul by truck) through the Shoreacres neighborhood, a community that was sensitive to the development of the BSCCT. Undeveloped acreage west across State Highway (SH) 146 is primarily part of Harris County land preserves along Taylor Bayou. Undeveloped acreage south of the BSCCT is primarily part of lands targeted for wetland preservation by the City of Seabrook. Due to pumping distances, haul costs, potential wetland impacts, and infrastructure conflicts, these constraints limit economic feasibility of dredged material placement in these undeveloped areas.

Considering these constraints, a range of dredged material placement alternatives was initially considered, including existing terrestrial confined upland PAs, new bay confined upland PAs with and without BU features, and existing confined bay PAs.

2.3.2 Initial Placement Alternatives

To help meet the dredged material placement planning objective of beneficial use while minimizing and mitigating for environmental impacts and potential environmental improvements, the Applicant sought the consideration and advice of the Beneficial Uses Group (BUG), consisting of representatives of several State and Federal resource agencies, including the USACE Galveston District. The Applicant has met and coordinated with the BUG on an ongoing basis throughout the implementation of the HGNC Project to get resource agency input and participation on all dredged material placement with a primary focus on ecological beneficial use of dredged materials from the HGNC project and its tributaries. The BUG has been instrumental in providing advice, guidance and input on the configuration, location, and design of dredged material PAs, with a goal that they incorporate BU features as much as is practicable. The BUG has also provided key guidance on the long-term plan to identify the needed PA/BU sites to manage the dredged material produced by the HGNC and its tributary channels, and the success and monitoring criteria for their construction. For the initial dredged material placement alternative phase of this study, the BUG helped provide input on the preferred location of placement features and general placement concepts. The BUG includes representatives from:

- National Marine Fisheries Service (NMFS)
- Natural Resources Conservation Service (NRCS)
- Texas General Land Office (TxGLO)
- Texas Parks and Wildlife Department (TPWD)
- USACE
- U.S. Environmental Protection Agency (USEPA) Region 6
- U.S. Fish and Wildlife Service (USFWS)

At the time of the conception and screening of these initial placement alternatives, the new work quantities used to devise PA concepts considered the additional new work quantities available from the Flare Easing, including the deepening to match the depth for this proposed project.

Initial Alternatives Conceived

The following describes the initial alternatives developed for consideration by the BUG. Exhibit 2.3.2-1 indicates the general locations of the existing facilities:

- **PAs 14 and 15 and Connection** – These are existing bay confined upland PAs consisting of PA 14 and PA 15 and the connection between them. These PAs are the nearest existing PAs, located adjacent to the BSC-HSC confluence and are an extension of the greater Atkinson Island PA. Currently, BSC maintenance material is designated to go these PAs. The alternatives involve either using the existing capacity, or raising the existing levees to a geotechnically-stable height with new work material, thereby creating more placement capacity for future maintenance dredging material. BSC maintenance material would continue to go here.

- **BU Cell M11** – This is a future BU marsh cell that has already been planned and approved by the USACE under the EA for the expansion of PAs 14 and 15 titled *Final Environmental Assessment Expansion of Placement Areas 14 and 15 Houston Ship Channel Chambers County, Texas* (hereafter referred to as the "PA 14/15 Expansion EA"). This BU cell would be an eastward extension of PAs 14 and 15. The alternative would consist of using the BSC new work material to construct part of the perimeter levee for this cell. As described in the PA 14/15 Expansion EA, the cell footprint has existing oil and gas facilities located within it. The levee would be constructed with the appropriate openings to allow necessary access and avoid overburden impacts until such time that these facilities can be relocated. The alternative would not involve closing these openings, but would provide the majority of levee material for construction of this future marsh cell. Another feature of the HSC and tributaries would likely be mined to significant depths to construct this levee if new work material from the BSC improvements weren't used. Utilizing the new work materials from the proposed action would be a beneficial alternative from this perspective.

- **Mid Bay PA** – This is an existing bay confined upland PA located adjacent to the HSC approximately 2.6 miles south of the BSC-HSC confluence. This is the next closest existing bay PA. Similar to the PA 14/15 alternative, this alternative would involve either using the existing capacity, or raising the existing levees to a geotechnically-stable height with new work material, thereby creating more placement capacity. In the USACE's efforts to manage the HGNC and its tributary channels, maintenance materials from the BSC have historically been placed here and it is expected that this practice would continue as warranted.

- **Bayport Container Terminal Dredged Material Placement Area (DMPA) #2** – This is an existing terrestrial confined upland PA located on the south side of the developing BSCCT and is permitted under the terminal's permit. It is located south of the part of the BSCCT that lies between the BSC and the planned sight and sound berm, which is currently being constructed. It currently has some dredged material placed and stockpiled from BSCCT berth dredging. It is the site of the terminal's future intermodal rail yard projected to be constructed within the next 10 years. The alternative would consist of borrowing onsite materials to construct and fortify the existing levees and expand the current footprint. New work materials would be confined within the site interior for eventual use as intermodal rail yard fill. The placed materials would be re-worked and graded to provide the required final intermodal yard site elevations. New work material would also be used to construct the remaining planned sight and sound berm along the southern edges of this PA and other BSCCT property. However, this option would only provide sufficient capacity to hold approximately half of the new work dredged materials from the proposed action and additional placement area would be needed.

- **New Bay Confined Upland PAs** – Several areas of the Upper Bay north, south, and southeast of the BSC were considered for the location of a new PA feature. Based on previous geotechnical information and confirmatory geotechnical probing data collected for this study, the southeast area was ruled out due to poor foundation characteristics for a new PA. The south area was also found to have more area of lesser quality foundation than the north, more pipeline infrastructure crossings, and a considerably higher larger area of oyster reefs that would potentially be impacted.

ERDC performed sediment transport studies for the HGNC project (Tate and Ross, 2009). As part of the reporting and presentations regarding their studies, ERDC made several recommendations to help alleviate some of the shoaling in the Upper Bay Reach of the HGNC and the Flare. The first recommendation was to close the gap between PAs 14 and 15 to reduce this sediment transport funnel. Another recommendation to alleviate shoaling would be the use of a wave barrier alongside the west side of the HSC and the north side of the BSC that would absorb and reduce ship wake kinetic energy and possibly prevent sediment transport mechanisms from influencing additional shoaling in the channel. The BUG identified the general area north of the BSC as a preferred location considering these factors.

This general alternative encompassed a series of 5 different conceptual options for constructing a new PA in Upper Galveston Bay that would primarily be configured as confined upland disposal, but had general BU marsh concepts identified for some options. See Exhibit 2.3.2-2 through Exhibit 2.3.2-6. The options were located in this preferred location, ranged from 485 acres to 505 acres of upland placement area, and were sized to provide a preliminary estimated capacity for 20 years of maintenance. These options were generally configured to provide wave barrier benefit around the north side of the BSC-HSC confluence.

The 5 options provided different configurations for impacting or avoiding one pipeline crossing, which at the time was still being verified as being operational or abandoned. Three of the options had a conceptual BU marsh feature. At the time of the formulation of this alternative, the Applicant’s preferred channel alternative had not been established. Therefore, conceptual PAs of various sizes and capacities were evaluated.

Legend

PROPOSED PLACEMENT OPTIONS

Bayport Container Terminal Dredged Material Placement Area (DMPA) #2

New Bay Confined Upland PAs

- Preliminary Option 1
- Preliminary Option 2
- Preliminary Option 3
- Preliminary Option 4
- Preliminary Option 5

EXISTING CHANNEL AND PLACEMENT FEATURES

Existing Placement Alternative

- Levee Raising
- Maintenance Material Placement

Existing Channel Alignment

- Existing Channel Limits
- Channel Centerline

N W E S

0 6,000

Feet

GENERAL NOTES

1. Project limits & features are shown for illustrative purposes only.
2. Widening extent shown is to top of slope.

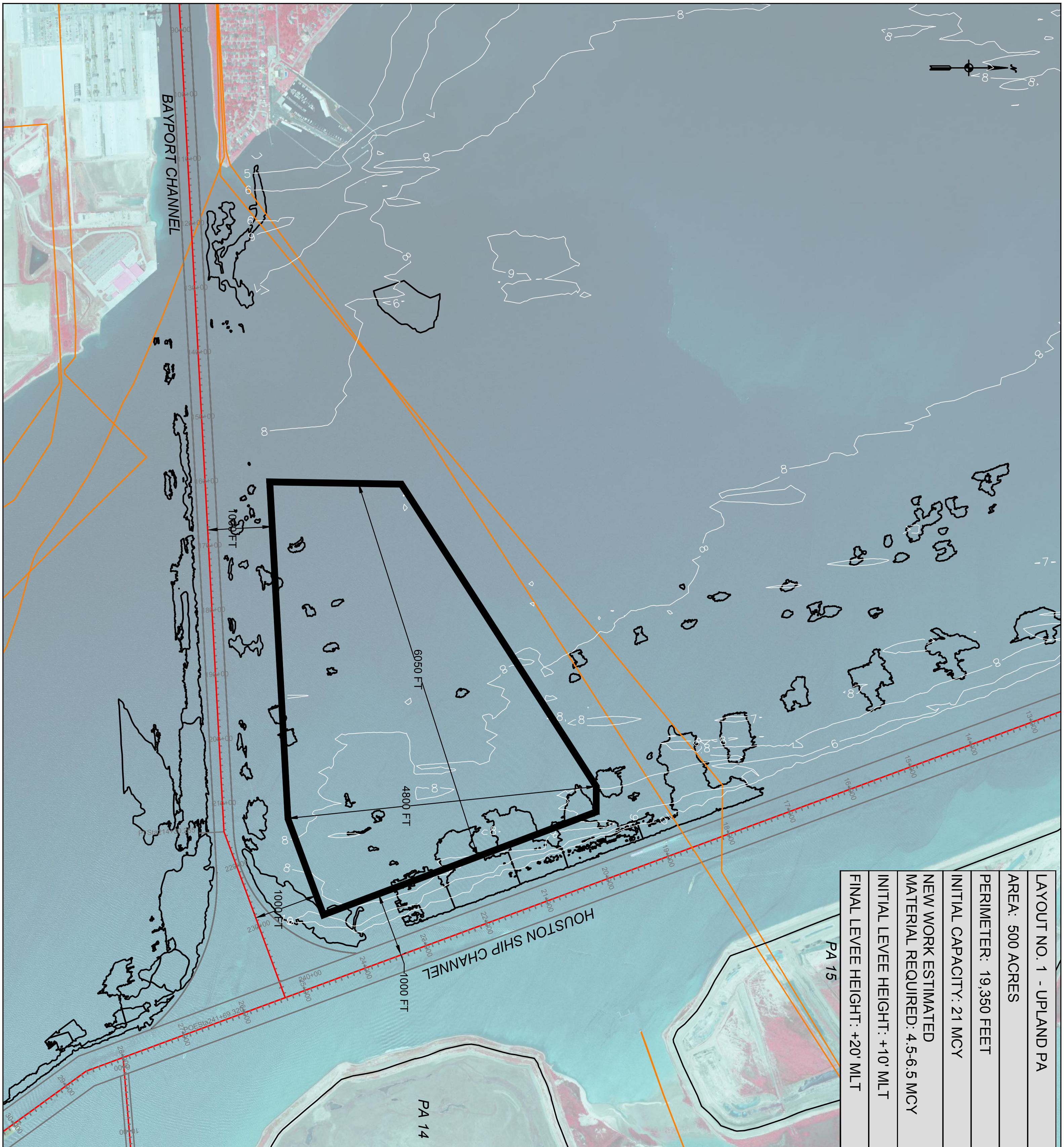
BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Initial Placement Alternatives

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date May 2013	Job No. 60183643	Exhibit 2.3.2-1

Path: P:\Bayport_Ch_Deepen_Widen_60183643\08_GIS\EA_Exhibits\Exhibit 2.3.2-1 Initial Placement Alternatives.mxd



LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

0' 1,000' 2,000'
Feet

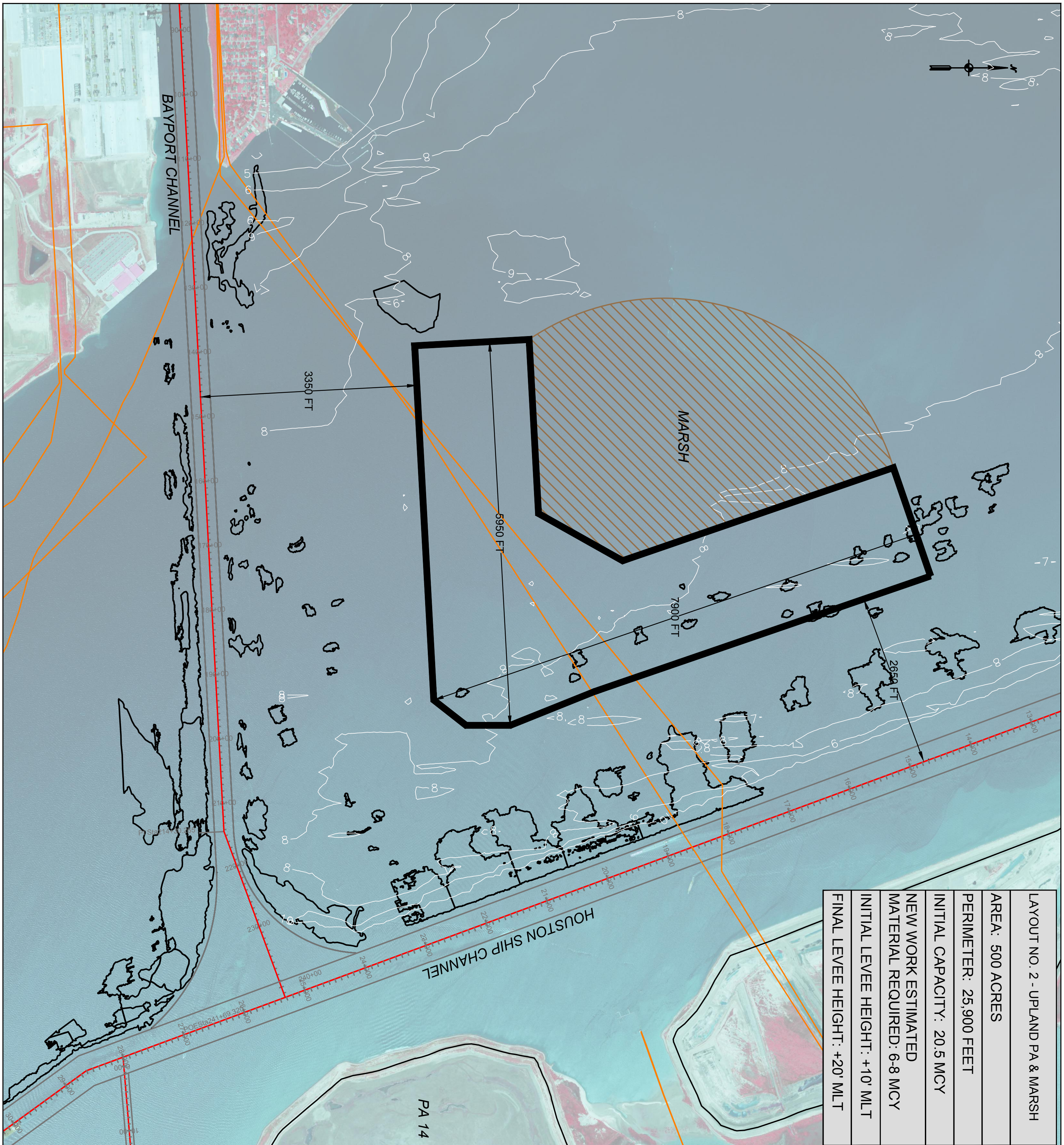
BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

NEW BAY PLACEMENT AREA
PRELIMINARY OPTION NO. 1

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-2

File Name: BP2013-EADocument.dwg



LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

0' 1,000' 2,000'
Feet

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

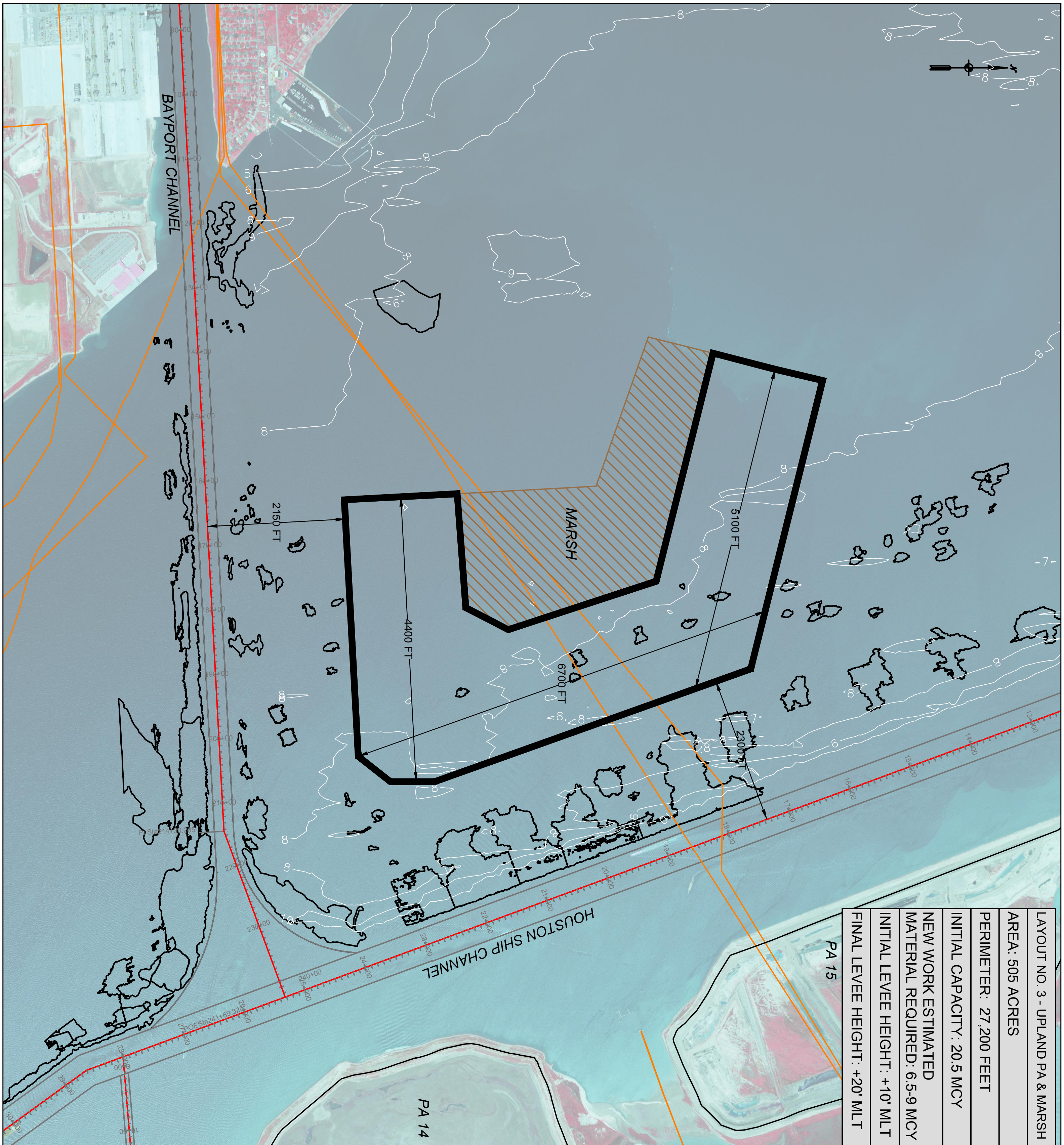
NEW BAY PLACEMENT AREA
PRELIMINARY OPTION NO. 2

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY HOUSTON, TEXAS

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-3

File Name: BP2013-EADocument.dwg



LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- 5 CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

NEW BAY PLACEMENT AREA
PRELIMINARY OPTION NO. 3

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY, HOUSTON, TEXAS

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-4

File Name: BP2013-EADocument.dwg

LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- 5 CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

0' 1,000' 2,000'
Feet

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

NEW BAY PLACEMENT AREA
PRELIMINARY OPTION NO. 4

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY • HOUSTON, TEXAS

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-5

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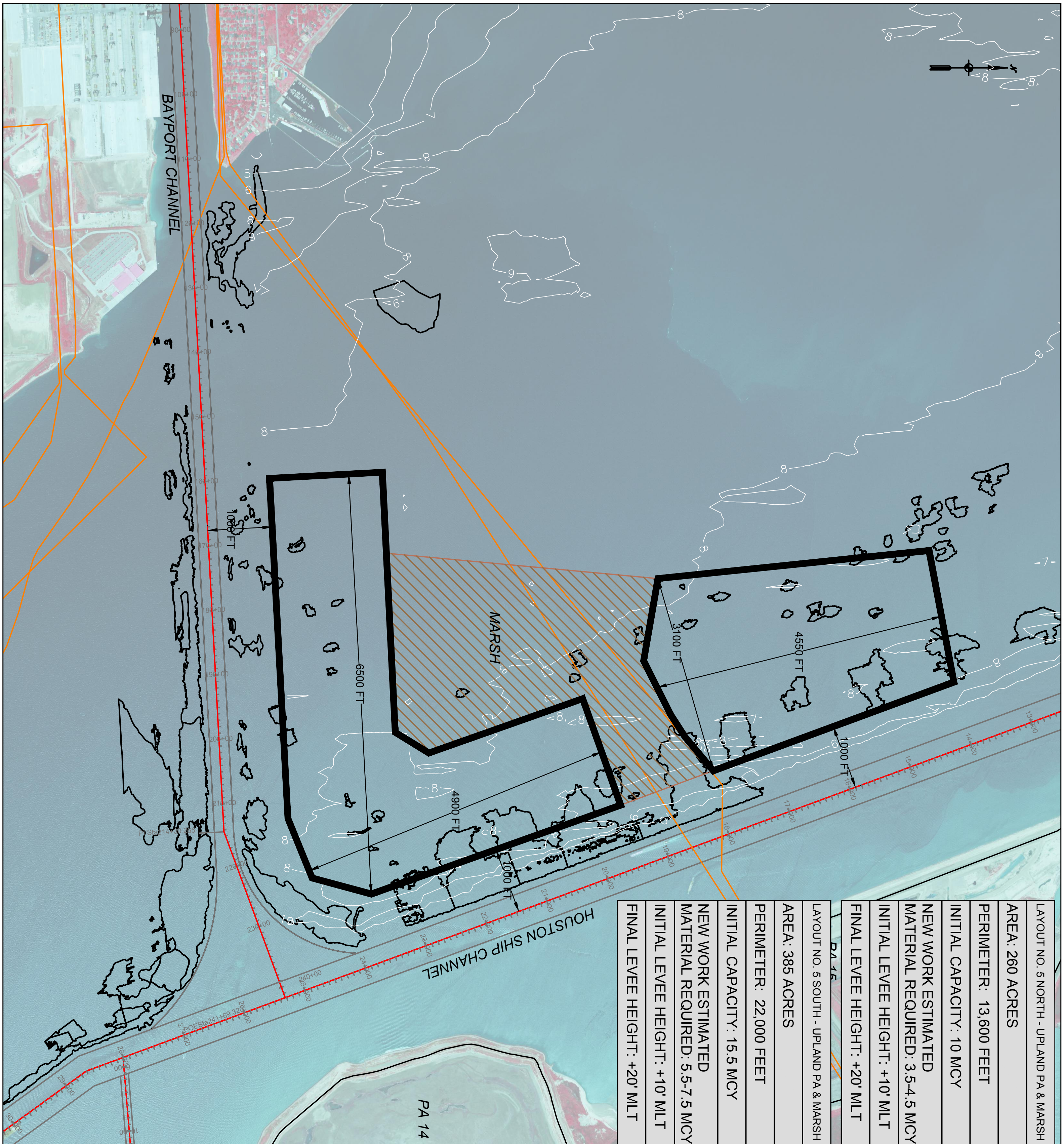

LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

0' 1,000' 2,000'
Feet

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

NEW BAY PLACEMENT AREA
PRELIMINARY OPTION NO. 5

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY, HOUSTON, TEXAS

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-6

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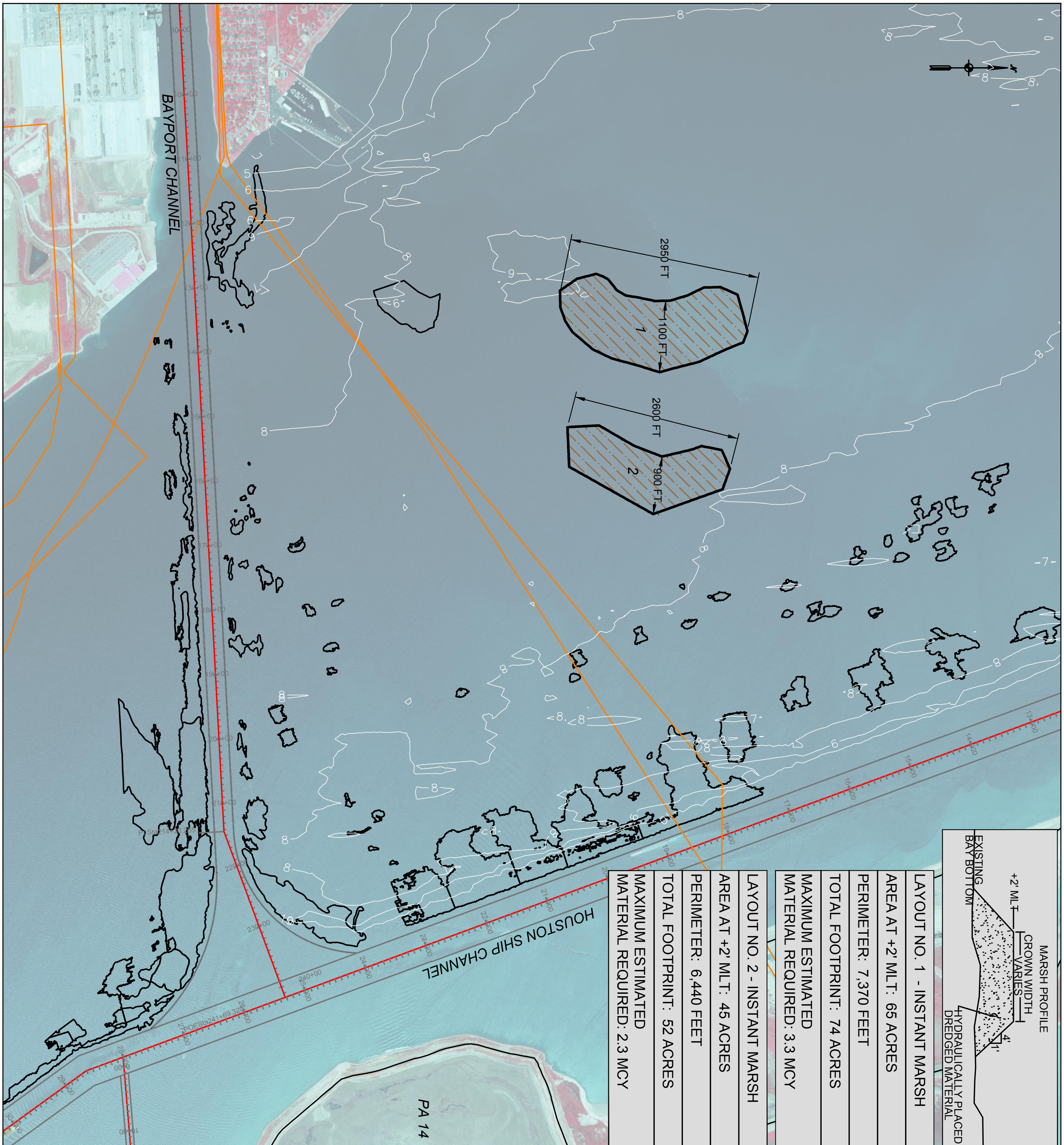


LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- 5 CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

0' 1,000' 2,000'
Feet

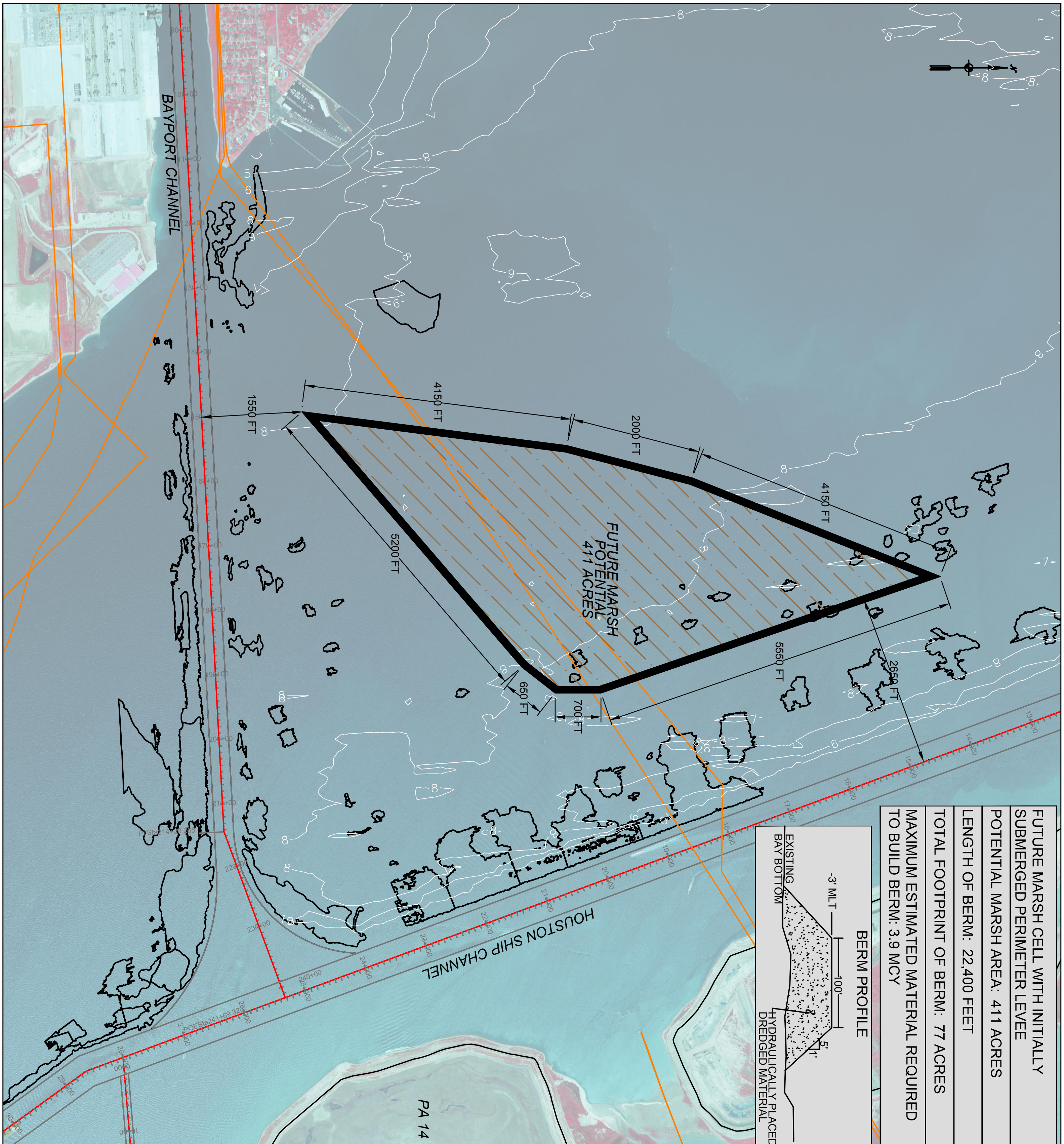
BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

BENEFICIAL USE PLACEMENT ALTERNATIVES NO. 1 & 2

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-7

File Name: BP2013-EADocument.dwg



LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- 5 CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

0' 1,000' 2,000'
Feet

File Name: BP2013-EADocument.dwg

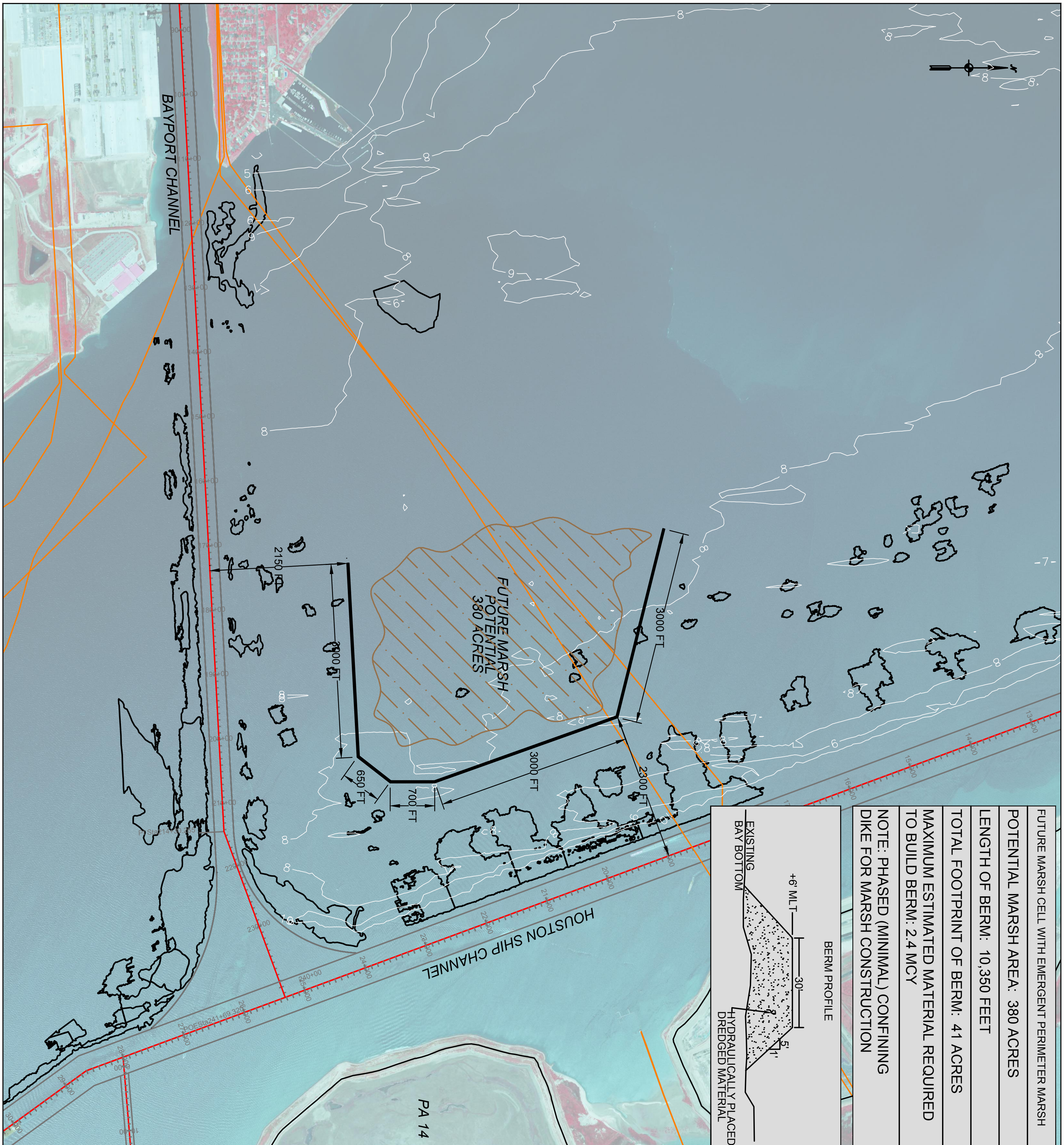
BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

BENEFICIAL USE PLACEMENT
ALTERNATIVE NO. 3

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY HOUSTON, TEXAS

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-8



LEGEND

- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- —5— CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

0' 1,000' 2,000'
Feet

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

BENEFICIAL USE PLACEMENT AREA
ALTERNATIVE NO. 4

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY HOUSTON, TEXAS

Date	May 2013	Job No.	60183643	Exhibit 2.3.2-9

File Name: BP2013-EADocument.dwg

These initial alternatives addressed various needs for the project and HSC navigation system dredged material placement. The alternatives were either carried forward for further screening or eliminated for the following reasons.

- **PAs 14 and 15 and Connection and Mid Bay PA -** These alternatives would not involve new direct environmental impacts as their footprints have already been constructed. These facilities have sufficient capacity to handle the proposed action. However, existing capacity to maintain the BSC and the HSC in the future would be reduced as indicated above. Using the new work materials to raise the levees to increase capacity is also feasible. These alternatives represent the most expedient in terms of permit actions to allow more rapid project implementation, as they all have been previously permitted. Therefore, the use of existing PAs alternatives are advanced for additional screening.

- **BU Cell M11 -** The environmental impacts have already been accounted for and documented in the PA 14/15 Expansion EA, and the use of new work material from the BSC improvements would alleviate the need to mine the nearby HSC or other PAs for levee-building material. This alternative in concert with the use of the existing upland PAs discussed above represents the most expedient in terms of permit actions to allow more rapid project implementation, as they all have been previously permitted. Therefore this alternative was advanced for additional screening.

- **Bayport Container Terminal DMPA #2 -** This PA also would not involve new direct environmental impacts as the majority of the placement tract has already been cleared and used, and the remaining undeveloped southern portion is covered under the BSCCT EIS and permit. Also, this alternative would likely help provide for more than the total volume of fill needed for the remaining terminal construction to avoid the need for offsite fill. However, the placement area site is not large enough to contain all of the new work materials nor does it provide for future capacity for maintenance of the proposed action. The use of this site would incur construction costs to repair the existing levees as well as to construct additional perimeter levees to maximize the use of available land. It is generally considered to be considerably more expensive when all of the factors such as initial construction costs, increased dredging costs to meet effluent standards, dewatering, and redevelopment costs are considered. Due to the fact that this alternative does not provide sufficient capacity to handle all of the new work materials, does not provide for any future maintenance capacity, and potential significant cost increases for both the proposed action as well as the future development of the BSCCT, it is eliminated from further screening.

- **New Bay Confined Upland PAs** – This alternative would provide new dredged material placement capacity for the proposed action as well as future maintenance of the BSC as a whole. This alternative would also benefit HSC navigation system maintenance. Upland placement provides the greatest placement volume per acre versus other applications such as low-elevation marsh. Therefore this alternative was conceived to address future capacity needs while being configured for potential wave barrier benefit.

  However, BUG input received during this initial phase for the New Bay Confined Upland PAs alternative indicated that this alternative was not desirable with the proposed proportion of upland placement versus ecological beneficial use. Although the alternative would provide some wave barrier benefits to reduce shoaling, its conversion of bay bottom to upland with no aquatic ecological benefit would not be desirable from an ecological BU standpoint. The BUG also had concerns of the proximity of a new upland PA to the existing shoreline community and the aesthetic desirability if it was to be constructed to heights up to or in excess of +20 ft MLT. Therefore, this alternative was eliminated from further consideration and a different set of new BU placement options was conceived to address these concerns.

Beneficial Use Placement Alternatives

Based on input from the BUG on the New Bay Confined Upland PAs alternative, four new BU concepts were developed focusing on ecological BU. The new placement options were located in the same part of Galveston Bay, north of the BSC and consisted of four BU marsh concepts ranging from 75 acres to 411 acres, with two of the four configured, sized, and located with the intent to also potentially reduce vessel wave energy. The four new BU alternatives are shown in Exhibit 2.3.2-7 through Exhibit 2.3.2-9. A description of these options is as follows:

- **Alternatives 1 and 2: Beneficial Use Placement , Immediate Marsh (two varying sizes)** – In this alternative, a portion of the new work clays would be placed in a manner that would result in marsh habitat at the end of the initial dredging and some portion of the new work clays would be placed in the existing facilities. The construction of the marsh would not be protected by large levees or rip rap. This feature could potentially also provide for a boater destination. This alternative does not provide for additional capacity in the future. The BUG did not consider the alternative for instant marsh further due to the fact that it did not create a mechanism for future capacity. Therefore, this alternative was not advanced for further screening.

- **Alternative 3: Beneficial Use Placement, Submerged Berm** – The new work clays would be placed in an underwater berm, forming the base of a new BU site perimeter levee, to approximate elevation -3 ft MLT with a minimum crest width of 100 ft to allow for some scouring as well as to provide materials for future levee construction. The underwater berm would serve multiple purposes. The underwater berm could potentially reduce wave energy from wind driven or vessel induced waves from the HSC and BSC and would serve as containment for multiple maintenance cycles of the proposed action before becoming emergent. The underwater berm would be pumped wide enough to be able to borrow from and raise the berm to become emergent as necessary to contain the placed maintenance materials. Once the berm becomes emergent it would potentially be protected with shore protection. Ultimately, this alternative would evolve from its initially submerged feature to become intertidal marsh through the placement of multiple cycles of maintenance material placement. The submerged berm alternative was the preferred alternative as it appears to be a more cost effective means of construction, provides for multiple maintenance cycles, uses the dredged materials beneficially for the creation of intertidal marsh, and minimizes the use of large containment levees that are not found in natural situations. This alternative would require significant signage to advise and warn of small craft navigation hazards. This alternative was carried forward for further screening.

- **Alternative 4: Beneficial Use Placement, Emergent Levee** – For this alternative, the new work clays would be pumped into an emergent “U” shaped levee to approximate elevation +6 MLT. The site would be filled with maintenance material to construct intertidal marsh over multiple fill events. One side of the area would be left open until it is necessary to close it for final fill cycles. Potentially either a small side cast berm or silt curtains would be placed across the opening to contain materials during pumping. This scenario would potentially require the use of significant amounts of shore protection upon construction but is considered for BU placement of maintenance materials for intertidal marsh. While this scenario mimics many of the traditional designs for intertidal marsh created on the HSC project, the BUG prefers a more natural type of marsh containment that allows for increased circulation and minimal shore protection. Therefore, based on BUG input, this alternative was not advanced for further screening.

2.3.3 Screened Placement Alternatives Evaluation

As the channel alternatives evaluation progressed, the needed placement capacities became known. The needed placement capacity for the preferred channel alternative was considered against the available or created placement capacity of the remaining screened alternatives. These were grouped together in a logical and engineering-feasible fashion to form individual placement alternatives that provide sufficient capacity for the preferred channel alternative new work quantities and 10 years of maintenance material of the improved portions of the channel. This resulted in the following set of dredged material placement (DMP) alternatives, which are shown in Exhibit 2.3.3-1:

- **DMP Alternative 1, Existing PA Use with No Levee-Raising –** This would consist of placement of new work materials in the following existing facilities: PA 14, PA 15, PA 14/15 connection, and Mid Bay. No PA levees would be raised under this alternative. See Exhibit 2.3.3-1 for location and Table 2.3.1-1 for estimated existing quantities.

- **DMP Alternative 2, New BU Marsh** – Create a BU marsh north of the BSC using new work dredging clay materials to initially construct a submerged berm with the new work clays associated with the proposed action. The hydraulically constructed berm would be initially constructed to the currently estimated elevation of -3 ft MLT with a minimum crown width of approximately 100 ft to allow sufficient materials to be borrowed to convert the berm into a levee structure in multiple lifts as the site is filled with future maintenance materials from the BCT. As the marsh cell fills in, the berm, built initially with a broader-than-required base, would be reworked into a taller, water-emergent berm with a crown elevation of approximately +6 ft to +8 ft MLT to allow the final filling required for tidal marsh elevations. The reason the berm is initially submerged, is to defer to a later point in time, the potential initial costs and maintenance of rock shore protection needed at minimum on the side facing the HSC. Submergence reduces exposure to the more destructive part of wave energy generated by the wind and wave environment. The submerged berm would also potentially provide some attenuation of wave energy to the mainland shore, and could potentially reduce sediment transport rates into the BSC over time. When the berm is reworked to a water-emergent profile, appropriate shore protection would be added which could consist of either more preferable robust, natural shore protection techniques, or traditional riprap. It is expected that through multiple placement events, the site would meet the consolidated intertidal marsh range of +1.9 ft-2.4 ft MLT established by the BUG for upper Galveston Bay marshes within approximately 10 years. Once the site achieves intertidal marsh elevation, it would be vegetated in the general manner employed by the BUG for the existing neighboring marshes. The final configuration of this alternative is dependent upon final design but is anticipated to generally be in the same location and configuration as shown below. The proposed levee templates, the associated neat line quantities required for beneficial placement of new work materials as well as their future capacities are shown in Exhibit 2.3.3-2 and Table 2.3.3-1. See Exhibit 2.3.3-1 for a conceptual layout. It is estimated that the submerged berm would require 3.9 MCY of new work materials to construct. The estimated ultimate and initial capacities for the placement of maintenance materials for this proposed layout are shown below.

Table 2.3.3-1 Projected Capacity of DMP Alternative 2 (New BU Marsh)

Placement Area	Proposed Top of Levee	Fill Elevation	Capacity	Units
New BU PA Initial Construction	-3 ft MLT	-2 ft MLT	3,900,000	CY
New BU PA Subsequent Construction	+6 ft MLT	+4 ft MLT	3,900,000	CY
		Total Capacity	**7,800,000**	**CY**

- **DMP Alternative 3, Raised Levees in Existing PAs** – This would consist of beneficially using the new work materials to raise the levees of PA 14 and PA 15, to a geotechnically-stable height as well as to hydraulically construct a berm that would serve as the earthen bases for the PA 14/15 connection levees as shown in Exhibit 2.3.3-3. Raising the levees would not provide a direct ecological benefit, but would extend the useful lives of these PAs, and be consistent with the other forms of BU recognized in EM 1110-2-5026, and in the USEPA/USACE joint BU manual. A previous study indicated that the ultimate levee heights at PAs 14 and 15 were estimated at + 40 ft MLT. Due to construction activities at the PAs since that time the levees have strengthened and the geotechnical analysis indicates that the levees can be raised to approximately +52 ft MLT. This alternative proposes an incremental levee raise to +35 ft MLT. The construction of the PA 14/15 connection levees would require leaving a gap for existing oil and gas facility access, until such time that these facilities can be relocated.

  As stated previously, the USACE is conducting a study to widen the Flare and conduct maintenance dredging. Based on the most recent schedule from the USACE, this work may occur in late 2015 or early 2016, dependent upon approval and funding. The Applicant's schedule for construction is estimated to begin January 2014 upon approval of the AOM Report. It is estimated that the USACE would dredge approximately 1.2 MCY of new work materials from the Flare and approximately 1.8 MCY of maintenance materials from the entire BSC. Their placement plan is currently under evaluation. The total amount of new work materials that may be dredged in for the BSC by both the USACE and the proposed project from 2014 through 2016 is approximately 6.8 MCY. During the initial development of these alternatives, it was originally thought that the USACE Bayport Flare Easing Project would be constructed around the same timeframe or before the Applicant's proposed project. Therefore upland solutions that could potentially hold the new work from both were generally considered in order to identify a flexible plan for the placement of the Applicant's proposed project that reduces the possibility of disruption to both projects.

  Dependent upon coordination with USACE activities and the use of the existing PAs for other activities, a portion of the new work materials could be utilized to begin construction of the levee for the Atkinson Marsh M11 cell. This would depend on whether PA 14 is being used for dredged material placement from other projects such as the Flare, which would preempt the use of the site by the Applicant. Therefore, this alternative is presented with a contingent option to either raise both PAs 14 and 15 levees with new work material, or to raise PA 15 and construct part of the M11 marsh cell with the new work material if there is excess material. The new capacity created from the new work placement from the Applicant's proposed project for levee construction would provide much needed capacity for the future maintenance of the BSC and HSC at no cost to those projects. The proposed levee templates, the associated neat line quantities required for beneficial placement of new work materials to create capacity for both contingent options, as well as their future potential capacities pending final design considerations are shown in Exhibit 2.3.3-3 and Table 2.3.3-2 through Table 2.3.3-4. These are neat line templates and do not assess or include assumptions for losses during hydraulic fill. Neat line is defined as the area within a fill template and does not necessarily reflect the total amount of fill needed when design considerations such as consolidation and compaction or construction methodologies are fully evaluated. Actual quantities of material needed may be higher.

The use of the Mid Bay site is not needed for the placement of new work materials for levee-raising in this scenario. Mid Bay may be used for the placement of dredged maintenance materials. It should be noted that the capacities shown are conservative because they depict neat line quantities that do not include capacity gains from compaction and active mechanical dewatering activities normally employed at the upland PAs for maintenance materials. Depending on whether PA 14 is raised or not, the total additional initial capacity created could be either 11.6 MCY or 18.2 MCY. No initial capacity would be created at the PA 14/15 connection until the existing gap is closed by the USACE. Maintenance material would be placed in existing HGNC upland or beneficial use PAs in the vicinity of BSC including PAs 14, 15, other Atkinson Island cells (M7/8/9, M10, M11, and the PA 14/15 connection), and Mid Bay.

Table 2.3.3-2 Projected Neat Line New Work Levee Quantities for DMP Alternative 3 (Raised Levees in Existing PAs) If PA 14 Is Used

Description	Levee Height (ft MLT)	Neat Line Volume (CY)
PA 15	35	**2,920,000**
PA 14	35	**1,560,000**
14-15 Connection West Side	10	**260,000**
14-15 Connection East Side	10	**120,000**
	Total	**4,860,000**

Table 2.3.3-3 Projected Neat Line New Work Levee Quantities for DMP Alternative 3 (Raised Levees in Existing PAs) If Atkinson Marsh Cell M11 Is Used

Description	Levee Height (ft MLT)	Neat Line Volume (CY)
PA 15	35	**2,920,000**
14-15 Connection West Side	10	**260,000**
14-15 Connection East Side	10	**120,000**
M11*	6	**1,450,000**
	Total	**4,750,000**

*Levee quantities assume displacement values similar to the construction of other BU marshes at Atkinson Island.

Table 2.3.3-4 Projected Neat Line Capacity Created By Raising PAs 14 and 15

Placement Area	Proposed Top of Levee	Fill Elevation	Capacity*	Units
14	35 ft MLT	31 ft MLT	6.6	MCY
15	35 ft MLT	31 ft MLT	11.6	MCY
Total Capacity			**18.2**	**MCY**

*Capacities could increase up to 26.5 MCY with active site management.

The alternatives were then evaluated with a set of criteria that addresses the various issues regarding placement. Since the HSC navigation system is currently undergoing a DMMP, and the Applicant has a standing relationship and commitment to the BUG for beneficial use of dredged materials, these opportunities and constraints should be reflected in criteria to evaluate placement alternatives. The three dimensions of environmental, engineering, and economics, for evaluating the worth of a dredge placement project that the BUG planning process has traditionally considered, is generally implemented in the evaluation criteria of alternatives. Other criteria pertinent to the Applicant's commitment, mission, and operating practices were also considered. The alternatives were evaluated using the following criteria:

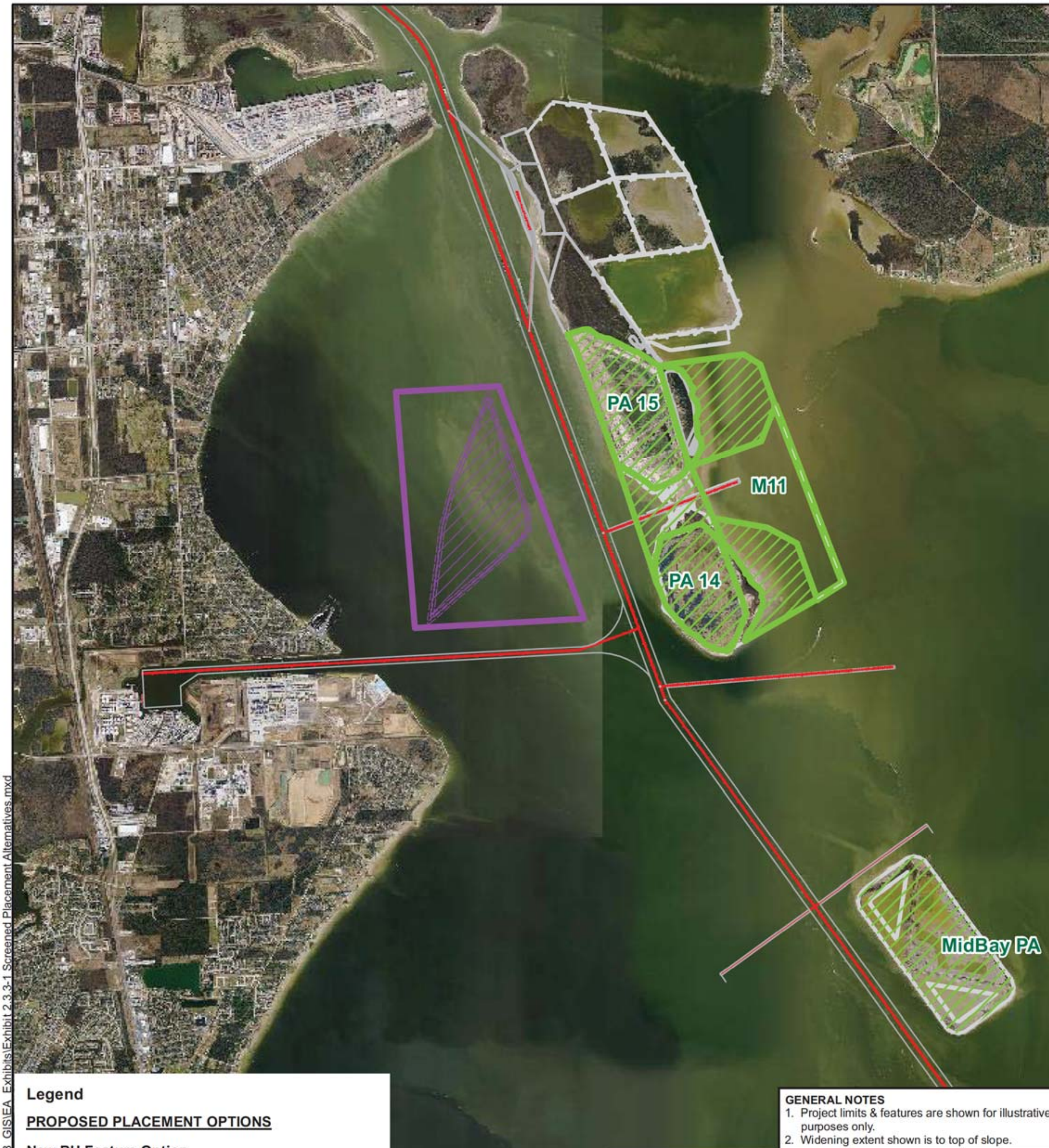
1) **Placement of Dredged Material in the Most Cost Effective Manner –** This criterion addresses not only the basic need for projects to be cost-effective, but also the part of the Applicant's mission statement to carry out its core mission related to navigation, trade, and economic development in a manner that provides sufficient funds to cover the operational expenses and capital investments. As the costs to dredge and transport the dredged materials from the proposed action are considered in the alternatives for the channel, only the additional costs for placement and handling of the dredged materials in the proposed placement alternatives are considered in this section.

2) **Optimize BU of Dredged Material Where Practical** – This criterion addresses the Applicant's involvement with and commitment to the BUG to consider BU of dredged material in their projects where it is practical. Dredged materials used for the expansion or raising of levees is considered a beneficial use of dredged materials. However dredged materials used for the creation of ecological features such as intertidal marsh is considered the preferred beneficial use method by the BUG in order to offset the thousands of acres of marsh lost in the Galveston Bay system due to subsidence, development, and sea-level rise.

3) **Provide Flexibility for Future Placement of Dredged Material in a Manner that Optimizes Long-Term Capacity** – This criterion addresses the fact that the HSC navigation system has a shortfall in capacity for projected dredged material placement needs. This criterion was considered from two different perspectives: the impacts on existing PA capacities, and the provision of future placement capacity.

4) **Does Not Create New Environmental Impacts** – This criterion considers the direct, immediate environmental impacts from the construction of the placement alternative such as oyster reef impacts and mitigation required, or new footprints.

5) **Provides Environmental Benefits** – This criterion recognizes the long-term environmental benefits of the placement alternative. As part of its mission for environmental stewardship, the PHA is committed to fulfill the responsibilities of each generation as trustee of the environment for succeeding generations. The PHA is recognized for its demonstrated efforts to enhance natural wildlife and is committed to continuing its operations in a manner that provides for environmental benefits to the Galveston Bay and surrounding communities where practicable.



GENERAL NOTES
1. Project limits & features are shown for illustrative purposes only.
2. Widening extent shown is to top of slope.

Legend

PROPOSED PLACEMENT OPTIONS

New BU Feature Option

- Marsh Levee
- Proposed New BU Marsh Permit Area
- Maintenance Material Placement

EXISTING CHANNEL AND PLACEMENT FEATURES

Existing Placement Options

- Levee Raising
- Maintenance Material Placement

Existing Channel Alignment

- Existing Channel Limits
- Channel Centerline

N
W E
S

0 6,000
Feet

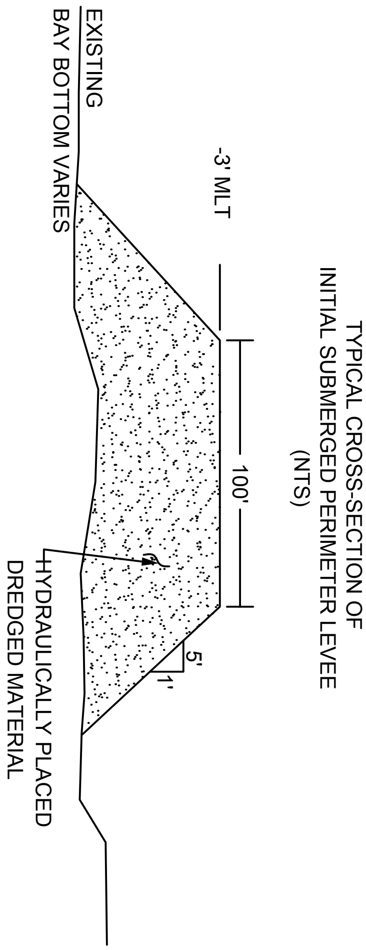
BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Screened Placement Options

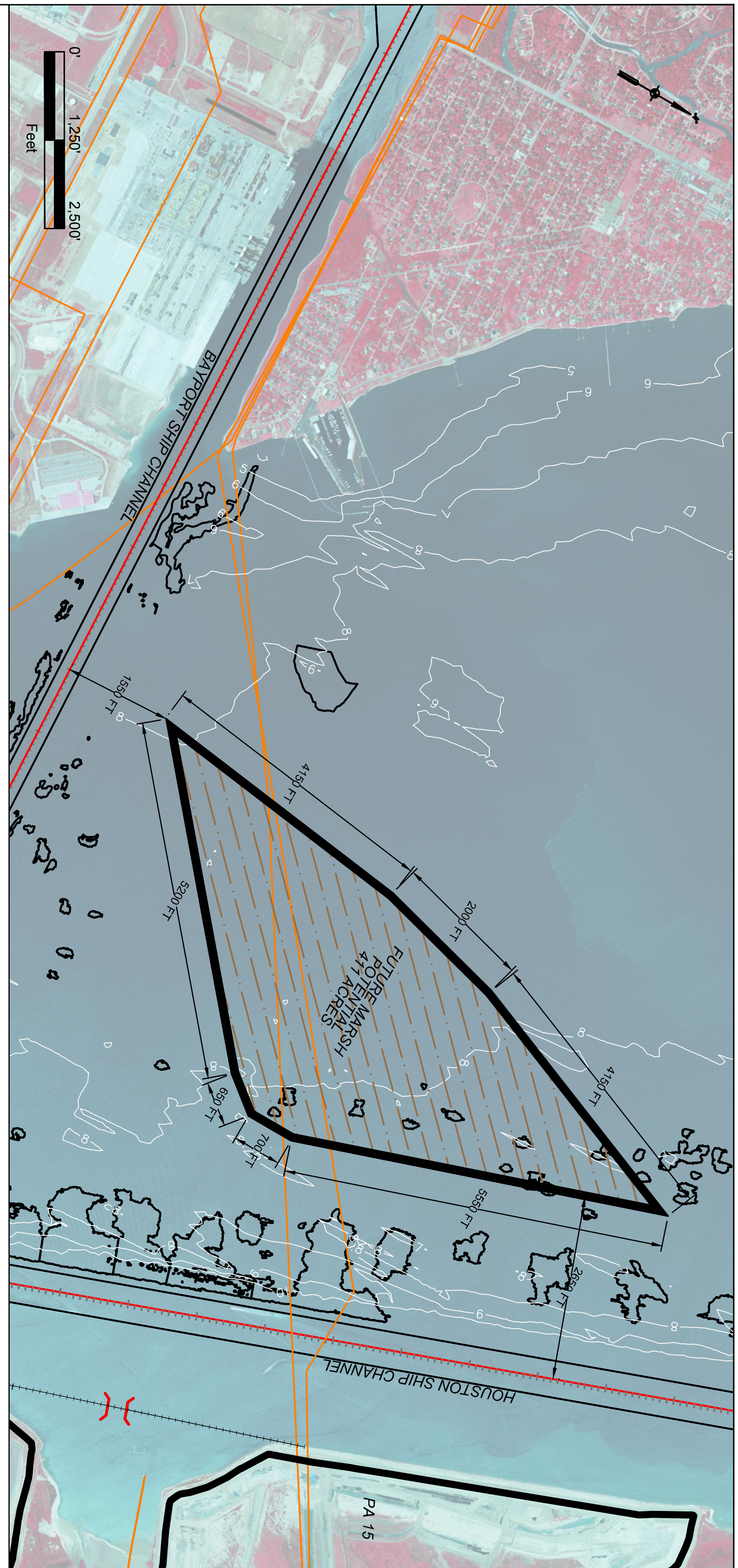
Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date	Job No.	Exhibit
May 2013	60183643	2.3.3-1

Path: P:\Bayport_Ch_Deepen_Widen_60183643\08_GIS\EA_Exhibits\Exhibit 2.3.3-1 Screened Placement Alternatives.mxd



FUTURE MARSH CELL WITH INITIALLY SUBMERGED PERIMETER LEVEE
POTENTIAL MARSH AREA: 411 ACRES
LENGTH OF BERM: 22,400 FEET
TOTAL FOOTPRINT OF BERM: 77 ACRES
MAXIMUM ESTIMATED MATERIAL REQUIRED TO BUILD BERM: 3.9 MCY



LEGEND
- PIPELINES
- CHANNEL ALIGNMENTS
- CHANNEL TOES
- MARSH AREA
- CONTOURS (FT MLT), JAN. 25-31, 2011
- OYSTERS

BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

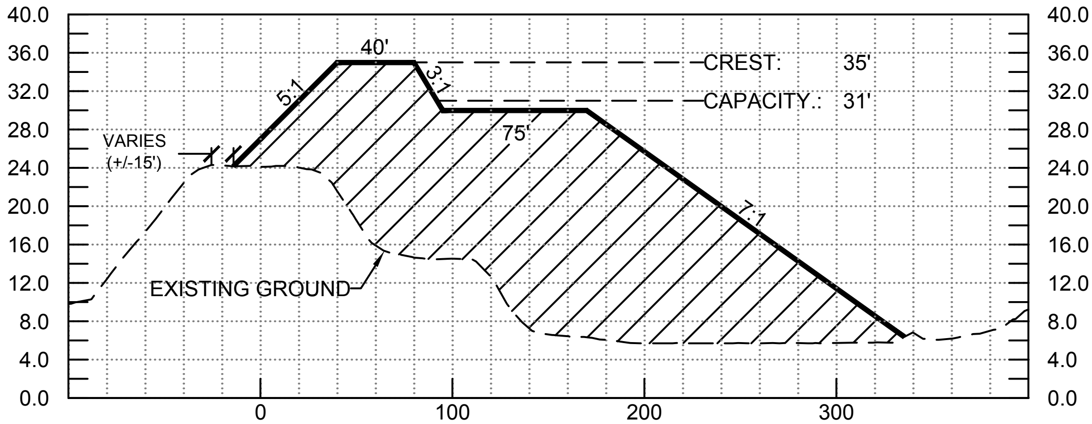
NEW BU SUBMERGED BERM AND CROSS SECTIONS

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY, HOUSTON, TEXAS

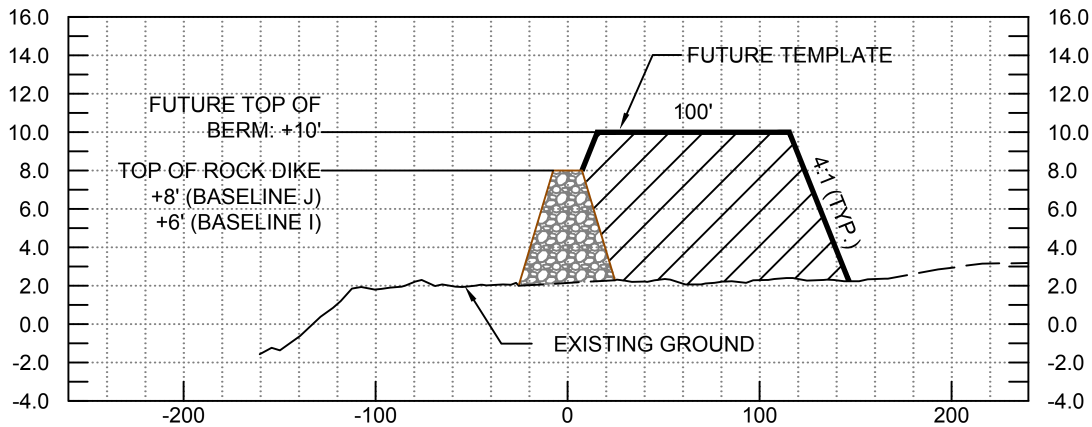
Date	May 2013	Job No.	60183643	Exhibit 2.3.3-2

File Name: BP2013-EADocument EX2.3.3-2.dwg



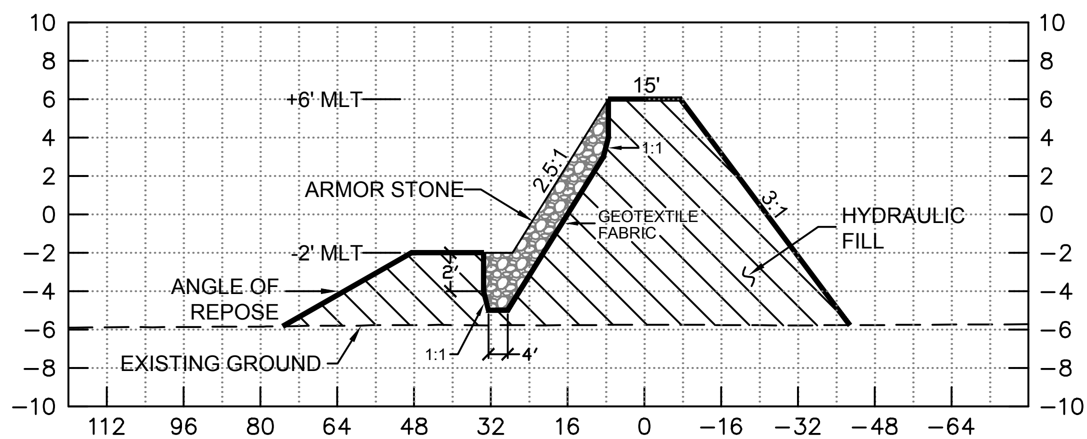
TYPICAL SECTION
PA 14/15 LEVEE
RAISING, +35' MLT

SCALE:
HORIZONTAL 1" = 100'
VERTICAL 1" = 20'



TYPICAL SECTION
PA 14/15 CONNECTION BERM
INITIAL FILL, +10' MLT

SCALE:
HORIZONTAL 1" = 100'
VERTICAL 1" = 10'



TYPICAL SECTION
M11 LEVEE
FINAL TEMPLATE

SCALE:
HORIZONTAL 1" = 40'
VERTICAL 1" = 10'

NOTES:

1. SURVEY DATA IS A COMBINATION OF LIDAR DATA AND 2009 HYDROGRAPHIC SURVEY DATA BY HYDROGRAPHIC CONSULTANTS.
2. LIDAR SURVEY DATA OBTAINED BY WILSON & COMPANY MAY 5TH, 2011.
3. LIDAR SURVEY DATA REFERENCED TO NAD 83, TEXAS STATE PLANE, SOUTH CENTRAL ZONE 4204.
4. LIDAR SURVEY DATA VERTICALLY PROJECTED TO NAVD 88 AND CONVERTED TO MLT. MLT IS 1.4' BELOW NAVD 88 IN THIS REACH BASED ON USACE PUBLICATIONS AND NOAA TIDAL DATUMS PUBLISHED FOR MORGAN'S POINT, TEXAS.

LEGEND:

- — — — EXISTING GROUND
- ——— LEVEE TEMPLATE
- LEVEE FILL

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

14 & 15 LEVEE RAISING, PA14/15
CONNECTION BERM AND M11 CROSS-SECTION

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

PORT OF HOUSTON AUTHORITY HOUSTON, TEXAS

DATE:	May 2013	JOB NO.	60183643	EXHIBIT: 2.3.3-3

File Name: LeveeTemplateExhibits2013.dwg

2.3.3.1. Performance of Screened Placement Alternatives

The alternatives were then evaluated using the criteria listed above. An estimate of construction costs were developed for each placement alternative that considered the costs placing and handling of the dredged material. Dredging costs are already considered in the channel alternatives. The costs associated with these placement alternatives only consider potential mitigation, potential shore protection measures, and costs for handling and shaping the dredged materials once they reach the site. These costs are preliminary in nature based on the concepts carried forward and are subject to change upon completion of final design.

DMP Alternative 1, Existing PA Use with No Levee-Raising Performance – This alternative represents the least cost construction alternative because no improvements would be made to the existing facilities and they would be used in their current condition. However it does not provide for the optimization of the beneficial use of dredged materials. This alternative includes the undirected placement of new work dredged materials within the existing PAs that would reduce the existing available capacity of the overall navigation system that includes the BSC and the Upper Bay and Mid Bay Reaches of the HSC from approximately 20.4 MCY to 12.9 MCY for new work dredging planned between 2014 and 2016. Therefore, this alternative does not provide for the flexibility for future placement of dredged materials. This alternative does not create any new direct environmental impacts nor does this alternative provide any environmental benefit.

DMP Alternative 2, New BU Marsh Performance – This alternative represents the most expensive construction alternative for the Applicant’s proposed project. Initial construction costs would include the general shaping of the initially submerged beneficial use berm and mitigation costs for oyster impacts. Future costs estimate two minimal levee shaping and raising events along with traditional rip rap shore protection along the front two sides of the placement area once it becomes emergent and seeding and planting of the site once it has consolidated and reaches intertidal elevation. The additional construction costs associated with this alternative are estimated at $11.6 million. This option optimizes the beneficial use of dredged material not only from a construction perspective but also provides for the beneficial use of maintenance material to account for the 10 year Section 10 permit duration as well as almost 20 years of the estimated shoaling resulting from the proposed channel option above what is already federally maintained. This alternative also provides for the flexibility of future placement of dredged materials in a manner that optimizes capacity due to the fact that it does not deplete existing or future capacities of the existing PAs with the new work or projected maintenance materials from the proposed action over the 10 year permit life. Based on the conceptual layout for the new PA, it would potentially directly impact 7.4 acres of oysters. Limited geotechnical data is available in the direct project area. Probings taken in the spring of 2011 indicate suitable foundation exists. However, geotechnical borings would have to be taken along and adjacent to the proposed alignments during the final engineering stages. Results of the geotechnical investigations may warrant slight reconfigurations of the proposed layout that could either reduce or increase the total acres of oysters impacted. Therefore the Applicant requested a general area to be permitted for this feature. The total acreage of potential oyster impact within the requested permit area is approximately 18.2 acres. Shore protection measures that encourage oyster growth would be evaluated in the final design process. Although the proposed placement alternative would convert approximately 475 acres of unvegetated, mostly featureless bay bottom to marsh, this would be a conversion to biologically more productive habitat, since studies conducted by NMFS in Galveston Bay (Minello et al., 2008) indicate the overall ecological productivity of intertidal marshes is greater than bay bottom for most cases where conditions are not favorable for seagrasses. The proposed placement alternative converts approximately 475 acres bay bottom to approximately 411 acres of intertidal marsh and the remainder to upland levee that would help to offset thousands of acres lost in the Galveston Bay system due to subsidence, development, and sea level rise. Therefore, this alternative is considered to provide an environmental betterment. Recreational benefits are not a direct consideration of the placement alternatives, however, it should be noted that this alternative could serve as a boater destination. The Applicant would consider recreational boater improvements in the final design of the placement area.

DMP Alternative 3, Raised Levees in Existing PAs Performance – The proposed alternative is the second-most cost effective means of the placement of the new work materials. The additional construction costs associated with this alternative are estimated at $7.7 million and include two 5-ft hydraulic lifts to achieve the proposed levee templates at PAs 14 and 15 and one hydraulic berm placement within the connection of PA 14/15. If PA 14 is not available for use due to Federal occupation for other projects, these costs could be reduced by $3 million. However, additional construction of Atkinson Marsh Cell M11 Levee is estimated at $5.3 million for dredged material placement, shaping, and shore protection, which would result in a placement cost of $9.9 million if all the materials could not be used to raise the levees on PA 15. This alternative utilizes the new work materials beneficially to construct levees but does not provide for the beneficial use of its dredged materials for the creation of intertidal marsh unless the construction of Atkinson Marsh Cell M11 becomes necessary due to Federal constraints potentially placed on the use of PA 14. This alternative also provides for the flexibility of future placement of dredged materials in a manner that optimizes capacity due to the fact that the new work materials will be used to create new capacity. Since essentially no new footprints would be impacted as a result of the proposed alternative, it does not create new environmental impacts nor does it provide for environmental benefits either ecologically or recreationally.

2.3.3.2. Comparison of Screened Placement Alternatives

Considering that DMP Alternative 1 is 1) the least cost effective when considering long-term costs of placement, 2) makes no beneficial use of new work material, 3) does not provide flexibility for future dredged material placement, and 4) provides no environmental benefit, these offset the lack of new environmental impact in determining the best-performing alternative on balance. Because of this, DMP Alternative 1 does not perform as well as the other two alternatives considering all criteria. Therefore, the applicant does not wish to carry this forward as a preferred alternative.

DMP Alternative 2 has the greatest initial construction costs and creates new environmental impacts, but it does provide a substantial amount of new placement capacity for long-term cost effectiveness, and it makes beneficial use of the new work and future maintenance material for both placement and ecological benefit. It also would provide the most certain and immediate environmental benefit.

DMP Alternative 3 is the most cost effective considering the balance of short-term construction costs and long-term placement capacity costs. It does make beneficial use of the material for placement capacity purposes, but its ecological beneficial use is contingent, and the environmental benefit it contributes to would have to wait until the Marsh Cell M11 levee is closed, if it is built. However, it provides the most flexibility for future material placement.

Considering these factors, DMP Alternative 2 and DMP Alternative 3 could be considered to perform equally well, with one having the advantage in optimizing beneficial use and environmental benefit, and the other in future material placement flexibility and cost effectiveness. Therefore, both of these alternatives were advanced for consideration during coordination with resource agencies and the public as part of the permit public comment period. Since that time, the project has been refined to incorporate public, agency, and geotechnical and engineering input as described in Section 2.3.3.3 below.

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Table 2.3.3-5 Summary of Dredged Material Placement Alternatives Evaluation

Alternative	Placement of Dredged Material in Most Cost Effective Manner	Optimize BU of Dredged Material Where Practical	Provide Flexibility for Future Placement of Dredged Material	Does Not Create New Environmental Impacts	Provides Environmental Benefit
DMP Alternative 1 – Existing PA Use with No Levee-Raising	• Cost = 0	• Would not use any new work clays for BU	• Would impact existing PA capacities by adding extra 4 MCY new work and approx. 3.8 MCY extra maintenance material • No extra capacity provided	• Does not create any new direct environmental impacts but could shorten the timeframe that a new PA would be required to maintain the HSC and BSC system	• The alternative does not create any environmental benefit
DMP Alternative 2 – New BU Marsh	• Cost = $11.6 M	• 100% of new work material would be used for optimal BU	• Would not impact existing PA capacity • Would provide for 7.8 MCY neat line unconsolidated extra capacity that would provide for 20 yrs of new BSC maintenance resulting from the proposed action	• Has the potential to impact 7.4 to 17.4 acres of oyster habitat, which would require mitigation • Would convert approx. 475 acres of featureless bay bottom to tidal marsh	• Provides for the creation of approximately 411 acres of intertidal habitat • Provides for recreational benefits
DMP Alternative 3 – Raised Levees in Existing PAs	• Cost = $ 7.7 - 9.9M	• 100% of new work material would be used for BU.	• Would not impact existing PA capacity • Provides from 11.6 MCY – 18.2 MCY neat line unconsolidated or managed extra capacity in PA 14/15 and would provide for 10 – 20+ yrs of incremental BSC maintenance resulting from the proposed action	• No new direct env. impacts other than temporary shorebird disturbances during placement	• This alternative does not create any new environmental benefit

The opinion of probable costs were established for the use of alternatives comparison. Actual construction costs will be evaluated as part of the 204 (f) AOM Report.

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2.3.3.3. Coordination of Screened Placement Alternatives

DMP Alternative 2, New BU Marsh, and DMP Alternative 3, Raised Levees in Existing PAs, were presented to and discussed with the resource agencies through the periodic 2011 and 2012 BUG meetings hosted by the Applicant. These alternatives were also presented and coordinated with key stakeholders through a series of meetings with individual groups representing environmental advocacy, recreation interests, shipping industry, and municipal and civic groups in the study area from November 2011 through August 2012. These included the Galveston Bay Foundation (GBF), the Cities of Shoreacres, La Porte, and Seabrook, Lonestar Harbor Safety Committee, yacht clubs, and other municipalities. These groups and the general public also provided comments on these two placement alternatives, and the Preferred Alternative for channel improvements during the public comment period for the initial permit application from May to July 2012. These comments and those received from the USACE Galveston District indicated more concerns for DMP Alternative 2 than the other proposed project components including recreational and safety impacts from the sailing community, and aesthetic impacts from shoreline residents and constructability issues. The Port Commission, the group of commissioners selected by local governmental entities to set policy and provide guidance to the PHA, considered the comments and feedback received, and issued a resolution on August 15, 2012 at a special meeting to remove DMP Alternative 2, New BU Marsh placement option from the permit application. Therefore, DMP Alternative 3, Raised Levees in Existing PAs, was carried forward as the placement option for the proposed project.

2.3.3.4. Refinement of Selected Placement Alternative

Ongoing coordination of dredging activities with the Operations Branch indicate that PA 14 will not be available for use during the prescribed timeframe for the Applicant's proposed project construction and will be utilized for maintenance dredging as well as being prepared to take the materials from the Flare project, if approved. Therefore, the proposed project will utilize PA 15. Alternative 3 was screened to provide options for flexibility of raising both PA 14 and 15 or to only raise PA 15 and utilize any excess new work materials to begin the construction of the M11 levees as discussed in Section 2.3.3. The preferred option of Alternative 3 is now to raise the levees on PA 15. Design analysis indicates that materials will not need to be placed to begin construction of the levees for M11. Maintenance material would be placed in existing HGNC upland or beneficial use PAs in the vicinity of BSC including PAs 14, 15, Mid Bay, and Atkinson Island.

As part of the construction design process, additional geotechnical borings were taken at PAs 14, 15, and the 14/15 connection in December of 2012 in order to provide a more comprehensive slope stability analysis for design and construction. When utilizing all of the existing and new geotechnical data, it was discovered that some of the sections of the existing levees at PA 15 did not meet the required factor of safety of 1.3 in the existing condition prior to any planned levee raising. The areas of instability are along the channel-side (west) and bay (east) sides of the PA. The results of this evaluation resulted in the re-evaluation of the levee templates evaluated in the previous analysis. Several scenarios were considered to correct the areas of instability while utilizing the dredged materials beneficially to the extent feasible. The overall recommendations to correct the areas of instability included either 1) constructing a stability berm to the exterior of the site with either in situ materials or constructing a rock dike berm or 2) offsetting the levee to the interior. Offsetting the levee to the interior reduces future capacities of the PA, that has the potential to require that a new PA be constructed sometime after the next twenty years, but sooner that would have been required if the levee is not offset to the interior. The creation of an exterior earthen berm or rock dike has the potential to create adverse new environmental impacts. Therefore, the evaluation of both strategies was conducted on the channel and bay-side levees on PA 15 using preliminary geotechnical evaluations.

These strategies were considered for both the channel and bay-side levees in the evaluation of the options below. In this discussion, the description used for the levees are channel-side, meaning the west-side (“front” side as referred in the geotechnical reports), and bay-side, or east-side (“back” side as referred in the geotechnical reports).

Channel-side Raising towards Exterior

In order to correct for current levee deficits in levee instability on the channel-side levees, the correction would require the levee to be offset to the interior approximately 74 feet as well as degrading the existing levee to a more stable height, or constructing a rock dike 90 feet to the exterior of the existing exterior rock dike. The construction of the rock dike would potentially convert approximately 16.5 acres of shallow, unvegetated bay bottom and water column habitat important to EFH to upland terrestrial habitat that would be considered an adverse impact. Considering the current proximity of PA15 to historically mapped reef on the east side of the HSC extensive new growth on the east side of the HSC could be present within the planned footprint of the dike, potentially resulting in more oyster impacts. The rock dike would result in the PA encroaching closer to the HSC which would have potential impacts to navigation and would impact the Applicant’s schedule of construction for additional geotechnical analysis and potential modeling in excess of 6 months to additional changes to two separate Federal Projects. The rock dike would potentially add approximately $40 million in construction costs for the rock to the project cost depending on the final design; and add approximately$825K to $2.475M in mitigation costs depending on the ratio of mitigation. For cost estimation purposes, it is assumed that a minimum of a 1:1 to 3:1 ratio of mitigation would be required in the absence of a full investigation and habitat modeling. Although the rock dike option would not impact the future site capacity, the environmental, navigation, as well as dike construction and mitigation cost impacts outweigh the potential losses in capacity for offsetting the levee to the interior.

Channel-side Raising towards Interior

The loss in capacity resulting from the levee offset, estimated at 74 ft towards the interior, would potentially reduce the acreage of the interior fill by 10.4 acres. Offsetting the levee to the interior places dredged materials in the most cost effective manner. While the placement of dredged materials using the current levee cross section in the exterior rock dike option above also places dredged materials in a cost effective manner just considering dredging placement alone, it requires an additional approximate $40 million in construction costs as well as potential estimated costs for mitigation of shallow water habitat for EFH ranging from $8.250K to $2.475M. This would potentially increase project costs by 50%. Both options optimize BU of dredged material to create capacity where feasible. Offsetting the levee to the interior provides less flexibility for future placement of dredged materials than the creation of the exterior rock dike; however it does not create new environmental impacts. Neither option creates environmental benefits. Considering the cost, risk to construction schedule, and potential environmental impacts of the exterior rock dike option, the Applicant chooses to offset the levee on the channel-side of PA 15 to the interior.

Bay-side Raising towards Exterior

In order to correct for current levee deficits in levee instability on the bay side levees, the correction would require the levee to be offset to the interior approximately 100 feet as well as degrading the existing levee to a more stable height or constructing a low grade earthen berm with a top crest width of 110 and ft and typically extending 145 feet to the exterior of the existing levee toe. The construction of earthen berm to the exterior would convert approximately 9.2 acres of predominantly high marsh to upland terrestrial habitat. This marsh area was inadvertently created as a side effect of the closure of the semi confined state of PA 15 to a confined state. The area was planted with marsh vegetation in effort to control erosion. Generally, the marsh is considered to be part of an overall large environmental restoration area consisting of Atkinson Marsh Cell M7/8/9. The current elevation of the proposed earthen berm location ranges from approximately +3.5 to 7.8 MLT. The estimated cost to construct the earthen berm by borrowing approximately 180,000 CY from the interior of existing PAs is $900,000 and the proposed mitigation is estimated between $500,000 to $1 million. The additional costs are on the order of 2% of the overall estimated construction costs. The construction of the earthen berm would have no direct impacts to navigation as the exterior rock dike to the channel side levees would have.

Bay-side Raising towards Interior

Approximately 9.6 acres of interior PA fill capacity would be reduced as a result of offsetting the levee to the interior on the bay side. However, by comparison, approximately 180,000 CY would be borrowed from the interior of the PA 15 or PA 14/15 Connection for the option to raise the levees of the existing centerline and construct a stability berm towards the exterior, which would add capacity back into the site. Because the channel-side levee would be raised towards the interior, depleting some potential capacity, doing this also on the bay-side would further decrease the maintenance placement capacity for a PA in one of the most capacity-demanding segments of the HGNC, which would not provide for future placement in a manner that optimizes long-term capacity. Further depleting placement capacity would accelerate the demand for a new PA, which would incur new impacts to the aquatic environment, and in the long run, cost more to provide capacity that could be addressed more cost efficiently in the existing PA.

In summary, the raising of the PA 15 levee will involve raising the channel-side segment either to the interior or exterior, and the bay-side segment to the interior or exterior, which presents the following possible combinations for consideration:

1. Channel-side Raising towards Exterior plus Bay-side Raising towards Exterior – Although this combination maximizes the potential interior placement capacity by going to the exterior on both sides, it is not the least environmentally damaging combination, nor is it practicable. It is not practicable considering the significantly greater cost it adds ranging from $40 Million to $42.5 Million, and navigation and schedule impact issues of the Channel-side Raising towards Exterior, and it poses environmental impacts on both sides due to the EFH and potential oyster environmental impacts of Channel-side Raising towards Exterior and the marsh impact of the Bay-side Raising towards Exterior.

2. Channel-side Raising towards Interior plus Bay-side Raising towards Interior – Although it avoids the immediate environmental impacts to EFH and marsh by going to the interior on both sides, it provides the least potential interior placement capacity, and would accelerate the need for a new PA, which would result in greater long-term costs and potentially greater aquatic impacts. It is not practicable considering it has the greatest loss of potential placement capacity in the greater HGNC placement system that has deficits in long-term placement capacity.

3. Channel-side Raising towards Exterior plus Bay-side Raising towards Interior – Although this preserves some of the potential interior placement capacity by going to the exterior on the channel-side, it is not practicable. It is not practicable considering the significantly greater cost of $40 Million to $42.5 Million,

and navigation and schedule impact issues of the Channel-side Raising towards Exterior, and it poses environmental impacts on one side due to the EFH and potential oyster environmental impacts of Channel-side Raising towards Exterior.

4. Channel-side Raising towards Interior plus Bay-side Raising towards Exterior – This combination preserves some of the potential interior placement capacity by going to the exterior on the bay-side. It is practicable considering the relatively smaller cost (approximately $1.9 Million including mitigation), existing technology and logistics factors by avoiding navigation and schedule impact issues associated with raising towards the exterior on the channel-side. It impacts 9.2 acres of marsh but avoids 16.5 acres of EFH impact. It is the least the least environmentally damaging practicable alternative.

In summary, due to the rock dike required, Combinations 1 and 3 are not practicable due to the significantly greater cost added and the navigation and schedule impact issues, and would have environmental impacts greater than Combination 4, because of the greater acreage of impact involved. Also, because the marsh impacted under Combination 4 and the rock dike displaces open water column and shallow bay bottom, the aquatic effect would be expected to be greater for Combinations 1 and 3. Although Combination 2 would have less immediate environmental impact than Combination 4, it is not practicable due to the greatest loss of potential placement capacity in a navigation system in need of capacity. This would also have greater long term costs and potential aquatic impact than Combination 4, due to accelerating the need for a new PA. A new PA would be sized not just for the residual placement needs of the proposed action, but also for future HGNC and BSC maintenance, and would therefore require a large initial footprint. A new PA would have to consider multiple siting and environmental impacts such as oil and gas infrastructure, oyster reefs, conversion of aquatic resources to upland, and public use of the bay, and would have to consider effects on hydrodynamic and littoral transport processes. One of the listed actions for minimizing adverse effects on aquatic resources listed in the Section 404(B)(1) Guidelines in 40 CFR 230.70(c), is to use a disposal site that has been used previously for dredged material discharge. Combination 4 maximizes the use of the existing PA 15 as much as is practicable considering the constraints discussed. Considering this discussion, Combination 4 is the least environmentally damaging practicable alternative.

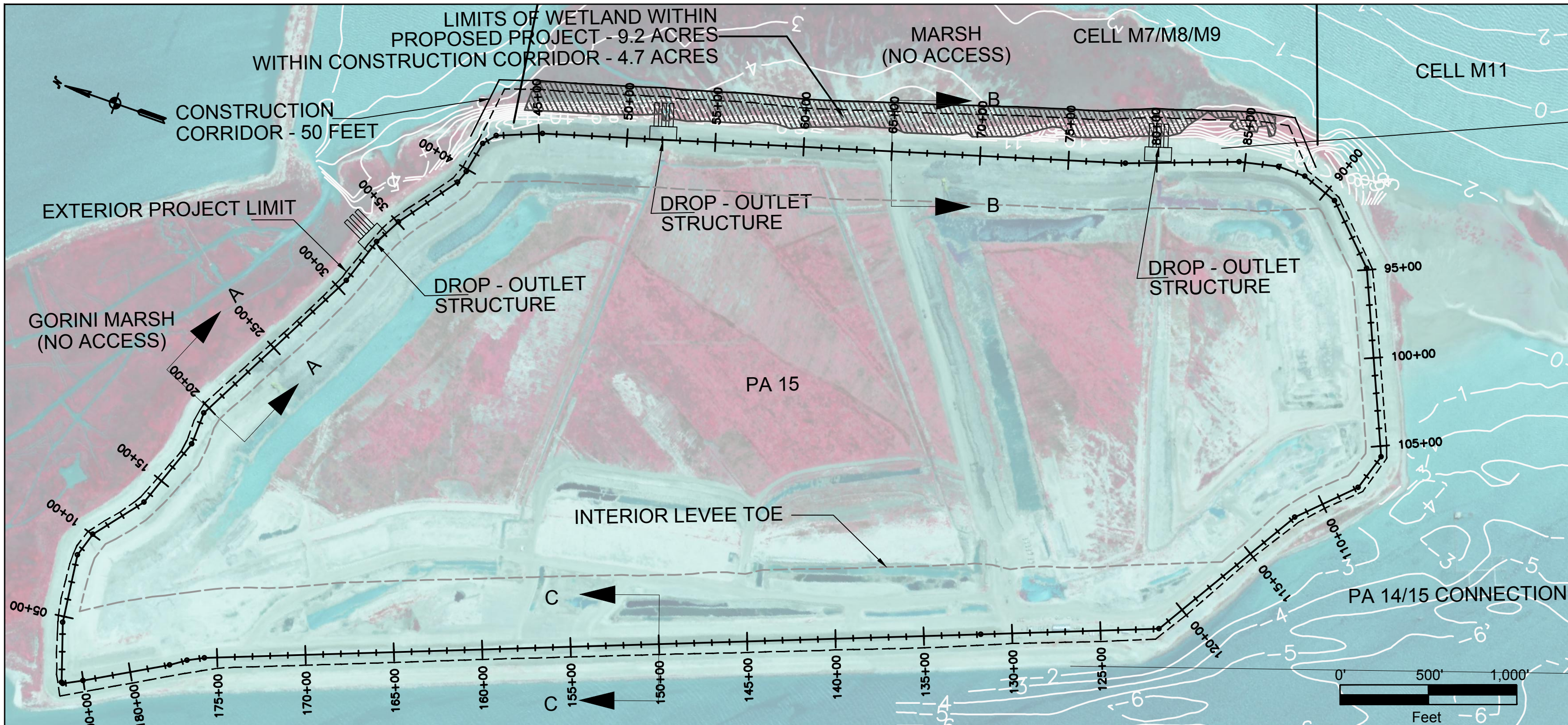
When weighing the overall losses in acreage capacity as the result of potentially moving both the channel and bay side levees to the interior with the environmental impacts moving them both to the exterior, the Applicant compromised in determining to offset only one section of levee to the interior (the channel side levee) in order to balance the overall screening criteria. Therefore the proposed configuration for raising the levees at PA 15 is Combination 4 and would consist of raising the channel-side levee with an offset to the interior, and raising the bay-side off the current levee alignment with a stability berm to the exterior. The options to configure the raising of PA 15 levees were evaluated based on the following placement evaluation criteria discussed earlier in the chapter: the extent practicable of placing the dredged materials in the most cost effective manner; while optimizing BU of dredged material to create capacity where feasible; providing for the flexibility of future placement of dredged materials in a manner that optimizes long term capacity; does not create new environmental impacts, and creates environmental benefits (such as enhacing or providing new habitat). Though not all criteria, such as creating environmental benefit (as this is an existing PA and not a new BU site), are invoked, as many as can be satisfied were considered in the evaluation.

Several cross sections were analyzed during the design with levee crest widths ranging from 25 to 100 ft and crest elevations of +30 and +35 ft MLT. Stability analysis was performed for the following cases: exterior levee slope at end of construction (Ext/EOC), interior slope end of construction (Int/EOC), and exterior slope long term

(Ext/LT). To achieve an acceptable factor of safety, the backside or bay side levee (Station 62+00) requires an exterior stability berm and the frontside or channel side levee (Station 160+00) requires degrading the existing levee crest elevation and offsetting the centerline to the interior. Depending on the crest width and elevation, the configuration of backside and frontside levee templates required to achieve an acceptable factor of safety varies.

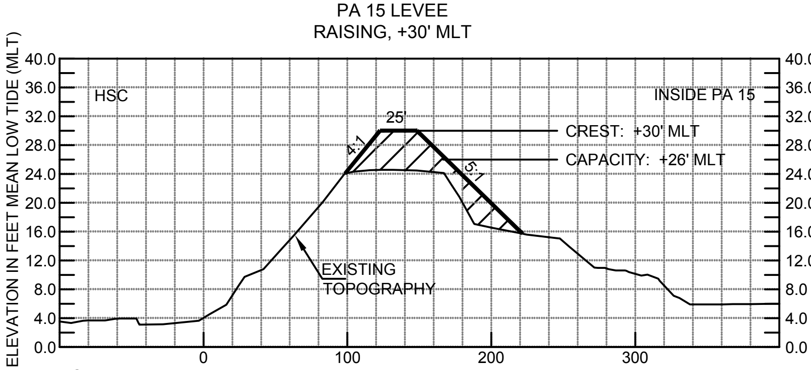
Upon completion of the described analyses, the NFS consultants met with the SWG Geotechnical Branch to review the analysis and make a recommendation to carry forward. The levee cross sections meeting the required factor of safety for crest elevations of +30 and +35 ft MLT were presented. Both parties concluded that while both the +35 and +30 ft MLT scenarios can reach the general required factors of safety, the scenario to raise the levees to +35 has a higher risk and would potentially decrease future capacities by moving the levees further to the interior more than necessary to meet the required factor of safety. The team's recommendation is to construct the levee at +30 ft MLT that would serve as a more stable base for subsequent levee raisings in the future while providing easily accessible good borrow materials. The team was also in favor of constructing the lower and wider levee in order to see if strength gains could be realized over time. It is not expected that the levees would need to be raised again for another 8-10 years. At that time, additional geotechnical investigations would be made to develop a comprehensive assessment of levee foundation conditions. The work will be facilitated by the presence of a wide crest and bench area from which to conduct field operations. This assessment will include areas not accessible during the current investigation, and may allow the levee crest to be constructed closer to the current levee centerline location during future levee raisings.

After considering volume balance with the available material from the channel dredging a final crest width of 25 ft at +30 ft MLT for the levee template and all materials from the proposed project construction will be placed in PA 15. Geotechnical analyses can be found in Appendix 3B of the 408 Report. The refined levee cross-section are shown as Exhibits 2.3.3.3-1 through 2.3.3.3-3. The capacity created through the beneficial placement of new work materials for levee construction to +30 is approximately 9.2MCY. This is more than double the 20-year period of analysis of the incremental shoaling estimated to result from the Proposed Action. The calculated maintenance capacity assumes a neatline volume that does not include additional capacity that can be gained from long term settling, dewatering, or compaction, nor does it include minimal capacity losses due to runoff of new work materials to the interior of the site.



TYPICAL SECTION - A

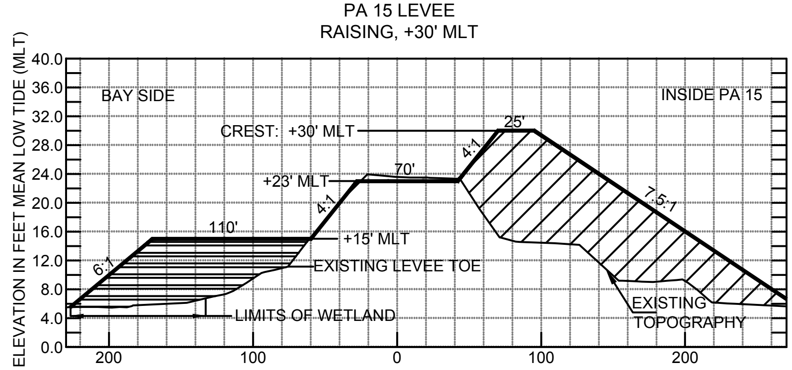
PA 15 LEVEE
RAISING, +30' MLT



NOTE: FINAL LEVEE TEMPLATE WILL BE DEPENDENT ON EXISTING SITE CONDITIONS WHICH ARE SUBJECT TO CHANGE FROM CONSTRUCTION ACTIVITIES FROM A SEPARATE PROJECT.

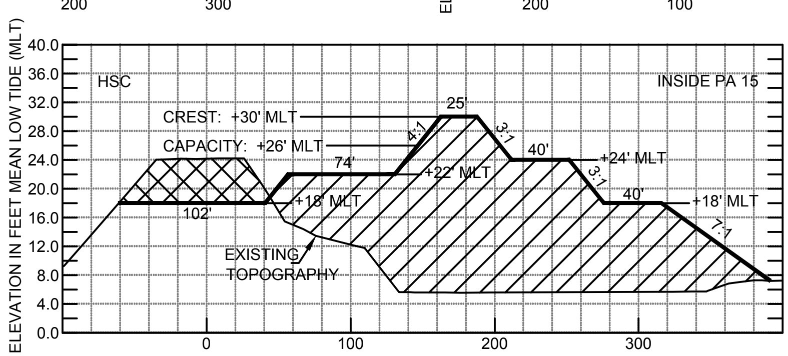
TYPICAL SECTION - B

PA 15 LEVEE
RAISING, +30' MLT



CROSS SECTION LEGEND:

- EXISTING GROUND
- LEVEE TEMPLATE
- HYDRAULIC LEVEE FILL
- DEGRADE LEVEE
- MECHANICALLY PLACED STABILITY BERM



TYPICAL SECTION - C

PA 15 LEVEE
RAISING, +30' MLT

BAYPORT SHIP CHANNEL IMPROVEMENTS
ENVIRONMENTAL ASSESSMENT

PLACEMENT AREA NO. 15
LEVEE RAISING CROSS SECTIONS

NOTES:
1. HYDROGRAPHIC SURVEY DATA COLLECTED IN 2009 BY HTI.
2. EXISTING SITE ELEVATION OF PA 15 IS FROM 2012/2013 TOPOGRAPHIC SURVEYS COMPLETED BY HTI AND 2011 LIDAR DATA OBTAINED BY WILSON & COMPANY.
3. SURVEYS ARE REFERENCED TO NAD 83, TEXAS STATE PLANE, SOUTH CENTRAL ZONE 4204.
4. LIDAR SURVEY DATA VERTICALLY PROJECTED TO NAVD 88 AND CONVERTED TO MLT. MLT IS 1.41' BELOW NAVD 88 IN THIS REACH BASED ON USACE PUBLICATIONS AND NOAA TIDAL DATUMS PUBLISHED FOR MORGAN'S POINT, TEXAS.

LEGEND:
- LEVEE ALIGNMENT
- PROPOSED INTERIOR LEVEE TOE
- PROPOSED EXTERIOR PROJECT LIMITS
- 50 FOOT CONSTRUCTION CORRIDOR
- LIMITS OF WETLAND
- CONTOURS (FT MLT), AUGUST 2009

Turner Collie & Braden Inc.
JOINT VENTURE PORT DEVELOPMENT AND ENVIRONMENTAL SERVICES
GAHAGAN & BRYANT ASSOCIATES

Date July 2013
Job No. 60183643
Exhibit 2.3.3-4

File Name: 2013.07.18 - BayportPermitUpdate.dwg

2.4 ALTERNATIVES CARRIED FORWARD

As a result of the screening and evaluation process and coordination described in the preceding sections, one alternative composed of the preferred channel alternative and the selected placement option, advanced in the analysis, are proposed and carried through for evaluation in this EA. The No Action Alternative is also carried through for evaluation.

2.4.1 No Action Alternative

The No Action Alternative consists of leaving the channel at its existing width and depth, and therefore involves no channel improvements that would require dredging. Since deepening and widening the channel requires dredging in navigable waters, it would require a permit from the USACE. Therefore, the No Action Alternative is equivalent to the USACE denying a permit for deepening and widening the BSC. Should this occur, the channel would not be deepened or widened. Under the No Action Alternative, current navigation restrictions discussed in Chapter 1 would continue, and the PHA and shippers would not benefit from the elimination of those operational constraints. Vessels transiting the BSC would continue to be delayed by operational restrictions and navigation efficiency would not be improved.

2.4.2 Preferred Alternative (with Raised Levees)

This alternative consists of the preferred channel alternative with placement at existing PAs with increased capacity (DMP Alternative 3 – Raised Levees in Existing PAs). The proposed channel improvements for the BSC are described in detail in Section 2.2.3.2, but are summarized as follows:

- Deepening from –40 ft MLT to –45 ft MLT, with 2 ft of advanced maintenance and 2 ft of allowable overdepth, from the start of the Flare at Station 239+04, all the way through the TB.

- Widening from an existing toe-to-toe width of 300 ft to a proposed width of 400 ft (Exhibit 2.2.3-1) by dredging 100 ft to the north, from where the BSC meets the Flare at Station 214+00 to the land cut, at approximately Station 115+00, with 3:1 side slopes. The widening would require some minor dredging east of the start of the northern Flare beginning at approximate station 221+00 to blend in the widened side slope on the north side of the channel to approximate station 214+00.

- Widening inside of the land cut from an existing toe-to-toe width of 300 ft to a proposed width of 350 ft (Exhibit 2.2.3-1) by dredging 50 ft to the north, approximately from Station 115+00 to the end of the TB at Station 25+58 with 3:1 side slopes.

- Near the entrance of the land cut, at approximate Station 135+00, the widening would transition from 100 ft to 50 ft until the eastern end of the land cut at approximate Station 115+00.

- Place all 3.7 MCY of new work dredged materials from the construction of the channel in PA 15, with approximately 2.4 MCY of clay materials of this new work material total used to hydraulically raise the levees on PA 15. Maintenance materials would be placed in existing PAs 14 and 15, other Atkinson Island PA cells (the PA 14/15 connection, Marsh Cells M7/8/9, M10 and M11 when it is constructed) and Mid Bay.

The total channel length proposed for deepening and widening is 4.1 miles. The project would generate 3.7 MCY of new work material from initial construction. The clay portion of the new work dredged material, approximately 2.4 MCY, would be used to increase the height of levees in the upland, confined PA 15. The Raised Levees in Existing PAs placement option was refined in response to updated geotechnical data as discussed in Section 2.3.3.3. The refined levee typical cross-sections were shown in Exhibits 2.3.3-1 through 2.3.3-3. The existing levee would be raised to have a final crest width of 25 ft at +30 ft MLT, and a wider base. The levee segments on the north and south (reference Exhibits 2.3.3-1), and west (channel-side) [Exhibits 2.3.3-3] sides would be raised with material for the wider base placed towards the inside where required. The west levee segment would be raised and reshaped to make up for a deficit in the factor of safety with the existing levee by degrading the existing levee crown elevation to approximate elevation +18 MLT ft, and reusing that material and new work material to provide the revised cross section. The east levee segment (reference Exhibits 2.3.3-2) would be raised and reshaped by placing new work material towards the inside, and building a stability berm needed to make up for a deficit in the factor of safety with the existing levee towards the outside. The stability berm would be constructed with materials borrowed from the interior of PA 15 or the PA 14/15 Connection. The estimated neat line quantity of borrow material needed is approximately 180,000 CY.

The total maintenance quantity for the next 20 years would be approximately 23.6 MCY, which includes an increase of 4.2 MCY due to the incremental increase in channel depth and width beyond existing conditions. Maintenance dredged material would be placed in existing HGNC upland or beneficial use PAs in the vicinity of BSC including PAs 14, 15, other Atkinson Island PA cells, and Mid Bay. The increased levee height at PA15 and resulting increased capacity of PA15 from new work levee raising would offset the decrease in overall system maintenance capacity that would otherwise result from this proposed project. It estimated that the proposed levee raising at PA 15 would provide approximately 9.2 MCY of capacity.

The placement of dredged materials in any given site will be coordinated with the USACE Operations Branch for each event to balance the maintenance needs of both the channels and the placement areas. Maintenance materials for BSC are currently placed or planned to be placed in the aforementioned PAs and are routinely rotated between sites. The incremental maintenance due to widening is on the order of 210,000 CY annually above the existing 879,000 CY annual shoaling rate. The Flare is dredged every 12-18 months while the channel and Flare are currently dredged every 24 to 36 months. A shoaling analysis indicates that the rate of dredging frequency did not change substantially when the project changed the advanced maintenance depth from 2 feet to 7 feet. The report detailing the shoaling analysis is available upon request. The currently variable maintenance dredging frequency for the project is expected to remain the same as the current project and is not anticipated to be dredged on a greater frequency than dredging the Flare every 12 months and the channel and Flare every 24 months.

The USACE is currently preparing a 25-year DMMP for the HGNC Navigation System which includes both Bayport Ship Channel and the Barbours Cut Channels. The preliminary assessment indicates that by raising the levees on the existing PAs to their ultimate geotechnically supported heights, a 25-year DMMP can be achieved. The analysis includes the planned improvements to the BSC.

3.0 AFFECTED ENVIRONMENT

The BSC is a navigation channel that was constructed in the late 1960s and early-to-mid 1970s by excavating part of it from dry land, and the other part, within the existing Galveston Bay. The part excavated from dry land is referred to as the land cut, and is the part of the channel closest to land-based resources and populated areas. The term “land cut” is used to reference this portion of the channel within this section. The other part of the channel is in unpopulated, open water of Galveston Bay. The land cut portion of the project area is located within the same area documented by the BSCCT FEIS. More specifically, the land cut portion is located within the area defined in the BSCCT FEIS as the Bayport Study Area. The BSCCT FEIS contains local information applicable to the land cut portion, as wells as regional information applicable to the project area, with regard to the affected environment. Policies for incorporation by reference are contained in Section 1502.21 of Title 40 of the Code of Federal Regulations (40 CFR 1502.21), and USACE Engineer Regulation (ER) 200-2-2, *Procedures for Implementing the National Environmental Policy Act (NEPA)*. These policies are intended to use incorporation by reference of material into environmental impact documents when the effect would be to cut down on bulk without impeding agency and public review. Therefore, in the interest of complying with these policies, information from the BSCCT FEIS applicable to the project area has been summarized, referenced and where needed, updated in this section. The following sub-sections describe the conditions and resources of the affected environment in the project area.

3.1 PHYSICAL ENVIRONMENT

This section provides general information on the non-living resources of the physical environment of the project area. General information is provided for the project setting, climate, geology, topography, soils, physical oceanography, and water and sediment quality.

3.1.1 Project Area and Climate

The project area is located in Galveston Bay. Galveston Bay is an estuary where freshwater flows mix with the salt water of the Gulf of Mexico. The surface area of Galveston Bay is approximately 600 square-miles. Galveston Bay is characterized by generally shallow water depths, generally ranging from 5 to 12 ft. Dredged navigation channels, with depths ranging from 12 to 45 ft, are located throughout the bay system. Galveston Bay consists of several subsystems: Trinity Bay, East Bay, and the confined portion of the HSC above Morgan's Point, San Jacinto Bay, upper Galveston Bay, and West Bay. The proposed project is located in Upper Galveston Bay.

The climate for the Greater Houston area is classified as humid subtropical. Temperatures on average range from a low of 45º Fahrenheit (F) in January to a high of 94º F in July with an average yearly precipitation of 54 inches (NOAA SRCC, 2011). The prevailing wind in Galveston Bay is from the southeast. The Greater Houston area and Galveston Bay region in general are susceptible to tropical cyclones during hurricane season (June through November). Storm tide heights recorded near the City of Galveston have ranged from 5.7 to 15.1 ft above mean sea level (MSL). The last major hurricane to impact the area was Hurricane Ike in 2008. More detailed information on the regional climate, winds, precipitation and storms can be found in Section 3.16.2.1 of the BSCCT FEIS, and is incorporated by reference.

As discussed in Engineering Circular (EC) 1165-2-212, *Sea-Level Change Considerations for Civil Works Programs*, recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea-level. Therefore, impacts to coastal and estuarine zones caused by sea-level change must be considered in all phases of Civil Works programs. The analysis of sea-level rise and impacts on the proposed project are discussed in Sections 3.1.4 and 4.1.5, respectively.

3.1.2 Topography and Soils

The topography in the general area of the project is relatively flat. The land cut portion of the project is located on the Gulf Coastal Plain of Texas which consists of flat low-lands. Elevation in the vicinity of the project, according to a review of U.S. Geological Survey topographic maps, ranges from sea level within Galveston Bay to approximately 35 ft on the surrounding mainland.

Soil survey data for Harris County, Texas was reviewed to determine the existing soils of the land adjacent to the project (NRCS 1976, and 1994). The soils are listed and described below in Table 3.1.2-1. The portion of the project area in Galveston Bay does not have a soil classification assigned and is classified as “Water” (W) because it is submerged by the estuarine waters of the bay.

Table 3.1.2-1 Soil Types and Characteristics

Soil Type	Soil Characteristics
Beaumont Clay (Ba)	The Beaumont series consists of very deep, poorly drained, very slowly permeable soils on low uplands. They formed in clayey sediments of the Pleistocene Age. These nearly level soils are on the Coast Prairie. Slopes range from 0 to 1 percent. Beaumont soils are poorly drained and very slowly permeable.
Beaumont – Urban Land Complex (Bc)	The Beaumont series consists of very deep, poorly drained, very slowly permeable soils on low uplands. They formed in clayey sediments of the Pleistocene Age. These nearly level soils are on the Coast Prairie. Slopes range from 0 to 1 percent. Beaumont soils are poorly drained and very slowly permeable. Urban land consists of areas that are covered by streets, parking lots, buildings, and other urban structures.
Ijam Soils and Ijam (Is and Im)	The Ijam series consists of very deep, poorly drained, very slowly permeable soils that formed from materials dredged from rivers, bays, and canals. Slope is dominantly less than 1 percent, but ranges from 0 to 10 percent. Ijam soils are poorly drained, and permeability is very slow. The water table ranges from the surface during wet periods to about 36 inches below the surface during dry periods. Ijam soils are frequently flooded with saline water during high tides.
Vamont Clay, 0 to 1 percent slopes, Vamont Clay, 1 to 4 percent slopes, and Vamont-Urban Land Complex (VaA, VaB, and Vn)	The Vamont series consists of very deep, somewhat poorly drained, very slowly permeable soils that formed in clayey sediments derived from the Beaumont Formation. These nearly level soils are located on uplands. Slope ranges from 0 to 3 percent. Urban land consists of areas that are covered by streets, parking lots, buildings, and other urban structures.

Prime farmland soils are defined by the Natural Resources Conservation Service (NRCS) as those soils that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. The NRCS identifies soil series meeting this definition for each county. Prime farmland soils, as defined by NRCS, are limited to the mainland surrounding the project area. Some soils are considered prime farmland in their native state, and others are considered prime farmland only if drained or watered well enough to grow the main crops of the area. In the immediate land area surrounding the BSC within the land cut, most of the prime farmland soils are classified as prime farmland soils if drained, with a few small areas classified as prime farmland soils. However, the land use surrounding the land cut is already developed as predominantly residential to the north, and industrial to the west and south, with no current agricultural activity.

The predominant sediment types in Galveston Bay are silt and clay muds, muddy sand, and sandy mud. The silt and clay muds are widely distributed in the northwest portion of Galveston Bay, where the project area is located. Muddy sands and sandy mud are associated with sandy shore margins and other areas of high wind/wave energy. More information on surficial soils and sediment of the project area can be found in Section 3.18.2 of the BSCCT FEIS in the Bayport Study Area subsection.

3.1.3 Geology

The geology within the project area is of the Quaternary Period. The geology of the mainland adjacent to the proposed project is mapped as Beaumont formation. The Beaumont formation is the youngest formation of the Pleistocene age. The origin of the Beaumont formation is primarily fluvial and deltaic; however some small areas might have originated as coastal marsh and lagoonal deposits. In the project area, the Beaumont formation is dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very-high shrink-swell potential, poor drainage, low shear strength, and high plasticity. The existing dredged material placement areas in the project area are mapped as fill and areas containing dredged material (Fisher et al., 1982). Modern geology of Galveston Bay results from interaction between marine and fluvial environments, with the bay, having formed by estuarine flooding during post-glacial sea level rise, and barrier islands forming after sea level still stand was reached (Lankford and Rehkemper, 1969). The top-most sediments of the bay bottom overlying the geologic formations in the project area are primarily the result of deposition from modern fluvial and coastal erosion processes, and sediment transport from currents and tides. Historic dredging of oyster shell for road construction in the 20th century has created voids filled in by this deposition, resulting in deeper pockets of unconsolidated sediment deposits in some parts of the bay bottom in the project area, while other areas have less depth of unconsolidated sediments overlying the stiffer materials of the Beaumont formation. More information on the regional geology of the project area is available in Section 3.18.2.1 of the BSCCT FEIS.

3.1.4 Physical Oceanography

Galveston Bay is characterized as a relatively large shallow bay with an extensive interconnected system of deeper navigational ship channels. With the exception of ship navigation channels and the Mid Bay constriction caused by Redfish Bar, both natural and anthropogenic oyster reefs constitute the largest physiographic feature in Galveston Bay as remaining portions are comprised of shell, sand, mud, silt and clay particles with little bottom relief. A description of the Galveston Bay bathymetry is provided in Section 3.1.1. The physical oceanography in Galveston Bay is dominated by tidal mixing and, to a lesser degree, freshwater input and wind driven circulation.

3.1.4.1. Tides, Currents, and Water Level

The proposed project area experiences semi-diurnal tides encompassing two high and two low tidal periods each daily tidal cycle, with an average mean tidal range of approximately 1 ft. Elevated tidal surge is experienced in Galveston Bay during storm conditions and high spring tide events. From May to September the Galveston Bay experiences increased precipitation driven freshwater input from the two largest river drainages, the Trinity and San Jacinto Rivers, and Buffalo Bayou. These increased freshwater inputs typically result in the formation of a fresh/saltwater wedge concentrated in the deeper areas of the Galveston Bay as well as navigational channels such as the HSC and BSC.

Water circulation and currents in Galveston Bay can also be affected by prevailing wind conditions, especially within the relatively shallower areas. The prevailing south and southeastern winds, typically experienced from spring through fall, force water against the mainland and create countercurrent eddies within the nearshore areas while north and northwest winds in the winter months cause bay water to push against the barrier islands of Galveston and Bolivar. Due to the low capacity to inflow ratio and small tidal range, water entering Galveston Bay has a relatively long residence time, with flushing times ranging from 75 to 280 days for the entire bay and from 16 to 28 days in the HSC (Sparr et al., 2010).

Although Galveston Bay is typically a low energy environment protected on the seaward side by a chain of barrier islands with limited inlets, the area experiences a high level of storm activity. Multiple hurricanes and tropical storms in recent years have had a dramatic effect on the location, composition, and function of shorelines throughout the bay. This storm activity combined with the creation of multiple large dredged material placement areas, has resulted in shoreline erosion and subsequent sediment deposition, which has altered historical hydrological regimes and heavily influenced bathymetry in Galveston Bay. Coastal flooding from hurricanes occurs when the effects of storm surge, driven by cyclonic winds and low pressure, cause water to pile up at levels higher than normal ocean water surface levels. Storm surge levels are highest when storm surge coincides with the astronomical high tide to result in storm tide. Storm surge effects are greatest in shallower offshore waters. Therefore, the bathymetry that tends to exacerbate storm surge effects are those that result in shallower water.

3.1.4.2. Salinity

The BSC is a tributary channel to the HSC with a closed terminus. The HGNC Entrance Channel and Jetties depth and width generally control the saltwater inflows and outflows of the Galveston and Trinity Bay Systems. Freshwater inflows are generally controlled by the San Jacinto and Trinity River as well as various local flood control district outflows and surface runoff.

The BSC is a dead-end, short, side channel to the HSC that does not control or connect areas of higher ocean salinity with the estuarine salinity of Galveston Bay, and has little to no freshwater inflow. Additionally, it is oriented east-west within an area of the same range of salinity. That is, the channel does not connect areas of disparate salinity.

3.1.4.3. Relative Sea Level Rise (RSLR)

Changes in local or relative sea level reflect the integrated changes in global or eustatic sea level plus changes due to vertical land movement, or subsidence. Based on 100 years of tide gauge data recorded locally at Galveston Pier 21 (National Oceanic and Atmospheric Administration (NOAA, 2013), the historic rate of relative MSL is estimated at 0.021 ± 0.00092 ft/yr. In accordance with Engineer Circular (EC) 1165-2-212, Sea-level Change Considerations for Civil Works Programs, the local subsidence rate may be estimated from tidal analysis by subtracting the rate of global mean sea level (GMSL) change from the historic rate of relative mean sea level (RMSL) change. Assuming the historic rate of GMSL change is equal to the globally averaged rate of 0.0056 ft/yr, the resulting estimated observed subsidence rate for the project area would be 0.0154 ft/yr. Using this estimated local subsidence rate for the project area, changes in relative MSL in the project area over the 20-year period of analysis would be 0.42 ft using the historic rate of GMSL change, 0.53 ft using the medium rate of accelerated GMSL change, and 0.89 ft using the high or accelerated rate of GMSL change.

Figure 1 displays the computed sea level rise based on the new guidance for the low (historic) rate, the intermediate (Modified NRC Curve I) rate, and the high (Modified NRC Curve III) rate. The sea level rise rates based on local monitored subsidence rates are also shown for the three NRC curves. The computed sea level rise given here assumes a 20 year project life, and gives the predicted rise for the years 2014-2034.

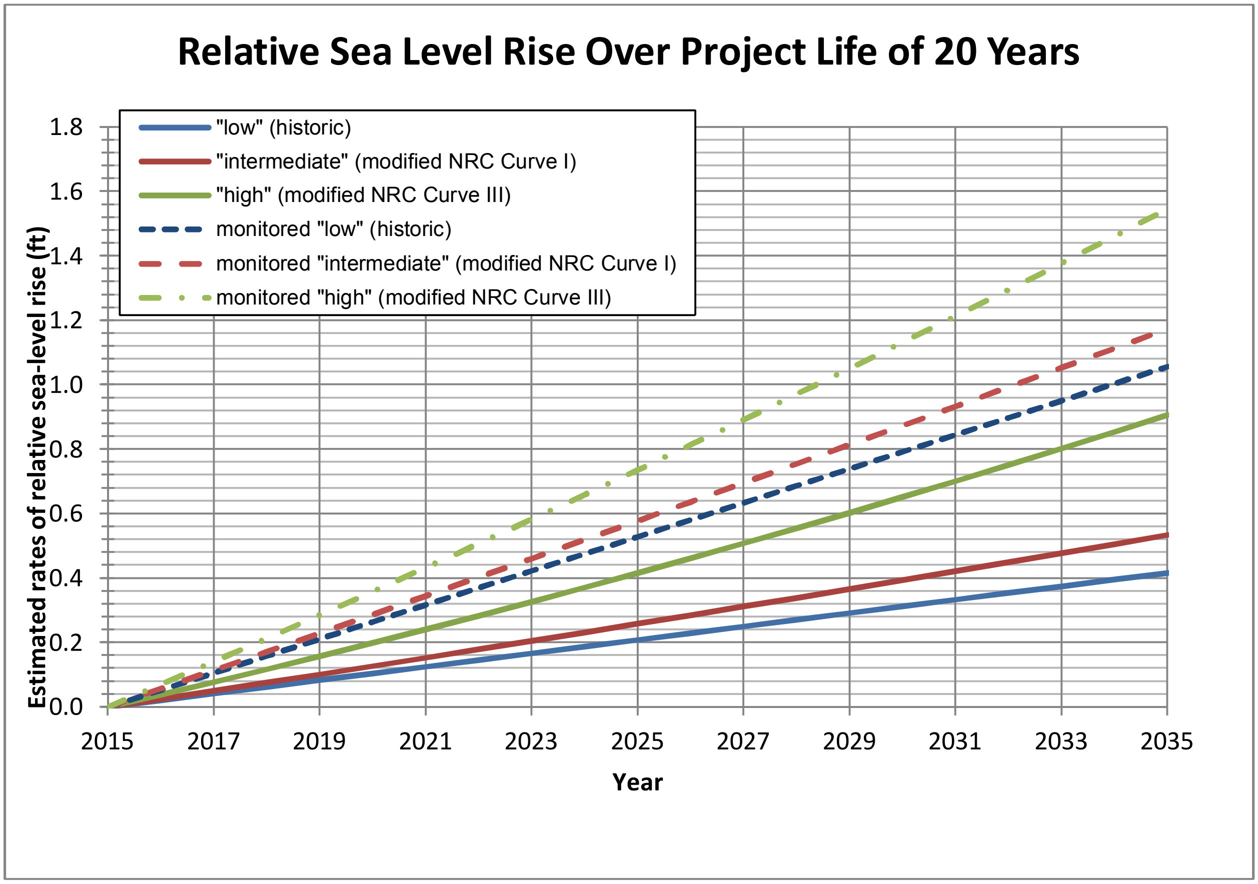


Figure 3.1.4-1 Relative Sea Level Rise Over the 20 Year Project Life

3.1.5 Water and Sediment Quality

The Clean Water Act (CWA), Section 303(c), requires states to review, establish, and revise water quality standards for all surface waters within the state. The major surface waters of the State are classified by the Texas Commission on Environmental Quality (TCEQ) into segments for purposes of water quality management and for the designation of site-specific uses and criteria. Classification supports the operation of the State's programs to assure compliance with State and Federal requirements (TCEQ, 2004). The BSC is identified as water quality Segment 2438 by TCEQ and is located in designated Bays and Estuaries Basin 24.

Water Quality

The BSC (water quality Segment 2438) has a designated use of High Quality Aquatic Habitat and Non-Contact Recreation. Site-specific uses and supporting numerical criteria for each segment of classified water bodies are listed in Section 307.10, Title 30, Chapter 307 of Texas Administrative Code (TAC). Classified segments are designated for primary contact recreation unless sufficient site-specific information demonstrates that elevated concentrations of indicator bacteria frequently occur due to sources of pollution that cannot be reasonably controlled by existing regulations, wildlife sources of bacteria are unavoidably high and there is limited aquatic recreational potential, or primary or secondary contact recreation is considered unsafe for other reasons such as ship or barge traffic. In a classified segment where contact recreation is considered unsafe for reasons unrelated to water quality, a designated use of noncontact recreation may be assigned either noncontact recreation criteria or criteria normally associated with primary contact recreation.

Water quality criteria are designed to be protective of uses. Substantial deviations from criteria indicate that related uses might be impaired. For Segment 2438 criteria, dissolved oxygen (DO) is 4.0 mg/l, the pH range is 6.5 to 9 standard units, and indicator bacteria are 35/100ml. The indicator bacteria for recreational suitability in saltwater is Enterococci, and is fecal coliform for oyster water use.

TCEQ Monitoring sites associated with Segment 2438 include Station IDs 13363, 13589 and 16508. Data is collected quarterly from these sites. In 2010, the average temperature for Station ID 13589 was 23.6ºC and the average salinity was 15.2 parts per thousand (ppth). Data is only available for Station 13363 through 2003, and for Station 16508 through 2008. For the BSC, there is a concern for water quality based on screening levels of chlorophyll-a, total phosphorous, ammonia, orthophosphorus, and nitrate (TCEQ, 2010a). In addition, based on the assessment results for Segment 2438 from December 1, 2001 to November 30, 2008, DO, Enterococcus, ammonia, chlorophyll-a, nitrate, orthophosphorus, and total phosphorus exceeded criteria for the single sample, or binomial, methods (TCEQ, 2010b).

Biennially, each state is required, under Section 305(b), to submit a report to the USEPA describing the status of surface waters in the state. A use is said to be "impaired" when it is only partially supported or not supported at all. A list of waters that are impaired is required by Section 303(d) and included in the 305(b) Water Quality Inventory Reports. Regulation (40 CFR 130.7) requires that each 303(d) list be prioritized and identify waters targeted for Total Maximum Daily Load (TMDL) development, with the goal to restore the full use of the water body. The TMDL defines an environmental target by determining the extent to which a certain pollutant must be reduced in order to attain and maintain the affected use. Based on this environmental target, the State develops an implementation plan to mitigate sources of pollution within the watershed and restore full use of the water body (TCEQ, 2007).

Segment 2438 was listed on the TCEQ's 2008 Texas Water Quality Inventory and 303(d) list (also referred to as the Section 303(d) list) for Polychlorinated biphenyl (PCBs) (first listed in 2004) and dioxins (first listed in 2000) in edible tissue. TMDLs for PCBs and dioxin are currently under development for Segment 2438 (TCEQ, 2008). Of note, Segment 2438 remains on the Draft 2010 Section 303(d) list with TMDL currently still under development (TCEQ, 2010a). Also of note, PCBs in sediments have been below screening levels in all samples for this segment, as discussed under sediment quality. The Texas Department of State Health Services (TDSHS) advises that consumers restrict their consumption of catfish, spotted seatrout, and blue crab caught in the area because dioxin concentrations found in them pose a risk to consumers (TCEQ, 2011b).

During summer months, DO concentrations in deeper portions of the BSC are depressed up to well below the Texas Water Quality Standard criteria for aquatic life use assigned to Segment 2438. Salinity at lower depths in the BSC is relatively high during summer months, but criteria for Texas estuaries have not been established for salinity, or for chlorides, sulfates, and total dissolved solids for the BSC. The proposed project area is located in the Upper Galveston Bay assessment area of the Section 303(d) list. This area includes all tidal waters in the Upper Bay from a line drawn from Red Bluff Point to Five Mile Cut to Houston Point to Morgan's Point. This area encompasses the project area shown in Exhibit 1.1.1-1. According to the Section 303(d) list, Upper

Galveston Bay is impaired due to multiple pollutants, including bacteria for oyster waters, dioxin in edible tissue, and PCBs in edible tissue. More information on the water quality and characteristics of the BSC is available in Section 3.17.2.4 of the BSCCT FEIS.

Sediment Quality

In compliance with Section 305(b), each state is required to submit a report to the USEPA describing the status of the surface waters of the state. In addition to water quality monitoring at the BSC, sediment in Segment 2438 was assessed over seven years (2001-2008) and presented in the Draft 2010 Texas Water Quality Inventory. The data collected includes metals, PAHs, VOCs, PCBs, trihalomethanes, pesticides, insecticides, and other organic compounds. No parameters monitored in sediment exceeded the Aquatic Life Use criteria within the seven year assessment period.

The USACE routinely samples areas where maintenance dredging occurs for sediment and elutriate analysis. Elutriate analysis involves analyzing water under conditions simulating agitation by dredging and subsequent leaching from sediment. Past sediment testing data for the BSC from the BSCCT FEIS, and more from recent sampling by the PHA, were reviewed to summarize sediment quality in the BSC. This data involved a wide array of compounds in sediment and elutriate. Data from the BSSCT FEIS was collected primarily by the USACE and spanned from 1992-2001. Surface sediment in and around the BSCCT area ranges from a sandy silt to a silty sand. Historically, copper and mercury were found to be below TCEQ screening levels; however, copper showed a possible increasing trend. Oil and grease were found to be above screening levels for an estuary but below those of a tidal stream. Sediment sampling from 1997 to 1998 showed some metals concentrations were elevated compared to TCEQ screening values, but in 1999, all constituents, including metals and polycyclic aromatic hydrocarbons (PAHs), were below the screening levels. The decreasing trend of constituents of concern is consistent with observations from studies conducted under the Galveston Bay Estuary Program (GBEP). Elutriate analyses from 1997 to 2001 showed all parameters were below chronic criteria, except for copper in 2001, which was only slightly above the chronic criteria, but the maximum concentration was well below acute criteria. Therefore elutriate copper was not considered to be a potentially significant source of environmental impact.

February 2001 sediment and water sampling conducted for the BSCCT FEIS at six locations along the BSC where berths and the cruise terminal were planned, was analyzed for 11 target metals, PCBs, pesticides, PAHs, TPH, phenols, total volatile solids, total sulfides, ammonia, total organic carbon (TOC), percent solids, and grain size. No pesticides, PCBs, or PAHs were detected in any of the samples. TPH was detected in all samples, ranging from 47.4 mg/kg to 260 mg/kg, but with no olfactory or visual evidence of hydrocarbons or phase separated hydrocarbons in any samples. Metals concentrations were generally low and relatively uniform in all samples, suggesting concentrations were consistent with background levels. Water samples were analyzed for many of the same parameters as sediment, and indicated no detectable levels of pesticides, PCBs, PAHs, TPH, or phenols in any sample. Of the 11 metals analyzed, only barium and zinc were detected. Ammonia was detected in all samples. Elutriate testing indicated no detectable levels of pesticides, PCBs, PAHs, TPH, or phenols in any sample. Barium and zinc were consistently detected in all samples, while low levels of cadmium, chromium, copper, and nickel were detected in a portion of the samples. Ammonia was detected in all elutriate samples. The details of BSC results from the BSCCT FEIS can be found in Section 13.18.2.2, and Appendix 3.18, of the FEIS.

PHA sediment core sampling conducted in August 6, 2004 at seven locations along the container and cruise terminals for the purpose of pre-dredging analysis were analyzed for 10 specific metals, TOC, total recoverable phenolics, acetone, 1,2-Dichloroethane and methylene chloride. At the terminal locations, Bis(2-

ethylhexyl)phthalate, Di-n-butyl phthalate and carbon disulfide were also analyzed. At the cruise terminal locations, gamma-chlordane, total chlordane and 4,4-DDT were also analyzed. Most analytes were below detection limits. Barium was detected at all locations, with container terminal concentrations higher than cruise terminal concentrations. Total chlordane was detected in one sample, exceeding the 10th percentile adverse effects range low (ERL) (NOAA, 1999) but not the 50th percentile adverse effects range median (ERM).

PHA sediment sampling was conducted in July 2010 at 10 container terminal locations, and at 8 cruise terminal locations (Benchmark Ecological Services, Inc. 2010). Parameters analyzed included 7 target metals, total dioxin/furan reported as toxicity equivalents (TEQ) in picograms per gram (or parts per trillion [ppt]), percent moisture, TOC, total solids, and total volatile solids. Specific sites were tested for heptachlor, benzoic acid, phenanthrene, pyrene, 4,4-DDT, total PCB, Aroclor 1260 PCB and gamma-BHC. No analytes were detected above their respective ERM values, but two samples exceeded ERL for phenanthrene, which is a PAH. Dioxin was detected in all of the samples, ranging from 2.18 ppt to 7.18 ppt, and most values around 6.5 ppt. However, no national marine sediment guidelines for dioxin exist, though some regional or state authorities have published their own thresholds. The Oregon Department of Environmental Quality's (DEQ) published screening level values (SLV) for the individual compounds that comprise dioxin for use in bioaccumulative risk assessment, including fish (Oregon DEQ 2007). Dioxin concentrations are usually expressed in TEQ, which is a toxicity-weighted average of all dioxin compounds, weighted relative to the most toxic dioxin compound 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). However, the Oregon DEQ SLVs allow comparison for the individual compounds in the group. The SLVs are conservative generic screening-level risk values that indicate a need to determine a site-specific SLV and does not necessarily mean that the bioaccumulation risk is unacceptable. The marine fish SLVs vary widely, as the toxicity for compounds under this group vary from relatively innocuous to highly toxic, ranging from 0.56 ppt for 2,3,7,8-TCDD to 4,300,000 ppt for Octachlorodibenzo-p-dioxin (OCDD) and Octachlorodibenzofuran (OCDF). All but 2,3,7,8-TCDD and 2,3,4,7,8-Pentachlorodibenzofuran (2,3,4,7,8-PeCDF) have a threshold of 17 ppt or greater. Of the detected dioxin compounds in the PHA sampling, only 2,3,7,8-TCDD exceeded the SLV of 0.56 ppt, by 1.6 times to 2.3 times. Results for all other compounds were below the other SLVs.

The most recent PHA sediment core sampling at 5 locations along the container terminal berths adjacent to the channel, were analyzed for 7 target metals, PAHs, xylenes, percent moisture, TOC, total solids, total volatile solids, and dioxins/furans. Many analytes were below detections limits, and of those with NOAA sediment guidelines, all were below the ERL and ERM. The dioxins ranged from 2.02 ppt to 2.53 ppt expressed as TEQ, with no detection for many compounds, including TCDD. As discussed in the previous paragraph, no national marine sediment guidelines for dioxin exist, but for comparison, the values detected were all below the Oregon DEQ SLVs for all dioxin compounds.

In summary, for substances with a numerical standard or screening threshold, BSC sediment quality data indicate no persistent concerns, with only a few isolated instances of exceedances for chronic or low percentile effects levels for copper, chlordane (a pesticide), and phenanthrene (a PAH). PCBs have been below screening thresholds, with the majority of samples having no detection, in all the results reviewed. Dioxins have no national guidelines, but for comparison, the most recent sampling shows levels below bioaccumulation screening values published by Oregon.

3.2 BIOLOGICAL RESOURCES

The following sections describe the biological resources found within the project area. This includes descriptions of habitat, flora, and fauna typically found in the aquatic and terrestrial portions of the project area.

3.2.1 Vegetation and Habitats

3.2.1.1. Terrestrial

The project area is located within the Gulf Coast Prairies and Marshes Natural Region as mapped by the TPWD (TPWD, 2011). The Upper Coastal Prairie of Texas (approximately 21,000 square-miles) is a narrow strip of land, approximately 50 miles wide, that borders the coastal marshes from Matagorda Bay to the Sabine River and corresponds to the wetter side of the Texas Coastal Prairie. Average annual rainfall increases from west to east and ranges from 30 to 50 inches per year. The region includes barrier islands on the coastline, estuarine marshes, remnant tall grass prairies (most converted to agricultural and/or developed lands), oak parklands, and oak mottes. Forested wetlands and riparian woodlands occur in the river bottomlands. According to the 1984 TPWD's Vegetation Types of Texas, landside portions of the project area are mapped as grassland and marsh/barrier island vegetation types (McMahan et al., 1984). The grassland vegetation is typically found inland from direct tidal influences of Galveston Bay. Examples of vegetation found in the grassland habitat include Bermuda grass (*Cynodon dactylon*), smutgrass (*Sporablus indicus*), live oak (*Quercus virgininiana*), and windmill grass (*Cholris canteri*). The marsh/barrier island habitat occurs more in the brackish and saline areas that are tidally influenced. Typical vegetation types include: big cordgrass (*Spartina cynosuroides*), black rush (*Juncus roemerianus*), glassworts (*Salicornia* spp), and smooth cordgrass (*Spartina alterniflora*). The channel improvement portion of the proposed project would be constructed in the marine environment where no terrestrial habitat is present. The dredged material placement portion of the project would take place in an existing active upland confined placement area which is mapped as a marsh/barrier island vegetation type.

3.2.1.2. Wetlands

Two basic types of wetlands are common to the mainland in the general area. The first type of wetland is a depressional wetland that occurs on the coastal prairie. The depressional wetlands typically occur in a depressed location on the landscape. Depressional wetlands usually receive moisture from rainfall and are poorly drained. The depressional wetlands typically support hydric soils caused by periods of inundation. Herbaceous vegetation typically is the dominate vegetation type within the depressional wetlands. Examples of common herbaceous wetland plants that typically grow in depressional wetlands include: spike rush (*Eleocharis* spp.), smartweed (*Polygonum hydropiperoides*), various sedges (*Carex* spp.), soft rush (*Juncus effusus*), and cattail (*Typha latifolia*). Some woody species have encroached on the depressional wetlands, examples of woody species found in depressional wetlands include: Chinese tallow (*Triadica sebifera*), black willow (*Salix nigra*), rattlebush (*Sesbania drummondii*), and eastern baccharis (*Baccharis halimifolia*).

The second type of wetland found in the project vicinity is estuarine wetlands. These types of wetlands are typically saline and are located in a transitional area between freshwater and saltwater marshes. Common species that occur in the estuarine wetlands include glasswort, salt marsh bulrush (*Scirpus maritimus*), smooth cordgrass, seashore saltgrass (*Distichlis spicata*), and sea-oxeye (*Borrichia frutescens*).

For the immediate vicinity of the channel improvement portion of the project, information from the BSCCT FEIS was reviewed to determine the general presence of wetlands surrounding the channel within the land cut. The BSCCT FEIS reviewed the USFWS National Wetlands Inventory (NWI) maps and found that, in general, the NWI data did not accurately depict the location and size of wetlands and, in particular, tended to overestimate salt/brackish marsh habitats. The BSCCT FEIS reviewed aerial photography and conducted a formal wetland delineation of the Bayport Container Terminal project which found no jurisdictional wetlands associated with the northern shore of the BSC and two wetlands associated with the southern shoreline (Figure 3.19-7, BSCCT FEIS). These two jurisdictional wetlands along the southern shoreline were filled during the construction of the Bayport Container Terminal facilities and no longer exist. Field visits to the land cut part of the channel, and the eastern shoreline of Galveston Bay immediately south of the entrance to the land cut part of the channel were conducted as part of the BSCCT FEIS during 2001 and 2002 to verify NWI-based wetland mapping. These field visits resulted in findings of no estuarine wetlands. Details of this information can be found in Section 3.19.2.4 of the BSCCT FEIS. The BSCCT was subsequently built, and the entire south shoreline of the channel was either bulkheaded, or armored with riprap. This was observed to be the condition during a field visit on February 17, 2011 conducted for the proposed action. Most of the northern shoreline is armored with riprap or other artificial material, and a minor portion has only an abrupt elevation transition not conducive to development of shoreline marsh, commensurate with the lack of wetlands observed on the north shoreline in 2001 and 2002 for the BSCCT FEIS. This was the condition observed during the February 17, 2011 field visit conducted for the proposed action. Therefore, there are no wetlands within the land cut part of the channel, or along the Galveston Bay shoreline at the entrance to the land cut part of the channel.

Information from the PA 14/15 Expansion EA indicates salt water marsh habitats are found adjacent to and between PAs 14 and 15. The constructed demonstration marsh, Gorini Marsh, located immediately north of PA 15, is approximately 200 acres (USACE, 2010). Also, narrow bands of salt marsh and intertidal sand flats are found around the fringe of the existing PAs 14 and 15. The salt marsh adjacent to the east side of PA 15 developed between 2002-2004 as a result of dredged material deposition from the closure of the levee for this PA in 2001, erosion prevention planting, and natural vegetation recruitment. This area of approximately 67 acres is within the footprint of the M7/8/9 marsh cell that will, with the exception of the berm that will be constructed to the east of the existing PA 15 levee, eventually receive dredged material fill, and be converted to BU marsh. The salt marsh gently slopes downward from the PA 15 levee, and is a mixture of high marsh dominated by more salt tolerant species such as sea oxeye and some brackish-condition species such as marshhay cordgrass (*Spartina patens*) closer towards the levee, low marsh with species such as marshhay cordgrass, seashore saltgrass, and smooth cordgrass farther away from the levee, and Salicornia flats dominated by dwarf saltwort (*Salicornia bigelovii*) on relatively bare dredge deposits interspersed among the low marsh. Section 4.2.1.2 discusses more detailed information for the nature of the marsh within the project footprint.

Background: HGAC 2012 Aerial

Legend

- 50 ft Construction Corridor Limit
- Toe of Proposed Stability Berm
- Tidal Wetlands within Footprint of Proposed Stability Berm and the 50 ft Construction Buffer
- HGNC PAs Already Built, In-Progress, or Planned

BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT FOR SECTION 408 AND SECTION 204 REPORTS

Tidal Wetland Delineation East of PA15 Levee

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date	Job No.	Exhibit
July 2013	60183643	3.2.1-1

Path: P:\ ENVP\Bayport Ch Deepen Widen 60183643\08 GIS\EA Exhibits\Revised for 408-204 EA\Exh 3.2.1-1 Delineation of Wetlands.mxd

3.2.2 Wildlife

The wildlife in the project area includes species typical of the Gulf Coast Plain and the Galveston Bay system. The following sections describe the terrestrial and aquatic wildlife found in the project area.

3.2.2.1. Terrestrial

The Gulf Coast region provides habitat for numerous species of terrestrial wildlife. Some common species of terrestrial wildlife that occur in the vicinity of the project include: raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), black rat (*Rattus rattus*), killdeer (*Charadrius vociferus*), rock dove (*Columba livia*), red-winged blackbird (*Agelaius phoeniceus*), northern mockingbird (*Mimus polyglottos*), western ribbon snake (*Thamnophis proximus*), western cottonmouth (*Agkistrodon piscivorous*), cricket frog (*Acris crepitans*), and five-line skink (*Eumeces fasciatus*), among many others. No terrestrial habitat is present within the channel improvement portion of proposed project.

The project area includes Atkinson Island and the existing dredged material placement areas considered for this project for new work and maintenance dredged material placement, including PAs 14, 15, other Atkinson Island PA cells (M7/8/9, M10 etc.) and Mid Bay. The southern end of Atkinson Island, including PAs 14 and 15, are part of the Atkinson Island Wildlife Management Area (WMA) managed by the TPWD. Habitat in the WMA includes a 40-acre woodlot primarily composed of hackberry and yaupon, approximately 90 acres of brackish marsh, and 20 acres of dredged material from HSC maintenance (TPWD 2009). Wildlife documented here includes shore and wading birds, raccoons, and rattlesnakes (TPWD, 2009). Coyotes (*Canis latrans*) and nutria (*Myocaster coypus*) can also be found on islands and PAs along the HSC (USACE, 2010). Atkinson Island has been a historical nesting site for colonial water birds and is identified by the USFWS as colony#600-181 (USACE, 2010). The area consisting of Atkinson Island, and PAs 14 and 15, are mapped by the USFWS as a colonial waterbird rookery.

Information from the last available waterbird census contained in the PA 14/15 Expansion EA indicates the following bird species have been observed nesting on Atkinson Island since 1974: anhinga (*Anhinga anhinga*), black skimmers (*Rynchops niger*), black-crowned night heron (*Nycticorax nycticorax*), Caspian tern (*Sterna caspia*), cattle egret (*Bubulcus ibis*), Forster's tern (*Sterna forsteri*), great blue heron (*Andea erodias*), great egret (*Casmerodius albus*), gull-billed tern (*Gelochelidon nilotica*), laughing gull (*Larus atricilla*), least tern (*Sternula antillarum*), little blue heron (*Egretta caerulea*), neotropic cormorant (*Phalacrocorax brasilianus*), reddish egret (*Egretta rufescens*), roseate spoonbill (*Ajaia ajaia*), royal tern (*Sterna maxima*), sandwich tern (*Sterna sandvicensis*), snowy egret (*Egretta thula*), tricolored heron (*Hydranassa tricolor*), white ibis (*Eudocimus albus*), white-faced ibis (*Plegadis falcinellus*), and yellow-crowned night heron (*Nyctanassa violacea*) (USACE, 2010). Other bird species observed on the sand flats between PAs 14 and 15 during field work conducted in October 2009 for the PA 14/15 Expansion EA included brown pelican (*Pelecanus occidentalis*), white pelican (*Pelecanus erythrorhynchos*), sandpiper species, and seagull species. Apart from the WMA area, Atkinson Island, and its extensions (PAs 14, 15 etc.) consists of active upland dredged material placement areas, and with the exception of the completed Gorini Marsh (discussed in Section 3.2.1.2), also consists of BU marsh cells that are currently partially filled with intertidal salt marsh or open water transitioning to salt marsh as they are filled and planted. These are BU marsh cells that have been requested for maintenance material use and are currently either leveed sections of open water in the process of filling. Some are partially filled with areas at intertidal marsh elevation with marsh vegetation, and other areas approaching the intended elevation that may have volunteer vegetation developing that would get disturbed by fill activity needed to bring it to the design elevation for permanent marsh vegetation establishment. The MidBay PA is an upland PA consisting of cells that have mostly been filled to above sea level, and are in the process of being filled to their design upland elevation. As the elevation transitions past intertidal level and the dewatering process continues, pioneer emergent and submerged vegetation species may periodically develop in between filling cycles, and volunteer terrestrial species are expected for areas above intertidal elevation. Smaller areas of the cell are currently open water.

3.2.2.2. Aquatic

A description of the aquatic habitat types and wildlife present within Galveston Bay and the proposed project area is provided below.

3.2.2.2.1. Benthic

Estuary-wide surveys of benthic invertebrates have been conducted within Galveston Bay and a list of the common assemblages that occur is provided in Table 3.2.2-1. Typically, few species of polychaetes, molluscs, and crustaceans dominate Galveston Bay's benthic community. Silty clay (or muddy) sediments tend to support a polychaete dominated community, while the benthic community in more sandy (or coarse) sediments is primarily composed of crustaceans (GBEP, 2002). The assemblage within the proposed project area is most likely a combination of the Open Bay and Deep Channel assemblages.

Table 3.2.2-1 Soft Bottom Assemblages in Galveston Bay

Assemblage	Predominant Species
River Influenced, Low Salinity Assemblages (Salinity < 10 ppth)	*Rangia cuneata, Rangia flexuosa, Macoma mitchelli, Texadina, Vioscalba louisianea, Streblospio benedicti, Mediomastus ambista, Hobsonia florida, Tubificoides heterochaetus, Peloscolex gabriellae, Macrobrachium spp., Chironomidae*
Enclosed Bay or Inter-reef Assemblage (Salinity variable)	*Nuculana acuta, Nuculana concentrica, Mulinia lateralis, Tagelus pebius, Ensis minor, Acteocina caniculata, Streblospio benedicti, Mediomastus ambiseta, Microphiopholis atra*
Open Bay Assemblage (Salinity Range 10-35 ppth)	*Abra aequalis, Corbula contracta, Mulinia lateralis, Nuculana concentrica, Pandora trilineata, Periploma orbicularis, Acteocina canaliculata, Paraprionospio pinnata*
Bay Margin Assemblage	*Ensis minor, Heteromastus filiformis, Streblospio benedicti, Mediomastus ambiseta, Capitella capitata, Ampelisca abdita, Corophium louisianum, Hargeria rapax*
Inlet and Deep Channel Assemblage (Salinity Near-Gulf)	*Nassarius acutus, Tellina texana, Owenia fusiformis, Onuphis eremita oculata*

Source: Parker, 1960 and White et. al, 1985 as noted in GBEP, 1992

Benthic invertebrate abundance generally increases in a north to south direction from the Trinity Bay-Upper Bay region to the Lower Galveston-West Bay region. A seasonal trend also occurs, with peak benthos abundance in the spring, between February and May, and lower abundances in October and November. Macrofaunal diversity within Galveston Bay is considered to be low or moderate compared to other estuaries in the Gulf of Mexico (GOM), with the highest diversity in areas with stable salinity regimes (e.g., near inlets such as Bolivar Roads and Rollover Pass). The general HSC area, which would include the proposed project area, generally has a lower species diversity compared to the more open bay stations (GBEP, 2002).

The Environmental Monitoring and Assessment Program (EMAP) was designed by the USEPA to periodically estimate the status and trends of the Nation's ecological resources on a regional basis. As part of this program, benthos data was collected in Galveston Bay in 1993. The objective of the benthic sampling was to provide summary data at the individual taxon level. Total and mean abundance of each taxa were estimated from grab samples which were collected at various sampling stations throughout the bay. The EMAP study concluded that Galveston Bay in general has a similar macrofaunal density and species richness as other sampled estuaries along the Louisianan Province. In addition, marina sites, one of which was sampled included Bayport, had much lower values than the rest of the Galveston Bay.

A summary of that data from the three closest EMAP stations to the proposed project area is provided in Table 3.2.2-2. Based upon the EMAP data, polychaetes dominated the benthic grab samples. Of note, the samples were all collected during a single season. A more general description of the invertebrate community within the proposed project area is provided below.

Table 3.2.2-2 A Summary of the EMAP Data for Galveston Bay (1993) – Stations GB1, GB2, & GB3

Species (or Family)	Taxonomic Group	Mean Abundance when Present[1]	No. of Documented Occurrences (Maximum of 3)[2]
Bivalve		1	1
Callinectes sabidus	Decapoda	1	1
Mediomastus ambiseta	Polychaete	3.3 (+/-0.3)	3
Nemertean		1.3 (+/-0.3	3
Parandalia spp.	Polychaete	13.7 (+/-5.7)	3
Paraprionospio pinnata	Polychaete	2 (+/- 1)	3
Petricola pholadiformis	Bivalve	1	1
Xanthidae	Decapoda	1	1

[1]Samples were taken using a Van Veen Grab with a 440 cm2 surface area, no depth of grab penetration is provided

[2]Only one sample was collected at Stations GB1,GB2, and GB3

Note: The USEPA has required that the following disclaimer be placed upon use of the EMAP data set - "Although the data described in this article have been funded wholly or in part by the U.S. Environmental Protection Agency through its EMAP Estuaries Program, it has not been subjected to Agency review, and therefore does not necessarily reflect the views of the Agency and no official endorsement should be inferred."

Open Bay Habitat

Results from studies conducted within the open habitat of Upper Galveston and Trinity Bays indicate macrofaunal abundance typically ranges from 2-4,000 individuals per square-meter (m^2). Two polychaete species, *Mediomastus ambiseta* and *Streblospio benedicti*, have been commonly noted as being the dominant macrofaunal species present. The population of these species can be so large in areas that it significantly influences abundance trends for the entire assemblage. Other species occasionally reported as dominant, depending upon season, include *Vioscalba louisianae* (Gastropod), *Peloscolex gabriellae* (Oligochaetea), and *Mulinia lateralis* (Mussel) (GBEP, 1992).

M. ambiseta is a small, opportunistic capitellid polychaete. It occurs within surficial muds and is a deposit-feeder which actively reworks the sediment and deposits copious fecal pellets at the sediment surface (Hughes, 1996). This species lives primarily within the top 2 centimeters of sediment in thin-walled, semi-permanent tubes that protrude several millimeters above the sediment surface. *M. ambiseta* is considered an opportunistic species that responds to disturbance and has the potential for rapid population increase (Starczak et al., 1992).

S. benedicti is a small, segmented, tube-dwelling Spionidae polychaete. This species lives in the top few centimeters of silty clay sediments and is a deposit and suspension feeder at the sediment-water interface. It exhibits two different reproductive strategies (sometimes within the same population) in which either a relatively large number of small eggs develop into small planktotrophic larvae or lecithotrophic brood development occurs in which fewer, larger offspring spend only a short time in the water column and subsist on yolk reserves (Smithsonian, 2009). Similar to *M. ambiseta*, *S. benedicti* is an opportunist species and it colonizes stressed or organically enriched sediments (Levin, 1984). Sears and Mueller (1989) reported peak densities of more than 5,000 *S. benedicti* individuals/m^2 on Galveston Bay tidal flats.

Marsh Habitat

Marsh-dwelling benthoses in Galveston Bay are comprised of generally the same species found in other GOM estuaries, with over 90 percent of the infauna consisting of polychaetes and crustaceans. Polychaetes, oligochaetes, and peracarid crustaceans (primarily amphipods and tanaidaceans) have been found to make up more than 90 percent of macroinvertebrate infaunal abundances in marsh sites in the Galveston Bay (GBEP, 2002). Annelids have been found to be prevalent in marshes of the upper and lower system and peracarids dominate the middle system marshes. Peracarids have been found to be virtually absent from the upper system. A summary of typical dominant species found within marsh habitat in the Upper Galveston Bay is provided in Table 3.2.2-3.

Densities of marsh infauna and epifauna are generally higher on the marsh surface than in bare subtidal habitat adjacent to the marsh and within the marsh itself. In addition, infauna are generally more numerous when associated with plants, than in the bare substrate of marsh embayments and channels. Spatially, the highest densities and greatest species richness in the Galveston Bay occur in the mid-salinity marshes near Moses Lake and Smith Point (GBEP, 2002). In general, infaunal densities are highest during the winter and early spring.

Hard-Bottom Habitat

Hard-bottom habitats such as rocky outcrops or coral reefs do not exist in Galveston Bay; however oyster reef habitat (*Crassostrea virginica*) is common within the bay. Oysters start life as a floating egg that upon fertilization develops into a planktonic larva that settles to the bottom where it seeks an appropriate substrate and if successful, metamorphoses into a miniature oyster called a spat. The environmental cues used by larval oysters to detect preferred settling points include the presence of a hard substrate (preferably the shell of an adult oyster) water movement, salinity and food supply. Thus the presence of living and historic reefs is important for the continued settling of oyster larvae. This can be noted by the areas where oyster shell dredging has removed the substrate needed for spat settlement and reef continuance (GBEP, 2002). Additional information concerning the location of oyster reefs within the project area is provided in Section 3.2.2.2.5.

Within the oyster reef system, significant predators are present including crabs (e.g., green porcelain crab [*Petrolisthes armatus*], mud crabs [*Panopeus herbstii*, *Eurypanopeus depressus*]) and an oyster drill, *Thais* *haemastoma*. Mussel competitors are also present and include species such as *Brachidontes spp.* Oyster surveys have found that the presence of crab predators and mussel competitors within oyster reefs is related more to the salinity of the region than oyster abundance, per se. Also common within the oyster reef habitat are bryozoans, barnacles, and polychaetes (GBEP, 1997).

Table 3.2.2-3 A Summary of the Dominant Infauna Collected in Shoreline Spartina Marsh Habitat of Upper Galveston Bay

Taxa[1]	Mean Abundance (+/- s.e.) (No. per 60.8 cm^2)	
	Fall (September)	Spring (May)
	Annelids	
Oligochaetes	47.2 (+/-6.55)	24.6 (+/-4.66)
Polydora ligni	31.1 (+/-8.41)	5.4 (+/-1.55)
Streblspio benedicti	12 (+/-1.86)	0.5 (+/-0.15)
Nereis succinea	11.3 (+/-2.23)	6.4 (+/-1.17)
Mediomastus spp.	2.9 (+/-0.58)	6.5 (+/-1.48)
Laeonereis culveri	1.4 (+/-0.58)	2.3 (+/-1.10)
Capitella capitata	1.1 (+/-0.24)	14.0 (+/-3.41)
Hobsonia gunneri	1.0 (+/-0.33)	ND
Eteone heteropoda	ND	0.8 (+/-0.19)
Streblospio benedicti	ND	0.5 (+/-0.15)
Total Annelids	108.3 (+/-14.47)	61.0 (+/-6.44)
	Crustaceans	
Corophuim spp.	4.1 (+/-1.72)	2.0 (+/-1.05)
Hagaria rapax	3.4 (+/-0.97)	10.4 (+/-3.62)
Cassidinidea ovalis	1.3 (+/-0.35)	1.1 (+/-0.36)
Gammarus macronatus	ND	0.9 (+/-0.28)
Grandidierella bonneroides	ND	0.6 (+/-0.35)
Total Crustaceans	12.1 (+/-3.27)	15.4 (+/-5.04)
	Molluscs[2]	
Texadina sphinctostoma	1.5 (+/-0.43)	ND
Geukensia demissa	ND	0.5 (+/-0.15)
Total Molluscs	2.1 (+/-0.49)	0.8 (+/-0.17)

Source: Rozas et. al, 2000
[1]ND = Not Dominant that Season
[2]Two other mollusc species have been noted to be abundant in subtidal habitat adjacent to marshes, Rangia cuneata and R. flexuosa (GBEP, 2002)

3.2.2.2.2. Phytoplankton and Macroalgae

Galveston Bay is similar to most open-bay Texas estuaries with respect to photosynthetic phytoplankton communities being the prime source of primary productivity. Due to the shallow bathymetry and resulting high light attenuation throughout the water column, production rates of carbon in Galveston Bay are the highest of all major Texas estuaries (Armstrong, 1987). The phytoplankton communities in Galveston Bay follow repeatable and predictable temporal successional patterns comprised of an estimated 132 species of phytoplankton including the dominant diatoms (54), green algae (45), and blue green algae (14) (Lester, 2002).

More specifically, diatoms constitute over 40 percent of all phytoplankton in Galveston Bay. The major diatom species include *Skeletonema costatum*, *Thalassionema nitzschoides*, and *Navicula abunda* all of which exhibit peak abundance in the early spring months. The freshwater diatom species *Cyclotella meneghiniana* blooms in January as a result of the high freshwater inputs typical for this time period. During the summer months the phytoplankton community is dominated by blue-green algae *Oscillatoria* species while in the late summer and early fall months the water column is dominated by green algae *Ankistrodesmus* species, and comprise over 24 percent and 23 percent, respectively (Texas Department of Water Resources, 1981).The highest density of phytoplankton in Galveston Bay were observed in the summer months with approximately 480 cells/milliliter (mL), followed by 400 cells/mL in the late summer, and only 50 cells/mL in the late fall. In recent years a decline in chlorophyll-a concentrations, a direct indicator of primary production, has been observed which may be attributed to bay effluent improvements, reduced nutrient inputs, and abundance increases in the fish and shellfish planktivore communities (Lester, 2002).

Although it is believed that the majority of photosynthetic seagrass in Galveston Bay has been lost over the past 50 years (Pulich and White, 1990), Edwards and Kapraum (1973) noted that large buoyant macroalgal communities present have the capacity for considerable primary production output in the bay. These large macroalgae complexes comprised of *Gracilaria verrucosa*, *Digenia simplex*, and *Chondria cnicophylla* were observed attached to shells in Redfish Bay, a Texas estuary located to the south of Galveston Bay. Another potential source of primary productivity in Galveston Bay could be the *Sargassum* sp. which periodically enters the bay from the Gulf of Mexico.

3.2.2.2.3. Zooplankton

The phytoplankton in Galveston Bay has been well described and has the highest resultant primary productivity of all Texas bays and estuaries. Adversely, information on the temporal and spatial trends in zooplankton abundance and diversity is comparatively less robust and data indicates that the Galveston Bay may have lower zooplankton densities than other Texas estuaries. In Galveston Bay, it has been observed that zooplankton abundance is closely linked to water temperatures and inversely related to salinity levels (Armstrong, 1987). The increased zooplankton populations observed in the warmer summer months have the capacity to severely limit phytoplankton abundance through intensive grazing and leave the less palatable cyanobacteria (blue green algae) as the dominant phytoplankton group (Ornolfsdottir, 2003).

Zooplankton abundance (not including meroplankton) in Galveston Bay is primarily comprised of copepods, cladocerans, and chaetognaths. Surveys conducted by the Texas Department of Water Resources in 1975 and 1976 concluded that the barnacle nauplii *Acartia tonsa,* a calenoid copepod, comprised over 70 percent of all the zooplankton collected. Other marine organisms collected in high abundances included the copepods *Oithona* sp. and *Labidocera aestiva*, and the protozoan dinoflagellate *Noctiluca scintillans*. Freshwater organisms collected in the northern portion of the Galveston Bay during the same survey effort included the cyclopoid copepod *Cyclops* sp. and the rotifers *Asplancha* sp. and *Branchionus* sp. (Texas Department of Water Resources, 1981).

Zooplankton abundance in Galveston Bay appears to follow repeatable temporal patterns. Peaks in standing crop abundance have been identified in April and late summer, and are correlated with high freshwater input into the bay and elevated water temperatures, respectively. The lowest zooplankton abundances in Galveston Bay are observed during the winter months (Texas Department of Water Resources, 1981). In Galveston Bay, zooplankton in the warm water periods (>22^0 F) are dominated by holoplankton, while the cooler water in the fall is dominated by meroplankton (Holt and Strawn, 1983), organisms such as fish and benthic invertebrates which are only planktonic for early life history stages.

3.2.2.2.4. Typical Fish Assemblages and Nonmanaged Species

The open bay habitat consists of mostly nekton species comprising of crustaceans and finfish species. The diversity and distribution of the fish species can be affected at any time during the year by migrations and spawning cycles (Armstrong, 1987). Newly spawned fish species begin migrating in to Galveston Bay in winter and early spring, with the maximum biomass observed during the summer months (Armstrong et al., 1978; Parker, 1965).

Dominant finfish species inhabiting the open waters of Galveston Bay include Atlantic croaker (*Micropogonias undulates*), Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), sand seatrout (*Cynoscion arenarius*), gizzard shad (*Dorosoma cepedianum*), spot (*Leiostomus xanthurus*), and hardhead catfish (*Arius felis*) (Chambers and Spark, 1959; Parker, 1965). Section 3.20.2.1 of the BSCCT FEIS contains more detail on the common finfish species of Galveston Bay.

The Galveston Bay system also maintains important recreational and commercial fisheries for shrimps, crabs, and fishes. Additional information associated with commercial and recreational species is further referenced in Section 3.2.3.

3.2.2.2.5. Oyster Reefs

Oyster reefs are present in many areas of the Galveston Bay system and provide ecologically important functions. Two species inhabit Texas coastal waters. Eastern oysters (Crassostrea virginica) are the dominant bivalve species in shallow saltwater bays, lagoons and estuaries, in water 8 to 25 ft (2.5 to 7.5 m) deep and between 28 and 90 degrees F. The species feeds on plankton and algae. About seven weeks after hatching, the eastern oyster reaches sexual maturity. Spawning season is from late spring to early fall during warm weather. Females may release more than 100 million eggs during a season. Only about one percent of the fertilized eggs reach the next stage of maturity. The oyster glues itself in place and spends the rest of its life there. Its lifespan varies, depending on freshwater inflow and predators. Oysters are protandric in the first year, they spawn as males, but as they grow larger and develop more energy reserves, they spawn as females. Oysters are also filter-feeders. They feed by using their gills to filter tiny food particles out of the water. Oysters have been found attached to bricks, boats, cans, tires, bottles, crabs, and turtles, but they prefer to attach to other oysters. When a large number of oysters join together, it's called an "oyster reef" (TPWD, 2009).

Oyster habitat surveys were conducted within the potential project footprint and a 500-ft buffer, using sonar side-scan data and ground-truthing by diver in 2011. The potential project footprint was the area encompassing the full range of widening alternatives considered for the project. The buffer zone is an area required by TPWD to be monitored to determine if direct or indirect impacts would occur to oyster habitat beyond the proposed project's direct footprint. TPWD has determined that a buffer zone of 500-ft is sufficient for this project. The results of an oyster reef survey performed March 7-11 for the BSC, 2011 suggested that consolidated oyster reef habitat was not typically identified within the potential project footprint except in the deeper waters adjacent to the turning Flare, the area where ships turn to enter into the BSC. Consolidated oyster reefs were also identified in greater abundance within the 500-ft buffer zone. Oyster clusters ranging in size from singular oysters to 3-ft and spaced between 5 to 30-ft apart were identified from within the potential project footprint as well as from the buffer zone in addition to the consolidated reef habitat identified within the buffer zone and turning area. Maps delineating consolidated oyster reef, areas with shell hash (with or without oysters), areas with oysters but no shell hash, and areas without shell hash or oysters are provided within Exhibit 3.2.2-1. Approximately 4.6 acres of oyster habitat were found to occur within the footprint of the proposed action.

P:\Bayport_Ch_Deepen_Widen_60183643\08_GIS\Oyster_buffer.mxd

3.2.3 Essential Fish Habitat

3.2.3.1. Introduction to Essential Fish Habitat (EFH)

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth a new mandate for the National Marine Fisheries Service (NMFS), regional Fishery Management Councils (FMC), and other Federal agencies to identify and protect important marine and anadromous fisheries habitat, referred to as EFH. To achieve this goal, it was recognized by NMFS that suitable marine fishery habitat needed to be maintained. The NMFS and the regional FMCs were required to delineate EFH in Fishery Management Plans (FMP) for all federally managed fisheries. The 1996 amendments to the MSFCMA also required that EFH consultation be conducted for any activity that may affect important habitats of federally managed marine and anadromous fish species.

EFH has been defined in 16 U.S.C. § 1801[10] as those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. The EFH interim final rule summarizing EFH regulations (62 CFR 66551) further specified the EFH definition as waters and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate including sediment, hard-bottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle.

The National Oceanic and Atmospheric Administration (NOAA) Fisheries Gulf of Mexico Fishery Management Council (GMFMC) is responsible for the creation of FMPs in Federal waters off Texas, Louisiana, Mississippi, Alabama, and Florida. GMFMC defines six FMPs for the Gulf of Mexico [GOM] (for shrimp, red drum, reef fish, coastal migratory pelagics, corals, and spiny lobster). There are 54 species managed, excluding the coral complex. EFH consists of areas of higher species density, based on the NOAA Atlas (NOAA, 1985) and functional relationships analysis for the Red Drum, Reef Fish, Coastal Migratory Pelagics, Shrimp, and Spiny Lobster FMPs; and on known distributions for the Coral FMP.

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.

Informal consultation with NMFS was initiated regarding EFH in the project area as detailed in Section 6.3. NMFS also provided comments on the permit application during the public and agency review period via a July 6, 2012 email and listed no ESA or EFH concerns. A copy of this correspondence is provided in Appendix D.

Per the recommendation of NMFS and in addition to the EFH information provided in Section 3.2.3, a separate EFH Assessment for this project was prepared that contains all of the elements outlined by the final rules for the MSFCMA under 50 CFR Part 600. The EFH assessment includes (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species, and associated species by life history stage; (3) the Federal agency's views regarding the effects of the action on EFH; and (4) proposed mitigation, if applicable. The assessment includes the results of an on-site inspection, the views of recognized experts on the habitat or species affects, a literature review, an analysis of alternatives to the proposed action, and any other relevant information. Given the scale of the proposed action, the proportion and type of habitat being impacted and mitigated for, and the current presence of shipping activity, the assessment does not result in identifying further mitigation actions. The EFH Assessment is available upon request. The following paragraphs describe the general impacts that would occur to EFH and the managed species.

3.2.3.2. Project Area EFH Determination by FMPs

EFH for the Gulf of Mexico is identified by the GMFMC as Ecoregion 4 and determined as the composite of EFH for various species and life stages in the fishery management units (FMU) of the Gulf of Mexico. General EFH information presented was derived from the EFH mapping tool provided by NOAA. Details on EFH for specific species and life stages in each FMU are provided in Section 3 of the EFH FEIS (GMFMC, 2004). Additionally, the Draft EFH Assessment is available upon request. A more detailed discussion of usage of habitat in the specific project area for the various individual or groups of species and their life stages is also included in the Draft EFH Assessment. This information is summarized in this section to provide a description of what EFH and managed species is defined for the project area. Additionally, informal consultation with NMFS has been initiated.

Information from the habitat descriptions from the GNFMC FMPs and the EFH FEIS were used to provide the following summary of what EFH and managed species (and associated life stages) are present in the project area (GMFMC 2004 and 2005).

Red Drum FMP EFH: All estuaries in the GOM, which would include Galveston Bay, are defined as EFH for the Red drum (*Sciaenops ocellatus*). The area of Galveston Bay where the proposed project is planned is considered to be EFH for larval to early juvenile stages of the Red drum.

Reef Fish and Coastal Migratory Pelagics FMPs EFH: All estuaries in the GOM, which would include Galveston Bay, are defined as EFH for Reef Fish and Coastal Migratory Pelagics. Of the species listed in the Reef Fish FMP, only the Gray snapper (*Lutjanus griseus*) has habitat descriptions associated with Galveston Bay. Of the species listed in the Coastal Migratory Pelagics FMP, only the Spanish mackerel (*S. maculates*) has habitat descriptions associated with Galveston Bay. The area of Galveston Bay where the proposed project is planned is considered to be EFH for post larval through adult life stages of the grey snapper, and for early to late juvenile and, occasionally, adult stages of the Spanish mackerel.

Shrimp FMP EFH: All estuaries in the GOM, which would include Galveston Bay, are defined as EFH for shrimp. Of the species listed in the Shrimp FMP, only brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*F. duorarum*), and white shrimp (*Litopenaeus setiferus*) have habitat descriptions associated with Galveston Bay. The area of Galveston Bay where the proposed project is planned is determined to be EFH for late post-larval to sub-adult life stages for brown, white and pink shrimp (GMFMC, 2004).

Galveston Bay does not have habitat defined as EFH for the other GMFMC FMPs, which are the Spiny Lobster FMP and Coral FMP. The absence of EFH for the species not found in Galveston Bay is generally attributable to life stage requirements for oceanic salinity, continental shelf or reef structure, and seagrass, but also may be due to natural range, offshore spawning habits, and other causes.

In addition to the species discussed above, the highly migratory species are managed by the NOAA Fisheries Highly Migratory Species Management Unit, Office of Sustainable Fisheries and two FMPs have recently been developed for these species; one which includes EFH descriptions for sharks, tunas, and swordfish, and another which was prepared for Atlantic billfishes and was amended to include EFH designations for these species (NOAA 1999). EFH has been mapped for 39 of the species managed by these two FMPs, and are listed in and discussed in more detail in the Draft EFH Assessment which is available upon request. Of the 39 highly migratory species for which EFH has been mapped, only the following have EFH within the area in Galveston Bay where the proposed project is planned: Atlantic sharpnose shark neonates only (*Rhizoprionodon terraenovae*), Blacktip shark adult and neonates (*Carcharinus limbatus*), Bonnethead shark juveniles and neonates (*Sphyrna tiburo*), Bull shark juveniles and neonates (*Carcharhinus leucas*), and the Scalloped hammerhead shark neonates only (*Sphyrna lewini*).

The proposed project area is located within Ecoregion 4 as identified by the GMFMC. The categories of EFH in the project area include estuarine emergent marsh, estuarine shell substrate, estuarine mud substrate, and estuarine water column. In addition to being designated as EFH, these habitats provide nursery, foraging, and refuge habitats that support various economically important marine fishery species, such as spotted seatrout (*Cynoscion nebulosus*), flounder (*Paralichthys spp.*), Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), gulf menhaden (*Brevoortia patronus*), striped mullet (*Mugil cephalus*), and blue crab (*Callinectes sapidus*). Such estuarine-dependent organisms serve as prey for other fisheries managed under the Magnuson-Stevens Act by the GMFMC (e.g., red drum, mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks). These habitats also provide other essential estuarine support functions, including: (1) providing a physically recognizable structure and substrate for refuge and attachment above and below the sediment surface; (2) binding sediments; (3) preventing erosion; (4) collecting organic and inorganic material by slowing currents; and (5) providing nutrients and detrital matter to the Galveston Bay estuary.

3.2.3.3. Description of Project Area EFH Identified by the GMFMC

Open Water Column: Zooplankton and phytoplankton are the dominant organisms in this habitat and serve as the foundation of the estuarine and marine food webs. Phytoplanktons are major contributors to primary production, which is directly linked to production of biomass of species managed under the MSFCMA. In addition to supplying food for animals, phytoplankton plays a central role in nutrient cycling in Galveston Bay.

Open-Bay Bottom: The open-bay bottoms in the project area include flat areas consisting of mixtures of mud and mud/shell hash. Benthic epifauna and infauna are the primary organisms that utilize this habitat by adhering to the surface or burrowing into the sediment. These organisms feed by filter feeding particles from the water column or by ingesting sediments and extracting nutrients. Many of the epifauna and infauna feed on plankton, and are then directly fed upon by some of the species managed under the MSFCMA, such as shrimp.

Submerged Aquatic Vegetation (SAV): Seagrass areas provide nursery grounds for many species of fish support a tremendously complex ecosystem and are extremely productive. Seagrass areas are considered EFH for many species of fish. Surveys performed March 7-11, 2011 confirmed that there is no seagrass present within or adjacent to the proposed project area.

Oyster Reefs: Oyster reefs provide structural complexity in soft sediment environments by increasing available surface area for use by other organisms. Oyster reefs serve as fish habitat by providing structure, protection and trophic support to juveniles and adults (SAFMC, 1998). In the northern Gulf of Mexico (north of Galveston Bay, Texas, to northwestern Florida) spotted seatrout and red drum appear to favor oysters reefs as foraging areas in much the same way they use seagrass meadows in areas where seagrasses are abundant.

Oyster reefs of various sizes are present in all Texas estuaries, but are best developed between Galveston Bay and Corpus Christi Bay (Diener, 1975). The majority of oyster reefs in Texas (~7,095 ha; 88.3 percent) are public (GMFMC, 2004). North of the Brazos River, eastern oysters are typically found in the intertidal zone while along the central and southern coast, they are most often subtidal (Britton and Morton, 1989).

Oyster reef habitat is found in the general area of the project as confirmed by diver ground-truthing performed during March 7-11, 2011. The majority of the oyster fishery as well as the oyster reefs in Texas are located within the Galveston Bay area (80-90 percent) with some additional areas in the Corpus Christi-Aransas Bay area (Kilgen and Dugas, 1989). Project-area specific oyster habitat description and delineation is provided within Section 3.2.2.2.5.

Estuarine Emergent Marsh: Estuarine wetlands exist in the Galveston Bay system across a salinity gradient and are classified into salt marshes and brackish marshes. In addition to the marshes found near the shoreline, several dredged material placement areas are and have been beneficially used for creation of emergent marsh. This type of habitat is discussed further in Section 3.2.1. Specifically within the proposed project footprint, no marsh is found within the area of the channel improvements. Salt marsh is located directly adjacent eastward of PA 15within the proposed footprint of the stability berm, and a salt marsh is located between PAs 14 and 15, where a connection planned by the USACE will be expanding these placement areas. The marsh impacts of the connection area are already mitigated for under that project.

Coral Areas: There are no coral areas within Galveston Bay.

3.2.3.4. Priority Habitats and Other Fisheries Concerns

3.2.3.4.1. Habitat Areas of Particular Concern (HAPC)

Habitat Areas of Particular Concern (HAPC) are a subset of the EFH information. They are areas that provide extremely important ecological functions or are especially vulnerable to degradation. The EFH regulations require that designation of specific HAPC's be based on one or more of the following considerations:

- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether and to what extent development activities are or will be stressing the habitat; and
- The rarity of the habitat type.

The GMFMC designated HAPC's in the Gulf of Mexico Generic EFH Amendment (1998; Amendment). In the Final Generic Amendment Number 3 for Addressing HAPC, the Council identified several HAPC's to benefit all FMP-managed species under Council jurisdiction. The proposed project is not in or near any of these areas identified as HAPC. These areas are all offshore and not close to Galveston Bay. The Draft EFH Assessment, available upon request, discusses the details and lists the locations of the areas designated as HAPC under the proposed amendment.

3.2.3.5. State Managed

Texas recreational and commercial fishermen fishing less than 9 nautical miles off the coast of Texas are considered to be in State regulated waters, and must comply with the rules and regulations for each type of fishing that have been published by the TPWD. The TPWD provides electronic access to the rules and regulations for coastal fishing on its website at http://www.tpwd.state.tx.us/fishboat/, as accessed on April 26, 2013. The former Texas Parks and Wildlife Commission adopted management plans for only the shrimp, oyster and crab fisheries. The remaining species which are regulated by the State of Texas are regulated only through written rules and regulations, not through FMPs.

3.2.3.6. Commercial and Recreational Fisheries

The finfish and shellfish resources in Galveston Bay support the most lucrative commercial and recreational fisheries of all the major ports in Texas and annually constitute approximately 33 percent of the total commercial revenue and 50 percent of the total recreational revenue for the entire State (Lester, 2002). While the majority of recreational revenue is generated through the collection of finfish, the commercial catch is predominantly comprised of shellfish. Large scale commercial fishing in Galveston Bay dates back to the 1870's as a result of increasingly efficient processing and refrigerated shipping techniques. Since that time, considerable advancements in fishing gear has allowed the commercial fishing industry to flourish, as evidenced by 2009 landings in the Galveston Bay worth approximately $35 million (all values given are in U.S. dollars (USD)) (NMFS, 2011). From 1997 to 2001, landings of white shrimp (*Penaeus setiferus*) from Galveston Bay comprised 62 percent of the landings from Texas bay systems and were valued at $5.7 million in 1999, while brown (*Panaeus aztecus*) and pink (*Panaeus duorarum*) shrimp comprised the majority of landings (36 percent) for these species in Texas bays, with Galveston Bay landings worth an estimated $2.5 million in 1999 (Culbertson et. al., 2004). In addition, Galveston Bay supports a robust live and dead bait shrimp fishery and is responsible for over 50 percent of coastal Texas landings worth $1.6 million in 2001 (Culbertson et. al., 2004).

Although trawl based shrimp landings account for nearly half of Galveston Bay's commercial harvest, other shellfish landed relatively frequently from the bay include blue crab (*Callinectes sapidus*), accounting for 28 percent of coastal Texas landings from 1997-2001 and worth $1.6 million in 1998, and eastern oyster (*Crassostrea virginica*), which accounts for 91 percent of Texas landings from 1997-2001 worth an estimated $13.2 million in 1999. Galveston Bay commercial finfish landings ($234,000 in 1999) pale in comparison to shellfish landings and typically only account for about 7 percent of annual coastal Texas finfish landings (Robinson et. al. 1998). Commercial finfish landings in the bay are primarily comprised of mullet (*Mugil cephalus*) at 26 percent, southern flounder (*Paralichthys lethostigma*) at 13 percent, black drum (*Pogonias cromis*) at 11 percent, and sheepshead (*Archosargus probatocephalus)* at 10 percent, in order of decreasing pounds landed from 1991 to 2001.

The Texas recreational fishery is an economically important segment of the total coastal fishery industry with resultant direct expenditures translating to over $2 billion annually to the State's economy (Texas Water Development Board, 1987). Recreational fishing in the Galveston Bay system accounts for almost 40 percent of this coastal fishing and 35 percent of the landings, and is accomplished through the issuance of over 262,000 fishing licenses and caught by anglers using primarily hook and line equipment (TPWD, 2000). The primary species targeted and landed by recreational fisherman largely include members of the drum family (*Sciaenidae* sp.) and sheepshead.

Although commercial and recreational fishing is important in the Galveston Bay area, much of the bay is subject to fishing restrictions and consumption advisories. The entire area of Galveston Bay where the proposed project is planned is currently within an area restricted for shellfishing. This designation means the area is closed to the harvesting of shellfish for direct marketing.

The entire HSC and Upper Galveston Bay area is also within a consumption advisory area for blue crabs. It is recommended that adults limit consumption of blue crab from this area to no more than one (1) eight ounce (8 oz) meal per month; and that women who are nursing, pregnant, or who may become pregnant and children under twelve (12) years old should not consume blue crab from this area. All of Galveston Bay is within a consumption advisory area by the TDSHS for all catfish species and spotted seatrout due to PCBs and dioxins in edible tissue.

3.2.4 Threatened and Endangered Species

A Biological Assessment (BA) of the study area describing the federally-listed threatened and endangered species likely to occur and the potential impact associated with the proposed Federal actions has been prepared and is attached as Appendix B. The BA accounts for any species that have been added to or deleted from the USFWS and NMFS Federal lists of endangered and threatened species, presents any new information regarding the previously assessed species, and provides an effects determination based on habitats available that may be affected by the proposed action. Table 3.2.4-1 includes a list of federally-listed species, and those recently de-listed and in a monitoring status, under the jurisdiction of USFWS and/or NMFS. Of these species, only the brown pelican, bald eagle, and sea turtles are likely to occur in areas adjacent to the project. .

The bald eagle has been delisted from the Federal list of endangered and threatened species, but receives Federal protection under the Bald Eagle Protection Act and the Migratory Bird Treaty Act. The brown pelican was removed from the Federal list of endangered and threatened species on December 17, 2009 (74 *Federal Register* 59443), but receives protection under the Migratory Bird Treaty Act and the Lacey Act. There is no designated critical habitat for any species located within or adjacent to the project area. Refer to the BA in Appendix B for more details regarding the federally listed species that may be affected by the proposed project.

In addition to the federally protected species, the TPWD maintains a separate county-specific list of threatened and endangered species that may potentially occur as a resident or migrant in the project area. The TPWD protected species is also listed in Table 3.2.4-1. Of the State-listed species that are not also listed on the Federal list of protected species, only the reddish egret and white-faced ibis are likely to occur in the areas around the project. Those species with only a State-listed status were not considered in further detail in the BA. All species listed in Table 3.2.4-1 were compiled from USFWS and TPWD county-specific lists for Harris and Chambers Counties. State-listed species with "rare" designation were also not considered due to their non-regulatory status under the Endangered Species Act.

Table 3.2.4-1 Federally-Listed Threatened and Endangered Species in Harris and Chambers Counties

Common Name	Scientific Name	Listing Status		
		USFWS[1] County by County List	TPWD[2]	NMFS[3] List for State of Texas
Amphibians				
Houston toad	*Anaxyrus houstonensis*	NL	E	NL
Birds				
American peregrine falcon	*Falco peregrinus anatum*	NL	T	NL
Bald eagle	*Haliaeetus leucocephalus*	NL	T	NA
Brown pelican#	*Pelecanus occidentalis*	DM	NL	NA
Piping plover#	*Charadrius melodus*	T, CH[4]	T	NA
Red-cockaded woodpecker	*Picoides borealis*	NL	E	NL
Reddish egret	*Egretta rufescens*	NL	T	NL
Swallow-tailed kite	*Elanoides forficatus*	NL	T	NL
White-faced Ibis	*Plegadis chihi*	NL	T	NL
White-tailed hawk	*Buteo albicaudatus*	NL	T	NL
Whooping crane	*Grus americana*	NL	E	NL
Wood stork	*Mycteria americana*	NL	T	NL
Fishes				
Creek chubsucker	*Erimyzon oblongus*	NL	T	NL
Smalltooth sawfish	*Pristis pectinata*	NL	E	E
Mammals				
Blue whale	*Balaenoptera musculus*	NL	NL	E
Finback whale	*Balaenoptera physalus*	NL	NL	E
Humpback whale	*Megaptera novaeanglaie*	NL	NL	E
Sei whale	*Balaenoptera borealis*	NL	NL	E
Sperm whale	*Physeter macrocephalus*	NL	NL	E
West Indian Manatee	*Trichechus manatus*	E	NL	
Louisiana black bear	*Ursus americanus luteolus*	NL	T	NL
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	NL	T	NL
Red wolf	*Canis rufus*	NL	E	NL
Mollusks				
Louisiana pigtoe	*Pleurobema riddellii*	NL	T	NL
Sandbank pocketbook	*Lampsilis satura*	NL	T	NL
Texas pigtoe	*Fusconaia askewi*	NL	T	NL
Reptiles				
Alligator snapping turtle	*Macrochelys temminckii*		T	
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	E	E	E
Green sea turtle#	*Chelonia mydas*	T	T	T
Kemp's Ridley sea turtle#	*Lepidochelys kempii*	E	E	E
Leatherback sea turtle	*Dermochelys coriacea*	E	E	E
Loggerhead sea turtle#	*Caretta caretta*	NL	T	T
Northern scarlet snake	*Cemophora coccinea copei*	NL	T	NL
Smooth green snake	*Liochlorophis vernalis*	NL	T	NL
Texas horned lizard	*Phrynosoma cornutum*	NL	T	NL
Timber/Canebrake rattlesnake	*Crotalus horridus*	NL	T	NL
Plants				
Texas prairie dawn	*Hymenoxys texana*	E	E	NA

[1] USFWS 2013, Texas prairie dawn only listed in Harris County. Piping plover listed only for Chambers County.
[2] TPWD 2013; [3] NOAA/NMFS 2013; [4] Critical Habitat is listed, but not present within the project study area
[5] E = Endangered; T = Threatened; DL - Delisted; DM -- Delisted, Being Monitored First Five Years; CH = Critical Habitat has been designated NL = Not Listed; NA = Not Applicable
#Federal- listed species likely to be found in the project area.

Only those species with a federally endangered or threatened status were considered in further detail in the attached BA. Species with a Federal status of threatened or endangered that are likely to be present within the project area include the Kemp's Ridley sea turtle, loggerhead sea turtle, and green sea turtle. All other species listed in Table 3.2.4-1 are not likely to be found within the project area.

3.2.5 Invasive Species

An invasive species is defined as a species that is non-native or "alien" to the ecosystem or habitat under consideration and may cause economic, environmental, or human health harm (Executive Order 13112, February 1999). Invasive species can be spread by a number of different methods including ballast water and boat hulls. Invasive species may also be introduced by imported nursery stock and fruits, on vehicles, in packing materials and shipping containers, through human-built canals, and from human travel. Dumping aquarium exotic fish and unwanted exotics into the water or wild are other common ways invasive species spread (TexasInvasives.org, 2010).

Three invasive species - Australian spotted jellyfish (*Phyllorhiza punctata)*, sauerkrautgrass (*Zoobotryon verticillatum*), and grass carp (*Ctenopharyngodon idella*) - have been identified as having the potential to occur near or within the upper Galveston Bay area. General information on the distribution of these species is provided below.

Australian spotted jellyfish were first reported in the U.S. off the coast of California in 1981. A cryptic (i.e. isolated, genetically distinct) population may have existed in the northern Gulf of Mexico since 1993 (Graham et al., 2003). In the spring and summer of 2000, millions were found in coastal regions of Mississippi and Louisiana in the northern Gulf of Mexico (Graham et al., 2003; Johnson et al., 2005). One juvenile was collected in West Galveston Bay in June 2006 (GBEP, 2010a).

Sauerkrautgrass, spaghetti bryozoans are believed by researchers to have a worldwide distribution in tropical and warm temperate seas (Hill, 2001). *Z. verticillatum* is known to occur in Galveston Bay (GBEP, 2010b).

Grass carp are able to invade new habitats due to their ability to produce many eggs, grow quickly, and produce more eggs as they mature. Unlike the other carps, grass carp prefer to spawn in large rivers instead of lakes or slower-moving water (however, grass carp has the potential to breed in slower-moving water if need be). Breeding populations have been established by escapees from legal experiments in Lake Conroe and illegal stockings. These fish are known to reproduce in the Trinity River-Galveston Bay area (GBEP, 2010c).

Several species are listed as potential invasive with a status of "concern", which means that they have been found in Texas or within the Gulf of Mexico but have yet to be identified within Galveston Bay.

Invasive plant species such as Chinese tallow (*Triadica sebifera*), Brazilian pepper (*Schinus terebinthifolius*), and saltcedar (*Tamarix ramosissima*) are already ubiquitous on the mainland and on Galveston Island within the Galveston Bay area in a variety of upland and marsh settings. Unmaintained portions of dredged material PAs are likely subject to colonization by several invasive species already present on the mainland. Given their ubiquity and origin (e.g. historical ornamental cultivation on the mainland), it is more likely that invasive species propagation occurs from mainland areas, rather than from offshore PAs.

3.2.5.1. Marine Invasive Species of Concern

Two brown mexihalo green mussel (*Perna perna, Perna viridis*) species are of concern. *P. perna* has been found along the Texas coast between Freeport and Brownsville. It was first reported in the GOM in 1990 at the Port Aransas Jetty and has since spread south along the Texas coast. *P. viridis* has been established along the Atlantic coast and the Gulf Coast of Florida as early as 1999. Neither of these species is established in the Lower Galveston Bay watershed (GBEP, 2010j).

3.2.6 Coastal Zone Management Resources

The Texas General Land Office (TxGLO) is responsible for administering the Texas Coastal Management Program (TCMP) within the State to manage the Coastal Natural Resource Areas (CNRA) under the Coastal Zone Management Act (CZMA). The project area is located within the TCMP Coastal Zone Boundary. Of the sixteen types of CNRAs listed in the governing rules in Texas Natural Resources Code (TNRC) Chapter 33, Paragraph §33.203, the following CNRAs are found in the vicinity of the project:

- Coastal historic areas – Onshore historical markers and archaeological sites adjacent to the land cut, but none within the proposed project's Area of Potential Effect (APE).
- Coastal preserves – Atkinson Island WMA discussed in Section 3.2.2.
- Coastal shore areas – Areas 100-ft landward of the highwater mark on submerged lands, which includes land surrounding the land cut and existing placement areas, such as PAs 14 and 15.
- Coastal wetlands – Estuarine wetlands (salt water marsh etc.) discussed in Section 3.2.1.
- Critical erosion areas – Galveston Bay shoreline in general is listed as eroding per latest Texas Bureau of Economic Geology data.
- Hard substrate reefs and oyster reefs – Hard-bottom habitat and oyster reef discussed in Section 3.2.2.
- Submerged land – Galveston Bay bottom in the project area.
- Special hazard areas – Floodplain areas mapped by the Federal Emergency Management Agency (FEMA) as subject to inundation by the one percent annual chance event within and adjacent to the land cut, as discussed in Section 6.16.
- Tidal sand or mud flats – Tidal sand flats located between and around the fringes of PAs 14 and 15 as discussed in Section 3.2.1.
- Water under tidal influence – Galveston Bay waters

These resources are subject to the requirements of the CZMA and TCMP discussed in Section 6.7.

3.3 HUMAN ENVIRONMENT

3.3.1 Socioeconomics

The socioeconomic analysis in the BSCCT FEIS (Section 3.4) was conducted for Harris, Galveston, and Chambers County (3-county area) and the Bayport Community Study Area. The Bayport Community Study Area encompassed 5 Census tracts including Census tracts 3414, 3415, 3416, 3417, and 3418. The affected environment socioeconomic resources were discussed in Section 3.3.2 of the BSCCT FEIS. For purposes of this EA, socioeconomic information for the affected environment will focus on the Bayport Community Study Area because this encompasses the land and political divisions in the vicinity of the proposed project. Some information from the BSCCT FEIS was used or updated for this section. The BSCCT FEIS documented economic characteristics of the area population and income.

3.3.1.1. Population and Employment

As defined in the the BSCCT FEIS, the Bayport Community Study Area was used for documenting the affected socioeconomic environment for this EA. The Bayport Community Study Area is located in Harris and Chambers Counties and crosses the city limits of Shoreacres, Seabrook, El Lago, Taylor Lake Village, and La Porte, and the El Jardin Del Mar neighborhood (within the City of Pasadena). The 1990, 2000, and preliminary 2010 Census population counts for the cities and counties in the Bayport Community Study Area are shown in Table 3.3.1-1.

Table 3.3.1-1 Population Statistics for Counties and Cities in the Bayport Community Study Area

Geographic Area	Population		
	1990	2000	2010*
Harris County	2,818,199	3,400,578	4,092,459
Chambers County	20,088	26,031	35,096
Shoreacres	1,316	1,488	1,493
Seabrook	6,685	9,443	11,952
El Lago	3,269	3,075	2,706
Taylor Lake Village	3,394	3,694	3,544
La Porte	27,910	31,880	33,800
Pasadena	119,363	141,674	149,043

U.S. Census 1990 and 2000
* HGAC tables for 2010 Census population estimates.

The population of the cities of Shoreacres, Seabrook, Taylor Lake Village, La Porte and Pasadena between 1990 and 2010 increased by 13, 78, 4, 21 and 25 percent, respectively. The City of El Lago had a 17.2 decrease in population between 1990 and 2010. The population for Harris and Chamber counties between 1990 and 2010 had a 45 and 75 percent increase, respectively. According to U.S. Census data tables, the populations for Census tracts in the Bayport Community Study Area declined between 2000 and 2010. In 2008, this area was impacted by Hurricane Ike, which caused damage to many homes adjacent to the Galveston Bay shoreline, and some residents left the area.

There is a civilian labor force of 2,010,696 and 156,875 in Harris and Chambers counties, respectively, with respective unemployment rates of 8.8, and 11.0 percent as of January 2011, according to the Bureau of Labor Statistics. As shown in Table 3.3.2-1, the 2009 average median household income for the Bayport Community

Area was $76,781. In the BSCCT FEIS, the changes in population growth, impacts to local businesses, the tax base, property values, government revenues, community impacts, employment, wage and salary data from 2000 through 2030 were projected by the SGM Group, Inc., based on economic modeling.

3.3.1.2. Social Characteristics

3.3.1.2.1. Population by Race and Ethnicity

As shown in Table 3.3.2-1, the Bayport Community Study Area (6-tract area) has a 19.5 minority population. The demographic breakdown is 80.5 percent White (Caucasian), 11.0 percent Hispanic, 3.1 percent Black or African American, 3.6 percent Asian, and 1.8 Other. As compared to Harris and Chambers counties, with 67.0 and 29.2 percent minority populations, the Bayport Community Study Area has less than half the percentage minority population, respectively. The surroundings small communities, such as Shoreacres, El Lago, and Taylor Lake Village are predominantly White race/ethnicity, while Pasadena and La Porte have higher minority populations.

In 2009, the median age of residents in the Bayport Community Study Area was 37.7, compared to Harris and Chambers counties with 31.8 and 37.1 median ages, respectively (ACS, 2005-2009). In 2000, the Bayport Community Study Area had an average household size of 2.5 people per household compared to surrounding Harris and Chambers counties which both have an average household size of 2.8 people per household.

3.3.2 Environmental Justice

Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, mandates that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of programs on minority and low-income populations (59 *Federal Register* 7629-7633, February 1994). A minority population is defined as a group of people and/or a community experiencing common conditions of exposure or impact, consisting of persons classified by the U.S. Census Bureau as Black, Asian, American Indian or Alaska Native, Hispanic, or other non-white persons including those persons of two or more races. A low-income population is defined as a group of people and/or a community that, as a whole, live below the national poverty level. The poverty guideline for a family of four people in 2000, as defined by the U.S. Department of Health and Human Services, was a total annual household income of $17,050, which increased to $22,350 in 2011, the year the latest city and census tract-level statistics are available through the American Community Survey (ACS). Disproportionate environmental impact occurs when the risk or rate for a minority population or low-income population from exposure to an environmental hazard exceeds the risk or rate of the general population and, where available, to another appropriate comparison group(s) (U.S. Department of Defense [DOD], 1995; USEPA, 1998).

To comply with requirements of EO 12898, a two-part study was performed and is described in detail in Section 3.4 and Appendix 3.4-2 of the BSCCT FEIS and is incorporated by reference. The first part of the study employed the EJ Index Methodology developed in 1994 by USEPA Region 6. Further analyses were performed using the U.S. Census Bureau tract level data. The EJ Index study examined a 1 and 50 square-mile radius around the Bayport Marine Terminal for Degree of Vulnerability based on minority status, economic distressed households and population density, as shown in Appendix 3.4-2 of the BSCCT FEIS. The EJ index study areas were ranked on a scale from 0 to 100. Generally higher scores indicated a greater potential for EJ concerns.

To comply with requirements of EO 12898, a two-part study was performed and is described in detail in Section 3.4 and Appendix 3.4-2 of the BSCCT FEIS and is incorporated by reference. The first part of the study employed the EJ Index Methodology developed in 1994 by USEPA Region 6. Further analyses were performed using the U.S. Census Bureau tract level data. The EJ Index study examined a 1 and 50 square-mile radius around the Bayport Marine Terminal for Degree of Vulnerability based on minority status, economic distressed households and population density, as shown in Appendix 3.4-2 of the BSCCT FEIS. The EJ index study areas were ranked on a scale from 0 to 100. Generally higher scores indicated a greater potential for EJ concerns.

EJ Index Methodology

Three levels of analysis were provided in the EJ Index Methodology, as defined below:

Minority Status Degree of Vulnerability maps portrayed the degree of vulnerability for minority status by census block. This factor was derived by comparing the area's percentage of minority population (based on census block data) with the State percentage (39.4 percent). Minority status was defined to include all non-white as well as Hispanic origin households. In this study, the degree of vulnerability (minority) was ranked 1 for both the 1 and 50 square-mile radius areas.

Economic Status Degree of Vulnerability maps showed the potential degree of vulnerability based on household income (the risk group is defined as households with incomes less than $15,000 per year). The State's percentage of such households is 27.6 percent. In the study, the degree of vulnerability (economic status) was ranked 1 for both the 1 and 50 square-mile radius areas.

The USEPA Potential Environmental Justice Index maps showed a composite index incorporating population density, income and ethnicity factors. As this number is a relative determination based on several factors, there is no State EJ index number for comparison purposes. In this study, the degree of vulnerability was ranked 1 for the 1 square-mile radius area and 2 for the 50 square-mile radius area.

Census Tract Analysis

The data used to determine the potential for disproportionate effects to low-income and/or minority (EJ) populations within the vicinity of the project area are also presented in detail in the BSCCT FEIS. The information was based on 2000 U.S. Census and Texas State Data Center data at the county and census tract level data for ethnicity and income. The decision regarding which census tracts to use was based on the proximity to the project area and the possibility of beneficial or adverse effects potentially accruing to a particular population. The census tract level data was compared with county level data. A threshold of 10 percent over the county's average percentage of minorities and low-income persons was used to evaluate whether a disproportionate percentage of EJ populations were within the potentially affected area.

In order to determine the affected environment for this EA, updated demographic data for the Bayport Community Study Area (now a 6-tract area), was compared to the cities, communities or municipalities in which the Bayport Community Study Area lies, shown in Table 3.3.2-1. The proposed project for this EA is located within Harris and Chambers counties. The county border lies along the shoreline (Exhibit 1.1.1-1). Currently, the 2010 Census redistricting data is available for race/ethnicity and population. The latest income characteristics are available for the geographies of interest from the Census Bureau are through the 2011 American Community Survey (ACS). As shown in Table 3.3.2-1 the Bayport Community Study Area is 80.5 percent White, well below the county percentage, the percentages of families living below the poverty threshold are primarily well below the county percentage but all are within 10 percent of the county value, and the median household income is more than three times the 2011 HHS poverty level. The FEIS EJ Index study showed a low potential for EJ impacts based on the populations that exist in the Bayport Community Study Area. The current census data corroborates the conclusion of the FEIS EJ Index study with more current data and indicates a low potential for EJ impacts.

Table 3.3.2-1 Percent Race/Ethnicity and Median Household Income for Counties, Cities, and the Bayport Community Study Area

Geographic Area	2010 Population	Race/Ethnicity (Percent)					Percent Minority	Median* Household Income	Percent Families Living Below Poverty Threshold
		White	Hispanic/Latino	Black/ African American	Asian	Other			
Counties									
Harris	4,092,459	32.9	40.8	18.4	6.2	1.7	67.0	$50,569	14.2
Chambers	35,096	70.6	18.8	8.1	0.9	1.6	29.4	$60,451	5.7
Cities within the Bayport Community Study Area									
Shoreacres	1,493	78.6	17.5	1.5	0.5	1.9	21.4	$97,798	1.8
Seabrook	11,952	75.3	14.3	3.9	4.3	2.2	24.7	$62,248	6.7
El Lago	2,706	84.8	9.9	1.7	1.5	2.1	15.2	$79,375	10.6
Taylor Lake	3,544	85.4	7.3	2.3	3.6	1.4	14.6	$125,724	7.9
La Porte	33,800	61.5	29.4	6.0	1.1	2.0	38.5	$65,710	2.2
Pasadena	149,043	32.7	62.2	1.9	2.1	1.2	67.3	$44,945	17.5
Bayport Community Study Area, 6-tract area									
3414	3,881	82.1	7.8	2.2	6.2	1.7	17.9	$114,208	1.7
3415.01	4,854	80.2	11.4	3.2	3.3	1.9	19.8	$64,936	9.5
3415.02	3,050	79.8	10.0	4.4	4.3	1.5	20.2	$64,936	12.3
3416	4,018	80.0	12.2	2.7	3.4	1.7	20.0	$71,161	2.2
3417	1,936	81.9	11.9	3.8	0.3	2.1	18.1	$84,643	8.4
3418	1,398	78.8	16.2	2.9	0.7	1.4	21.2	$48,958	8.3
Bayport Community Study Area (Totals)	**19,137**	**80.5**	**11.0**	**3.1**	**3.6**	**1.8**	**19.5**	**$76,781***	

Source: U.S. Census Bureau 2010 redistricting data and 2005-2009 ACS sample/estimate data.
*ACS data currently uses U.S. 2000 Census geographic boundaries.
Notes: All race/ethnicity data was used from the 2010 Census data tables provided by H-GAC and Factfinder2 from the U.S. Census Bureau redistricting data.

3.3.3 Community and Recreational Resources

Galveston Bay assets contribute billions of dollars to the region's economy and supports employment of tens of thousands of people through several key water-based industries including recreational and commercial fishing, shellfish harvesting, and tourism (TCEQ, 2007).

The shoreline to the west of the project area is within Harris County. Along this stretch of this shoreline, to the north of the BSC, are the cities, towns and communities of Morgan's Point, La Porte, and Shoreacres, and along the shoreline to the south are Pasadena and Seabrook.

Harris County has well developed infrastructure to provide health, police, fire, emergency, and social services to the communities surrounding the project area in addition to a wide range of public facilities, including education facilities, places of worship, cemeteries and many recreation resources.

3.3.3.1. Community Facilities

Police, Fire Protection and Emergency Services

Harris County is served by the Harris County Sheriff's Department as well as the Texas Department of Public Safety. Individual communities are served by police or marshals. All departments have regular 24-hour patrols.

Fire protection within the communities to the west of the project area is provided by a number of local Fire Departments including the La Porte Fire Department, and Seabrook Volunteer Fire Department. The La Porte Fire & Emergency Medical Service (EMS) Department currently provides EMS service to the communities to the west of the project area.

Education Facilities

Schools surrounding the communities surrounding the project area include La Porte High School, Beacon School, Seabrook Intermediate School, and Bay Elementary. Many of the local schools have attached playing fields, and notably La Porte High School has a baseball field and sports stadium (Bulldog Stadium) located in the local area.

Cemeteries and Places of Worship

In the communities surrounding the project area, there are numerous places of worship. There are two nearby cemeteries - La Porte Cemetery and Seabrook Cemetery.

3.3.3.2. Recreational Facilities

Recreational activities in the project area and the communities to the west of the project area include duck hunting, saltwater fishing, swimming, nature viewing, pleasure boating, camping, picnicking, and sightseeing. Ecotourism, or tourism that is based on nature rather than man-made attractions, is the tourist industry's most rapidly expanding sector.

A 1993 study found that 20 percent of Houston-Galveston Area households used Galveston Bay for recreational boating and/or fishing at least once per year (TPWD, 1995). In addition, 13 percent reported that they used the bay for recreational activities such as hiking, picnicking, camping, hunting, swimming, bird watching, etc. Approximately 34 percent of Houston-Galveston Bay households were likely to use the bay at least once a year for recreational purposes including swimming, picnicking, shoreline walks, bird or wildlife watching, and fishing (GBNEP, 1994b). A general recreational activity summary indicated that 27 percent of Texas travel destination in the Gulf Coast Region, defined by the Texas Department of Economic Development (TDED) as the Houston, Galveston-Texas City, and Brazoria Metropolitan Statistical Areas, include nature or outdoor sports activities (TDED, 1999).

Tourism in the Gulf Coast Region creates notable economic benefit to the community and provides employment. In 1999, overall recreation-related travel spending in the region contributed over $5 billion to the economy and grew at an average rate of 6.6 percent annually over 4 years. For the same year, TDED reported that recreation-related travel spending for Texas destinations was an estimated $700 million and generated 10,700 jobs (TDED, 1999a).

3.3.3.2.1. Public Parks and Beaches

Within the communities surrounding the project area, there are a number of public parks, beaches and recreational vehicle (RV) campgrounds. North and south of the BSC, within 1,000-ft of the shoreline, are five public parks; Sylvan Beach Park, Rex L Meador Park, Miramar Park, El Jardin del Mar Parks; and Sylvan (Public) Beach and El Jardin del Mar (Community) Beach.

3.3.3.2.2. Boating

By law boats, sail boats, motorized boats, and U.S. Coast Guard (USCG) documented vessels, must be registered with TPWD when on Texas public water. About 90,000 pleasure boats are registered in Galveston Bay. Galveston Bay has the 3rd highest concentration of privately-owned marinas in the U. S. (TCEQ, 2007). There are many popular boating and yacht clubs within the Galveston Bay area that utilize the bay for their boating activities, including Houston Yacht Club and Seabrook Sailing Club.

The Houston Yacht Club

The Houston Yacht Club (HYC) is based at Miramar Drive, Shoreacres at Galveston Bay, approximately 0.5 km north of the BSC. HYC was established in 1897 and has a long tradition of organizing regattas, hosting national and world championships, and promoting Houston as a nationally recognized yacht racing and recreational boating center. The club's activities include sailing, power boating, cruising, racing, youth sailing, sailing lessons, fishing tournaments and social events. The HYC hosts World or National Championships on an annual basis, with Olympic Trials held by the HYC in Galveston Bay.

Seabrook Sailing Club

Seabrook Sailing Club (SSC) is located at 602 4th Street, Seabrook, approximately 4 miles south of the BSC. The club sponsors activities include sailing, youth sailing, sailing lessons, and social events, and utilizes Galveston Bay for lessons and sailing competitions.

3.3.3.2.3. Recreational Fishing

Fishing in Galveston Bay accounts for over half of the State's recreational fishing expenditures and the Galveston Bay area hosts more sports fishermen than any other place on the Texas Coast. Galveston Bay has a wide variety of fish species, including speckled trout, redfish, flounder, golden croaker, drum and Spanish mackerel (TCEQ, 2007).

Anglers take part in fishing from the piers located around Galveston Bay, including Sylvan Beach Fishing Pier, La Porte, approximately 3 miles to the north of the BSC, as well as fishing from boats in the bay. A number of companies located in the Galveston Bay area offer chartered fishing trips, making recreational fishing in the bay also accessible to those who do not own a boat.

3.3.3.2.4. Bird Watching

Birding is a popular outdoor activity along the Texas Coast. The Great Texas Coastal Birding Trail is a State-designated system of trails, bird sanctuaries, and nature preserves along the entire length of the Texas Gulf Coast. As the State of Texas is home to more bird species than any other in the U.S., the birding trail system offers many suggestions for bird-watching locations on the Great Texas Coastal Birding Trail around Galveston Bay.

Water and shore birds, including American avocet, willet, sanderling, western sandpiper, dunlin, dowitchers, piping plover and black-bellied plover are common in the Galveston Bay area throughout the year, while rare species are spotted during fall and spring migration when 75 percent of all North American bird species travel through Galveston during fall and spring migration. Further detail regarding birds within the project area can be found in Section 3.2.2.

The Galveston Bay system has been identified as a regionally significant reserve site for resident and migratory shorebirds, and supports more than five percent of all mid-continental shorebird populations during their annual migrations (TCEQ, 2007).

3.3.4 Visual and Aesthetic Resources

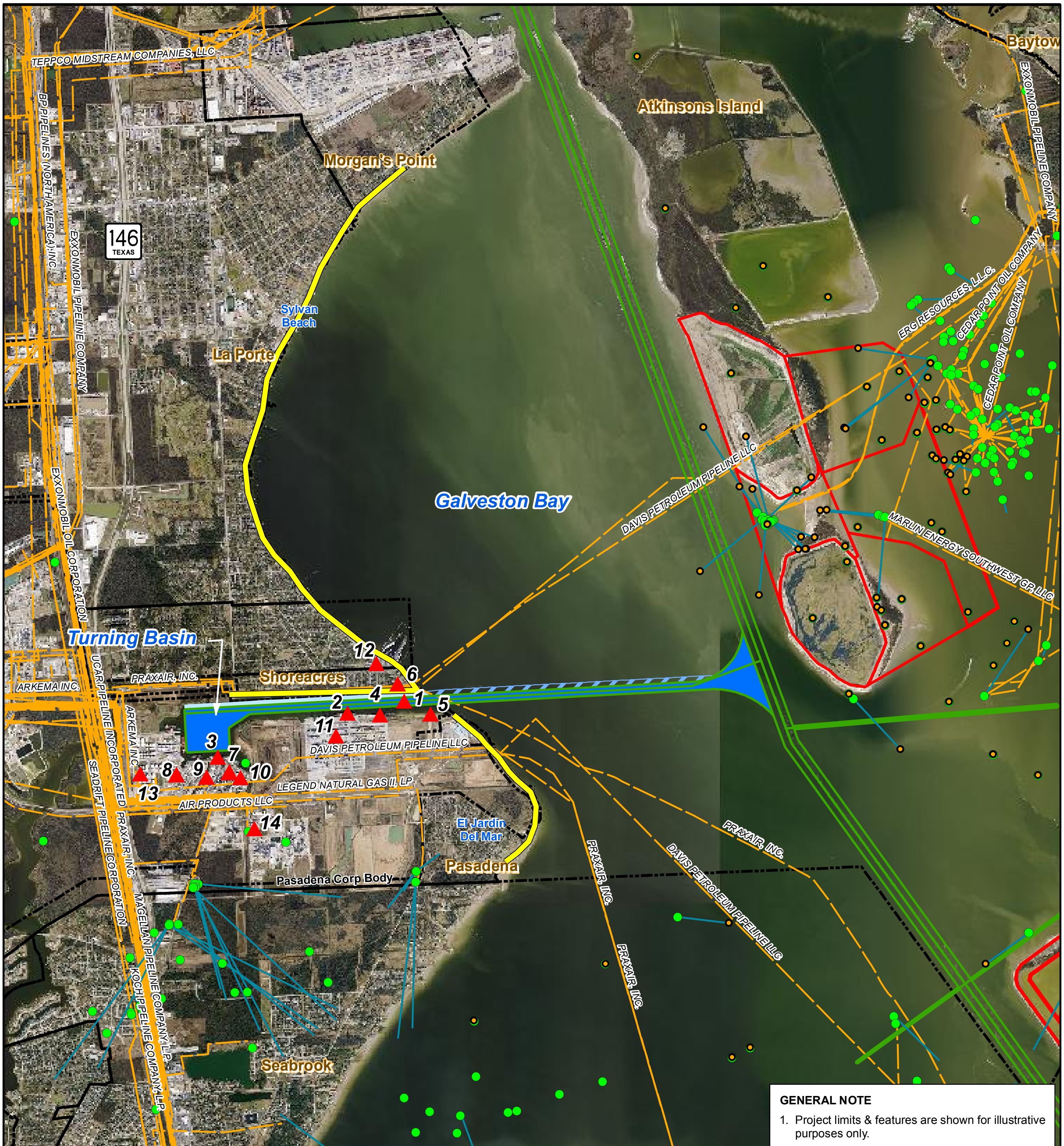
Existing characteristics of the viewsheds for the proposed project area are discussed in this section. A viewshed is defined as the entire area an individual can see from a given point. The study area for visual and aesthetic resources consists of viewsheds of the project area looking out from the existing shoreline in residential areas or public parks. The viewshed area boundary starts at the residential area north of Sylvan Beach park, continues south to the BSC, follows the northern shoreline along residential streets closest to the channel, and continues along the shoreline of the El Jardin Del Mar neighborhood and ends south at Surf Oaks, as shown in Exhibit 3.3.4-1. The viewshed area was set based on the location of the proposed project and potential project impacts from the PAs and areas where dredging would take place in the BSC. Representative viewsheds will be discussed in three locations. The first existing viewshed is located along the shoreline near Sylvan Beach Park, the second existing viewshed is from Shoreacres north of the BSC, and the third viewshed is from the residential area, El Jardin Del Mar, south of the Bayport Cruise Terminal.

In general, the coastline within Galveston Bay is somewhat irregular due to numerous inlets, bays, bayous, bogs, and canals. Within the viewshed area five water bodies touch the shoreline including two unnamed tributaries, Cedar Bayou, BSC, and Pine Gully. In addition, Boggy Bayou is connected to the BSC. The terrain in the viewshed area varies from 0 to 22-ft MSL.

The views from the Shoreacres residential neighborhood, directly north of the BSC, are somewhat limited due to thick vegetation, large trees, and the Pasadena Corp body setback. However, tall industrial equipment on the south side of the BSC, such as elevated tanks and cranes at the BSCCT and other industrial facilities, are visible from many of the residences.

The views vary north of the channel to Sylvan Beach Park from the shoreline. From the Sylvan Beach Park looking north/northeast from the shoreline the view is open water, with PAs and industrial cranes at the Barbours Cut terminal visible in the distance, and residential homes along the shoreline. The view directly east is open water, with the pier in the foreground and the PA sites in the distance. The view south/southeast is open water, with residences along the shoreline and the view of industrial cranes located along the BSC.

The current views from the shoreline of the El Jardin Del Mar neighborhood consist of open water with distant barges or ships in the HSC directly to the east. The viewshed also includes in the distance, a view of existing land masses of PAs, and the view to the south is the Kemah Bridge and residential areas. The view to the north is blocked by a large berm indicated on the USGS map at Red Bluff which is at an elevation of 20-ft MSL, which is approximately 4-ft above the neighborhood's general elevation. Even though there is minimal view of the BSC to the north from the shoreline, some residents can view industrial cranes located at the BSCCT from their properties.



Legend

- ▲ Regulatory Database Site
- Oil/Gas Wells (bottom wells)
- Oil/Gas Wells (top wells)
- View Shed
- Houston Ship Channel
- Pipeline
- Direction Oil/Gas Line
- Existing Placement Areas

Proposed Channel Improvements

- 100 Feet Widening and Deepening
- 50 Feet Widening and Deepening
- Deepening to -45 MLT

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Feet

BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Hazardous Material Sites, Pipelines, and Well Sites

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date August 2013	Job No. 60183643	Exhibit 3.3.4-1

p:\bayport_ch_deepen_widen_60183643\08_gis\ea_exhibits\haz_map.mxd

3.3.5 Existing Infrastructure

Resources produced in the proposed project area and vicinity include oil and natural gas, sulfur, brine, sand, clay, and shell for the making of lime and other materials. Sulfur is an important industrial mineral occurring primarily in the cap rock of certain regional salt domes. Oil and gas fields are densely distributed throughout the proposed project vicinity, but none are within the boundaries of the proposed project area.

Pipelines and other existing infrastructure within the proposed project area can be seen in Exhibit 3.3.3-1. Six oil/gas pipelines cross the proposed project area. To the north of the BSC, two parallel pipelines owned by Davis Petroleum Pipeline LLC (DPP) cross the Galveston Bay. This was later confirmed with a DPP representative to consist of a single line that is inactive. To the south of the BSC, two pipelines, one owned by Praxair and one owned by DPP, cross the bay within the proposed project area. Only one of the six pipelines within the proposed project area crosses the BSC. Owned by Praxair, Inc., the pipeline is north of the BSC, running parallel with the channel until the pipeline crosses the channel at the channels opening to the Galveston Bay, and the pipeline then heads southeast across the bay.

There are two oil/gas wells within the proposed project area, both south of the proposed project area, neither within nor in close proximity of the BSC.

3.3.6 Traffic and Transportation

3.3.6.1. Surface Transportation

Road Transportation

There is direct access to the BSCCT utilizing State Highway (SH) 146 with easy access to Interstate Highway 10 (IH 10) and Interstate Highway 45 (IH 45). A direct connect overpass has been constructed connecting SH 146 to Port Road, the road leading from the BSCCT. IH 45 is the primary land route connecting the Bayport area with the Houston metropolitan area, approximately 30 miles to the northwest. Road traffic impacts from the completion of the BSCCT are already covered in the BSCCT FEIS, and no additional road traffic impacts are expected from the proposed action as discussed in Section 4.3.6.1

Rail Transportation

An existing rail yard services the bulk liquid petrochemical terminal users at the west end of the land cut, is utilized to transport commodities arriving at Bayport, and connects to the terminal to the BCT to the north via the rail line going north-south along SH 146. In addition, as part of the BSCCT improvements, a new rail track from the BSCCT to Strang Yard, and a new intermodal rail yard, are to be added to the site. The 123-acre intermodal rail yard will run along the existing rail right-of-way along SH146 and will include space for a total of 192 double-stack rail cars (each 305-foot in length) on working and storage tracks.

3.3.6.2. Marine Transportation

Galveston Bay is a major center of both commercial and recreational navigation. Concentrations of recreational boating facilities and activity exist along the shoreline to the west of the proposed project area and utilize the Galveston Bay. Both activities have traditionally coexisted with deep-draft commercial navigation. Generally this means that recreational boats stay clear of larger commercial vessels that are restricted to navigation in the dredged channels.

Commercial Shipping

The HSC and the BSC are the focal point for commercial marine transport in the Galveston Bay system. Heavy industry, petrochemical plants, container terminals, and bulk cargo terminals are accessed through the HSC, BSC and ancillary channels. Areas adjacent to the BSC are important to commercial transportation destinations. Barges (or tows) and oceangoing vessels, including container ships, general cargo shops, dry and liquid bulk shops, and workboats carry cargo through the Galveston Bay system to cargo terminals and industrial facilities.

Further detail regarding commercial marine transportation in the BSC can be found in Section 1.3.

3.3.7 Hazardous, Toxic and Radioactive Waste

A Hazardous, Toxic, and Radioactive Waste (HTRW) investigation was conducted to identify indicators of potential hazardous materials or waste issues in the vicinity of the proposed project that have the potential for impacts as result of the proposed project. A regulatory database search was performed in accordance with American Society for Testing and Materials (ASTM) standard: E 1527-05 Standard Practice for Environmental Site Assessment. A commercial database vendor, BANKS Environmental Data (Banks), prepared a regulatory database report originally on February 10, 2011, and an update on May 14, 2013 for the geographic area that includes the BSC and Flare area and the recommended record search distances (Banks 2011 and 2013). The search radius also covered the existing PA 15. Several addresses listed in Table 3.3.7-1 represent old instances of ownership superseded by another entity on the list. For example, 11807 Port Road is part of the complex that Celanese sold to LBC in 2000. As discussed, in Section 3.3.5, oil and gas sites, and pipelines were examined in the BSC and PA areas. The regulatory listings are limited and include only those sites that are known to the regulatory agencies to be permitted, contaminated, or in the process of evaluation for potential contamination at the time of publication.

Large industrial complexes are located west and south of BSC. The sites listed below are known to handle hazardous materials, experience releases of pollutants, and are listed in regulatory databases. The regulatory database reports included a review of the ASTM and All Appropriate Inquiry (AAI) required databases. The project regulatory database search radius was based on the dredged area footprint of the proposed action, which starts at the HSC and continues to the Bayport TB (Exhibit 3.3.4-1). An abbreviated list of ASTM and AAI recommended Federal and State databases and other records that were searched for relevant information is included below. Additional databases were searched but no information was found.

- National Priority List (NPL), within 1.00 mile; USEPA list of confirmed or proposed Superfund sites
- Comprehensive Environmental Response, Compensation, and Liability Information Service (CERCLIS), within 0.50 mile; proposed or possible NPL sites from the USEPA database of current and potential Superfund sites currently or previously under investigation. This includes emergency response actions involving hazardous materials, especially those near water.
- CERCLIS No Further Remedial Action Planned (CERCLIS NFRAP), within 0.50 mile; proposed or possible NPL sites where no contamination was found, removed quickly or was not serious enough to require Federal Superfund action or NPL consideration

- Resource Conservation and Recovery Act (RCRA), within 0.25 mile; USEPA database of unclassifiable as treatment, storage, disposal of hazardous waste or subject to corrective action activity
- RCRA treatment, storage, or disposal (TSD) sites, within 0.50 mile; USEPA database of sites that treat, store, dispose, or incinerate hazardous waste
- RCRA Corrective Action Site (COR), within 1.00 mile; USEPA database of Resource Conservation and Recovery Information System (RCRIS) sites (hazardous waste handlers) subject to corrective action activity
- RCRA Generators (GEN), within 0.25 mile; USEPA database of RCRIS sites that create over the minimum specified limit of hazardous waste per month or meet other RCRA requirements including the RCRA Administrative Action Tracking System and Compliance Monitoring and Enforcement List
- Emergency Response Notification System (ERNS), within 0.25 mile; USEPA database of emergency response actions for reported spills or releases of regulated materials
- State/Tribal Storage Tanks (PST), within 0.25 mile; TCEQ database contains information on above and underground petroleum storage tanks, compliance, and releases in the State
- State/Tribal Voluntary Cleanup Program (VCP) and Innocent Owner/Operator Program (IOP), within 0.50 mile; VCP sites are noted as contaminated sites that private parties have cleaned up through assistance with the State. IOP sites have received certificates from the State acknowledging their property is contaminated as result of release from a source not located on their property.
- Industrial Hazardous Water (IHW), within 0.25 mile; TCEQ database contains information about facilities which store, process, or dispose of hazardous waste as maintained by the Industrial and Hazardous Waste permits section of the TCEQ.

According to the regulatory database search, 324 listings were identified at 14 sites within the search radius. Approximately 270 of these listing are ERNS sites. The following sites listed in Table 3.3.7-1 are located within the search radius.

Table 3.3.7-1 Regulatory Database Summary

Type of Database	Number of Sites within ASTM Search Radius
CERCLIS CER	2
CERCLIS NFRAP	2
RCRA COR	3
RCRA TSD	3
RCRA Generator	3
ERNS	300
State/Tribal PST	2
State/Tribal VCP	2
RCRA	2
State/Tribal HW	5
Total number of sites identified in the search radius	324

Source: Banks 2013.

Several sites are registered in multiple databases. Multiple database sites may be located at a single facility or map location. Table 3.3.7-2 lists regulatory database sites by facility/site name, address, and Map ID number (No.). The facility locations are shown on Exhibit 3.3.4-1. Several large industrial facilities are located along the BSC. The facilities located at Map ID Nos. 7, 8, 9, and 13 are large quantity generators (LQG) of hazardous waste. A LQG is defined as a facility that generates over 1,000 kilograms (kg) per month of hazardous waste.

Table 3.3.7-2 Summary of facilities identified in database or during field investigation in the Project Area

Map ID No.	Name (s) of Facilities/Sites	Site Address	Regulatory Database Site Listings
1	Orion Group	Vessel Incident	ERNS
2	Unlisted Vessels*	Vessel Incident – Bayport Terminal	ERNS
3	Odjfell Asia 2PTE LTD	Vessel Incident – Odjfell Tank Terminal	ERNS
4	Transete Schiffahrt	Vessel Incident – Bayport Container Terminal, Berth T3	ERNS
5	M/V Cap York*	Vessel Incident	ERNS
6	Merchants Standard	207 Bay Colony Circle, La Porte, Texas 77571	RCRA
7	Odjfell Terminal USA Gp Inc./ Baytank Houston Inc/SGS Control Services	12211 Port Road, Seabrook, Texas 77586	RCRA COR, RCRA TSD, RCRA GEN, IHW, ERNS, VCP(ID 1862), and VCP (ID 2255)
7A	Inspectorate America Corporation	12211 A Port Road, Seabrook, Texas 77586	RCRA, IHW
8	Celanese Chemical Co Inc-Bayport/ LBC Houston LP	11807 Port Road, Seabrook, Texas	RCRA COR,RCRA TSD, RCRA GEN, IHW, ERNS
9	REG Houston LLC	11815 Port Road, Seabrook, Texas	RCRA GEN, IHW
10	Unknown Facility Name	12221 Port Road	ERNS
11	Bayport Terminal	12500 Port Road, Pasadena, Texas 77507/ 12619 Port Rd., Seabrook, TX 77586	PST, CER
12	Houston Yacht Club	3620 Miramar Drive, La Porte, Texas 77571	PST
13	LBC Houston LP	11666 Port Road, Seabrook, Texas 77586	RCRA COR
14	Nova Chemicals (Styrolution America LLC)	12222 Port Road, Pasadena, TX	CER

Source: Banks 2011; TCEQ Central Registry 2010.
*Reported as non-release incident

The VCP sites identified in the regulatory database search are both associated with Map ID No. 7 and are listed under the facility name Odjfell Terminals (Houston) LP. VCP ID 1862 is associated with a harbor bottom spill where sediment was impacted by chlorinated solvents. The exact location of the spill is not specified but is assumed to be in the Bayport TB because that is where unloading and loading of material takes place. Odjfell Terminals (Houston) LP received a TCEQ certificate of completion for the cleanup of VCP 1862 in 2007. VCP ID 2255 is associated with a release of volatile organic compounds (VOCs), chlorinated solvents, and total petroleum hydrocarbon (TPH); the medium impacted is listed as soil. This VCP site has been in the process of clean-up approval since 2003 and TCEQ approval is pending.

The two CERCLIS CER sites are associated with fire incidents and neither is on the NPL. One, at a chemical plant (Map ID No. 14), is a 2003 incident identified as a site requiring removal action only with no site assessment needed according to the USEPA's detailed CERCLIS site record (USEPA 2013), and is likely a non-time critical removal action given the age of the incident. This would indicate the threat of offsite migration of contaminants is not imminent. The other, at a cargo trailer containing primarily janitorial chemicals at the BSCCT (Map ID No. 11) was a July 2011 incident on land that was listed as cleaned up in the detailed CERCLIS site record. According to the PHA incident report, the trailer was moved to the BSCCT's designated hazardous material containment area, which has a drainage retention and containment system, and the leaking product and fire-fighting water was contained, cleaned up, with no release to water. Sites that are not put on the NPL or require further cleanup under another program (e.g. RCRA) eventually get moved into the CERCLIS NFRAP database.

A majority of the regulatory database sites were listed as ERNS (release sites). The release dates ranged from 1990 to 2012. Of the 300 reported release sites, 85 percent were releases to water, 9 percent were releases to land, and 5 percent were releases to air. Approximately 1 percent were reported as non-releases or were records generated by emergency response drills. Apart from possible use of existing placement islands with no development, the proposed project would directly impact only underwater bay bottom; therefore, water-related releases in proximity to the proposed dredging locations were examined. Approximately 253 releases were in the water, or on vessels located in the water. The water releases were primarily located within the Bayport TB, BSC-HSC and Galveston Bay. It is important to note that limited information is provided in the records on the location of spills. The spills reported in Galveston Bay or the HSC may or may not be within the project area boundaries. Table 3.3.7-3 lists characteristics, locations, and type of pollutants released during the reported events.

Table 3.3.7-3 Description of Water Related Releases of Regulated Materials in the Regulatory Database Search Area

Map ID No.	No. of Releases	Percent of Releases Bayport Turning Basin	Percent of Releases in Bayport Ship Channel-Houston Ship Channel	Percent of Releases in Galveston Bay or Other Location	Percent of Releases - Oil or Petroleum Product	Percent of Releases - Chemical or Other Pollutant	Percent of Releases - Unknown substance
1	1	0	100	0	100	0	0
3	1	100	0	0	0	100	0
4	1	0	100	0	0	100	0
7	230	76	14	9	31	63	5
8	15	60	27	13	53	34	13
10	1	0	100	0	100	0	0
11	4	0	100	0	0	50	50
Total Percentage of Releases	253	73	13	14	35	58	7

Notes: Percentages are rounded. Depending on the release report description and size of the release, some reported locations overlapped. For example some releases were listed in both Galveston Bay and the Houston Ship Channel.
Other location is described as onboard ship releases, storm drains or other water features on-site at facilities.

Most releases in water would be expected to dissipate in water with dispersion and tidal exchange, and degrade over time following the spill incident, not posing a permanent water quality impact. Some non-water soluble pollutants released in water might leave more residual contaminants in bay sediments, portions of which would degrade and portions which could be more persistent. Therefore, dredged sediment quality would be the primary HTRW concern. Approximately 66 percent of the water spills are older than 10 years old. In Section 0, existing sediment quality is discussed in detail, using data from periodic testing of the maintenance dredging of the current BSC. In general, this data has not shown that residual contamination is a problem. Prior to excavation or placement of any sediment in the project area, sediment to be excavated would be sampled and analyzed to determine the potential for contamination of dredged material.

Other potential hazardous materials sites in the project area include pipelines, and oil and gas facilities. Data from the Texas Railroad Commission (TRCC) were reviewed to identify the location of oil and gas sites, and pipelines within the project area. Detailed description of these locations are discussed in Section 3.3.5 and shown on Exhibit 3.3.4-1.

3.3.8 Air Quality

The Clean Air Act (CAA), as amended in 1990, regulates air emissions from area, stationary, and mobile sources, and requires the USEPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. Currently, there are air quality standards for six "criteria" pollutants designated by USEPA; carbon monoxide, nitrogen dioxide, ozone, lead, sulfur oxides, and inhalable airborne particulate matter (USEPA, 2011). A list of the standards is provided in Table 3.3.8-1.

The Houston-Galveston-Brazoria (HGB) area, consisting of Harris, Montgomery, Liberty, Chambers, Galveston, Brazoria, Fort Bend, and Waller Counties, meets all of the USEPA NAAQS, except for ozone. The attainment status of the HGB area is summarized in Table 3.3.8-2.

Table 3.3.8-1 National Ambient Air Quality Standards

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide	9,000 ppb (10 mg/m3)	8-hour	None	
	35,000 ppb (40 mg/m3)	1-hour		
Lead	0.15 µg/m3	Rolling 3-Month Average	Same as Primary	
	1.5 µg/m3	Quarterly Average	Same as Primary	
Nitrogen Dioxide	53 ppb	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour	None	
Particulate Matter (PM10)	150 µg/m3	24-hour	Same as Primary	
Particulate Matter (PM2.5)	15.0 µg/m3	Annual (Arithmetic Average)	Same as Primary	
	35 µg/m3	24-hour	Same as Primary	
Ozone	75 ppb (2008 std)	8-hour	Same as Primary	
	84 ppb (1997 std)	8-hour	Same as Primary	
	124 ppb	1-hour	Same as Primary	
Sulfur Dioxide	30 ppb	Annual (Arithmetic Average)	500 ppb	3-hour (1)
	140 ppb	24-hour		
	75 ppb	1-hour	None	

Table 3.3.8-2 Attainment Status of Houston-Galveston-Brazoria Area

Pollutant	Primary NAAQS	Averaging Period	Designation	Attainment Deadline
Ozone (O3)	0.075 ppm (2008 standard)	8-hour	Marginal Nonattainment	31-Dec-15
	0.08 ppm (1997 standard)	8-hour	Severe Nonattainment	15-Jun-19
Lead (Pb)	0.15 μg/m^3 (2008 standard)	Rolling 3-Month Avg.	Attainment/ Unclassifiable	
	1.5 μg/m^3 (1978 standard)	Quarterly Average	Attainment/ Unclassifiable	
Carbon Monoxide (CO)	9 ppm	8-hour	Attainment/ Unclassifiable	
	(10 mg/m^3)			
	35 ppm	1-hour	Attainment/ Unclassifiable	
	(40 mg/m^3)			
Nitrogen Dioxide (NO2)	0.053 ppm (100 μg/m^3)	Annual	Attainment/ Unclassifiable	
	100 ppb	1-hour	Pending	
Particulate Matter (PM10)	150 μg/m^3	24-hour	Attainment/ Unclassifiable	
Particulate Matter (PM2.5)	15.0 μg/m^3	Annual (Arith. Mean)	Attainment/ Unclassifiable	
	35 μg/m^3	24-hour	Attainment/ Unclassifiable	
Sulfur Dioxide (SO2)	0.03 ppm	Annual (Arith. Mean)	Standard Revoked August 23, 2010	
	0.14 ppm	24-hour	Standard Revoked August 23, 2010	
	75 ppb	1-hour	Pending	

Source: TCEQ 2011

Ozone is a reactive form of oxygen that can occur in two different levels of the atmosphere, the stratosphere and troposphere. Exposure to ground level ozone (troposphere) in high concentrations can result in adverse effects to humans, plants and animals.

Ground level ozone is primarily formed by the reaction of sunlight with man-made emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Urban areas typically have high levels of ground level ozone. In 2008 USEPA strengthened the 1997 eight-hour ozone standard from 84 parts per billion (ppb) to the current 75 ppb value. On March 10, 2009, the Governor of the State of Texas recommended to the USEPA that the HGB counties be designated nonattainment for the 2008 eight-hour ozone standard. In September 2009, USEPA proposed strengthening the primary eight-hour ozone standard from 75 ppb to within the range of 60 to 70 ppb as the 2010 standard, extending the deadline for designations for the 2008 standard from March 2010 to March 12, 2011, with the deadline applying if the proposed 2010 standard is not finalized. The 2010 standard has not been finalized and the 2008 designation deadline has passed (TCEQ, 2011b). Therefore, the HGB area is currently classified as being in marginal nonattainment for the 2008 primary eight-hour ozone standard and as in severe nonattainment of the 1997 eight-hour ozone standard. The HGB area reached the 84 ppb level associated with the 1997 eight-hour ozone standard in 2009 (Houston-Galveston Area Council [HGAC], 2010a).

For several years, the PHA has maintained a commitment to reducing NO_x and VOC emissions from the Port's mobile fleet equipment and operations. The Clean Air Strategy Plan (CASP) is the PHA's plan to reduce real and sustainable emissions from maritime and port-related engines and operations. The CASP is an element of PHA's strategic goals, focusing on economically and technically feasible ways and means to plan for and implement emissions reduction from maritime intermodal interests in the greater Port of Houston, including Bayport facilities (PHA, 2009).

3.3.8.1. Greenhouse Gases

Air emissions from equipment powered by internal combustion engines used for constructing a proposed project, or from increased activity of these types of sources resulting indirectly from a project will result in releases of Greenhouse Gas (GHG) emissions that could contribute more than negligibly to global climate change depending the magnitude and duration. To date, specific thresholds to evaluate adverse impacts pertaining to GHG emissions have not been established by local decision-making agencies, the State, or the Federal government. The Council on Environmental Quality (CEQ) has published "Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions," February 10, 2010. This document was issued for the purpose of obtaining public comments, but not to regulate Federal land and resource management actions. The Draft Guidance suggests that the impacts of projects directly emitting GHGs in excess of 25,000 metric tons or more of carbon dioxide (CO_2)-equivalent (CO_{2e}) GHG emissions on an annual basis be considered in a qualitative and quantitative manner. However, the guidance stresses that, given the nature of GHGs and their persistence in the atmosphere, climate change impacts should be considered on a cumulative level. In this context, proportion and duration of such emissions compared to large scale emissions (e.g. regional and larger) would serve this purpose.

3.3.9 Noise

Noise is typically categorized as unwanted sound. Sound is characterized by a number of variables including frequency, duration, and intensity. Sound intensity is measured in decibels (dB), which is a logarithmic measure for which values cannot be simply added arithmetically to calculate the aggregate levels. Environmental sound levels are often expressed in terms of averages over standard durations such as 1-hour, 8-hour, and 24-hour periods. These averages are expressed as an equivalent continuous sound level (L_{eq}) with the same duration. Normal speech has a typical sound level of approximately 60 dB. The human ear typically cannot detect variations of 3 dB or less (U.S. Department of Transportation, 2010; Minnesota Pollution Control Agency, 2008; Nevada Department of Transportation, 2000). Human hearing is less sensitive to low frequencies and extremely high frequencies, and is most sensitive to mid-range frequencies. The most widely accepted method of quantifying sound for human receptors is to measure sound across a wide frequency spectrum and apply a weighting known as "A-weighting" to the individual decibel value of each frequency interval. The logarithmic sum of these values is known as the A-weighted sound level, expressed as dB A-weighted units, or dBA. Another sound measure that compensates for increased sensitivity to noise during quieter nighttime hours is the Day-Night Average Sound Level (L_{dn}). It is a 24-hour averaged sound level with a 10 dBA penalty added to measured nighttime levels (from 10:00 P.M. to 7:00 A.M.) and has been used by several agencies such as the U.S. Department of Housing and Urban Development (HUD) and the U.S. Air Force to determine compatibility of noise with the existing land use.

Noise-sensitive receivers are locations or areas where excessive noise may disrupt normal activity, or 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. The nearest residence to the project area (proposed project footprint and immediate vicinity) is approximately 220-ft north of the Bayport Ship Channel (BSC) in the Shoreacres community. The closest church to the project area is the Micah Church, located approximately 3,300-ft north of the project area. The closest park to the project area is Goldenacres Park, located approximately 1,500-ft north of the BSC within the land cut. The closest school to the project area is Bayshore Elementary School, which is located approximately 3,300-ft north of the BSC within the land cut. The closest cemetery is the Seabrook Cemetery, located approximately 7,200-ft south of the BSC within the land cut. There are no hospitals located within the project study area. The existing land use within the project study area varies greatly from residential to heavy industrial. Through the interpretation of aerial photography and site visits, it was determined that the project study area is a mixture of suburban residential, open water/undeveloped land, commercial development, and industrial land uses. Development adjacent to Galveston Bay is primarily residential, and includes the communities of Shoreacres, El Jardin, Bayside Terrace (La Porte), and Morgan's Point. Dense industrial development also exists around the Bayport Ship Channel and Bayport TB. The Shoreacres community, including the Shady Oaks and Bay Colony subdivisions, is the nearest residential area to the BSC in the project area.

The existing sound environment of the area surrounding the BSC is influenced by numerous noise generating sources, many of which are transportation-related (i.e. waterways, roadways, etc.). Waterborne transportation activities in the area include the operation of ships, barges, commercial fishing vessels, and sport and recreational boats. Numerous surface roadways traverse the mainland portion of the project area and these traffic sources also influence the existing sound environment. SH 146 and Port Road are two of the more heavily traveled roads in the project area.

Operations of the existing Bayport container terminal facilities south of the BSC within the land cut also contribute to the sound environment of the area to the north of the BSC. The BSCCT FEIS documented the results of ambient noise measurements taken prior to the construction of the container terminal facilities at various sensitive receptor locations, and provided the results of noise contribution modeling for sensitive receptor locations.

The ambient noise measurements were taken at many sensitive receptor locations, including nine locations in the Shoreacres community, which is closest to the container terminal and berths, and four in the El Jardin community, which is closest to the future intermodal rail yard planned under the BSCCCT FEIS. To estimate noise conditions with the proposed container terminal facilities and servicing intermodal train yard, extensive measurements were taken at the existing Barbours Cut Terminal (BCT) as it had the same type of facilities and noise-producing activity. Measurements accounted for all major noise-producing activities including loading operations, rail and terminal vehicular traffic.

As detailed in the BSCCCT FEIS, Sections 3.8.2.1 and 3.8.3.1, vessel traffic transiting the channel is not expected to be a major or constant sound source for the nearest receptors in Shoreacres, as they are transient throughout the day.

Section 3.8 of the BSCCT FEIS contains more detail regarding the measurement, modeling and expected noise levels at sensitive receptors associated with the existing container terminal facilities around the BSC within the land cut. This information is incorporated by reference.

3.3.10 Cultural Resources

The cultural resources review for this EA is limited to the proposed project area which consists of the BSC. The project area is located in the counties of Harris and Chambers, Texas which is part of the Southeast Texas Archeological Region of the Eastern Planning Region of Texas (Kenmotsu and Perttula, 1993). The cultural history of the project area has been assigned to four board primary developmental stages: Paleo-Indian (12000 to 8000 BC), Archaic (8000 BC to 100 AD), Ceramic or Woodland (100 AD to 1700 AD), and Historic (1700 AD to the present day). These divisions generally are believed to reflect changes in subsistence as reflected by the material remains and settlement patterns of the people occupying this portion of Texas in prehistoric and early historic times.

The earliest generally accepted culture of the Americas, the Paleondian (10,000–6,500 B.C.), appears to have extended over most, if not all, of North America by the end of the Pleistocene epoch. It has been hypothesized that in Texas the Pleistocene coastline extended as much as 25 miles into the present Gulf of Mexico, and that rivers cut deep canyons into sediments deposited during previous periods of glaciations (Aten, 1983). With the close of the Pleistocene came a period of climatic warming and a consequent rise in sea level as surface water was released from glaciers and polar ice. Paleoindian cultural developments in the Gulf Coastal Plain region, as in most areas of North America, appear to have been intimately related to these gradual but vast changes in the world climate and local environmental conditions.

Occupation of the Texas Gulf Coast during the terminal Pleistocene is evidenced by the recovery of several types of well-made, lanceolate, parallel-flaked projectile points such as Scottsbluff, Clovis, Plainview, Angostura, and possibly San Patrice types. The presence of these distinctive projectile point types along the coastal plain appears to reflect activities that would typically have occurred in areas further inland where the environment is characterized by a mixture of deciduous and pine woodlands (Aten, 1983). According to Aten (1983), this type of habitat typically supports low-density human populations. Archaeological evidence synthesized by Story et al. (1990) from numerous counties comprising the greater Gulf Coastal Plain in Texas, Louisiana, Arkansas and Oklahoma supports the suggestion that the Paleoindian groups probably existed in small nuclear families or bands which migrated widely in pursuit of seasonal subsistence resources.

When Europeans arrived on the northern Texas coast, they encountered two major native groups, the Atakapa and the Karankawa Indians, who occupied separate territories divided approximately at the western shore of Galveston Bay. The Atakapan, speaking a language of the Tunican family, displayed traits closely related to the natives of southwestern Louisiana. The Karankawan groups spoke a language of the Coahuiltecan family and were more closely related to the Indians further south in Texas and Mexico.

The prehistoric period in the Galveston Bay region lasted until the 18th century when Spanish and French explorers, merchants, and missionaries arrived by using the natural inlets and harbors carved in the Texas coast. Between Galveston Island and neighboring Pelican Island is the Galveston Ship Channel, which formed a natural harbor for sailing vessels and small steamers. The gap between Galveston Island and Bolivar Peninsula offers the principal entrance into Galveston Bay, while San Luis Pass affords a smaller entryway at the Galveston Island's western end.

During the 19th century, Galveston Bay saw massive colonization by European immigrants and the extermination of the indigenous populations through disease and warfare (Aten, 1979; Gadus and Moss, 2000; Story et al., 1990). Many pirates and privateers called Galveston Island home during the 19th century, including the privateer

Jean Lafitte. In 1836, four ships of the Texas Navy headquartered on Galveston Island and protected the Texas coast from harassment by Santa Ana and the Mexican Navy (McComb, 1986). Galveston Island was an important harbor during the Civil War. Major General John B. Magruder of the Confederacy recaptured Galveston Island although the Union blockading ships limited commerce in and out of the harbor (Cumberland, 1947). Historical settlement around Galveston Bay originally centered on the Houston area, the northern bay shoreline, and on Galveston Island.

The USS Westfield, a U.S. Navy flagship that ran aground during the Battle of Galveston and scuttled to prevent capture on January I, 1863, is situated at the merge point of the Texas City Ship Channel and the HSC. The U.S. Army Corps of Engineers undertook several weeks of recovery operations to retrieve artifacts from the USS Westfield in September 2009. During this investigation and recovery Westfield's largest cannon, the 9-inch Dahlgren, was recovered along with five cannonballs from a depth of 47-ft near the merge point of the Texas City Ship Channel and the HSC.

From the late 19th century onward, settlement and industry have expanded throughout the area. Most portions of Galveston Bay are in use or have been used by historic settlers within the last 200 years (Gadus and Moss, 2000). Physical modifications associated with excavation and disposal of sediments are the single most obvious manifestation of human impact on Galveston Bay.

By 1900, the Federal government had dredged the HSC, including a 12-ft draft spanning Galveston Bay from the Bolivar Roads, across Red Fish Bar, though the cut at Morgan’s Point, and up Buffalo Bayou to Houston. The appearance of oil tankers in the world fleet after WWI resulted in an additional HSC expansion. In close association with the development of the HSC was the creation of a channel to Texas City (Hudson, 1979).

In order to identify potential cultural resources within the channel portion of the proposed project, HRA Gray & Pape, LLC (HRAGP) of Houston, Texas, conducted a cultural resources survey covering an approximately 600-ft wide extent that encompassed the preferred channel alternative’s Areas of Potential Effects (APE). The investigation consisted of a records review, visual reconnaissance, and an underwater remote-sensing survey of the APE.

Archaeological site files, architectural resource files and previously conducted cultural resource surveys in the vicinity were reviewed in order to identify previously recorded archaeological sites and resources. Since 1991, at least seven marine cultural resource surveys have taken place within 1.6 kilometers (1 mile) of the Preferred Channel Alternative. Aside from a small number of anomalies, no significant cultural resources have been discovered or recorded in the APE. In general, the anomalies encountered were most likely modern debris or naturally occurring bottom features.

The records review and inspection of historic and current aerials reveals that terrestrial areas surrounding the APE have been thoroughly disturbed. Land impacts are only expected along the previously disturbed shoreline. Specifically, the shoreline has been covered with rip-rap to slow erosion and the construction of such erosion controls would likely have destroyed any sites that may have existed. The fact that erosion was such a problem at the mouth of the BSC suggests that the location was a poor environment for site preservation. A reconnaissance survey of the surrounding area indicated there are no structures adjacent to the APE with a potential to be included in the National Register of Historic Places (NRHP); therefore, an architectural assessment was not performed.

Following the literature search, a marine underwater archeological remote sensing survey was conducted in accordance with Federal and local standards. Because the land cut portion of the BSC was artificially excavated from land in the late 1960's, and completed to its current geometry in 1977, there is no potential for historical properties or historically significant submerged resources in this portion. Therefore, the remote sensing survey extended seaward from the land cut. Comprehensive remote sensing survey of the project areas using magnetic and acoustic instrumentation resulted in the identification of 13 magnetic and sonar targets in the vicinity of the preferred channel alternative. All targets generated remote sensing signatures suggestive of modern debris or single source isolated objects.

Given the results of the review and survey, HRAGP recommended that no further archaeological work is required for the channel APE and that examined portions of the channel be cleared to proceed as currently planned. The cultural resource coordination for the area of the existing PAs considered under the Raised Levees in Existing PAs placement option were previously conducted and documented in the PA 14/15 Expansion EA. This also includes the associated cells, such as M10, proposed for maintenance material. The results of that survey and coordination indicated that no potential for resources is likely and no further investigation was warranted except for one anomaly warranting further investigation was identified at Atkinson Marsh Cell M11. The Texas State Historic Preservation Officer (SHPO) concurred with these findings. Updated information from the literature review performed for the BSC Improvements cultural resource surveys confirmed a subsequent diving investigation of the anomaly was performed that recorded 2 isolated pieces of debris, and recommended the target be cleared from further consideration as a potential historic site (Jones et al., 2010). The cultural resource coordination for MidBay was accomplished and accounted for in the HGNC FEIS.

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4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION

This chapter discusses the impacts to the environment of the alternatives advanced for evaluation in this EA, and any measures proposed to mitigate for impacts to sensitive resources that would be a consequence of project implementation. Since the proposed project consists of new work dredging to improve an existing navigation channel, and 20 years of operation and maintenance (O&M) of the improved channel, any new and initial impacts to ecological resources would occur primarily during the new work dredging to construct the project. Maintenance dredging for the improved channel would only occur in areas initially impacted by new work dredging, and areas of the existing channel already receiving maintenance dredging. Therefore, maintenance dredging for the improved channel would not produce any new impacts, and would consist of the same periodic disturbances experienced during the current maintenance dredging of the BSC.

4.1 PHYSICAL ENVIRONMENT IMPACTS

The following subsections describe the potential physical environment impacts of the alternatives advanced for evaluation in this EA.

4.1.1 Topography and Soils

No Action Alternative

The No Action Alternative would continue to result in periodic changes in topography from regular channel maintenance dredged material placement at PAs.

Preferred Alternative

The channel improvements would not impact surface topography, but would have minor bathymetric changes discussed in Section 4.1.3. The total amount of dredged material that would be generated from the construction of the Preferred Alternative is estimated to be approximately 3.7 MCY of new work material and approximately 2.1 MCY of maintenance material. The new work material would be used to raise the levees of the existing in-bay confined PA 15, as described in Section 2.4.2. The maintenance material would be placed in existing PAs including PAs 14, 15, other Atkinson Island PA cells and, Mid Bay.

While local changes would occur to topography during construction of the Preferred Alternative, these changes would occur on PAs, which are islands located away from the mainland, and would not alter topography or drainage patterns surrounding inhabited areas or land-based agricultural or water resources. Considering this, the Preferred Alternative would be expected to have no impacts on the regional physiography and topography of the study area.

Under this alternative, no impacts to native surface soils within the project area would occur. A large portion of the new work material removed from the bay bottom would be clay and some sand. However, this would represent a small percentage of the bay bottom's clay, which is primarily the Beaumont Formation covering much of Galveston Bay. The new work materials would be used raise the levees at PA15 which would eliminate a potential future need to mine clay from other parts of the bay solely for levee construction. This would be a positive impact. Considering this information, the Preferred Alternative would result in no impacts to topography or soils.

Over the 20-year maintenance period, no impacts would be anticipated as a result of periodic maintenance dredging and placement events, as the expanded capacity of PA15 would accommodate the existing BSC maintenance and incremental increase in maintenance material anticipated from the proposed project.

4.1.2 Geology

No Action Alternative

The No Action Alternative would not impact geology within the study area.

Preferred Alternative

Dredging to construct the channel improvements would minimally impact the local geology by redistributing existing bay bottom clays and sediments, causing local temporary increases in turbidity, and potential increases of local shoaling rates within the BSC. Net changes to the local or regional nature of the existing geology of the study area would be minimal. Additionally, there would be no impacts or changes to geologic hazards such as faults and subsidence.

Over the 20 year maintenance period, no new impacts would occur as a result of periodic maintenance dredging and placement events. Maintenance activities would only affect areas previously disturbed during the initial construction of the project.

4.1.3 Bathymetry

No Action Alternative

The No Action Alternative would have the same changes to local bathymetry from maintenance dredging of the existing HSC and BSC over the next 20 years. These would be limited changes within the existing BSC and HSC.

Preferred Alternative

Constructing channel improvements under the Preferred Alternative would result in local bathymetric changes within and adjacent to the existing BSC. These changes would be small compared to the scale of regional bathymetry. The raising of the existing PA15 levees would result in no net changes in bathymetry from the No Action Alternative. Deepening and widening the BSC would be expected to result in a reduction in drawdown wave heights for existing vessels.

While local changes to bathymetry and topography would occur from construction of the proposed channel improvements and placement features, these changes would be expected to have minimal impacts on the regional bathymetry of the submerged portions of the study area.

Over the 20 year maintenance period, no new impacts would occur as a result of periodic maintenance dredging and placement events. Maintenance activities would only affect areas previously disturbed during the initial construction of the project.

4.1.4 Water and Sediment Quality

No Action Alternative

No construction would occur under the No Action Alternative. Only the periodic maintenance dredging and dredged material placement already performed for the BSC and HSC occurring over the next 20 years, and the temporary and localized effects due to increases in turbidity associated with those actions, would continue. Because the expansion of PAs 14 and 15 is a project already planned and approved for implementation by the USACE Galveston District, the connection between PAs 14 and 15, and Atkinson Marsh Cell M11, as well as other planned marsh and placement cells, would eventually be built. Therefore the temporary and localized effects due to increases in turbidity associated with those actions would also occur.

Preferred Alternative

Dredging the channel improvements under the Preferred Alternative would result in minimal impacts, but would not be expected to degrade the long-term water quality in or near the BSC. These effects would be consistent with those that would occur during normal maintenance dredging operations and planned placement area construction occurring in the No Action Alternative. Temperature, salinity, and density distribution patterns would temporarily be affected as a result of water column mixing during dredging and placement activities. These patterns would return to their previous condition following completion of dredging. Any impacts to the distribution patterns for these water quality parameters from dredging would be minimal.

Short-term changes in dissolved oxygen (DO), nutrients, and contaminant levels could occur due to mixing and disturbance of sediments into the water column during dredging and dredged material placement. Temporary decreases in DO concentration could occur during and immediately after dredging due to the movement of anoxic water and sediments through the water column. Temporary DO decreases could occur due to short-term increases in organic material in the water column, and the associated aerobic decomposition. These minimal impacts would be expected to be limited to the immediate vicinity of dredging and dredged material placement. Contaminants present in the surface sediments would be temporarily suspended during dredging and placement activity. However, considering the sediment and elutriate data discussed in Section 0, almost all contaminants detected in more recent results have been below screening thresholds or other thresholds of concern. Dioxin/furans have been detected in sediment samples, and are low concentrations in the single ppt range. Only copper, chlordane and phenanthrene were detected at levels above a chronic or low-percentile risk level, and these were limited to one or two samples out of ten, or were only slightly above the threshold, and therefore are isolated detections or not considered to be a potential environmental impact. Therefore, levels of sediment contaminants are expected to be predominantly low. Once the dredging activities stop, disturbed material would settle, and DO, nutrient, and contaminant concentrations would return to pre-disturbance levels. These impacts would be minimal, and similar to impacts occurring during the periodic maintenance dredge activity and placement that currently takes place in Galveston Bay. Therefore, temporary effects are expected from dredging due to short-term changes in DO, nutrients, and contaminant levels.

Dredging could cause short-term increases in turbidity. However, numerous studies indicate that dredge-induced turbidity plumes are, more often than not, localized, spreading less than a thousand meters from their sources and dissipating to ambient water quality within several hours after dredging is completed (Higgins et al., 2004). A literature review of dredging operation effects on suspended sediments found that in almost all cases, the vast majority of re-suspended sediments resettle close to the dredge within an hour (Anchor Environmental CA L.P., 2003). The anticipated dredging technique for this project would be hydraulic cutterhead dredging, which generally produces small plumes that rapidly decay (ERDC, 2002). Properly operated dredges can confine elevated suspended bottom sediments to several hundred meters from the cutterhead with levels dissipating exponentially towards the surface with little turbidity actually reaching surface waters, and in many cases, at concentrations no greater than those generated by commercial shipping operations or during severe storms (Higgins et al., 2004). Therefore, only temporary, minor effects are expected from dredging due to increased turbidity.

Because deepening and widening for the channel improvements would largely involve dredging into native clay and sand materials below the bay bottom surface, new work material used to raise or build levees under this alternative would not be contaminated. Therefore, no impacts are expected from use or placement of new work materials under this alternative. Maintenance dredging to remove unconsolidated sediments on the bay bottom surface during normal maintenance cycles would involve material more subject to environmental contamination. However, the USACE routinely collects water and sediment samples under their maintenance dredging program to ensure there are no causes for concern.

Because of the trend observed in the upper HSC, the USEPA conducted a dioxin/furan sediment characterization study for the HSC in Galveston Bay, from Morgan's Point to Galveston Island (Benchmark Ecological Services, Inc. 2009). The results indicated values ranging from a high of 9.05 ppt at Morgan's Point, and decreasing almost linearly from there, to a low of 0.21 ppt near Galveston Island. The strong linear decrease observed is consistent with a source upstream of the sampled segment of the HSC.

Dioxin/furans have been detected in sediment samples, and are low concentrations in the single ppt range (see Section 3.1.5). A review of the historical land use surrounding the land cut portion of the BSC has been undeveloped, bulk liquid petrochemical terminals, residential development, or BSCCT container terminal facilities according to historical information, aerials, and USGS quadrangle maps reviewed in developing this EA. It has not included historical dioxin sources such as paper pulp mills, solid waste incinerators, pesticide manufacturing, cement kilns, sludge disposal, or chlorinated compound refining. As such it would not be expected to be a source for elevated dioxin levels. The 2012 results, from locations in the BSC that overlapped with the 2010 sample locations, are all considerably lower, and were taken two years later. Considering their magnitude and location, the 2012 results suggest sediment concentrations have gone down in the vicinity.

The upper HSC (north of Mid Bay PA) and BSC maintenance materials are routinely placed in PAs 14 and 15, Atkinson Marsh Cells M7/8/9 and M10, and Mid Bay with several of these having received this material since the 2009 USEPA study. Therefore, these PAs receive maintenance material from the same channel and from the same upper part of the Bay as the proposed action. Therefore, the proposed action would not be expected to alter the nature of the maintenance material already being placed into these PAs. Considering the short-term increases in turbidity, only minimal impacts from re-suspension of sediments would be expected, as the vast majority of re-suspended material resettles close to the dredge within an hour, and hydraulic dredging produces small, rapidly decaying plumes that can be confined to within several hundred meters under proper operation, as previously noted. In many cases, concentrations no greater than those generated by commercial shipping or severe storms are produced. Storms, floods, and large tides can increase suspended sediments over much larger areas and for longer periods than dredging operations (Higgins et al., 2004). Considering this, maintenance dredging performed over the next 20 years as part of the periodic maintenance of the improved channel under the Preferred Alternative, would not be expected to result in more suspension and dispersal of sediments as compared to the No Action Alternative, or natural storm, flood, and tidal events.

In summary, the following points from the previous information can be considered:

- New work material used to raise or build levees would not be contaminated and therefore would not have impacts from placement.
- For substances with a numerical standard or screening threshold, BSC sediment quality data indicate no persistent concerns, with only a few isolated instances of exceedances for chronic or low percentile effects levels for copper, chlordane (a pesticide), and phenanthrene (a PAH). PCBs have been below screening thresholds, with the majority of samples having no detection, in all the results reviewed. Dioxins currently have no national guidelines, but for comparison, the most recent sampling shows levels below bioaccumulation screening values published by Oregon (Section 3.1.5);
- Hydraulic dredging produces small, localized, rapidly decaying suspended sediment plumes, which are expected to be considerably smaller and of shorter duration than what storm, floods, and tides already cause.
- The upper HSC and BSC currently receive maintenance dredging, with placement into the PAs identified for use for the proposed action, and the proposed action would not change the nature of the material going into these PAs. The maintenance material is routinely tested by the USACE and PHA to ensure there are no concerns for material placement.

Considering these factors, new work or maintenance dredging under this alternative would not be expected to have impacts.

4.1.5 Physical Oceanography

The following subsections described impacts of the alternatives on physical oceanographic processes in the Bay.

4.1.5.1. Tides, Currents, and Water Level

No Action Alternative

The No Action Alternative would not impact the tides, currents, or water level in the project area.

Preferred Alternative

The proposed action involves deepening and widening an existing navigation channel that is volumetrically small compared to the volume of Galveston Bay. The proposed action also does not involved putting in new bathymetric features in the Bay that would interfere with tidal exchange, increase shoreline currents, or change the littoral transport in the Bay. The proposed action does not change the freshwater input or wind driven circulation within the project area. Therefore, no impacts to tides, currents, and associated processes, are anticipated.

Although the size of the BSC is negligibly small compared to the volume or the tidal prism of the Bay and would have negligible influence on water level, the proposed action for the BSC will deepen, not fill, the current channel. Therefore, the bathymetric change would be shallower water to deeper water. As such, it would not impact storm surge and/or coastal flooding. Since it is not a part of any riverine channel, it has no potential to alter riverine flow or floodplains. Therefore, no impacts to flooding from altering water levels in the Bay during storm conditions are expected.

4.1.5.2. Salinity

No Action Alternative

The No Action Alternative would not impact salinity within the project area.

Preferred Alternative

The proposed action does not involve changing any freshwater inflow related sediment transport and doesn't alter any littoral sediment budget or transport processes in the floodplain. The BSC is a tributary channel to the HSC with a closed terminus. The proposed channel improvements will not alter or change saltwater flows in the BSC or Galveston Bay as the BSC inflows and outflows are controlled by the HSC and Galveston Bay.

Moreover, since the channel is a dead end one that does not form part of a natural cove or estuarine inlet, or connect a part of Galveston Bay with different salinity to these types of aquatic habitats, it does not have a potential to alter salinity to impact aquatic resources using them.

4.1.5.3. Relative Sea Level Rise

No Action Alternative

Under the No Action Alternative, the estimated change in sea level over 20 years discussed in 3.1.4.3 would occur, and range between 0.42 ft and 0.89 ft, depending on the rate of change scenario assumed. There would be no proposed project that would be impacted, but existing projects could experience some impact, and several possible effects to the Bay environment could occur. Existing tidal wetlands could be inundated. New wetlands could develop where the shoreline is not armored or altered by development. Tidal amplitude could increase due to an increase in depth that reduces the effects of bottom friction. The increase in tidal amplitude could in turn increase tidal current velocities and erosion at the shoreline. Given the elevation range of tidal wetlands, and the scale of sea level rise predicted, these effects would be expected to occur only under the highest rates of change.

Preferred Alternative

The potential for RSLR impacts on the proposed project is minimal as the increase in RSLR is relatively small. There may be a slight increase in currents and potential increase in shoaling rates; however, these would be minimal and difficult to measure. The calculated low historic rate over the 20-year period of analysis is less than one half foot (0.42 ft) and the high rate is less than a foot (0.89 ft). Nevertheless, increasing RSLR would not impact the function of the channel or purpose of the proposed action, which is to provide sufficient draft for vessels to use the BSC. A rise in sea level would increase draft; however, this increase is expected to be small at less than one foot.

Impacts on surge levels due to the project, with and without RSLR, are expected to be minimal. The lack of effect on storm surge from proposed channel improvements was explained in Section 4.1.5.1. The dredged material would be placed into existing placement areas that are well above the elevation where surge would be a factor; therefore, the dredged material placement plan would not impact future RSLR. The PA 15 levees will be raised from +25 ft MLT to an elevation of +30 ft MLT. Therefore, the projected increases in sea level are unlikely to require any levee modifications. Impacts on the Preferred Alternative will be minimal.

4.2 BIOLOGICAL RESOURCES IMPACTS

The following sections describe the anticipated impact to biological resources within the project area and the mainland surrounding the project area. Placement would occur in PAs 14, 15, Mid Bay, and Atkinson Island under the Preferred Alternative and associated wetland impacts have already been accounted and mitigated for these existing PAs.

4.2.1 Vegetation

4.2.1.1. Terrestrial

No Action Alternative

No changes to terrestrial vegetation would occur under the No Action Alternative.

Preferred Alternative

Channel improvements would impact no vegetation. Raising the existing PA15 levees would have no impacts on terrestrial vegetation from the construction of this alternative or the associated maintenance over the next 20 years at this established and regularly used PA, and the other PAs proposed for maintenance material placement.

4.2.1.2. Wetlands

No Action Alternative

No changes to wetlands would occur under the No Action Alternative other than the continuing construction and development of BU marsh cells at Atkinson Island, which would add estuarine marsh. The initial filling of Marsh Cell M7/8/9 is planned for 2015.

Preferred Alternative

No wetlands exist along the shoreline surrounding the proposed channel improvements. No impacts to wetlands along the shoreline would occur as a result of the proposed dredging to improve the channel. In order to identify extent of existing salt marsh specifically within the construction footprint of the proposed stability berm necessary for raising PA 15, field surveys were performed on May 30, 2013 to determine the extent of marsh, and had data collected on June 5, 2013 to apply the USACE Galveston District's (SWG) Tidal Fringe Hydrogeomorphic (HGM) [interim] model to estimate the functional capacity impacts of constructing the proposed stability berm. The Tidal Fringe HGM (interim) model is described in more detail under Section 4.4.2.2. Elevations for these areas were also surveyed. Approximately 9.2 acres of tidal marsh were found within the planned footprint of the stability berm, consisting of three subtypes: high marsh dominated by more salt tolerant species such as sea oxeye and some brackish-condition species such as marshhay cordgrass, low marsh with a greater predominance of smooth cordgrass and seashore saltgrass, and Salicornia flats dominated by dwarf saltwort. The marsh continues into the area of a 50-ft construction corridor proposed for equipment access, encompassing approximately 4.7 more acres of tidal marsh. Further east of the 50-ft construction corridor, the marsh conditions continue roughly to the extent of emergent land. The marsh area east of the 50-ft construction corridor would be identified as a "no access" zone in construction documents to prohibit entry and use by construction equipment. The site will be accessed from the HSC side of PA 15. Table 3.2.1-1 shows the acreage and distribution of the subtypes of marsh, and the associated functional capacity units (FCU).

Table 4.2.1-1: Tidal Fringe HGM (Interim) Results for Area Fringing PA 15 Eastern Levee within Proposed Project Footprint

Wetland Assessment Areas		Functional Capacity Units			
Type	**Acres**	**Biota**	**Botanical**	**Physical**	**Chemical**
Open Water*	0.139				
Tidal Marsh					
High	5.279	3.9	5.3	3.3	4.1
Low	2.275	1.5	1.8	1.4	1.5
Salicornia	1.678	0.7	0.5	0.8	0.7
Area Weighted Average Total	**9.233**	**6.0**	**7.5**	**5.4**	**6.3**
Temporary Wetland Impacts	**4.7**				

*These areas are PA spillbox drainage channels

Constructing the stability berm to raise the eastern levee segment of the existing PA 15 would permanently impact approximately 9.2 acres of marsh. This would result in the loss of the tidal fringe marsh FCUs shown in Table 3.2.1-1. Proposed mitigation for this impact is discussed in Section 4.4. The 4.7 acres of tidal marsh within the proposed 50-ft construction corridor would be temporarily disturbed by construction equipment access to build the proposed stability berm. Construction mats, that disperse equipment weight over larger areas and would prevent uprooting of vegetation, would be required in the construction corridor. Once construction is complete, the mats would be removed, and the site would be restored to pre-project contours and elevations, and planted. Raising the other levee segments of the existing PA 15 would not impact any of the other narrow bands of salt marsh and intertidal sand flats found around the fringe of the existing PA, as the levee base would be widened to the inside. No wetlands or other special aquatic sites are found in the footprint of the proposed mitigation site, as it is open water located at the Baytown Nature Center. More detail can be found in Section 4.4.2.1 and Appendix G.

In summary, approximately 9.2 acres of wetland habitat would be permanently impacted from the construction of this alternative, but would be mitigated, and up to 4.7 acres of marsh vegetation would be impacted temporarily by construction activities, but would be restored. No impacts would occur from the associated maintenance over the next 20 years, but maintenance material would be used in the construction of estuarine marsh.

4.2.2 Wildlife

4.2.2.1. Terrestrial

No Action Alternative

No changes to terrestrial habitat would occur under the No Action Alternative.

<u>Preferred Alternative</u>

No loss of upland habitat is anticipated as a result of the proposed channel dredging. Dredged material placement into the existing PAs 14, 15, Mid Bay, and Atkinson Island, would not impact native habitat. Any vegetation that may become established between maintenance use of these active PAs would be temporary in nature at best.

Wildlife (e.g., foraging or nesting avian species, raccoons) may be temporarily displaced during levee construction and PA use. Noise and light associated with raising the PA 15 levees would be expected to affect wildlife behavior, as would the general increase in human activity. Construction impacts would be considered minimal in these areas that are subjected to routine disposal disturbances. Measures to minimize disruption of nesting and foraging for migratory birds during the appropriate time windows would be implemented.

4.2.2.2. Aquatic

<u>No Action Alternative</u>

No new changes to aquatic habitat would occur under the No Action Alternative, and there would be no new impacts beyond what occurs during routine, periodic maintenance for the existing channel. However, continuing construction and development of BU marsh cells at Atkinson Island, would add estuarine marsh, which would benefit the aquatic environment.

<u>Preferred</u>

Aquatic habitat within the project area and vicinity includes open-bay water, open-bay bottom, intertidal (e.g., marsh, mudflat), wetlands (salt marsh), and oyster habitat. Within the project footprint, the only special aquatic site present is wetlands within the proposed stability berm for PA 15. There are no other special aquatic sites regulated under 40 CFR 230 such as sanctuaries and refuges, coral reefs, mudflats, vegetated shallows, or riffle and pool complexes present within the project footprint. Portions of the aquatic habitat in the project area would be directly impacted by the construction of the channel improvement, including impacts to oyster habitat, presented below. Temporary and minimal impacts to aquatic life in the project area and immediate project vicinity similar to what occurs during existing channel maintenance dredging could occur as a result of increased turbidity, sedimentation, noise, light, and vessel activity during the construction period. Turbidity may temporarily affect the respiration, foraging, and/or reproductive capability of some species. Construction vessel traffic could increase wave activity and water uptake/discharge while construction activity may also result in temporary avoidance of the construction area and a temporary reduction in marine life production. Dredging activities would be intermittent and localized. These impacts are considered temporary and of short duration.

Aquatic habitat within the project area and vicinity includes open-bay water, open-bay bottom, intertidal (e.g., marsh, mudflat), and oyster habitat. Portions of the aquatic habitat in the project area would be directly impacted by the construction of the channel improvement, including impacts to oyster habitat, presented below. Temporary and minimal impacts to aquatic life in the project area and immediate project vicinity could occur as a result of increased turbidity, sedimentation, noise, light, and vessel activity during the construction period. Turbidity may temporarily affect the respiration, foraging, and/or reproductive capability of some species. Construction vessel traffic could increase wave activity and water uptake/discharge while construction activity may also result in temporary avoidance of the construction area and a temporary reduction in marine life production. Dredging activities would be intermittent and localized. These impacts are considered temporary and of short duration. The raising of the PA 15 levee under the new work dredged material placement option for this alternative would permanently impact approximately 9.2 acres of marsh and temporarily impact 4.7 acres of marsh.

4.2.2.2.1. Benthic

No Action Alternative

No new impacts to benthic habitat would occur beyond what occurs during routine, periodic maintenance for the existing channel, under the No Action Alternative.

Preferred Alternative

The benthic habitat in the project area and adjacent areas is comprised of featureless soft-bottom substrates likely dominated by benthic infauna, such as polychaetes and amphipods. It can be assumed that BSC dredging for deepening and widening purposes would result in 100 percent mortality to benthic infaunal communities present. Benthic organisms within the project vicinity may also be subjected to down-current deposition of sediments during dredging. The resultant turbidity and settling from dredging has the potential for smothering sessile benthic organisms and/or inhibiting filtration functions required for respiration and nutrition. The temporary lower DO concentrations that could result from temporary suspension of organic material during dredging could cause a temporary displacement of mobile organisms and may stress or cause mortality to sessile organisms. As discussed in Section 4.1.4, these effects would be temporary, as suspended sediments would return to background levels within a short time frame, and would be similar to what occurs during existing channel maintenance dredging. This would also apply to the periodic maintenance dredging over 20 years. Furthermore, it is assumed that marine organisms present in upper Galveston Bay have adapted to the naturally occurring yet highly variable turbidity levels caused by dynamic freshwater and tidal inputs compounded by strong wind driven currents which are typically observed.

As the BSC is already an existing active navigational channel which undergoes routine maintenance dredging, the benthic community that is present is likely adapted to frequent dredging disturbance. The BSCCT FEIS noted that recovery of benthic infauna has been observed as quickly as 18 months following disturbance in experimental dredge plots in upper Galveston Bay. As such, the impact to benthic infauna would be considered a temporary, short-term impact.

Under the Preferred Alternative, dredged material placement would occur in areas with existing levees whose impacts have been previously described and accounted for as part of other ongoing USACE dredge projects in Galveston Bay. This placement alternative would result in no additional impacts to the benthic marine community. Therefore, over the 20-year maintenance period, no new or additional impacts would occur as a result of periodic maintenance dredging and placement events.

In summary, the dominant infaunal species within Galveston Bay are opportunistic species expected to rapidly recolonize the area following disturbance. Therefore, only temporary impacts to the soft-bottom open-bay community from deepening and widening of the BSC under both the Preferred Alternative and Alternative 2 options would occur.

4.2.2.2.2. Phytoplankton and Macroalgae

No Action Alternative

No new impacts to phytoplankton and macroalgae beyond what occurs during routine, periodic maintenance for the existing channel would occur under the No Action Alternative.

Preferred Alternative

Phytoplankton communities are highly sensitive to reductions in light levels. The BSC channel improvements would generate turbidity and subsequently decrease photosynthetic activity of phytoplankton present within the vicinity dredge operations. Due to the transitory nature of dredging operation, the impact of the resultant sediment plume would be short-term and confined to a relatively small portion of the Upper Bay at any one time. Phytoplanktons also have the potential for entrainment in hydraulic dredge equipment. In both cases it is highly unlikely that interactions with phytoplankton would occur as dredge operations would be conducted below the photic zone where phytoplanktons inhabit. In the event phytoplankton are impacted, plankton turnover time is on the order of hours to days, and therefore any primary productivity losses would quickly be compensated by supplemental phytoplankton growth upon dissipation of the sediment plume. Only minimal impacts to phytoplankton from initial construction or maintenance dredging activities are expected from this alternative over the 20-year maintenance period.

Vessels would need to cycle water for engine cooling as well as potentially exchange ballast water. Heated engine effluent would be quickly diluted, and the resulting increase in water temperature is expected to be minor. Heavy shipping traffic augments the mixing and circulation of water in the waterway. Wind, tidal and isohaline water mixing in Galveston Bay is highly dynamic and would also assist in dissipation of thermal plumes resulting from cooling water intake and discharge. However, temporary entrainment of phytoplankton within the dissipating thermal discharge plume could result. Water intake related to ballast water and engine cooling could also result in the entrainment of aquatic resources. Turnover of phytoplankton however is high and the relatively low number of individuals removed from the species' populations would be expected to have a minimal impact on the ecology and trophic relationships within the proposed project area and the surrounding waters. Additionally, the transited waterway is an active commercial ship channel that is already subject to withdrawal and discharge of vessel engine cooling and ballast water activities. In summary, only minimal impacts to phytoplankton from water uptake and discharge are expected.

Buoyant macroalgae communities have the potential to be present in the project area during dredge activity. No aspects of the project would result in intentional algae collection and removal from the Galveston Bay system. This is especially true since the channel improvements are being made to the existing navigation channel alignment, which is the most direct route in and out of the BSCCT, and not providing new routes of travel through other parts of the Galveston Bay. Vessels might however encounter floating algal mats (e.g. *Sargassum*) while transiting the BSC. Impacts related to increased vessel traffic are anticipated to be minor and of short duration. The BSC already supports extensive vessel traffic and is a focal point for commercial marine transport in the Galveston Bay system. In addition, deepening and widening of the channel should reduce the need for transiting support vessels and tug vessels associated with transit in the channel.

4.2.2.2.3. Zooplankton

No Action Alternative

No new impacts to zooplankton beyond what occurs during routine, periodic maintenance for the existing channel would occur under the No Action Alternative.

Preferred Alternative

Similar to phytoplankton, dredging of the BSC and cycling of vessel cooling and ballast water has the potential to minimally impact zooplankton populations. Dredging of the BSC would generate turbidity which could clog feeding appendages and impede respiration of zooplankton. Due to the transitory nature of dredging operations, the impact of the resultant plume would be short-term and confined to a relatively small portion of the Upper Bay at any one time, and would be similar to what occurs during existing channel maintenance dredging. Although zooplankton also have the potential for entrainment in dredge equipment at depth, these organisms primarily graze on the phytoplankton community which is found exclusively in the photic zone and therefore would have little interaction with the operation of hydraulic dredges. Because zooplankton turnover time is on the order of hours to days, any losses resulting from either of these scenarios would quickly be offset by reproduction upon dissipation of the sediment plume. Vessels would need to cycle water for engine cooling as well as potentially exchange ballast water. Water discharged for engine cooling would be quickly diluted, and the resulting increase in water temperature is expected to be minor. Heavy shipping traffic augments the mixing and circulation of water in the waterway. Wind, tidal and isohaline water mixing in Galveston Bay is highly dynamic and would also assist with dissipation of thermal plumes resulting from cooling water intake and discharge. However, temporary entrainment of zooplankton within the dissipating thermal discharge plume could result. Water intake related to ballast water and engine cooling could also result in the entrainment of zooplankton as well as potential impingement on screening devices installed on intake and discharge equipment. Turnover of zooplankton, however, is high and the relatively low number of individuals removed from different species' populations would be expected to have a minimal impact on the overall trophic structure in the proposed project area and the surrounding Galveston Bay. Additionally, the transited waterway is an active commercial ship channel that is already subject to the withdrawal and discharge of vessel engine cooling and ballast water activities.

In summary, only minimal impacts to zooplankton are expected to occur from the initial construction of this alternative or the related periodic maintenance dredging events over the 20-year maintenance period.

4.2.2.2.4. Typical Fish Assemblages and Nonmanaged Species

No Action Alternative

No new impacts to typical fish assemblages and nonmanaged species would occur under the No Action Alternative.

Preferred Alternative

Noise and light levels associated with construction dredging operations for improving the channel, as well as increased vessel activity, would affect fish and nonmanaged species behavior. Unlike passive benthic organisms and plankton, it is anticipated that these mobile species have sensory mechanisms to detect and actively avoid the potentially adverse environmental conditions created in active dredging areas. Any disruption to foraging would be considered minor and short-term, as large expanses of similar, suitable habitat are located immediately adjacent to the project area for refuge purposes.

Following deepening and widening of the BSC, decreases in fish abundance in the project area are possible if vessel traffic increases and/or water quality conditions of the altered environment. The BSC already supports extensive vessel traffic and is a focal point for commercial marine transport in the Galveston Bay system. Increased cargo tonnage as addressed in the BSCCT FEIS would likely be offset by the reduction in tug support required for container vessel traffic transiting the channel, and the fewer, larger vessel transits needed to convey cargo due to the channel improvements. Therefore, a net increase in vessel traffic that would increase the disruptions is not anticipated. The expanded area of the BSC may experience decreased dissolved oxygen levels compared to the pre-existing bay-bottom, however, these conditions likely already exist in the BSC. The project area encompasses an existing channel and large expanses of suitable, oxygen enriched, shallow-water habitat is available immediately adjacent to the project area.

As noted above, vessels would need to cycle water for engine cooling as well as potentially exchange ballast water. This water exchange combined with at depth hydraulic dredge has the potential for negatively affecting specific species and life stages of fish. While passively floating planktonic fish eggs and larvae may not be able to avoid water intakes and are more susceptible to impingement and entrainment impacts, adult and juvenile fish life stages are capable of actively avoiding these adverse conditions. Entrained and impinged fish eggs and larvae would be subjected to physical stress and abrupt pressure changes. Physical stresses are the result of abrasion or contact with screens and with the impellers from the pumps. The pressure changes experienced by entrained organisms once withdrawn into vessel equipment have the potential to destroy fish eggs and larvae. Pressure changes which exceed ambient pressure of 40 percent or more of the acclimation pressure typically result in immediate or latent mortality (Cada, 1990). Similarly, impingement of organisms defined as adhesion to screening mechanism or other intake equipment, prevents escape and typically results in 100% mortality. Although unlikely, the mortality rate of impinged and entrained eggs and larvae that are entrained or on vessel operations may be less than 100 percent if certain species and life stages can escape these stresses.

Factors that affect the numbers of species and individuals that would be impinged or entrained in intakes include the distance of the water intake from shore, depth of the water intake, through-screen intake velocity, screen size, pumping capacity, differences in life history and distribution patterns of organisms, and quality and availability of habitat and water quality at the intake (GBNEP, 1993; Saila et al., 1997). In addition, the number of eggs and larvae entrained depends on the distribution of eggs and larvae. Distribution and abundance of eggs and larvae in the water column and in benthic environments is highly variable on temporal and spatial scales and is solely a function of species specific spawning behavior coupled with oceanographic circulation (Gledhill and Lyckowski-Shultz, 2000).

Due to the very high natural mortality rate of eggs and larvae, the prolific reproductive capacity of many of the forage fish species present in the project area, and the relatively small volume of water exchanged, the minimal impacts associated with egg and larval entrainment and impingement should not affect fisheries resources. Additionally, the transited waterway is an active commercial ship channel that is already subject to the withdrawal and discharge of vessel engine cooling and ballast water activities.

In summary, only minimal impacts to fish are expected to occur from the initial construction of this alternative or the related periodic maintenance dredging events over the 20-year maintenance period.

4.2.2.2.5. Oyster Reefs

No Action Alternative

No new impacts to oyster reefs would occur under the No Action Alternative.

Preferred Alternative

The Preferred Alternative dredging for channel improvements would result in removal of both consolidated oyster reef and shell hash habitat that has been verified within the project footprint. While channel deepening and widening of the BSC would impact a small proportion of consolidated oyster reef, habitat along the existing BSC east to west edges is primarily comprised of shell hash substrates containing less dense isolated oyster clusters. Additional detail regarding the results of extensive habitat mapping and characterizations are available upon request. If not mitigated for, this would be a permanent impact to the local oyster reef habitat along the BSC and the Flare widening at the intersection with the HSC. Mitigation of these impacts will include rehabilitation of healthy oyster reefs damaged by Hurricane Ike and construction of reef pads in nearby analogous environments. Further detail regarding BSC modification mitigation is described in Section 4.4.

Geospatial data developed from the side-scan and ground-truthing survey described in Section 3.2.2 was analyzed using the preferred alternative geospatial extent data and a geographic information system (GIS) to determine acreages of direct impact within the full widening/deepening extent (to the planned proposed channel top-of-banks) (Exhibit 3.2.2-1). Estimates of directly impacted oyster habitat within the area of the preferred widening and deepening total 4.63 acres and included both consolidated reef as well as variable proportions of isolated oyster clusters overlying shell hash substrates. Due to the previous mining of the existing BSC discussed in Section 1.1.2, the proposed project does not require new work to deepen along most of the existing channel footprint. The limits of the mining cover the length along which oyster reef is located on the south side of the channel. Therefore, any horizontal shift in the top of bank due to deepening will not be necessary, which is corroborated by recent bathymetry showing the existing side slope already reflects the necessary deepened profile. Therefore, no reef would be affected on the south due to deepening. The anticipated impacted acreage constitutes approximately 1.5% of the total deepening and widening area which encompasses approximately 298 acres. This acreage is comprised of less than 0.2 acres of consolidated oyster reef (less than 1% of total dredge area), while the majority of this habitat (4.43 acres) is comprised of isolated oyster clusters overlaid on shell hash substrates. This constitutes an adverse impact to a significant resource and would be fully mitigated if the project is constructed.

Indirect impacts from turbidity and sedimentation could occur to the oyster habitat down-current from the directly impacted areas, but are expected to minimal, considering literature reviewed and the extensive presence of reef directly adjacent to the HSC and BSC. Turbidity can inhibit successful filter-feeding and spawning activity while excess sedimentation can prevent efficient settlement and recruitment over existing consolidated reef and shell hash substrates. However, these effects from hydraulic dredge induced turbidity are expected to be minimal, considering the literature discussed in Section 4.1.4. The vast majority of suspended particles would be expected to resettle close to the dredge and turbidity concentrated at the bottom of the water column. In another study of total suspended solid (TSS) around a hydraulic dredge in the vicinity of oyster beds in Calcasieu Lake during maintenance dredging of a navigation channel, results showed no discernible differences in concentrations upstream, parallel to, and downstream of the dredge, indicating the dredging operation had no influence on TSS (USACE New Orleans District 2007). Results of earlier densitometry surveys from this study indicated silt suspension during maintenance dredging was confined to the deep parts of the channel. These results are expected because hydraulic cutterheads blades are designed to direct loosened material efficiently toward the suction intake.

With the exception of a few smaller complexes, reef within the part of Upper Galveston Bay that the project is located in, is almost exclusively located directly adjacent to the navigations channels of the BSC and HSC. This is clearly observed in the 1991 historical mapping of reef by Texas A&M University at Galveston (TAMUG),shown in Exhibit 2.3.1-1, and was corroborated in the oyster survey side scan sonar data that was later groundtruthed by diver for this project. The channel margins are covered with extensive reef, and the trend is observed along the HSC south of the project area. The HSC was widened and deepened under the HGNC project between 1998 and 2008, and extensive HSC adjacent reef was still observed in the sidescan sonar data for this project in 2011. Considering the extensive reef coverage directly adjacent to the channels, and considering that these channels are periodically dredged for maintenance (which would involve higher percentages of unconsolidated fines), the new work dredging required for construction of the proposed project and subsequent maintenance dredging would not be expected to result in reef losses due to turbidity effects, and only minimal impacts would occur.

Approximately 35 acres of oyster habitat (consolidated reef and shell hash habitats) are located within the 500-ft buffer zone of the channel. Consolidated reef habitat includes less than 4 acres and is restricted to a relatively small area located in the northern section of the buffer zone. The remaining 31 acres of oyster habitat in the buffer zone are located adjacent north and south of the existing channel, and the northern turning portion of the Flare. Considering the information on turbidity, and the extensive presence reef directly adjacent to the HSC and BSC which have been periodically dredged and/or widened, no permanent impacts to reef in the buffer zone from new work or maintenance dredging activity are expected.

Following construction, additional permanent vessel traffic through the BSC resulting from the BSCCT project is anticipated as the BSCCT continues to expand. Turbidity and sedimentation impacts as a result of the increased vessel traffic would be considered minimal and temporary as the BSC already supports extensive vessel traffic and is a focal point for commercial marine transport in the Galveston Bay system. In addition, with the deepening and widening of the channel resulting from the proposed action, the need for tug support required to transit the length of the channel should be reduced, as well as a shift to fewer, larger container vessels. Considering the extensive presence of reef directly adjacent to the active HSC and BSC, changes in vessel traffic would not be expected to have any permanent impacts to reef.

The Preferred Alternative placement scenario is not expected to impact additional oyster habitat outside of the channel modification or buffer zone limits as all material would be placed into existing emergent placement areas. Although increased vessel traffic and ballast withdrawal has the potential for impacting planktonic life stages, the losses in biomass are negligible as the oyster is highly fecund and historically habitat limited throughout its geographical range. Also, accretion of oyster reefs in areas adjacent to the BSC modifications is probable considering the high occurrence of this habitat within close proximity of other anthropogenic activity, such as navigation channels in Galveston Bay. As a result, no impact upon oyster habitat is expected from the placement of dredged material during initial construction or periodic maintenance dredging events over the 20-year maintenance period. Within the mitigation site, which is land that has subsided into open water, probing investigations only indicated sporadic, isolated areas of live and dead oyster clusters associated with growth around debris such as old dead tree stumps and broken concrete or riprap, and not continuous or extensive bottom reef. More detail on the investigation is discussed in Section 4.4.2.1 and the Compensatory Mitigation Plan for

Tidal Marsh in Attachment G. The proposed, mitigation marsh containment levee with a continuous rip-rap veneer would provide far more attachment surface area than the sporadic areas of live and dead oyster clusters observed within the proposed footprint. Therefore, recolonization of the proposed shore protection substrate would result in greater live oyster cluster density than what is present.

4.2.3 Essential Fish Habitat

No Action Alternative

No impacts to EFH would occur under the No Action Alternative. Continuing construction and development of BU marsh cells at Atkinson Island, would add estuarine marsh, which would benefit primary productivity for juvenile stages of several managed species, including red drum and shrimp species.

Preferred Alternative

The proposed channel improvement dredging project has been sited and designed to minimize impacts to managed species and their associated EFH as much as possible while achieving the project goal. EFH has been described over broad spatial scales throughout the coastal Gulf of Mexico region; therefore it is difficult to propose any large scale project without impacting EFH for some species.

The majority of impacts to managed species and their associated EFH would be limited to the estuarine benthic environment where the actual dredging would take place, as well as temporary impacts to the water column as a result of increased turbidity. The life stages anticipated to be most impacted are the eggs and larval stages, with those utilizing benthic habitats within the dredged footprint expected to have 100 percent mortality. The majority of the juvenile and adult lives stages present in the project footprint are primarily forage and pelagic species capable of detection and avoidance behavior when exposed to unfavorable conditions. It is expected that construction of the proposed project would not have any direct impacts to juvenile and adult fish other than a temporary displacement, and individuals would re-inhabit temporarily affected areas upon dredging completion. No aquatic vegetation has been identified in the dredged or adjacent buffer zone areas, therefore no impacts to seagrass or the nursery habitat it provides to juvenile fish would occur from the proposed project. Therefore, only minimal impacts to benthic EFH are expected to occur.

The dredging would occur in the estuary of Galveston Bay, which is a nursery area for some species known to inhabit the GOM. The degradation of coastal and estuarine EFH habitats is associated with the following:

- Temporary disturbance and displacement of fish species;
- Increased sediment loads and turbidity in the water column;
- Temporary loss of benthic food items to fisheries;
- Limited disruption or destruction of oyster habitats; and
- Limited sediment transport and redeposition.

For the purposes of this project, most of the above effects are temporary and likely either offset by environmental protection guidelines, or are negligible considering the localized effect of the actions compared to the proportional area of the Gulf that would be unaffected. In this sense, the coastal and marine environmental degradation from the proposed action would have minor effects on designated EFH or commercial fisheries.

Turbidity generated by the project could affect the foraging behavior of visual predators and the efficiency of filter feeders. The turbidity plume would be expected to migrate only a short distance cover a small area relative to the total pelagic habitat area available to managed species, and dissipate quickly due to prevailing water circulation. The impact to the water column EFH would be considered minor and short-term.

Deposition of suspended sediments could partially or entirely bury shellfish and other sessile organisms. Although existing oyster reefs within the footprint of the dredged areas would be lost, mitigation is anticipated as described in Section 4.4. If not mitigated for, this would be a permanent impact. Oyster reefs near the project area may be indirectly affected by the temporary increased turbidity during the dredging operations, but long-term effects to oyster reefs are not expected from the proposed project. In fact, accretion of oyster reefs in areas adjacent to the BSC modifications is probable considering the high occurrence of this habitat within close proximity of other anthropogenic activity in Galveston Bay. The details of oyster habitat impacted for this alternative are discussed in Section 4.2.2.2.5 above.

The impact of 9.2 acres of marsh east of PA 15 within the proposed footprint of the stability berm for raising the levee under the placement option for this alternative would impact estuarine marsh.

The proposed project is not in or near any of the areas identified as HAPC. These areas are all located offshore. Therefore, no impacts to HAPC are anticipated through the completion or maintenance of the proposed project.

Over the 20-year maintenance period, no new or additional impacts would occur as a result of periodic maintenance dredging and placement events.

4.2.4 Commercial and Recreational Fisheries

No Action Alternative

No new impacts to commercial and recreational fishing would occur under the No Action Alternative.

Preferred Alternative

No commercial or recreational fishing would be allowed to occur within and near the dredging operations. The commercial fishing widely done in Galveston Bay is trawling for shrimp. The trawlers typically avoid active shipping lanes and would be required to avoid the areas of dredging and placement operations. Other shellfish species frequently landed include blue crab and eastern oyster. The area of the proposed project is within an area restricted to shellfishing, and is closed to the harvesting of shellfish for direct marketing. Therefore, the actual dredge operation would have no impacts on any commercial fishing that might be done in the project area.

All recreational fishing would not be allowed within and near the dredging and placement operations. The entire HSC and upper Galveston Bay is within a consumption advisory area for blue crabs, and the entire Galveston Bay is within a consumption advisory area for all catfish species as well as spotted seatrout. The BSC already supports extensive vessel traffic and is a focal point for commercial marine transport in the Galveston Bay system. While the recreational landings associated with Galveston Bay account for 35 percent of the State total, it is unclear how much of this fishing is actually done within or near the BSC. The recreational fishing could resume upon completion of dredge operations. Therefore, no disruption to recreational fishing is expected to occur during the initial construction or periodic maintenance dredging events over the 20-year maintenance period.

4.2.5 Threatened and Endangered Species

No Action Alternative

No new impacts to Federal or State-listed threatened or endangered species would occur under the No Action Alternative.

Preferred Alternative

No federally or State-listed plant species occur within the proposed project area. No impact to listed plant species is anticipated as a result of the proposed project, either from the channel improvements, or dredged material placement over the 20-year maintenance period.

Species with a Federal status of threatened or endangered that may be present within the proposed project area include the Kemp's ridley sea turtle, loggerhead sea turtle, and green sea turtle. Other species listed are not likely to occur in the vicinity of the project due to lack of suitable habitat or the area is beyond their known range limits. There is no designated critical habitat for any of the listed species within the project area. Of the Texas State listed species that are not also listed on the Federal list of protected species, the reddish egret and white-faced ibis may also occur within the area. The proposed project area does not include any nesting habitat for any of the species and all of the species are highly mobile and can easily avoid construction activities. Large expanses of similar habitat are located adjacent to the proposed project area for displaced individuals.

The BSC is currently an active commercial shipping channel capable of receiving high frequencies of relatively moderate sized vessels. Cutterhead dredges (non-hopper) are proposed for use on this project for both construction and maintenance. A Regional Biological Opinion (RBO), dated November 19, 2003, by the NMFS for the Galveston, New Orleans, Mobile, and Jacksonville Districts of the USACE concluded that non-hopper dredges are not known to take sea turtles. As such, the proposed project would have no effect on any listed sea turtle species within the area.

4.2.6 Invasive Species

No Action Alternative

No impacts to habitats from the introduction of invasive species would occur under the No Action Alternative.

Preferred Alternative

Improvements to the BSC would result in increased vessel traffic from container ships which use minimal ballast water. Some modern container vessels have closed systems with virtually no ballast water discharge. The proposed project would allow for a more modern container fleet with fewer larger vessels than the current configuration would support. The BSCCT FEIS concluded that the minimal introduction of ballast water into Galveston Bay from increased container ship traffic would result in an increase in the potential for introducing invasive species. However, all vessels would be subject to the Ballast Water Management Regulations as applicable in 33 CFR Part 151 Subpart D for the protection to the spread of non-indigenous species. In addition, shipping operations throughout the Galveston Bay System currently result in ballast water discharges in Galveston Bay. The additional potential for introduction and spread of invasive marine species would be a minimal impact.

Invasive species typically thrive in disturbed environments like active PAs, which undergo periodic use that destroys or impacts invasives. Based upon the ubiquity and amount of invasive species in the project area, as identified in the BSCCT FEIS, the potential for introduction and spread of invasive terrestrial species is considered a minor impact. Over the 20-year maintenance period, no new or additional impacts would occur as result of periodic maintenance dredging and placement events.

4.3 HUMAN ENVIRONMENT IMPACTS

A summary of potential human impacts within the project area as well as surrounding areas is presented in the section below. The scope of this review includes an analysis of the area's socioeconomics, environmental justice, community and recreation resources, air quality, noise and vibration, and cultural resources as well as other categories.

4.3.1 Socioeconomics

No Action Alternative

Under the No Action Alternative, the Bayport Community Study Area, as described in Section 3.3, Chambers and Harris Counties, and other communities within or near the project would continue to have the same population trends. According to Texas Water Development Board population projections, a population increase is expected for the cities of Shoreacres, Seabrook, Taylor Lake Village, La Porte, and Pasadena and the population is expected to stay the same in El Lago. Harris and Chambers Counties populations are projected to have a 52.3 and 80.0 percent increase in population, respectively, by 2030 regardless of the proposed project. The locations of these resources would generally follow development and land use plans identified by surrounding cities such as Shoreacres, La Porte and Harris and Chambers counties. Because no property is likely to be removed from the tax rolls, the tax base would not be affected.

Preferred Alternative

The Preferred Alternative would likely have a negligible effect on population growth trends within the Bayport Community Study Area, surrounding cities, and counties in which the project is located, as discussed under the No Action alternative. As a result, the demand for community facilities, services, and housing would increase at a rate that is consistent with the projected population growth. The location of these resources would generally follow development and land use plans currently identified. Most of the construction workers are likely to come from the labor force that is already living within Gulf Coast area; therefore, no change to employment in the study area is expected. As a result of this alternative an increase in jobs in the community is expected but impacts to local resources is not expected to change. It is likely, because of the current economic downturn, that any jobs created by the proposed project would be taken by unemployed persons in the Gulf Coast area. No impacts would be expected as a result of maintenance dredging events over the 20-year maintenance period.

4.3.2 Environmental Justice

As shown in Table 3.3.2-1, the Bayport Community Study Area is 80.5 percent White. The median household income is for the study area census tracts was $76,781, more than three times above the 2011 HHS poverty level. The EJ Index study showed a low potential for EJ impacts based on the populations that currently exist in the Bayport Community Study Area. Therefore, the study area is not considered a high minority or low-income area.

No Action Alternative

No impacts to environmental justice or the Bayport Community Study Area are anticipated to occur under the No Action Alternative.

Preferred Alternative

The minority and low-income individuals or families living within the Bayport Community Study Area would likely experience no adverse changes to the demographic, economic, or community cohesion characteristics within their respective neighborhoods as a result of the proposed project. Generally speaking, the population living within the Bayport Community Study Area would likely benefit from the proposed project through increased economic vitality as a result of increased efficiency at the Port. Therefore, the proposed action would not result in disproportionately high and adverse impacts on minority and low-income persons living within the study area. The potential for air quality and noise impacts to EJ individuals or families living within the Bayport Community Study Area are discussed further in Sections 4.3.8 and 4.3.9. Over the 20 year maintenance period, no new or additional impacts would result as maintenance dredging and placement events.

4.3.3 Community and Recreational Resources

As discussed in Section 1.3, the proposed project is anticipated to improve transportation costs and operational inefficiencies with the existing BSC which in turn would improve ship mobility and efficiency, allowing more efficient delivery of commercial goods to the Bayport Terminal, resulting in additional economic growth introduced into the regional community.

No Action Alternative

Under the No Action Alternative, no impacts would occur to community and recreational resources from new construction, and the same existing conditions and pattern of use of these resources as currently happens would continue to occur. The traffic projected for future years in the BSCCT FEIS would be anticipated to increase the potential for container and recreational vessel encounters, although these events are too randomized to reliably predict adverse consequences, as discussed in Section 3.7 of the BSCCT FEIS.

Preferred Alternative

The Preferred Alternative is not expected to have any direct physical impact to land-based community and recreational resources as the alternative would be located in open water and placement islands. The channel improvements would result in a deeper and wider channel than would be expected to reduce large vessel wakes from existing vessels compared to the current channel. The results of the ship simulation study discussed in Chapter 2 indicated that slower vessel speeds were needed to maintain current vessel sizes in the channel. These reduced speeds would also contribute to reducing the vessel wave amplitudes. Periodic maintenance dredging and placement events over the next 20 years would result in similar impacts as all affected areas would be previously disturbed by initial construction activities.

4.3.4 Visual and Aesthetic Resources

No Action Alternative

Existing characteristics of the viewsheds for the proposed project area are discussed in Section 3.3.3. The study area for visual and aesthetic resources consists of viewsheds within the project area looking out from the existing shoreline in residential areas or public parks. Under the No Action Alternative residents with a view of the BSC have a view of marine vessels that would use the Bayport Terminal and maintenance dredging along the HSC.

Preferred Alternative

In the short-term, during construction of the proposed project, dredging activities would be visible to and heard by local residents, shoreline residents, and recreational watercraft users that have a view of the construction activities. However, views from the three vantage points discussed are limited and it is likely that few residents or recreationalists using Sylvan Beach and the beach located in the El Jardin neighborhood would be impacted from visual and aesthetic changes during construction of the proposed project.

In the long-term, construction of this project is not expected to change surrounding land use. Placement of dredged material would be in existing PAs and would be consistent with existing land use. The addition of dredged material to PAs 14, 15, Mid Bay, and Atkinson would eventually become an area for wildlife. The addition of the dredged material to the PAs would help create habitat for different species of shorebirds and other animals. Therefore, these PAs when finished could serve as recreational areas for anglers and birdwatchers. The proposed project is expected to allow marine vessels to transport more tonnage, reducing the number of marine vessels. Therefore, the view of the marine vessels if not desirable to local residents or recreationalists would improve if not remain the same. Periodic maintenance dredging and placement events over the next 20 years would result in similar impacts as all affected areas would be previously disturbed by initial construction activities

4.3.5 Existing Infrastructure

No Action Alternative

Under the No Action Alternative, no impact is anticipated to existing infrastructure.

Preferred Alternative

Under the Preferred Alternative, no impact is anticipated to existing infrastructure from the proposed channel improvements or new work dredge material placement on the existing PA 15 levees. The other PAs proposed for maintenance material placement do not have existing infrastructure conflicts (e.g. pipelines, oil and gas production) with the exception of the PA 14/15 connection being constructed and future M11 marsh cell as part of the USACE's PA 14/15 Expansion Project. Provisions for the existing oil and gas well facility access in these cells are accounted for and discussed in the PA 14/15 Expansion EA.

4.3.6 Traffic and Transportation

4.3.6.1. Surface Transportation

No Action Alternative

Under the No Action Alternative, no impact is anticipated to surface transport, road and rail, as detailed in Section 3.3.6. The direct connect overpass discussed in that section has already been constructed, and has provided relief for any congestion of port-related surface traffic, and was planned for the activity anticipated for the BSCCT at full build-out (i.e. when it is fully constructed) as documented in Section 3.5 and Appendix 3.5 of the FEIS.

Preferred Alternative

Under the Preferred Alternative, no direct impact to surface transport, road and rail detailed in Section 3.3.6 will occur. No indirect impacts to surface transport are expected from the proposed action either, because the proposed action is not expected to increase the net tonnage serviced at the BSCCT documented in the FEIS, and would therefore not increase the related truck or rail activity at the terminal. This assumption is made because the capacity (throughput) of the terminal is determined by the terminal facilities (e.g. numbers of cranes berths, acres of storage area) and the proposed action, which only involves the channel, will not change any of these facilities. This assumption is explained in detail in Section 4.3.8.

4.3.6.2. Marine Transportation

No Action Alternative

Under the No Action Alternative, no channel improvements would be constructed. Therefore, the current navigation restrictions, and the associated efficiency problems, would continue.

Preferred Alternative

During the construction phase under the Preferred Alternative, dredge vessels and equipment would be required to move out of the active channel to maintain an open shipping lane when vessels are approaching within the BSC. The channel improvements of the Preferred Alternative would improve the navigation of vessel transit in the BSC as it is the main purpose of the proposed project. This would reduce cost for shippers due to entrance restrictions, delays, and need for fewer tug assists for traversing the channel. Therefore, marine transportation conditions are expected to improve. Periodic maintenance dredging and placement events over the next 20 years would not result in any new or additional impacts as all construction activities would preserve the proposed channel conditions.

4.3.7 Hazardous, Toxic and Radioactive Waste (HTRW)

No Action Alternative

The No Action Alternative would have no impact on hazardous materials associated with regulated facilities in the area. However, maintenance dredging of the existing BSC and the placement of dredged materials at PAs would continue under the No Action Alternative.

Preferred Alternative

As discussed in Section 3.3.6 chemical and petroleum releases have been reported in the BSC and BSC TBOne open VCP site 2255 is located in the vicinity of the proposed project area, but the affected media listed was soil, and would not be expected to impact the BSC. Impacts associated with regulated facilities are most likely to be encountered near the source of the contaminants. These sources include, but are not limited to, industry facilities located in the Bayport TB area. The industrial activity adjacent to BSC is extensive and is primarily related to two large industrial complexes (ODJFELL Terminal USA Gp. Inc. and Celanese Chemical Co Inc-Bayport) located immediately adjacent to the project in the Bayport TB.

Most releases of hazardous materials in water would be expected to dissipate in water with dispersion and tidal exchange, and degrade over time following the spill incident, not posing a permanent water quality impact. Some non-water soluble pollutants released in water might leave more residual contaminants in bay sediments, portions of which would degrade and portions which could be more persistent. Therefore, dredged sediment quality would be the primary HTRW concern. In Section 0, existing sediment quality is discussed in detail, using data from periodic testing of the maintenance dredging of the current BSC. In general, this data has not shown that residual contamination is a problem. Prior to excavation or placement of any sediment in the proposed project area, sediment to be excavated would be sampled and analyzed to determine the potential for contamination of dredged material. Based on the findings of the HTRW survey, the probability of encountering contaminated sites or toxic substances during project construction of the channel or during dredged material placement is considered low. Information compiled by this assessment indicates additional investigations are not warranted at this time.

Other potential hazardous materials sites in the project area include pipelines, and oil and gas facilities. Data from the TRCC were reviewed to identify the location of oil and gas sites, and pipelines within the project area. All known oil and gas sites and pipelines would be avoided or accommodated with the appropriate access gaps until they are relocated. Therefore, no impacts to these facilities are expected from the Preferred Alternative.

Periodic maintenance dredging and placement events over the next 20 years would not result in any new or additional impacts as all affected areas would be previously disturbed by initial construction activities.

4.3.8 Air Quality

4.3.8.1. Construction Air Emission Analysis

General Conformity is a Federal/state program designed to ensure that actions taken by Federal entities do not hinder states' efforts to meet the national ambient air quality standards (NAAQS). The definition of a Federal action as specified in 40 CFR 93.152 includes "…a permit, license, or other approval for some aspect of a nonfederal undertaking, (and) the relevant activity is the part, portion, or phase of the nonfederal undertaking that required the federal permit, license, or approval." (USEPA, 2010a)

With regard to a dredging project such as the Bayport Ship Channel Improvement Project, the Federal Action is the Section 10/404 permit, and Section 408 permits issued by the USACE authorizing the dredging, and any work that depends on the issuance of the permits is subject to General Conformity review.

The USEPA has established a series of steps to determine whether a given Federal Action is subject to General Conformity review as follows (USEPA, 2010b).

1. Whether the action will occur in a nonattainment or maintenance area;

2. Whether one or more of the specific exemptions apply to the action;

3. Whether the federal agency has included the action on its list of "presumed to conform" actions;

4. Whether the total direct and indirect emissions are below or above the de minimis levels (see below Table 4.3.8 1 for the de minimis levels); and/or

5. Where the facility has an emission budget approved by the state as part of the SIP, the federal agency determines if the emissions from the proposed action are within the budget.

Regarding the proposed Bayport Ship Channel Improvement Project,

1. The action would be occurring in the 8-county HGB ozone nonattainment area, which is designated as a severe nonattainment area for the pollutant ozone in the absence of State and Federal decisions to determine the finally attainment status, as discussed in Chapter 3;

2. None of the specific exemptions apply to the action, except for maintenance dredging, which is specifically exempt;

3. The USACE has not included dredging projects on a list of "presumed to conform" actions;

4. Total direct and indirect emissions of NO_x, as currently estimated, would exceed the relevant de minimis levels of 25 tons for oxides of NO_x and VOCs in a severe ozone nonattainment area and only the de minimis level of 100 tons of NO_x in a marginal nonattainment area. (see Table 4.3.8-2 below for estimated project related emissions); and

5. The Port of Houston does not possess an emissions budget approved as part of the HGB area SIP.

Based on the discussion presented above and the emissions presented below, a General Conformity Determination is required for both NO_x and VOC emissions from the proposed project. Since the action is required to demonstrate conformity, one or more of the following conditions must be met (USEPA, 2010).

1. Demonstrating that the total direct and indirect emissions are specifically identified and accounted for in the applicable SIP;

2. Obtaining a written statement from the state documenting that the total direct and indirect emissions from the action, along with all other emissions in the area, would not exceed the current SIP emission budget;

3. Obtaining a written commitment from the state to revise the SIP to include the emissions from the action;

4. Obtaining a statement from the metropolitan planning organization (MPO) for the area documenting that any on-road motor vehicle emissions are included in the current regional emission analysis for the Regional Transportation Plan and the Transportation Improvement Program;

5. Fully offsetting the total direct and indirect emissions by reducing emissions of the same pollutant or precursor in the same nonattainment or maintenance area.

A sixth potential demonstration method, conducting air quality modeling that demonstrates that the emissions would not cause or contribute to new violations of the standards, or increase the frequency or severity of any existing violations of the standards, is not available for the proposed project because modeling is not acceptable for ozone nonattainment areas due to the complexity of ozone formation from precursor pollutants and the limitations of current air quality models.

Of the options detailed above, the Applicant elected to utilize the second option, obtaining concurrence from the Texas Commission on Environmental Quality (TCEQ) that the total direct and indirect NO_x and VOC emissions from the action will not exceed the applicable SIP as well as the most recent TCEQ adopted SIP emissions budget, because of the very low level of emissions compared with the SIP budget, and the temporary nature of the emissions. It is important to note that no emissions will occur during 2017 and 2018, the three years that will be used to determine attainment in 2019.

The project emissions estimates presented in Table 4.3.8-2 have been based on operational and equipment assumptions developed as part of the detailed project planning process, and on published emission factors and other emission-related operational information. Diesel engines used in dredging and placement work have been assumed to be "Tier 1" level engines while the passenger cars and light duty trucks used in employee commuting have been assumed to be typical of the general fleet, using default settings in the MOBILE6.2 model.

Table 4.3.8-1 De Minimis Thresholds in Nonattainment Areas

Ambient Pollutant	Nonattainment Status	Tons/yr
Ozone (VOC's or NO_x):		
	Serious NAA's	50
	Severe NAA's	**25**
	Extreme NAA's	10
	Other ozone NAA's outside an ozone transport region	100
	Marginal and moderate NAA's inside an ozone transport region	
	VOC	50
	NO_x	100
Carbon monoxide:	All NAA's	100
SO_2 or NO_2	All NAA's	100
PM–10:		
	Moderate NAA's	100
	Serious NAA's	70
PM–2.5:		
	Direct emissions	100
	SO_2	100
	NO_x (unless determined not to be a significant precursor)	100
	VOC or ammonia (if determined to be significant precursors)	100
Pb:	All NAA's	25

Source: 40 CFR §93.153 Applicability. (Amended to include PM2.5)

Table 4.3.8-2 Estimated Emissions from Proposed Project Construction (Tons per Year)

Component of Work	2014 Channel and TB	
	NO_x	VOCs
Dredging	366	14.2
Booster Pump	57	2.7
Support Vessels	195	8.7
Placement Site Work	16	2.4
Employee Vehicles	0.29	0.31
Total	**634**	**28**

In summary, the estimated project construction NO_x emissions require a General Conformity Determination (GCD) to be coordinated with the TCEQ to demonstrate that these emissions can be accounted for in HGB SIP emissions budgets. The GCD also requires a public notice and a 30-day public comment period, as well as coordination with USEPA Region 6, HGAC (the local MPO), and other local air quality agencies as appropriate. A Draft GCD was prepared for coordination by the USACE, the lead agency approving the Federal action, with the aforementioned agencies and is included as Appendix C to this EA document. Concurrence was received from the TCEQ that emissions can be accounted for in HGB SIP emissions budgets via a February 20, 2013 letter. The

Draft GCD was also publicly coordinated and comments received. Details of the concurrence and coordination are discussed in Section 6.6.

It should be noted that the project coordinated for the Draft GCD included two components that have since been removed. The first was the deletion of the further deepening of the USACE BSC Flare Widening project that was originally included in this project (the BSC Improvements project) to ensure the depth of the proposed channel improvements would be matched. A relatively small portion of total project emissions associated with this portion were estimated to occur in the Year 2016. This project change would only result in a decrease of emissions, and therefore re-coordination to ensure that emissions are accounted for in the USEPA-approved SIP would not be necessary. The second component was portions of the original Raised Levees in Existing PAs placement option chosen as part of the Preferred Alternative, consisting of levees for PA 14, the PA 14/15 connection, and Atkinson BU Marsh Cell M11. As explained in Section 2.3.3.3, more geotechnical analysis led to modification of the proposed PA 15 levee to a wider, lower profile that would account for all the planned new work material, making the use of these other features not needed. This change would not increase the construction emissions, because the same amount of material would be placed whether using PA 15 alone or in conjunction with the other features, and because the landside equipment operating hours, originally conservatively estimated for operating durations, already account for any changes in grading effort driven by the change in levee configuration. It should be noted that landside equipment emissions constitute a minor (<2.5%) of overall construction emissions. Therefore, the analysis of emissions for conformity determination would not change due to the change in the PA 15 levee configuration. Another change driven by the revised levee configuration is construction of marsh mitigation at the BNC. The Draft GCD does not include emissions due to construction of the proposed marsh mitigation, as the final configuration of the PA 15 levee-raising was not determined until after the issuance of the Draft GCD. The mitigation emissions are anticipated to be minimal compared to the project conformity emissions documented in the Draft GCD. A preliminary estimate considering the mitigation quantities involved, HGNC PA construction production information, equipment manufacturer literature, and the current landside emissions indicate the marsh construction mitigation emissions will be on the order of just over 0.5 ton of NOx, compared to the project total of 634 tons of NOx, or around 0.1%. This is not expected to affect the determination of conformity. The emissions will be estimated in full and coordinated with the TCEQ to confirm this prior to the issuance of the Final GCD. These changes will be documented in detail in the Final GCD.

To support demonstration that the project construction NO_x emissions can be accommodated in the HGB SIP emissions budgets, Table 4.3.8-3 illustrates the minor percentages of the NO_x budgets that the project construction emissions represent. The most recent USEPA-approved SIP demonstration, *HGB Eight-Hour Ozone Standard SIP Demonstrating Reasonable Further Progress (RFP), Rule Log 2006-1892-SIP*, includes modeled daily emission estimates for 2006 and 2018 (reference). Since the project construction phase would take place approximately midway between these two years, project construction emissions are compared with both sets of SIP emissions. Also, since the project construction phase is expected to encompass two calendar years, the table compares the higher year of emissions against the emissions budget figures.

Table 4.3.8-3 Comparison of Proposed Project Emissions with Modeled SIP Emissions Budgets (Tons per Day)

Project Activities	SIP Inventory Categories	Project Emissions (tpd) NOx	Project Emissions (tpd) VOC	HGA SIP 2008 NOx Emissions Budget (tpd)	HGA SIP 2008 NOx % of Budget	HGA SIP 2008 VOC Emissions Budget (tpd)	HGA SIP 2008 VOC % of Budget
Dredging Activities (dredge, support vessels)	Commercial Marine Vessels	1.69	0.07	39.48	4.29%	1.86	3.77%
Land-side Activities (dredged mat'l placement)	Construction and	0.04	0.01	28.45	0.15%	7.6	0.09%
On-road Activities (employee commuting)	Mining On-road Mobile Sources	0.001	0.001	171.65	0.00%	78.88	0.001%
Overall Totals (on-road plus non-road)		**2**	**0.078**	**239.58**	**0.73%**	**88.34**	**0.09%**

Overall, the proposed project construction emissions of NO_x and VOC represent only 0.73% and 0.09%, respectively, of emissions from marine, on-road, and construction sources modeled in the SIP for 2008. Emissions from the dredging equipment itself, plus support vessels, represents 4.29% and 3.77% of the commercial marine vessel NO_x and VOC emissions, respectively, modeled in the SIP, while emissions from construction equipment represent 0.15% and 0.09% of construction and mining NO_x and VOC emissions, respectively. As noted earlier, the applicant is seeking TCEQ concurrence that the NO_x and VOC emissions representing these low percentages will not hinder timely attainment of the 1997 8–hour ozone standard.

Because maintenance dredging is specifically exempt from the General Conformity Rules, maintenance dredging for the proposed improved channel over 20 years will not affect conformity compliance.

4.3.8.2. Operational Air Emission Analysis

Operational air emissions are those emissions resulting from the use of the BSC and the related terminal facilities. These emissions include those associated with harbor (tugs, refueling barges etc.) and ocean-going vessels (container and bulk liquid vessels etc.), and terminal equipment (cranes, loaders etc.), vehicles (trucks), and the intermodal railyard (trains). The impacts of the various alternatives on operational air emissions relate to how the proposed channel improvements are expected to influence these air emission activities through changes in navigation efficiency, cargo tonnage, and vessel calls. Except for the immediate vessel transit effects (i.e. faster, less restricted entry/exit from the channel), these impacts are indirect effects. It is important to note that increases in container tonnage are already projected to occur at the BSCCT with the existing channel under the No Action Alternative, and will be accommodated by the continuing completion of the planned terminal facilities already planned for the BSCCT. These increases would occur in the No Action alternative, irrespective of the proposed action, and the impacts to operational air emissions from terminal equipment and cargo surface transport activity (e.g. truck and rail) are already analyzed and accounted for in the BSCCT FEIS. This is discussed in detail in this section under Terminal Emissions for the No Action Alternative. It is also important to note the assumption that the proposed action channel improvements will not increase net container tonnage, because the throughput is limited by the capacity of the terminal and its facilities (i.e. number cranes, berths etc.). This is explained in detail in this section under the Terminal Emissions section for the Preferred Alternative. The following discusses the operational air emissions impacts of the alternatives.

No Action Alternative

Vessel Emissions

The impacts of the No Action alternative on operational air emissions are related to the effects of lack of channel improvements on navigation, and the vessel fleet. The trend for the world containerized cargo vessel fleet is towards ever larger ships, since economies of scale favor this trend (Transportation Economics & Management Systems, Inc. 2008). Fuel costs are a primary cost factor to shippers and therefore fuel efficiency is a primary goal for shippers to control costs (TEMS, 2008). Larger vessels are more fuel efficient per ton-mile and thus have less emissions per ton-mile moved. To illustrate the trend towards larger ships, the strongest growth of vessels in 2008 was reported to be in the largest size sector of 8,000 TEU and above; while the ships sent to the scrapyard were either approximately 1,000 TEU or 5,800 TEU in size (RS Platou 2008). The current channel's restricted draft requires larger vessels to come in light-loaded which increases costs to shippers. Also, the largest vessels being built and planned are 10,000 TEU and above. These could not successfully enter the current BSC during ship simulations discussed in Chapter 2, which is confirmed by PHA operational staff. These factors would discourage or prevent the use of larger, newer vessels that are more fuel efficient to carry the same tonnage, resulting in more emissions to carry the same tonnage compared to alternatives that allow larger ship access.

The requirements for greater fuel efficiency, impending foreign climate change policy, and clean air regulations are driving several trends in the design of newer, larger container vessels, including advanced nautical design, more fuel efficient engines, power co-generation, and cleaner engines. These trends are explained in more detail under the Preferred Alternative impacts. Since the existing channel restrictions would discourage or prevent shippers to use newer, larger vessels in the existing BSC, these trends would further exacerbate the disparity in emissions under the No Action Alternative compared to improved channel alternatives, since ships with the greater efficiency and reduced emissions resulting from these trends, would not use the BSC.

Some recent changes in national and international marine emissions standards will help reduce future marine vessel emissions under all scenarios, including the No Action Alternative, but some may occur only with the use of newer vessels. These changes include the following:

- **More Stringent USEPA Emissions Standards**. Recent USEPA Clean Air Act (CAA) regulations will require new U.S. flagged or manufactured ocean-going vessels (OGV) with Category 3 marine diesel engines (which container ships use) to have engines meeting Tier 2 standards by 2011 which would reduce NO_x from current standards by 15 to 25 percent. Thereafter, new engines must meet Tier 3 standards by 2016 which would reduce NO_x 80 percent from current standards. Also, all fuel produced and sold here for Category 3 engines must have reduce fuel sulfur content that bring the content down from a typical 30,000 parts per million (ppm) to 1,000 ppm by 2015.

- **North American Emissions Control Area (ECA) Designation**. In 2010, most of the North American coastal area, including the Gulf Coast was designated by the United Nations International Maritime Organization (IMO), to be an ECA that will require all OGVs to meet fuel and emissions standards similar to the USEPA standards discussed above. The ECA is managed in the U.S. by the USCG, and it applies to all OGVs calling or traveling through ECA. The standards for this ECA require that when the

ECA becomes into force on August 1, 2012 that the fuel sulfur content is reduced to 10,000 ppm, and to 1,000 ppm in 2015. Starting in 2016, new engines must use NO_x exhaust after-treatment systems, like the seawater-based scrubbers previously discussed, to achieve reduced emissions equivalent to the USEPA Tier 3 standard.

The USEPA reduced sulfur fuel use would apply to both new and existing vessels, and therefore reduced SO_x emissions could be expected under the No Action Alternative. Since the USEPA Tier 2 and 3 emissions standards apples to new engines, and since use of newer, larger container ships would be discouraged without channel improvements, vessels using the BSC under the No Action Alternative would likely continue to be the older, smaller container vessels that do not meet these standards (which especially affect NO_x) until they are replaced due to age. Similarly, the reduced fuel use of the ECA standards would result in reduced SO_x emissions under the No Action Alternative, but the NO_x after-treatment applicable to new engines, would not likely be in use due to the continued use of older, smaller container vessels, until these are replaced due to age. Therefore, the No Action Alternative would delay the use of newer vessels meeting the more stringent emissions standards, compared to channel improvement alternatives, and would result in greater NO_x emissions from vessel activity by comparison until the smaller, older light-loaded vessel fleet is replaced or repowered due to age.

One assumption contained in the BSCCT FEIS that is still considered current is that most of the containerized cargo entering Houston ports are destined for the immediate Houston area, based on past trends. It was assumed in the BSCCT FEIS that 80 percent of the future cargo would be destined for the immediate Houston area. This is still considered true to the extent that the majority of this cargo is destined for metropolitan Houston, and Texas cities that receive containerized cargo from rail lines and truck routes from the Houston area after transfer from Houston port facilities. The implication of this assumption for the No Action Alternative is that since most of the containerized cargo processed through PHA facilities is destined for the Houston area, most of this cargo would have to arrive by truck, rail or smaller barge into the Houston area (after presumably arriving at some other container port) if it didn't arrive by OGV to Houston ports. This scenario was described in the BSCCT FEIS No Action Alternative, which assumed that most of this cargo would arrive via a container port to the east (e.g. New Orleans), and would be transferred into the Houston area with 65 percent of the cargo by truck using Interstate Highway (IH) 10, and 15 percent by barge, if container terminal capacity were not available. Because of the efficiency of scale, OGVs are recognized as the most fuel-efficient means of moving cargo, compared to other transportation modes (McCarthy, 2009; Perry et al., 2008). For example, in terms of fuel consumption [kilowatt (kW)/ton/kilometer], a 3,700 TEU container ship is estimated to consume on average 77 times less energy than a Boeing 747-400 freight aircraft, about 7 times less than a heavy truck, and about 3 times less than rail (McCarthy 2009). As previously discussed, fuel-efficiency is a primary cost factor for shippers. Therefore under the No Action Alternative, even with the existing restrictive channel, it is likely shippers would continue to call at Bayport for the Houston-bound containerized cargo, which is most of the cargo expected, and the associated vessel transit emissions would continue in the HGB non-attainment area. In addition, the Houston area is growing by more than one million people every ten years and trending upward, according to the H-GAC Regional Growth Forecast for 2035, as developed to support the MPO's Travel Demand Modeling used in regional transportation planning. To accommodate this growth in the population, cargo arriving in the region would continue to increase, and as based on the assumptions in the BSCCT FEIS No Action Alternative, the 80% of future cargo destined for the Houston region would arrive via other transportation modes and therefore would result in greater emissions.

Terminal Emissions

Emissions from BSCCT cargo loading/unloading operations are directly related to the containerized cargo tonnage processed there. The BSCCT will have 7 berths constructed at build-out, which is projected to occur between 2020 and 2030. The 7 berths have a finite total cargo tonnage throughput of 2.3 Million TEU per year that was already projected to occur at the end of the terminal build-out with the existing BSC in place, as documented in Appendix 2.2 of the BSCCT FEIS. This would be expected to increase emissions as more berths are put into operation and loading/unloading activity increases. However, these impacts have already been accounted for and permitted under the BSCCT FEIS and permit, and the PHA has made several improvements to terminal facilities and equipment under their Clean Air Strategy Plan (CASP) that have reduced emissions including the following:

- Diesel Emissions Reduction Act funding of $3.4 Million to replace, repower and retrofit over 112 pieces of older diesel equipment owned by the PHA and its partners, including cargo handling equipment (CHE), on-road trucks, and marine engines.
- Reduced-sulfur fuel study and demonstration participation with the USEPA for two OGVs
- Heavy Duty Diesel Vehicle Bridge Loan Program Facilitation – A clean truck program to provide a revolving loan fund that helps port drayage truck operators purchase and operate cleaner trucks in the HGB area. Drayage means the final short-distance transport of goods, usually by truck or rail, as part of a longer overall move.
- Texas Emission Reduction Program (TERP) – PHA supported the start and funding of the TERP to help the HGB region meet the clean air goals of the State Implementation Plan (SIP).
- Cargo Handling Equipment (CHE) Initiatives – A variety of actions to target reducing emission from CHE including the following:
  - Securing of $651,000 in TERP funding to repower 14 yard cranes with newer, cleaner engines
  - Fueling policy for the PHA fleet to purchase the cleanest on-road diesel available for equipment and vehicles, use of Texas Low Emission Diesel with 15 ppm sulfur content for on-road and off-road fleets
  - Purchased and operate the first diesel-electric hybrid yard tractor on the market at PHA Barbours Cut Container Terminal
  - Participation in several reduced emission equipment demonstrations including installation of low temperature SCR system on an RTG and compressed natural gas yard tractors
  - Purchase of 9 new rubber tired gantries (RTG) with fuel saving technology and anti-idling systems (automatic switch-off devices)

In addition to these measures, the CASP has goals and strategies for future emission reductions that can be used to off-set emission increases. PHA has participated in many more clean air policy actions and initiatives, and is committed to implementing more clean air initiatives, such as the Smartway Drayage Truck Program, vapor refueling recovery system evaluation, LEEDs standards for buildings, and idling policy. Therefore, under the No Action Alternative, the terminal operation emissions at maximum would be the same as those described for the Bayport Alternative in the BSCCT FEIS, but would likely be lower due to the CASP implementation.

Maintenance Dredging

Maintenance dredging is currently performed once every 2 to 3 years for the channel and yearly for the existing Flare, and is needed to maintain the current channel dimensions. Therefore, the existing maintenance dredging emissions would continue to occur. Maintenance dredging is currently exempt from the General Conformity rules in 40 CFR 93, Subpart B.

Preferred Alternative

General Impact on Vessel Emissions

The impacts of the Preferred Alternative on operational air emissions are related to the effects of the channel improvements on navigation, vessel fleet, cargo traffic, and terminal operations. The channel improvements directly address increasing the navigability of the BSC, and therefore would improve the efficiency of vessel transit. This would result in reducing the tug assists required to guide vessels of a given size through the channel. Therefore, the Preferred Alternative would reduce emissions associated with vessel transit in and out of the channel.

A key assumption related to the vessel traffic is the effect of the deepening on the containerized cargo vessel fleet. The proposed channel improvements include deepening and widening that would allow the largest container vessel class efficient access that the current channel cannot provide and reduce light loading. Because of transportation cost savings to shippers due to the improved channel, over time, fewer, larger, more fully loaded ships would replace the current smaller, light-loaded fleet to carry same projected tonnage. This is the same conclusion made in several other navigation channel improvement studies involving containerized cargo, including those for the Corpus Christi Ship Channel, Savannah Harbor, Sacramento Deep Water Ship Channel, and Miami Harbor (USACE, 2003; USACE, 2004; USACE, 2010; and USACE, 2011). As discussed under the No Action Alternative, the trend towards larger, newer vessels would mean more fuel efficient delivery per ton-mile, which means reduced emissions to carry a same given tonnage, where larger vessels can be used. Because container cargo is expected to be moved by fewer, larger vessels with the channel improvements of the Preferred Alternative in place, this would result in reduced air emissions to move the same tonnage, compared to cargo movement under the No Action alternative, which would involve the smaller light-loaded vessel fleet.

Fuel efficiency is becoming more important to shippers, not only through gains via larger vessels, but also through other means. Impending, more stringent foreign climate change policy in European nations and elsewhere are incentivizing ship engine manufacturers to seek ways to lower greenhouse gas emissions from new vessels. Also, more stringent, impending clean air regulations domestically and abroad are encouraging manufacturers to use current and new technologies to make engines cleaner. This has led to several trends in large vessel design towards these ends, including the following:

- **Advanced Nautical Design**. Advances resulted in more hydrodynamic hulls with reduced drag and larger, more efficient propellers (Clausen, 2009; Jakobsen, 2009; MAN Diesel and Turbo SE, 2008; Mewis and Svardal, 2009).
- **More Fuel-Efficient Engines**. Engine manufacturers are using and modifying currently available technologies such as improved turbocharging design and tuning retrofits/new engines to make them more fuel-efficient, especially at lower operating speeds (Banisoleiman, 2008; Clausen, 2009; Jakobsen, 2009; MAN Diesel and Turbo SE, 2008).

- **Power Co-Generation**. Waste heat recovery systems are being used to generate electricity that would otherwise be generated by directly drawing power from the main engine (Jakobsen, 2009; Scott, 2011).
- **Alternative Fuel Engines**. Technologies such as liquid natural gas (LNG) engines are being prototyped to replace the more carbon-emitting, and polluting, heavy fuel oil engines (Henderson, 2010b and 2010c; Wirth, 2009).
- **Cleaner Engines**. Pollutant emission reductions are being designed into propulsion systems using more recent current technologies such as seawater-based exhaust scrubbers and combustion temperature controls to reduce nitrogen oxides (NO_x) and sulfur oxides (SO_x) formation (Henderson, 2010a; Scott, 2011; Wirth, 2009)..
- **More Fuel Efficient Operating Speeds**. Just as cars can achieve increased fuel economy within a certain range of reduced speed, so can container vessels. "Slow steaming" is a more recent and emerging practice to operate lower speeds that although may increase sea time, overall reduces fuel consumption and costs to be economical. This is being achieved not just by operation, but also by designing and tuning the current 2-stroke engines to inherently operate more efficiently at lower speeds (Banisoleiman, 2008; Clausen, 2009; Jakobsen, 2009; Mewis and Svardal, 2009).

These trends are not only happening for European shipping companies, and vessel and engine builders (Maersk, MAN etc.), but also for Asian ones (Korea, China, Japan and Vietnam) which is the other large foreign component of container vessel and engine builders. This makes it more likely that not only domestic, but also foreign-flagged vessels would have these improvements in the future.

Since larger container vessels in practicality means newer vessels, the future larger vessel fleet would not only be more fuel efficient, but would meet more stringent emissions standards discussed under the No Action Alternative for new vessels. The standards include the USEPA Tier 2 and 3 standards and the North American ECA requirements for NO_x after-treatment. Therefore, both U.S. and foreign-flagged OGVs entering the project area in the future would either be new U.S. vessels meeting the more stringent USEPA emissions standards, older U.S. vessels using reduced sulfur fuel, vessels of any nation using the reduced-sulfur fuel, or new vessels of any nation with exhaust after-treatment required by the ECA standards. Both the USEPA and ECA standards would ensure the future vessel fleet within the project area would have reduced emissions. Due to these standards, USEPA expects emissions in the ECA to be reduced by 23 percent for NO_x, 74 percent for particulate matter of 2.5 micron and below (PM2.5), and 86 percent, for SO_x. Because the Preferred Alternative channel improvements would provide an incentive for shippers to use larger, newer container vessels, the Preferred Alternative would help ensure that more of the future OGV fleet using the BSC would have newer vessels meeting the USEPA and ECA emissions standards sooner, compared to the No Action Alternative. Because of this, yearly NO_x emissions from vessel activity would be less under the Preferred Alternative than the No Action Alternative for the time it takes the older, smaller container vessel fleet to be replaced under the No Action Alternative. Because of the additional fuel efficiency per ton-mile, the larger, newer vessels would still be expected to have lower emissions per ton-mile compared to smaller, new vessels, and therefore, the Preferred Alternative would continue to produce fewer emissions for the same given tonnage moved than the No Action Alternative in future years.

The previously-discussed assumption that most of the containerized cargo entering Houston ports is destined for the immediate Houston area and would arrive mostly by truck and also by barge, has air emission implications for the Preferred Alternative. As previously discussed, the most fuel-efficient transportation mode is by large OGV. In terms of greenhouse gas emissions (GHG) per ton-mile, freight trains produce 1.6 times as many emissions; trucks 10 times as many emissions; and international air freight 47 times as many emissions as cargo ships

(Dizikes, 2010). Even as more stringent marine engine emissions control standards are just now being phased in the next few years, and truck diesel engines have had more emissions control standards in the past two decades, the efficiency per ton-mile of cargo ships still results in less amount of pollutants per ton-mile than other modes including truck. For example, the NO_x emissions in grams (gm)/ton-km for a medium sized truck are 0.8 gm/ton-km compared to 0.54 gm/ton-km for a cargo ship in the 2,000 to 8,000 deadweight tons (dwt) size class (Perry et al., 2008). With the implementation of the previously discussed technology for greater fuel efficiency, and the impending USEPA and North American ECA standards, the difference would likely grow when comparing the newer, larger OGVs. Therefore, where cargo has to move into the Houston area, maintaining cargo shipment by container vessel would produce fewer emissions than if it had to move by truck or rail. Another major cost consideration for shippers are time delays, since they translate into idle labor costs for a full crew. These time delays manifest either through terminal or channel capacity constraints. Channel transit delays could increase with the projected increase in cargo tonnage documented in the BSCCT. If these delays are large enough to overcome the fuel efficiency of OGV shipping within the distances that rail or truck becomes economically competitive, it could encourage shippers to call at other Gulf Coast ports and ship part of the Houston-bound cargo via truck or rail. Although, most of the future Houston-bound containerized cargo traffic would still be expected to call at the BSCCT under the No Action Alternative, the increased navigation efficiency of the Preferred Alternative would help ensure that this cargo does not shift towards road or rail modes due to inefficiencies of the channel, which would increase emissions of NO_x and other pollutants to move the same cargo.

Potential Vessel Emissions Reductions

To get an idea of what the OGV emissions reduction could be with the Preferred Alternative channel improvements, emissions per 100,000 TEU moved were estimated considering the ton-mile efficiency of the larger vessels, the emissions standards and reductions driven by the ECA, and an increase in the average percent capacity used per ship (i.e. decrease in light-loading). USCG data was used to determine the average TEU capacity of ships in the 5000+ TEU category that called during 2010 and 2011. Additional data was obtained from the PHA's 2007 Goods Movement Emissions Inventory (GMEI), and from information collected by the Port's consultants during visits to vessels in the size ranges depicted. The vessel fleet assumptions and data are summarized in Table 4.3.8-4.

Table 4.3.8-4 Vessel Fleet Assumptions and Data

Fleet Assumptions	Average TEU Capacity	Max Speed	Average ME kW	Average Aux kW Transit	Average Aux kW Maneuvering	Average Aux kW @ berth
Current mix of 5,000+TEU ships	5,871	24	55,372	1,385	2,289	1,034
Prospective 8,500 TEU ship	8,500	25	68,603	1,717	2,875	1,150

Emission factors and emission estimating methods are consistent with the Port's GMEI. Average load factors, which account for the fraction of rated engine horsepower used, were calculated using the Propeller Law and the ratio of actual rated vessel speeds, as described in the GMEI report. Briefly, the Propeller Law assumes that a vessel engine's load varies with the cube of vessel's speed. Load is calculated using the equation LF = $(S_{act}/S_{max})3$, where LF = load factor, S_{act} = actual speed, S_{max} = maximum rated speed. Current vessel fleet engines were assumed to meet the IMO Tier 1 emissions standard for NO_x because they were all constructed during or after 2000, the applicability year for the standard, and the larger vessels were also assumed to meet this standard. Emissions per 100,000 TEU moved were calculated for the various scenarios, including the use of ECA-compliant reduced-sulfur fuel at the 1 percent and 0.1 percent content requirements previously discussed. The percent reductions from current emissions were also calculated and all results are given in Table 4.3.8-5.

While it's not possible to precisely predict either future throughput or the sizes of vessels that ship owners would choose to use in the future, reasonably conservative estimates indicate that the larger vessels would lower NO_x and PM emissions by 10% on a tons-per-TEU basis without consideration of the effects of the ECA. The addition of the ECA will increase the reductions to 17% of NO_x emissions and 67% of PM emissions.

Currently, containerships calling at the BSCCT discharge and reload only approximately half of their container capacity on average. The reductions noted above are based on the larger vessels also moving half their capacity on each call. If the larger vessels were utilized such that they discharged and reloaded a greater percentage of their capacity (made possible by the deeper channel), then emissions per TEU would be further reduced. With the first phase of the ECA in place, NO_x emissions could be reduced by approximately 31% and PM would be reduced by approximately 73%. These are potential reductions achieved only by the increased loading efficiency and reduced fuel sulfur content, and would be greater for NO_x in future years when specific NO_x controls become mandatory in 2016.

As previously discussed, fewer ship calls for a given level of container throughput would mean relatively less assist tug activity required to guide vessels through the channel. Information about typical tug assist requirements for the existing BSC channel and existing Flare were obtained from the HPA, the organization of ships' pilots that help guide vessels in at the Port of Houston, in order to develop some assumptions solely for the purpose of enabling air emissions calculations to demonstrate the possible magnitude and scale of emissions reductions for tugs. This information was not gathered for purposes of defining vessel operating conditions for navigation economic analysis. The HPA estimated that approximately 25% of calls by the larger vessels that would be able to take advantage of the deeper channel would be able to make the turn into and out of the BSC without requiring tug assistance under the existing Flare conditions due to these larger vessels having advanced maneuvering features such as multiple bow and stern thrusters. The rest of the vessels would still require assist to make the turn at the existing Flare. The potential emissions due to tug assist reduction were estimated for the smaller, current vessel size category listed in Table 4.3.8-6 assuming an average of one tug per ship at the turn and two during channel transit, with 25% of future, larger vessel calls not requiring the one tug at the turn (but still using two tugs for channel transit). To conservatively estimate the potential magnitude of reduction, the assumptions of tugs per vessel were not changed for the larger vessels assumed to be used in the with-project condition, so that the reduction reflects the effect of reducing the vessel calls, and not reducing tugs needed per vessel, which varies with different bay and vessel conditions. To isolate the effects of the channel, the reduction in tug time was limited to that required for channel transit. An average rated main engine horsepower of 6,299 HP was assumed for each tug, based on data on the fleet of assist tugs serving the PHA. Emission factors and load factors were again obtained from the PHA's GMEI. The results are given in Table 4.3.8-6. The fewer ship calls for a given level of container throughput and resultant lower assist tug activity would result in an approximate 29% reduction in tug emissions per TEU if larger OGVs were to meet the container throughput with fewer calls, and if the OGVs were also more able to bring in a higher percentage of their capacity on average, the reduction in assist tug emissions would be approximately 44%. While tug emissions are low compared to emissions from OGVs, this would still represent a significant reduction in emissions from the harbor craft source category. Again, these are potential reductions achieved only by the increased container ship loading efficiency and resultant fewer vessels to guide, and the reduced sulfur fuel content. The emissions reductions would be greater for NO_x in future years when specific NO_x controls become mandatory in 2016.

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Table 4.3.8-5 Summary of OGV Emissions per 100,000 TEUs and Reduction Percentages

Fleet / Emissions Scenario	Units	NO_x	VOC	CO	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Current distribution of 5,000+ TEU vessels								
Emissions from current fleet	tons/100k TEU	48	3.3	5.9	38	4.8	3.7	2,179
Current fleet with ECA, 1.0% S fuel	tons/100k TEU	45	3.3	5.9	14	1.7	1.3	2,179
Current fleet with ECA, 0.1% S fuel	tons/100k TEU	45	3.3	5.9	2	0.8	0.6	2,179
Reduction percentage, ECA at 1.0% S	% reduction	-6%	0%	0%	-63%	-65%	-65%	0%
Reduction percentage, ECA at 0.1% S	% reduction	-6%	0%	0%	-95%	-83%	-84%	0%
Larger vessels, same percentage of capacity								
Larger vessels, without ECA	tons/100k TEU	43	3.0	5.5	35	4.3	3.3	1,973
Larger vessels with ECA, 1.0% S fuel	tons/100k TEU	40	3.0	5.5	13	1.6	1.2	1,973
Larger vessels with ECA, 0.1% S fuel	tons/100k TEU	40	3.0	5.5	1.4	0.7	0.6	1,973
Reduction from current fleet, without ECA	% reduction	-10%	-9%	-7%	-8%	-10%	-11%	-9%
Reduction from current fleet, ECA at 1.0% S	% reduction	-17%	-9%	-7%	-66%	-67%	-68%	-9%
Reduction from current fleet, ECA at 0.1% S	% reduction	-17%	-9%	-7%	-96%	-85%	-84%	-9%
Larger vessels, 25% increase in average percent of capacity								
Larger vessels, without ECA	tons/100k TEU	35	2.4	4.6	30	3.6	2.8	1,716
Larger vessels with ECA, 1.0% S fuel	tons/100k TEU	33	2.4	4.6	11	1.3	1.0	1,716
Larger vessels with ECA, 0.1% S fuel	tons/100k TEU	33	2.4	4.6	1.2	0.6	0.5	1,716
Reduction from current fleet, without ECA	% reduction	-27%	-27%	-22%	-21%	-25%	-24%	-21%
Reduction from current fleet, ECA at 1.0% S	% reduction	-31%	-27%	-22%	-71%	-73%	-73%	-21%
Reduction from current fleet, ECA at 0.1% S	% reduction	-31%	-27%	-22%	-97%	-88%	-86%	-21%

Table 4.3.8-6 Assist Tug Emissions and Potential Emissions Reduction

Fleet / Emissions Scenario	Units	NO_x	VOC	CO	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Current fleet of vessels requiring assistance making turn	tons/100k TEU	2.0	0.06	0.3	0.05	0.07	0.07	148
Larger vessels, same percentage of capacity	tons/100k TEU	1.4	0.04	0.2	0.03	0.05	0.05	105
Larger vessels, higher % of capacity	tons/100k TEU	1.1	0.03	0.2	0.03	0.04	0.04	83
Reductions from 2011 levels								
Larger vessels, same percentage of capacity	% reduction	-29%	-29%	-29%	-29%	-29%	-29%	-29%
Larger vessels, higher % of capacity	% reduction	-44%	-44%	-44%	-44%	-44%	-44%	-44%

Currently, because of the configuration of the channel and the size of the vessels that transit the waterway, HPA have imposed daylight restrictions on various vessels exceeding specific lengths and/or drafts to ensure safe navigation. Therefore, some vessels may only enter or exit the Port during daylight hours and, otherwise, are required to berth or dock at the BSCCT for extended periods of time until daylight arrives. While berthed to load or unload cargo, vessels typically shut down the propulsion engines but continue to utilize auxiliary engines to generate electrical power for the ship, a practice referred to as "hoteling." While power requirements are specific to ship type and cargo, air emissions are produced by the auxiliary diesel engines of the docked vessels in hoteling mode. This can be exacerbated when unloading of a vessel finishes at the end of daylight, too late for the daylight-restricted vessel to depart, requiring hoteling through the night.

Deepening and widening the existing BSC is expected to lessen the current transit restrictions and increase travel efficiencies for vessel operations. Unrestricted passage would allow vessels currently restricted to daylight entry/exit to enter and exit the Port as necessary rather than being required to remain at the dock in hoteling mode overnight. Consequently, the less time vessels spend hoteling as result of daylight restrictions, the greater air emissions reductions can be achieved from reduced or eliminated operation of diesel auxiliary engines within the BSCCT.

A previous evaluation (TTI, 2010) concluded that the overall delay averages three hours per vessel call – a period during which the delayed vessel must run its auxiliary generators and auxiliary boiler. This was based on a study of vessel delays on the Upper HSC, but for discussion, this assumption was used to demonstrate the possible reductions associated with eliminating daylight restriction delays. The effect on emissions of removing the daylight restrictions and the associated departure delay was estimated by calculating hoteling (auxiliary and boiler) emissions for three hours of delay, and multiplying those emissions by the number of calls per 100,000 TEU for both of the larger vessel scenarios described above. The emissions reduced per call and per 100,000 TEUs are presented in Table 4.3.8-7 below. It should be noted, however, that the delay per vessel call may extend past the three hours average when some vessels are finished loading/unloading at the end of daylight and are delayed overnight.

Table 4.3.8-7 Potential Emissions Reduction from Removal of Daylight Restrictions

Emission Source Type	NO_x	VOC	CO	SO_x	PM_{10}	$PM_{2.5}$	CO_2
Tons per call							
Auxiliary engines	0.049	0.0015	0.0042	0.051	0.0049	0.0038	2.75
Boilers	0.0068	0.0002	0.0004	0.036	0.0018	0.0013	2.13
Total	0.056	0.0017	0.0046	0.087	0.0067	0.0051	4.88
Tons per 100,000 TEUs							
Larger vessels, same % of capacity							
Auxiliary engines	1.18	0.04	0.1	1.22	0.12	0.09	66
Boilers	0.16	0.005	0.01	0.86	0.04	0.03	51
Total	1.34	0.04	0.11	2.09	0.16	0.12	117
Larger vessels, 25% increase in average % of capacity							
Auxiliary engines	0.93	0.03	0.08	0.97	0.09	0.07	52
Boilers	0.13	0.004	0.008	0.68	0.03	0.02	40
Total	1.06	0.03	0.09	1.65	0.13	0.1	93

Terminal Emissions

Emissions from BSCCT cargo loading/unloading operations are directly related to the containerized cargo tonnage processed there. The Preferred Alternative would only modify the current navigation channel, and therefore would not involve any modifications to the terminal facilities, offloading equipment, intermodal yard, roads, or vehicles. Therefore, it would not alter the efficiency, operation practices, or inherent emissions rates of the equipment and facilities used to load/unload and transport cargo from docked ships to landside facilities or to other surface transportation modes (e.g. rail, truck). A typical 5,000 TEU container vessel takes up to 18 hours to load/unload. Therefore reductions in travel time through the channel due to improvements would not substantially alter the time spent in berth, and in turn throughput, since this is limited by loading/unloading. The Panama Canal expansion will allow the larger TEU-capacity container vessels to pass through the canal, which would allow part of the container ship traffic currently calling at West Coast ports to call on Gulf Coast ports. The Preferred Alternative could encourage shippers associated with this traffic to ship to the BSCCT. Therefore, the channel improvements of the Preferred Alternative may result in an additional source of container cargo tonnage. As discussed in the No Action Alternative, the BSCCT will have seven berths constructed at build-out, projected to occur between 2020 and 2030, and with a finite total cargo tonnage throughput of 2.3 Million TEU per year that was already projected to occur at the end of the terminal build-out in the absence of channel improvements. Any increase in container traffic tonnage resulting from the Preferred Alternative would only result in supplanting the non-Panama Canal-related tonnage increase already projected, since it was projected to increase up to the terminal's ultimate capacity in the BSCCT FEIS. The Preferred Alternative may change how fast the future tonnage increases up to the ultimate capacity, but it would not result in a net increase of tonnage. Therefore, the Preferred Alternative would not result in a net increase in tonnage processed, and therefore would not result in a net change of emissions from terminal operations from the No Action Alternative. Similarly, the clean air initiatives in the CASP related to terminal operations and equipment would continue to reduce the emissions.

Maintenance Dredging

Maintenance dredging would continue to be needed to maintain the planned and constructed channel dimensions. Considering this, maintenance dredging is necessary to maintain the full navigation efficiency that would result in the positive impacts for air emissions discussed in the preceding subsections. Without the periodic dredging of the improved channel, reduced draft would increase light loading, reduced channel dimensions could reinstate previous daylight restrictions and levels of tug assist, and channel dimension limitations could decrease the propensity to use larger, more efficient ships. The incremental increase in maintenance dredging emissions due to the extra material that would occur every few years would be small compared to the potential emissions reductions that could be realized with a fully maintained channel, especially considering the reductions would occur repeatedly with the hundreds of vessel calls each year, and over a 20 year period. Therefore, the overall impact of 20 years of maintenance dredging for the improved channel would be expected to be positive, given that it is necessary to maintaining the full improved capacity of the waterway essential to efficient shipping and the aforementioned associated emission reductions.

Conclusion

The information discussed above demonstrates several positive consequences of improving the channel, including allowing and encouraging fewer, larger, newer (and therefore more fuel efficient and less-emitting) container ships to call at the BSCCT, and reducing tug assists. The potential calculated emissions reductions shown are substantial and do not account for even further reductions that would be achieved when Tier III emissions standards become mandatory in the ECA or via USEPA standards phase-in deadlines, or due to trends towards better fuel efficiency. Because of the finite throughput capacity of the terminal which is already projected to be reached by current future traffic projections listed in the BSCCT FEIS, the maximum yearly cargo traffic is not expected to be impacted by the Preferred Alternative; potentially, only the timing of when that maximum throughput is reached would be affected. Maintenance for the improved channel would be necessary to maintain the channel dimensions that would result in shipping efficiencies and associated vessel emission reductions, and would therefore produce positive impacts compared to the relatively small incremental increase in current maintenance dredging emissions. Considering that the Preferred Alternative would have positive effects on vessel transit emissions and would not result in a net increase in container vessel traffic, this alternative would not be expected to negatively impact air quality from these operational emissions sources.

4.3.8.3. Greenhouse Gas Emissions and Climate Change

The GHG emissions from the Preferred Alternative will result from construction activities of the channel and during dredged material placement, as well as from vehicular traffic associated with on-road construction equipment and support vehicles associated with those activities. The principal greenhouse gases that enter the atmosphere as a result of human activities include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. GHG contribution from the Preferred Alternative will be temporary and only occur during construction, most of which will take place in one year. The Preferred Alternative will result in no permanent emission source, and will not have indirect effects of increasing the terminal equipment and vehicle activity that consume fossil fuel. As such, the contribution to GHG will be limited to construction emissions

Climate change due to GHG is a global and most, a regional-scale issue, and locally, the largest contributions are from on-road mobile sources (cars, trucks) and power plant stationary sources. CO_2 is the largest component of GHG emitted by these sources. The GHG emitted from constructing the Preferred Alternative will be insignificant compared to regional emissions. Consider that the maximum yearly NO_x emissions estimated for General Conformity determination constitute only 0.88% to 3.5% of the on-road source emissions and only 0.66% to 1.68% of marine, construction, and mobile emissions contained in the proposed revision to the HGB area SIP for the modeled years 2006 and 2018 respectively. If stationary emissions from powerplants, commercial and residential use were incorporated, the percentages would substantially less. The Preferred Alternative emissions will occur primarily from combustion of diesel by marine engine dredges and support vessels (tenders, barges etc.). The ratio of average CO2 emissions of diesel compared to gasoline is approximately 1.14 (USEPA 2005). Directly comparable emissions factors for marine diesel engines are not readily available, but the combustion and exhaust process is similar to that of engines used for Heavy Duty Diesel Vehicles (HDDV). The ratio of average NOx emissions per mass of fuel consumed between HDDV compared to gasoline light-duty trucks and passenger vehicles (which constitute the majority of on-road GHG sources) ranges from 9.06 to 12.43 (USEPA 2008a and b). Because the ratio comparing average emissions for NO_x of diesel to gasoline sources is greater than the ratio between these sources for CO_2, if Preferred Alternative NO_x emissions constitute an insignificant percentage of regional emissions, Preferred Alternative CO_2 emissions will constitute an even smaller percentage of regional emissions. Therefore Preferred Alternative emissions contribution to regional GHG emissions will be negligible.

4.3.9 Noise

Short term impacts of the different alternatives would primarily involve the construction sound during dredging. Since dredged material placement activity would take place in locations in the bay more than half a mile away from mainland shoreside receptors, the short term impacts would be much less, if at all perceptible. The effects of channel improvements on ship transit, BSCCT terminal activity, and related rail and roadway sound within the land cut portion of the BSC would primarily account for the potential long-term noise impacts of the different alternatives. These long-term impacts are indirect effects of the different alternatives. Dredged material placement areas do not involve permanent noise activity, and would therefore have no potential for long-term impacts.

No Action Alternative

The No Action Alternative would not change the sound environment of the existing BSC and BSCCT area. The BSCCT will continue to develop as described in the BSCCT FEIS. The BSCCT will have 7 berths constructed at build-out, which is projected to occur between 2020 and 2030. This would increase the sound levels of terminal activity. The BSCCT FEIS and permit accounted for this increase by modeling noise impacts using the maximum 1-hour L_{eq} recorded at Barbours Cut, modeling it as a linear source across all 7 berths to simulate all berths in operation, and assuming 24-hour operations. This is a conservative estimate, representing the maximum possible sound level and duration of activities. This estimate was intentionally conservatively generated because it was used to ensure that planned noise mitigation efforts would be effective for the maximum projected noise level possible. The 7 berths have a finite total cargo tonnage throughput of 2.3 Million TEU per year, which was already projected to be achieved at the end of the terminal build-out, absent any channel improvements, as discussed in Appendix 2.2 of the BSCCT FEIS.

Preferred Alternative

The Preferred Alternative would result in temporary impacts due to the dredging activities required for construction of the channel improvements. The maximum sound levels expected would be similar to those discussed in the BSCCT FEIS, Section 3.8.3.3 for dredging. They would be similar to the periodic maintenance dredging that occurs on the BSC in sound level and duration. Construction sound at the existing PA sites would be primarily from diesel shore or land-based equipment, such as bulldozers, backhoes, and marsh buggies, but would not impact any human receptors. Because the construction noise impacts would be temporary and similar to noise already generated periodically by maintenance dredging, they are considered minor.

As discussed in Section 3.3.9 of this EA, vessel transits are not expected to be a major contributor to sound levels above the ambient sound environment of the nearest receptors. However, the Preferred Alternative would include widening the channel within the land cut by 50-ft to the north. This would potentially shift the channel centerline 25-ft to the north, and would move the channel toe 50-ft further north as well. This would allow large vessel and tug transits to occur 50-ft closer to the north, where the nearest receptors in Shoreacres are located. To assess what this would mean to changes in sound level, calculations were performed for the change in sound pressure level (dBA) due to the change of 50-ft, at various receiver distances around the distance associated with the BSC Shoreacres receptors. The calculations were performed with two different assumptions as to how the sound source behaves and spreads: spherical, and cylindrical, with spherical being more conservative for maximum sound level changes. The calculations were performed using the following standard sound propagation equations for these assumptions.

$$L_{p1} - L_{p2} = 20\log\left(\frac{r_2}{r_1}\right) \quad \text{(Spherical)}$$

$$L_{p1} - L_{p2} = 10\log\left(\frac{r_2}{r_1}\right) \quad \text{(Cylindrical)}$$

Where:

L_{p1} = sound pressure level (dBA) at 50-ft less than original distance

L_{p2} = sound pressure level (dBA) at original distance

r_1 = 50-ft less than the original distance from sound source to receptor

r_2 = original distance from sound source to receptor

The results of the calculations are summarized in Table 4.3.9-1 and show that the increase in sound levels due to the sound source moving 50-ft closer is 1.3 dBA or less. The predicted increase drops as the distance to the receiver increases, with predicted sound level increases of less than 0.4 dBA for receiver distances greater than 1000-ft. The threshold of typical human perception of variation in loudness is 3 dBA as discussed in Section 3.3.9. Therefore, the predicted increases in sound level would not be perceptible to the normal human ear.

Table 4.3.9-1 Sound Level Increase Due to 50-ft Change in Source Distance

Receiver distance		Potential Increase in Sound Level, dBA	
r_1 (ft)	r_2 (ft)	Spherical	Cylindrical
300	350	1.3	0.7
400	450	1.0	0.5
500	550	0.8	0.4
600	650	0.7	0.4
1000	1050	0.4	0.2
2000	2050	0.2	0.1
3000	3050	0.1	0.1

As previously discussed in Section 4.3.8.2, the channel deepening of the Preferred Alternative would allow larger containerized cargo vessels to come in more fully loaded, which would result in transportation costs savings to shipping companies. This would encourage shipping companies to use larger, more fully-loaded, deeper draft vessels than the current smaller, lightly loaded vessels in order to realize the benefits of economies of scale. This change would result in an overall decrease in the number of container vessels calling at the terminal to convey a given tonnage. Even though the vessel transit sound is not a major sound source, the shift to fewer, larger vessels would result in fewer noise events resulting from vessel and tug transits as the vessels enter the BSC and dock at the terminal.

The Preferred Alternative would only modify the current navigation channel, and therefore would not involve any modifications to the terminal facilities, offloading equipment, intermodal yard, roads, vehicles, or sea-going vessels. Therefore, it would not alter the efficiency, operations practices, or inherent noise levels of the equipment and facilities used to load/unload and transport cargo from docked ships to landside facilities or to other surface transportation modes (e.g. rail, truck). The Preferred Alternative channel improvements could allow entry of the newest, largest class of container vessels at 10,000-plus TEUs. Although it would take longer to load/unload each of these larger ships, the increased duration of loading/unloading operations on a per-ship basis for these vessels would not affect daily sound level averages. It takes an average of 10 to 20 hours to unload 1,000 TEUs from a modern container vessel (Rodrigue et al., 2009). Therefore, it would take well over one 24-hour working day to unload an average container vessel in the 3,000 to 5,000 TEU range. Conversations with

PHA operational management staff at the BSCCT corroborate this. Since it already takes more than one working day to unload the largest container vessels that currently call at the BSCCT, and the longest sound level impact thresholds are daily quantities, the sound level averages would not change with the unloading of larger vessels, whether it is a 1-hour L_{eq}, 24-hour L_{eq}, or L_{dn}.

The Panama Canal expansion, which will allow the largest TEU-capacity container vessels to pass through, would enable part of the container ship traffic currently calling at West Coast ports to call on Gulf Coast ports. By providing a ship channel capable of handling these large vessels, the Preferred Alternative could encourage shippers associated with this traffic to ship to the BSCCT. As discussed in the No Action Alternative, the BSCCT FEIS and permit accounted for the increase in terminal sound at full build-out. The BSCCT FEIS modeled sound conservatively, using the maximum 1-hour L_{eq} for a 24-hour duration as a sound source for each berth. Therefore, any increase in terminal activity resulting from the increased container tonnage facilitated by the Preferred Alternative could not increase sound levels above those already permitted and modeled in the BSCCT FEIS.

In anticipation of the potential terminal activity and traffic sound level increases that may accompany build-out of all seven berths at the BSCCT, the PHA has implemented a number of sound level reduction efforts for terminal equipment including the following:

- Implemented a Sound Mitigation program that provides the owners of 411 nearby residential properties the opportunity to apply for a mitigation payment. The program boundaries were defined by the results of a sound study that consider the ultimate sound impacts of the facility. To date approximately 80% of eligible property owners are participating in the program.

- Implement a Soft Landing Laser System on all ship to shore cranes at Bayport. This system would limit the speed of containers placed on vessels and other containers, and the speed of spreader bars placed on containers for the majority of lifts that are made during a vessel operation. This system would reduce the instantaneous impact sound and is anticipated to be complete on the existing wharf cranes by January 2012.

- Yard trucks, top loaders, and rubber-tired gantries (RTG) with enhanced exhaust muffler systems.

- Wharf cranes with no-slap cable designs, and impact noise reduction systems on the spreader bars.

- Installation of broadband-sound movement/backup alarms on equipment/vehicle wherever feasible. The alarm sound is a more directional, more discrete “swish” sound rather than a standard beeping tone.

Because (i) fewer, larger container ships would decrease vessel transit noise events, (ii) terminal activity sound level averages would not be expected to increase as the result of loading/unloading larger ships, and (iii) any increase in tonnage resulting from the channel improvements would not increase terminal activity sound levels above the already-projected levels described in the BSCCT FEIS, the Preferred Alternative would not result in impacts from terminal activity.

Likewise, the Preferred Alternative would not result in any increase in noise impacts from the use of public roadways and rail facilities. According to Section 3.8.3.3 of the BSCCT FEIS, noise impacts from the changes in traffic on public roadways and increased rail activity were modeled using traffic for the build-out year, which represents terminal activity levels at the maximum cargo throughput of the terminal. These traffic and rail increases did not result in noise impacts at the nearest receptors either to the north or south of the terminal. For the same reasons discussed above with respect to terminal activity sound impacts, the Preferred Alternative would not result in a net increase in terminal activity that would in turn, result in a net increase of public roadway traffic or rail activity. Therefore, the Preferred Alternative would not result in increases in public roadway traffic or rail activity, and the noise impacts from these sound sources would continue to be minor.

The Preferred Alternative would have no impact on sound-induced vibration. As discussed in Section 3.3.9 of this EA, the potential for sound-induced vibration from terminal activity was limited to vibration produced during ship docking activity. The Preferred Alternative is likely to reduce the frequency of docking events occurring at BSCCT because the more numerous, smaller, lightly-loaded ships currently calling on Bayport are likely to be replaced by a smaller number of larger vessels. Additionally, increased prevalence of bow and stern thrusters in modern fleets would also reduce the use of tug boats and the corresponding vibration-inducing docking events. Considering the factors discussed above, the Preferred Alternative would have a minor impact on sound-induced vibration.

Maintenance dredging for the improved channel over 20 years would have the same impacts as the current maintenance for the existing channel, and therefore would not pose new impacts, as sound levels would be the same. The only difference is with approximately a third more maintenance volume, the maintenance dredging may last a third longer.

In summary, the Preferred Alternative is expected to have only minor impacts on noise and vibration from vessel transit, terminal, public roadway, or rail activity, and may reduce some impacts from fewer vessel transit and docking operations. Therefore, the Preferred Alternative would have only minimal impacts on the sound environment.

4.3.10 Cultural Resources

The inspection and review of historical records and aerials only identified previously recorded anomalies described as modern debris or naturally occurring bottom features. Additionally, the terrestrial areas surrounding the APE for the channel have been thoroughly disturbed and, it's likely that any sites that may have existed would have been destroyed during the development of the area. Protection along the shoreline in response to erosion at the mouth of BSC indicates that the local environment is not conducive to site preservation.

In addition to the thorough literature review, high-frequency side-scan sonar and magnetic remote sensing survey operations were simultaneously conducted within the project area to identify potential cultural resources. The marine survey was conducted in accordance with Federal and local standards.

No Action Alternative

Under the No Action Alternative there would be no new impacts to cultural resources.

Preferred Alternative

Results of the cultural resources survey discussed in Section 3.3.10 indicated that no historic properties or resources, or anomalies recommended for further investigation were identified in the preferred channel alternative's Area of Potential Effect (APE). Therefore, impacts to cultural resources would not occur from the channel improvements. If unidentified cultural resources are encountered during construction of the project, work would be suspended in that area until the resources are further evaluated. The cultural resource coordination for existing PAs proposed for new work and maintenance dredged material placement were previously conducted and documented in the PA 14/15 Expansion EA, and the HGNC FEIS as discussed in Section 3.3.10. No resources or anomalies warranting further investigation were found. It is not anticipated that this action would have any impacts on any other potential cultural resources, and no additional surveys are planned for this area. Because no potential cultural resources have been identified within the new work footprint of the proposed improved channel, and makes use of existing and planned PAs, O&M over 20 years for the improved channel would not result in any impacts on cultural resources.

4.3.11 Safety and National Security

In light of recent world events, global concern regarding acts of international terrorism, leading to heightened domestic and international security at U.S. ports. Security at Bayport relies on continuous alertness, open communication, and cooperative partnerships with the USCG, U.S. Customs and Border Protection, and numerous other law enforcement and regulatory agencies at the Federal, State, and local levels. These efforts have increased port security by requiring more stringent vessel inspections, deploying additional monitoring vessels, and increasing terminal owner/operator security measures.

The USCG has established security zones for certain areas within the Houston/Galveston area. A security zone is defined as an area of land, water, or land and water which is so designated for such time as is necessary to prevent damage or injury to any vessel or waterfront facility, to safeguard ports, harbors, territories, or waters of the U.S. or to secure the observance of the rights and obligations of the U.S. The BSC and TB security zone encompasses all waters south of latitude 29°36'45" N and west of BSC Light 9 (LLNR–23295) (NAD 1983). The latitude is a line approximately 340-ft south of the current channel centerline and encompasses the BSCCT berths and dock area. Recreational vessels and unauthorized vessels/persons are excluded from these areas without the express permission from the USCG and violators may be subject to civil penalties, fines and/or imprisonment.

The Preferred Alternative include widening the channel within the land cut by 50-ft to the north. This would potentially shift the channel centerline 25-ft to the north, and would move the toe of the channel 50-ft north as well. Therefore, security zones may require revisions in order to maintain the accepted level of safety in and around the BSC and TB. PHA will coordinate efforts with the USCG and the relevant law enforcement and regulatory agencies to ensure the proper revisions to the security zone boundary are made. No impacts to national security would occur as result of 20 years of O&M for the proposed improved channel.

4.4 MITIGATION

The following sections discuss the mitigation proposed for impacts that would occur from implementing the proposed action. The full detail of mitigation and monitoring for the proposed action will be outlined in the Compensatory Mitigation and Monitoring Plans (CMMP), one for oysters and one for tidal marsh, to be submitted to the USACE by the Applicant and included in this report as Appendix G.

4.4.1 Proposed Oyster Mitigation

The channel improvements of the Preferred Alternative would result in unavoidable, permanent impacts to approximately 4.6 acres of oyster hard-bottom habitat. Mitigation for these direct impacts would replace the oyster habitat that would be removed by the construction of this alternative by restoring oyster habitat on Fisher's Reef in Trinity Bay, Chambers County, Texas as shown on Exhibit 4.4.2-1. Specifically, the mitigation would add approximately 3,710 CY of cultch (limestone, rock or clean, crushed concrete rubble) to 4.6 acres on Fisher's Reef for the channel improvements to the BSC. This would increase the existing oyster habitat in Trinity Bay by up to 5 acres of hard surface area available for natural recruitment of oyster larvae. The Fisher's Reef mitigation area was recommended by TPWD. Fisher's Reef was impacted by Hurricane Ike induced sedimentation in 2008. Fisher's Reef has approximately 30 acres identified by TPWD for rehabilitation. This oyster restoration would replace the important ecological benefits to Galveston Bay of impacted oyster habitat such as improvement of water quality and clarity as well as re-establishment of essential fish and invertebrate habitat. As discussed in Section 4.2.2.2.5, the oyster habitat impacted predominantly consists of isolated oyster clusters overlying shell hash (shell-in-mud) substrates of varying density, and contains 0.2 acres of consolidated reef for the Preferred Alternative impacts. Because continuous hard-bottom surface would be created over the same amount of acreage impacted, the mitigation would be expected to result in greater densities of live oyster clusters, and more area of consolidated reef than what was impacted, as the mitigation would provide a greater density of attachment sites. Because the dredging activity to construct the proposed action is not expected to result in any lasting impacts to oyster reef outside of the direct impact footprint from material resuspension and redeposition, as explained in Section 4.2.2.2.5, no mitigation is proposed for these effects. The details of the proposed mitigation are provided in Appendix G-1, CMMP for Oysters.

4.4.1.1. Background on Site Selection and Method

Two Fisher's Reef areas were selected for maximum water depth and minimum sediment overburden based on post-Hurricane Ike TPWD side-scan sonar data and sub-bottom profiling data collected by Texas A & M University at Galveston. One reef footprint is in a shellfish harvesting area whereas the other reef footprint is in waters restricted from shellfish harvest thus allowing for research on harvested versus non-harvested adjacent oyster reefs. Cultch material would be placed in a layer approximately 6 inches deep depending on sediment depth in one of the two areas identified dependent on local site conditions such as bathymetry and results of probing of bay bottom foundation material being performed during preconstruction design to ensure appropriate portions of this area are used considering constructability. In discussions with TPWD, a one-to-one acreage replacement of oyster habitat would be appropriate mitigation. As previously discussed, the creation of continuous hard-bottom surface under mitigation would be expected to produce a greater amount of consolidated reef compared to the impacted habitat.

4.4.1.2. Monitoring

Monitoring of the restoration sites would be conducted pre- and post-restoration in order to assess the success of the project. Criteria for restoration success would include one structural and one functional endpoint. The structural endpoint would be the number of reef acres restored. Pre-restoration and post-restoration side-scan sonar data would be collected and processed into ArcGIS data layers. Restored reef acreage would be quantified by subtracting pre-restoration reef acreage from post-restoration reef acreage to determine the amount of habitat restored. Success would be defined as an increase in reef acreage of at least 4.6 acres for mitigating the channel improvement impacts. The functional endpoint would be oyster density (oysters/m^2). Density would be measured using the diver quadrat method twice a year (pre- and post-oyster harvest season) for three years. SCUBA divers would sample random points along a transect line by placing a 0.25 m^2 quadrat on the bay bottom and placing all shells and live oysters from within the quadrat into a mesh bag. All live oysters would be enumerated and a maximum of 10 individuals would be measured for shell length. Success would be defined as a post-restoration oyster density equal to or greater than densities observed during a pre-construction survey of a nearby control site selected by TPWD. Once the success criteria are met, the monitoring would cease and the mitigation project is determined to be successful.

4.4.1.3. Reporting

The results of all monitoring activities would be summarized in an annual report that summarizes the findings of final reports. The first report would include the findings of the restored reef acreage as determined by side-scan sonar and would be submitted no later than 90 days after project completion. The three annual reports would include the oyster density findings of the SCUBA divers including if the post-restoration oyster density has met the success criteria.

If the mitigation is not progressing to meeting the success criteria within three years, the TPWD and district engineer would be notified by the Applicant as soon as possible so that the mitigation plan can be evaluated and measures pursued to address deficiencies of the mitigation plan. The Applicant will conduct mitigation monitoring until success is documented.

4.4.1.4. Implementation and Long-Term Management

The proposed mitigation would be implemented either before or concurrently with the construction of the proposed project. Currently, it is anticipated that construction of the proposed project would begin in 2014, with construction lasting approximately one year. Pre- and post-construction monitoring for meeting the restoration objectives would occur before and after constructing the mitigation with post-construction monitoring lasting for three years. After the success criteria are met, the long-term management of the mitigation area would be conducted by the TPWD.

4.4.2 Proposed Wetland Mitigation

The proposed dredged material placement of the Preferred Alternative would result in unavoidable, permanent impacts to approximately 9.2 acres of salt marsh and temporary impacts to 4.7 acres of marsh. Mitigation for these direct impacts would replace the wetlands habitat that would be removed by the construction of this alternative by creating 8.25 tidal fringe salt marsh in Scott Bay, at the Baytown Nature Center (BNC), Harris County, Texas as shown in Exhibit 4.4.4-2. Specifically, an estimated approximate amount of 52,000 to 58,000 cubic yards of fill would be added into Scott Bay to be contoured and graded to meet the existing upland/shoreline interface at elevation +3.02 ft MLT and meet the grade at the proposed marsh creation levee at +2.52 ft MLT (approximately 6 inches below Mean High Water [MHW]), and then planted with smooth cordgrass and black mangroves. Thus, the marsh fill would be graded and contoured within this target elevation range. A marsh containment levee with a crest of +4.02 ft MLT (approximately 1 ft above MHW) would be constructed to contain the marsh fill, and provide wave energy protection to protect salt marsh plantings. The containment levee would be sufficiently porous or have sufficient gaps to allow tidal exchange at elevations below the levee crest.

The specific levee design would be determined in preconstruction design, but is proposed to be an earthen berm protected by a rip-rap veneer with a 4:1 levee slope. Beneficial use of non-contaminated sediments from suitable locations, is proposed, and would be tested for contaminants prior to use to ensure fill material used is environmentally acceptable. The proposed source and testing results will be coordinated with the USACE prior construction. Once soils have settled for approximately 3 months, smooth cordgrass would be harvested from nearby healthy and dense cordgrass communities at the BNC and transplanted to the proposed mitigation site. Mangrove saplings would be obtained from a reputable dealer. Vegetation will be installed on approximately 5-foot centers. Noxious and invasive species will be excluded from harvest and planting activities to the maximum extent possible using standard practices for selective removal such as mowing and spraying. The proposed mitigation would result in a low marsh subtype habitat that should replace the functions and services of the impacted high functioning marsh. As explained in Section 4.2.1.2, the temporary impacts to marsh vegetation within the proposed construction corridor will be mitigated by replanting impacted areas with native marsh vegetation following removal of construction mats used for equipment access and monitored to ensure success criteria are met. The details of the proposed mitigation are provided in Appendix G-2, CMMP for Tidal Marsh.

4.4.2.1. Background on Site Selection and Method

The BNC is a 450-acre site owned, protected, and managed by the City of Baytown Parks and Recreation Department, encompassing two connected peninsulas on the western of Baytown, and is surrounded by Burnet Bay to the north, Scott Bay to the south and Crystal Bay and the HSC to the west. The BNC was established at the site of the former Brownwood subdivision, which was abandoned after severe subsidence and repeated flooding. Approximately 150 acres of wetland restoration projects have already been constructed within the BNC, and this proposed mitigation has been designed to contribute to previous restoration efforts. During the site selection process, the NFS considered several options for providing compensatory mitigation for the unavoidable impacts proposed by the proposed action. The hierarchy of mitigation options in the 2008 Final Compensatory Mitigation Rule was considered. Because the impact site is outside of the primary and secondary service areas for any mitigation banks and in-lieu fee programs, the top two options of purchasing credits from an operational mitigation bank or from an approved in-lieu fee program, were not considered further. Therefore, the NFS proposes to perform permittee-responsible mitigation under a watershed approach, the next option.

This option ensures that the ecological functional gain provided by the proposed mitigation is performed within the same watershed as the ecological functional loss to ensure no net loss of aquatic resources in the watershed occurs. The proposed mitigation site is located in the Buffalo Bayou – San Jacinto River Watershed (Hydrologic Unit Code [HUC] 1204010407), which drains all or part of Harris, Montgomery, Waller, Walker, Grimes, Liberty and San Jacinto Counties. The impact site at PA 15, and the BNC, are located on the Houston Ship Channel and in the same 4-digit HUC (HUC 1204). Both of these locations contribute to the quality of habitat in the Houston Ship Channel and Galveston Bay. The BNC is located approximately 9 miles upstream of the impact site, and mitigation at the BNC will provide ecological functions for both of these waterbodies. The proposed mitigation site is a shallow cove located on the south side of the BNC peninsula that historical aerial photographs indicate was historically upland and saltmarsh in 1953, and by 1978, almost completely submerged due to subsidence. Although the area in the vicinity of the mitigation site has subsided more than 9 feet since 1900 (Region H Water Planning Group 2010), virtually no subsidence is projected for eastern Harris County (Neighbors 2003) due to the implementation of the 1999 Harris County Subsidence District Regulatory Plan by the Harris-Galveston Subsidence District (HGSD), which regulates groundwater withdrawals.

Currently, the proposed mitigation site is submerged by the tidal waters of Scott Bay. There are no wetlands or vegetation present in this open water area, nor are there any special aquatic site regulated under 40 CFR 230. The site depths vary between 8 feet at the deepest end farthest from the shoreline, and 0 ft at the shoreline. Dead, rooted trees are located on the submerged lands in the central and western portion of the proposed mitigation site. Sediments on the proposed mitigation site were observed to be predominantly sandy, with some areas overlain by several inches of silt. A general assessment of mitigation site bottom conditions on June 11, 2013 did not indicate continuous or extensive subtidal oyster reef within the proposed mitigation site. A more systematic, comprehensive bay bottom condition probing effort conducted on July 17 and 19, 2013 confirmed the lack of extensive or continuous bottom reef, and revealed only seven of 76 probe locations within the proposed site contained areas of remnant shell in mud, mainly corresponding to the location of the historical shoreline indicated in the 1953 aerial that has since subsided, but also areas around where dead tree stumps remain. These areas were probed with a grab sampler, and only two of the locations were observed to have sporadic live and dead oyster clusters with attached mussels, intermixed with sandy and silt areas. These were in areas containing fallen trees, stumps, and/or broken concrete or riprap. All other probe locations only indicated soft bottom conditions. There is no indication of any sizable, continuous, consolidated reef growth, and the live oyster clusters observed are indicative of small, scattered, sporadic growth on submerged debris (e.g. logs, rip-rap). The continuous area of rip-rap (approximately 1/3 of an acre) proposed as shore protection for the marsh containment levee will provide far more substrate surface area for oyster attachment than would the sporadic areas of live and dead oyster clusters observed within the proposed footprint. Therefore recolonization of the proposed shore protection substrate would result in greater live oyster cluster density than what is present, and no separate mitigation is proposed. No seagrasses were observed during these investigations.

4.4.2.2. Determination of Mitigation Quantities

To ensure the functions and services of impacted wetlands would be adequately compensated for, the same USACE-SWG Tidal Fringe HGM (interim) model, or “iHGM” for short, that was used to determine FCU impacts of the proposed action, was used to calculate compensation requirements. The iHGM model is the model available to determine functional impacts to tidal wetlands prescribed by USACE-SWG to determine mitigation under the Compensatory Mitigation Rule. The fundamental unit for evaluating impacts within the iHGM is the Functional Capacity Index (FCI), with the tidal fringe iHGM employing FCIs for biota, botanical, physical, and chemical functions. The FCIs for the wetland assessment areas (WAA) are multiplied by the acreage of the WAAs to determine the FCUs. The FCUs determined for the marsh to be impacted, discussed in Section 3.2.1.2 and listed in , were used to set FCU targets to determine the area of tidal fringe salt marsh creation necessary to compensate for the losses calculated. It was assumed that in the with-project, without-mitigation scenario, all of the FCUs present would be lost, because the stability berm footprint will consist of a relatively steep earthen berm, vegetated for erosion protection, that would be filled well above inundation elevations, and would not be conducive to re-developing marsh. Because the model employs 4 independent indices, the amount of mitigation was determined by finding the maximum acreage needed to satisfy replacing the FCUs of any one of the functions. The results of the modeling are summarized in Table 4.4.2-1, which show 8.25 acres is needed to fully replace the chemical subindex FCUs.

Table 4.4.2-1: Tidal Fringe HGM (Interim) Results for Proposed Mitigation at Baytown Nature Center

Calculated Quantity	Subindex			
	Biota	Botanical	Physical	Chemical
Impacted				
Impacted Marsh FCI (area weighted average)	0.65	0.81	0.59	0.69
Impacted Marsh FCU[1]	6.00	7.50	5.40	6.35
Mitigation				
Proposed Marsh FCI	0.79	1.00	0.67	0.77
Proposed Acreage Required[2]	7.59	7.50	8.06	8.25
Proposed Marsh FCU	6.00	7.50	5.40	6.35

1. FCU = FCI * acreage
2. Required Mitigation Acreage = Impacted FCU/Proposed Marsh FCI

The proposed compensatory mitigation area will compensate for unavoidable impacts to aquatic resources by providing functions and services similar to those provided by the impacted area, including providing suitable habitat for aquatic flora and fauna in the project vicinity and watershed, providing an area where suspended solids can be trapped and settle, and providing water quality treatment and polishing through the assimilation of non-point source pollutants.

4.4.2.3. Monitoring

Monitoring requirements for the compensatory mitigation area will adhere to the 2008 Final Compensatory Mitigation Rule and USACE Regulatory Guidance Letter (RGL) 08-03. Monitoring studies will be conducted on an annual basis for up to five years after all mitigation activities are complete. Monitoring studies will occur annually past the nominal five year required monitoring period only if the mitigation site does not meet success criteria during that time. Success criteria of the compensatory mitigation area will be evaluated annually for five years or until the success criteria are met. The project will be considered successful if the following conditions are met:

- A minimum of 50 percent survival of installed plugs is achieved within 60 calendar days of planting
- After one calendar year from planting, the target FCUs listed in Table 4.2.1-1 are met. These are: biota FCUs = 6.0, botanical FCUs = 7.5, physical FCUs = 5.4, and chemical FCUs = 6.3.

Monitoring would occur annually for five years and involve iHGM assessment to ensure the resultant FCUs are meeting the success criteria. A thorough review of the iHGM model indices and parameters indicated that for the mitigation area, the percent areal coverage of native vegetation is the only variable that has a temporal component, and is the only variable expected to change once the proposed mitigation is constructed. Areal coverage of native vegetation must be at least 90 percent to achieve the required number of FCUs for full compensation of permanent impacts at the end of one year. All variables required to apply the iHGM will be assessed and quantified. The assessment of wetland vegetation establishment and the quantification of vegetative areal coverage will be determined by a visual assessment of pre-established sample plots located in the created wetlands. All dominant vegetation will be identified in each sample plot, and areal coverage of each species will be determined. The location of each of these sample plots will be randomly determined, but will remain fixed for all subsequent monitoring events. This will allow for an accurate determination of the progress of the wetland as it matures, and will limit variation in assessment results due to site-specific differences.

For the temporarily-impacted construction corridor, pre- and post-construction elevation contour and vegetation areal coverage surveys would be performed. The soils in the construction corridor would be regraded to pre-project contours as necessary. If success criteria are not met, areas in need of attention will be replanted.

4.4.2.4. Reporting

The NFS would be responsible for conducting the monitoring and may choose to hire a consultant to perform the monitoring, analyze the data collected, and prepare the required monitoring reports. An as-built mitigation monitoring report, detailing the site conditions immediately after completion of construction, will be submitted to the USACE within three months after all construction and planting activities are complete. Thereafter, subsequent annual monitoring reports will describe the results of the monitoring assessments (including application of iHGM), the areal coverage of the upland and wetland vegetative communities, provide photographic documentation of the proposed mitigation sites, discuss results in comparison to performance standards, and if needed, provide recommendations for corrective actions that might be necessary to compensate for deficiencies.

Once it has been determined that the site meets the minimum success criteria, the USACE will be notified of this following the last monitoring event. After three years of monitoring, if appropriate, a success determination may be sought before the end of the five year monitoring period, if it is demonstrated that the mitigation areas are trending toward success and it is reasonable to assume that they will meet the success criteria prior to the end of the monitoring schedule. If the success criteria are not met at the scheduled times during the first four years of monitoring, areas in need of rehabilitation will be improved via methods specified in the CMMP, such as corrective action to for hydrological or vegetation establishment deficiencies. Conditions observed that are indicative of a problem will be evaluated and a solution recommended in annual monitoring reports. All monitoring reports will be submitted to the USACE Galveston District.

The NFS would implement the appropriate corrective action during the monitoring and maintenance period in order to assure that project success criteria are achieved. Solutions may include erection of predator barriers, installation of additional vegetation, adjusting site elevations, or other prudent solutions dependent on the site and situation. Undesirable plant species threatening mitigation success would be eradicated manually or mechanically by industry-approved methods that will not harm wildlife or aquatic resources.

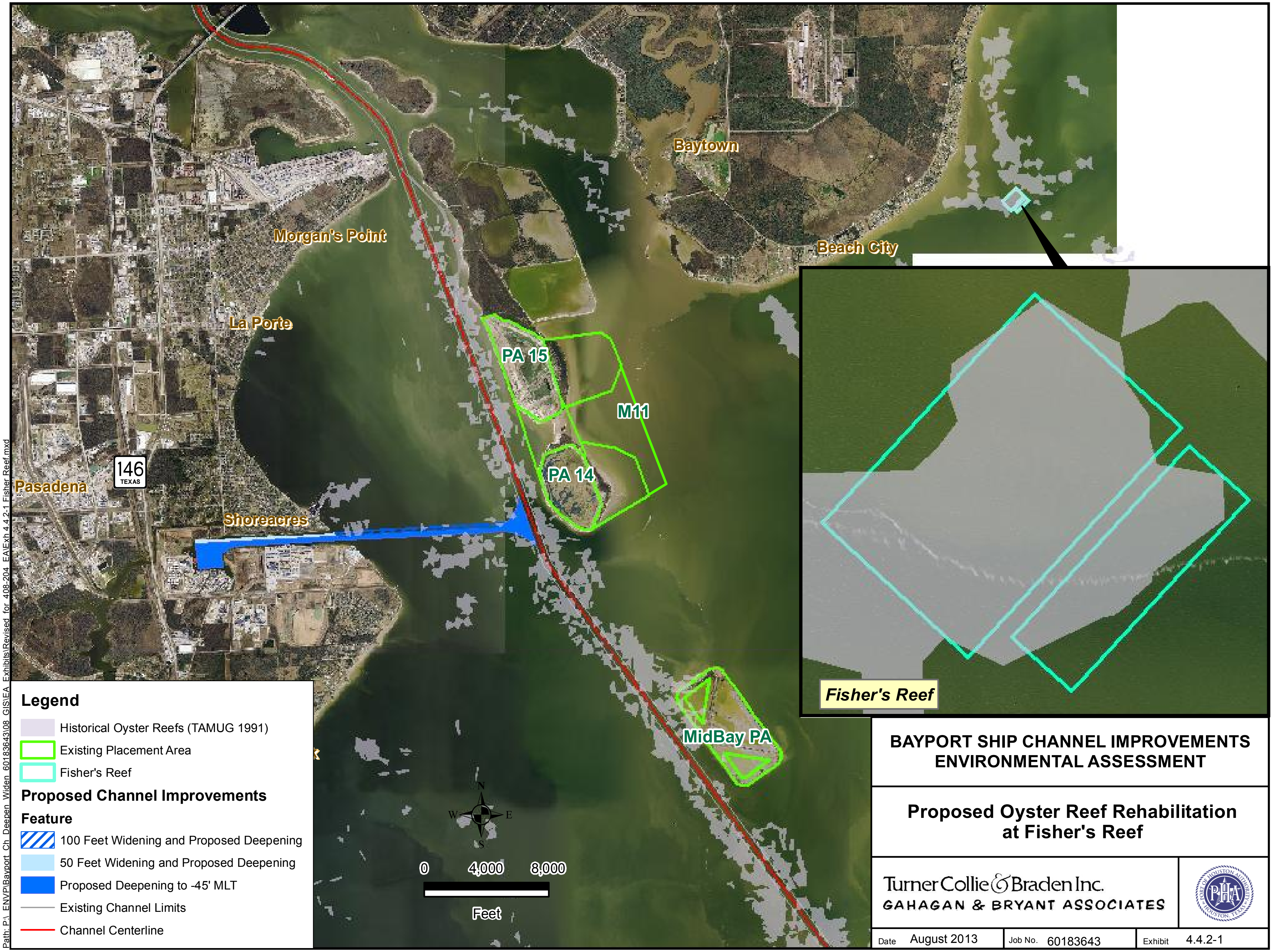
4.4.2.5. Implementation and Long-Term Management

The mitigation would be implemented by the NFS concurrent or prior to the construction of the stability berm during implementation of the proposed action, to ensure impacts are mitigated at or before the time they occur. Temporary construction or wire fencing would be installed to prevent grazing by species such as nutria and grass carp to protect created wetlands. Vehicular and other traffic would be prohibited from the area to prevent soil compaction, plant mortality, and seed dispersal. Adaptive management strategies would be adopted if mitigation cannot be constructed in accordance with the approved CMMP, or if performance standards are not being met, in which case, the NFS would notify the USACE to obtain approval any significant modification required to the CMMP. Performance standards may be revised in accordance with adaptive management to account for measures taken to address deficiencies in the mitigation project. Adaptive management may include the following measures:

- Plant additional wetland vegetation species in areas where new growth is inadequate

- Adjust site conditions to improve hydrologic conditions
- Improve or enhance erosion control measures
- Provide for additional access restrictions if human disturbance is impacting the site

The Final Mitigation Monitoring Report for the proposed project will include additional adaptive management details and guidelines for implementation. The NFS or its successors or assigns will be responsible for implementing adaptive management to achieve mitigation success. After performance standards have been achieved and the mitigation area has met all success criteria, management of the site would be turned over to the City of Baytown to be managed under the existing BNC management plan. Management and stewardship by the BNC will prohibit all development and other activities except those associated mitigation monitoring and maintenance to be outlined in the CMMP.

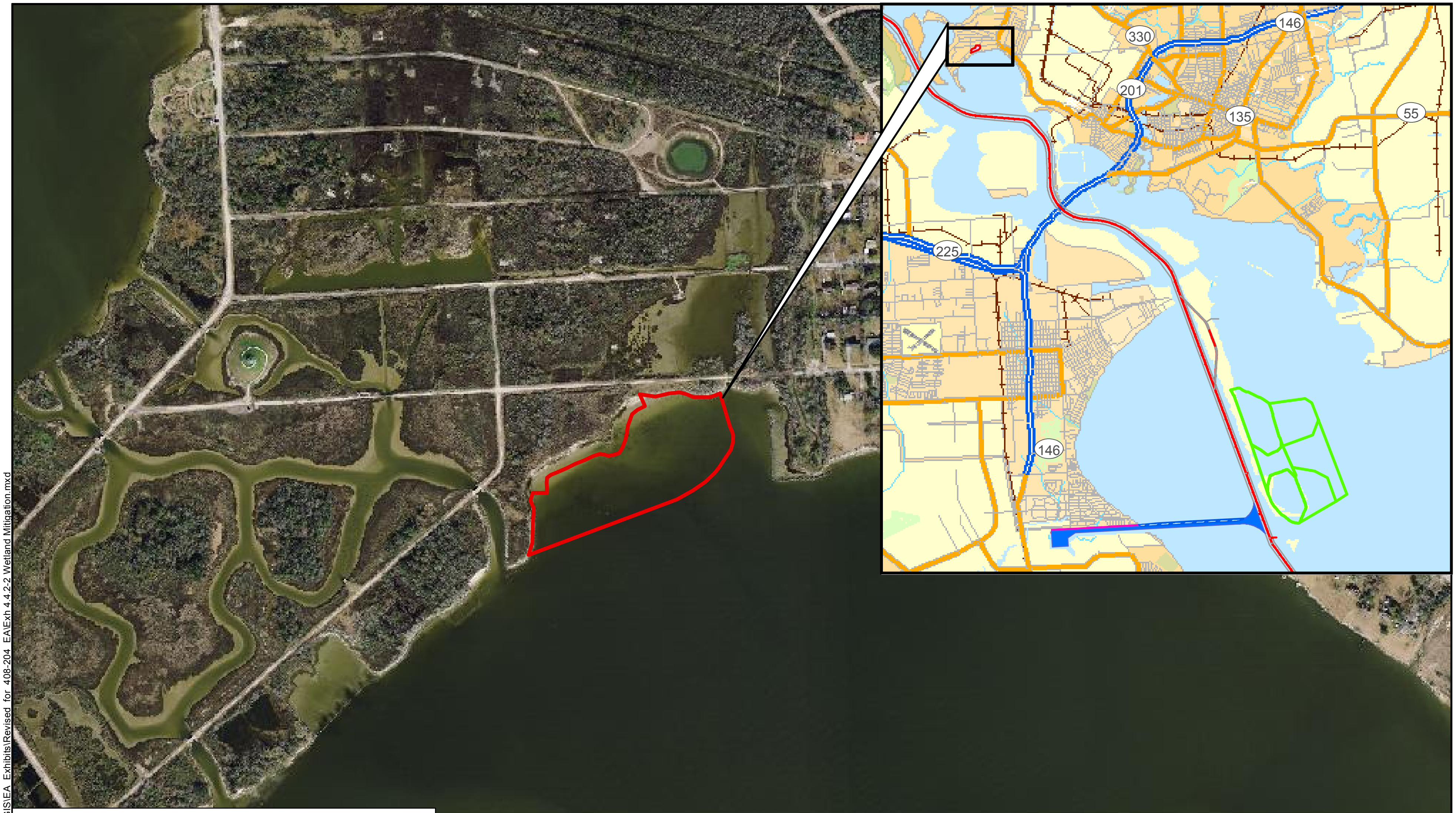


BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Proposed Oyster Reef Rehabilitation at Fisher's Reef

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date	August 2013	Job No.	60183643	Exhibit	4.4.2-1



Legend

Proposed Mitigation Area

Proposed Channel Improvements

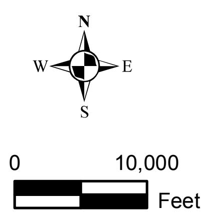
100 Feet Widening and Proposed Deepening

50 Feet Widening and Proposed Deepening

Proposed Deepening to -45' MLT

Existing Channel Limits

Channel Centerline



BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Proposed Wetland Mitigation at Baytown Nature Center

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date	August 2013	Job No.	60183643	Exhibit	4.4.2-2

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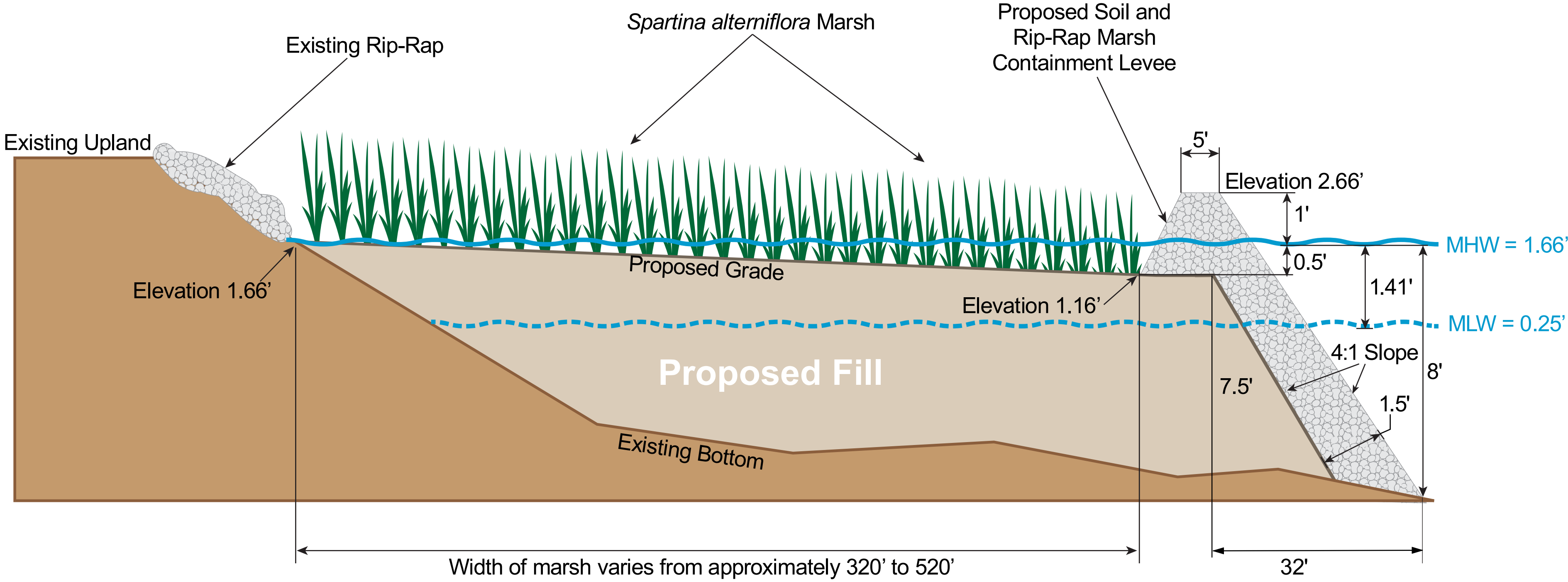

Tidal datum of all elevations shown is NAVD88

MHW = Mean High Water
MLW = Mean Low Water

Note:
1. Final shore protection method to be determined in design.

Scale: Not to Scale

BAYPORT SHIP CHANNEL IMPROVEMENTS ENVIRONMENTAL ASSESSMENT

Proposed Wetland Mitigation Typical Cross Section

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date	July 2013	Job No.	60183643	Exhibit	4.4.2-3

5.0 CUMULATIVE IMPACTS

This chapter discusses the cumulative impacts expected to result from the proposed action, in addition to impacts that have already occurred in the project area due to projects and development relevant to the impacts, and the impacts of relevant projects that are expected to occur in the project area and are reasonably foreseeable. This chapter summarizes the detailed cumulative impact discussion and analysis contained in Appendix E, which contains the tables, quantities, and other detail used in summarizing the cumulative impacts. This chapter provides the following information:

- The definition of cumulative impacts and an introduction to cumulative impact analysis
- A discussion of the methodology used, a summary of direct and indirect impacts, and a description of the types of impacts that were included in the cumulative impact assessment
- A description of past, present, and reasonably foreseeable future projects and activities that may have cumulative impacts to the project area and the surrounding region
- A discussion of cumulative impacts of those projects and activities relevant to the impacts included in the cumulative impact assessment.

5.1 INTRODUCTION

For purposes of this EA, cumulative impacts were discussed in further detail if the indirect and direct impacts have more than insubstantial temporary adverse or positive impacts than insubstantial temporary adverse or positive impacts to the particular resource. In addition, the health of the resource was taken into consideration.

The President's Council on Environmental Quality (CEQ) regulations defines cumulative effects as:

"…the impact on the environment which result from the incremental impact of the action (project) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). 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).

Cumulative effects (impacts) include both direct and indirect, or induced, effects that would result from the project, as well as the effects from other projects (past, present, and reasonably foreseeable future actions) not related to or caused by the proposed action. The cumulative effects analysis considers the magnitude of the cumulative effect on the resource health. Health refers to the general overall condition, stability, or vitality of the resource and the trend of that condition. Laws, regulations, policies, or other factors that may change or sustain the resource trend were considered to determine if more or less stress on the resource is likely in the foreseeable future.

Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. Cumulative effects of the proposed project would be the incremental effects that the project's direct or indirect effects have on that resource in the context of other past, present, and reasonably foreseeable future effects on that resource from unrelated activities. Cumulative impacts may also occur when the occurrence of disturbances are so close that the effects of one are not dissipated before the next occurs, or when the timings of disturbances are so close that their effects overlap.

5.2 METHODOLOGY

No standard approach or methodology is provided by NEPA or CEQ regulations to quantify cumulative effects, or to define the geographic area for which cumulative impacts should be assessed. A general approach and suggested analytical techniques are provided in the CEQ's 1997 publication, *Considering Cumulative Effects Under the National Environmental Policy Act*. Where these were useful and appropriate, they were considered. The first step in the general approach is to scope for the cumulative effects, which involves the following sub-steps:

- Identify the primary cumulative effects issues associated with the proposed action and define the assessment goals.
- Establish the geographic scope for the analysis.
- Establish the time frame for the analysis.
- Identify other actions affecting the resources, ecosystems, and human communities of concern.

The first step and associated sub-steps are discussed in Section 5.3 and includes a summary of the direct and indirect effects, which effects were carried forward in the cumulative impact analysis, what their geographic scopes are, what the other actions affecting the resources are, and the timeframe for analyzing these actions. Parameters addressed in the scoping included ecological, physical, chemical, socioeconomic, and cultural resources and attributes.

The second step is to describe the affected environment, and consists of the following sub-steps:

- Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses.
- Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds,
- Define a baseline condition for the resources, ecosystems, and human communities.

This first sub-step was done implicitly in describing the Affected Environment in Chapter 3, but a general discussion is provided in Section 5.4 for the cumulative impacts analysis. The second sub-step was carried out in the Affected Environment Chapter 3, by discussing the pertinent regulatory thresholds and statuses for the various resources, where applicable. Both of those sub-steps are also partially addressed in the discussion of trends for the resources in the cumulative impact analysis. The last sub-step was explicitly carried out for all resources in the Affected Environment Chapter 3, by discussing the existing conditions of the physical, biological, and human environmental resources of the project area. The baseline condition and general health of the resource, where appropriate are summarized in Table 5.3.5-1.

The third step in the general approach is to determine the environmental consequences. The following sub-steps were accomplished in this analysis:

- Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.

- Determine the magnitude and significance of cumulative effects.

The first sub-step was carried out in the cumulative impact analysis. Where quantitative data was practical, and reasonably available or estimable for the past, present, and reasonably foreseeable actions, it was used. Otherwise, the discussion of the magnitude and significance of the effects was qualitative, employing knowledge of the scale of projects, resources, and impacting agents (e.g. air or water emitters, size of development) to provide perspective the effects against the resources impacted. Because the cumulative impact analysis did not identify substantial contributions from the proposed action to cumulative impacts, mitigation of effects or monitoring of them was not part of the analysis.

5.3 CUMULATIVE EFFECTS SCOPING AND SUMMARY OF DIRECT AND INDIRECT IMPACTS

The first step in the CEQ's suggested general approach is to scope for the cumulative effects, of which the first sub-step is to identify the significant cumulative effects issues associated with the proposed action and define the assessment goals. This involves defining the direct and indirect effects of the proposed action, which resources are affected, and which effects are important from a cumulative perspective. This is done to focus the analysis on meaningful impacts relevant to the effects of the proposed action, and not include those effects that are irrelevant or inconsequential to decisions about the proposed action and alternatives. To accomplish this step, this section summarizes and discusses the direct and indirect effects detailed in Chapter 4, and which of those effects were carried forward in the cumulative impact analysis. The second sub-step in scoping is to identify the geographic scope for the analysis. This is also discussed in this section for the effects carried forward in the cumulative impact analysis.

Table 5.3.5-1 lists all the resource areas examined in this EA, summarizes the direct and indirect impacts, and indicates if the resource was carried forward in the cumulative impact analysis. Generally, if a more than an insubstantial temporary positive or adverse direct or indirect impact was identified in these resource categories, considering the status or health of the resource, then the resource discussion was carried forward to the cumulative impact analysis section. The subsections below synopsize the reasoning for focusing on the effects carried forward in the cumulative impact analysis relative to the direct and indirect impacts to the physical, human and biological environments. Discussion regarding rationale for the expected indirect effects for some resources is also provided in support of Table 5.3.5-1. A more detailed discussion of the resources, impacts, and reasoning are provided in Appendix E.

5.3.1 Physical Environment Impacts

- Scoping for the physical environment impacts of the proposed action is provided below. Regarding, the potential for indirect effects, no indirect changes to land features would occur since the proposed action is not expected to induce any substantial changes in land use patterns, such as the facilitation of agriculture, mining, or urbanization. The surrounding terrestrial area is already substantially developed with residential, industrial, and port terminal land uses, and further development of remaining nearby developable land would occur due to the normal population and commercial growth that already occurs in metropolitan Houston. **Topography, Soils, Geology, and Bathymetry** – Lack of terrestrial impacts, small proportion of the resource affected, and regional nature of these resources, would result in a minor direct impact. Therefore effects to topography, soils, geology, and bathymetry are not carried forward in the cumulative impacts analysis. For these reasons, impacts to the shoreline would not be expected and are not carried forward.

- **Water Quality and Sediment** – Indirect impacts to water quality from terrestrial land use changes are not expected for the reasons discussed at the beginning of this section. Temporary and minimal impacts to water quality, primarily from turbidity, during dredging and placement could result in temporary effects that overlap temporally or spatially with other foreseeable dredging projects. Therefore, water quality effects to turbidity are carried forward in the cumulative impact analysis. New work native clay being dredged during construction of the proposed action are not be expected to be impacted by contaminants in sediment, therefore, chemical impacts during maintenance dredging and placement from the proposed action are not expected. Dioxins have been detected in project sediments at low levels but because TCEQ has not established national marine sediment quality guidelines and dioxin is a parameter for which the TCEQ has designated the relevant water quality segment and Upper Galveston Bay as impaired by sediment quality related to dioxin is carried forward in the cumulative impact analysis.

Considering the limited spatial (several hundred meters) and temporal (several hours) range of turbidity effects and related sediment movement, the geographic scope used for water and sediment quality in cumulative impact analysis was Upper Galveston Bay (north of Redfish Island).

5.3.2 Biological Impacts

Scoping for the biological environment impacts of the proposed action is provided below. Regarding, the potential for indirect effects, the same factors discussed for the physical environment also limit potential for indirect effects to biological resources from land-based development. The reduction in numbers of vessels required to move a given tonnage allowed by the proposed action limits the potential for effects to marine resources due to vessel traffic changes.

- **Vegetation and Wetlands** – Lack of terrestrial impacts other than non-natural upland habitat isolated from the mainland that are associated with existing PAs would result in a minor impact on terrestrial habitat. Indirect impacts are not expected for the reasons discussed at the beginning of this section. Therefore, terrestrial vegetation and habitat impacts are not carried forward in the cumulative impacts analysis. Estuarine marsh is a historically declining regional resource. Permanent impacts to approximately 9.2 acres and temporary impacts up to 4.7 acres of salt marsh wetlands would result from the proposed action. Therefore, wetlands are carried forward in the cumulative impacts analysis.

Considering that the specific wetland type is tidal marsh, the geographic scope used for wetlands in cumulative impact analysis is Galveston Bay, primarily the Upper Bay.

- **Wildlife and Aquatic Fauna –** Only temporary disturbance impacts to migratory and colonial water bird nesting and foraging habitat similar to periodic maintenance dredging placement are expected, and other terrestrial species in PAs, like raccoons and coyotes, are common, resulting in a less than substantial impact to terrestrial wildlife. Therefore, terrestrial wildlife impacts are not carried forward in the cumulative impacts analysis. Permanent impacts to benthic habitat and oyster reefs within the dredging and placement footprint, and temporary effects primarily from turbidity would result in an impact to aquatic fauna. Also, the indirect temporary impacts could be overlapping or cumulative considering other bay dredging projects. Therefore, aquatic fauna impacts are carried forward in the cumulative impacts analysis. Considering the estuarine habitat involved and the spatial extent of dredging effects, the geographic scope for aquatic fauna in cumulative impact analysis was Galveston Bay, with a focus on the Upper Bay.

5.3.3 Human Environment Impacts

Scoping for the human environment impacts of the proposed action is provided below. Lack of substantial direct terrestrial impacts limits the direct and indirect effects, and influence, on land-based socioeconomic or community resources. Regarding, the potential for indirect effects, the same factors discussed for the physical environment also limit potential for indirect effects to human environment resources from land-based development. Regarding the potential for indirect inducement of port-related development and activity, the current and planned BSCCT facilities and external shipping market forces would be expected to influence this inducement, and not the channel improvements of the proposed action. However, Houston's strength as a major transportation hub, and the forecasted metropolitan population growth, would be expected to primarily influence shipping services-related induced development beyond the immediate land cut area. This is discussed in more detail in Appendix E. Therefore, no substantial indirect effects on socioeconomic resources resulting from induced development are anticipated from the proposed action, but would continue to occur from the continued strength of Houston as a major transportation hub, and its forecasted growth.

- **Socioeconomic, Community and Aesthetic Resources** – Lack of direct impacts, and lack of indirect effects for the reasons explained at the beginning of this section, would result in a minimal effect to socioeconomic resources. Although benefits to shipping from time and fuel savings through increased navigation efficiency would be a positive economic impact, the shipping industry economy in Houston has historically been and continues to be strong. Therefore, impacts to socioeconomic resources are not carried forward in the cumulative impact analysis. Lack of direct impacts, and lack of indirect effects for the reasons explained at the beginning of this section, would result in a minimal effect to land-based community or recreational resources. Therefore, impacts to community resources are not carried forward in the cumulative impact analysis. Lack of sight line impacts, or perceptible long-term visible changes to the horizon would result in minimal impacts to visual and aesthetic resources. Therefore effects to visual and aesthetic resources are not carried forward in the cumulative impact analysis.

- **Traffic, Transportation and Infrastructure –** No direct impacts, and no indirect effects for the reasons explained at the beginning of this section, would result in a minimal impact to surface transportation or traffic. Lack of a net effect on container tonnage processed as explained in Section 4.3.8.2 for the terminal emissions of the Preferred Alternative, also would result in a minimal indirect effect on terminal truck or rail traffic. Marine transportation in the BSC would be substantially improved, but this is not a critically or regionally impaired resource. Therefore impacts to transportation and traffic are not carried forward in the cumulative impact analysis. No direct impacts to municipal infrastructure, and continued access for pipelines and oil and gas facilities until they can be relocated, would result in a minimal impact to infrastructure. Therefore impacts to infrastructure are not carried forward in the cumulative impact analysis.

- **Air Quality –** Temporary constructions emissions, lack of direct and indirect effects on terminal emissions, and the long-term positive direct and indirect effects on vessel emissions would result in a minimal impact to air quality. However, because of the potentially substantial positive effects resulting from channel improvement, and the current nonattainment status of the HGB, impacts on air quality are carried forward in the cumulative impact analysis. Considering the resource and status for achieving air quality standards, the HGB NAA was selected as the geographic scope for air quality effects in the cumulative impact analysis.

- **Noise –** Temporary construction sound similar to current periodic maintenance dredging, lack of substantial direct or indirect effects on terminal and vessel sound sources, lack of perceptible difference from changes in vessel sound source proximity, and potential positive effects on vessel sound events, would result in a minimal impact on noise. Therefore, effects on noise are not carried forward in the cumulative impact analysis.

- **Cultural Resources –** No impact on any cultural resources or historic properties would occur from the proposed channel improvements or the use of existing PAs. Therefore effects on cultural resources are not carried forward in the cumulative impact analysis.

5.3.4 Relevant Past and Present Actions

The third and fourth sub-steps of the scoping step are to identify the timeframe for the analysis, and other actions affecting the resources, ecosystems, and human communities of concern. The relevant past and present actions are those that have had or continue to have effects on the resources carried forward in the analysis, and within the geographic scope identified for those effects. These represent the other actions that affect the resources, ecosystems, and human communities of concern. For purposes of these past or present impacts, a timeframe of 50 years from the present to the past was selected, which is the assumed lifespan of a USACE navigation/dredging project. This is also a timeframe for which sufficient impact information is reasonably and readily available.

The analysis focused on projects with a substantial impact to Galveston Bay and bay bottom through dredging or dredged material placement. Channel dredging projects that were for changes to an existing channel geometry were selected. Other projects resulting in substantial dredged material placement in Galveston Bay were also sought. Private docks and berthing areas were considered. However, with the exception of the Clear Lake Channel, the private berthing facilities on Upper Galveston Bay north of Redfish Island (which has northern limit of Morgan's Point) are all small piers and docks for recreational or small fishing shallow draft vessels that would only require small-scale dredging to maintain depths near the docks and shoreline to the relatively shallow drafts of Galveston Bay (6 to 8 ft). With regard to air impacts, the present and foreseeable actions that impact air in the HGB NAA are too numerous to individually list and discuss because of the number and variety of emissions sources, but are considered within the types of sources regulated by the CAA, and in the context of the cumulative effect these sources have had on regulated pollutant levels, as discussed in Section 5.4.1.3. However, for purposes of the analysis, the plan with one of the most broad-reaching effects on HGB emissions, and local transportation projects relevant to emissions directly in the project area are presented and discussed in this section. Table 5.3.5-2 summarizes the projects constituting the past and present actions. Data from publicly available environmental documents (i.e. EAs, EISs), Federal feasibility studies, and related documents were used. In a few cases where acreage information was lacking but channel project dimensions were available, approximate areas were estimated. The following synopsizes the individual past and present actions. These actions are discussed in more detail in Appendix E.

- Houston and Galveston Navigation Channels (HGNC) – This project involves deepening and widening the 53-mile long HSC and deepening the 2-mile long Galveston Ship Channel (GSC), which have already been completed as of 2010. Placement of dredged material was planned for 50 years to go to existing and future upland and BU marsh PAs and ocean disposal sites along these channels from the lower reach of the Buffalo Bayou/HSC before it enters Galveston Bay to just outside of Galveston Bay in the Gulf of Mexico (GOM).

- Cedar Bayou Federal Navigation Channel – This project involved the deepening of the Federal navigation barge channel in 1975, and is completed. The channel is located approximately 4.5 miles northeast of the BSC starting near Atkinson Island and extending into Cedar Bayou, to approximately Mile 3, near the City of Baytown in Chambers and Harris Counties, Texas. It joins the HSC between the north tip of Atkinson Island and Hog Island.

- Barbours Cut Terminal and Channel – This project involved the deepening of the Barbours Cut turning basin and side channel to the HSC, and constructing a container terminal along the channel in the 1970's. Barbours Cut Terminal and Channel are located approximately 4.6 miles north of the BSC at Morgan's Point, which is at the mouth of the HSC/Buffalo Bayou leading into Galveston Bay.

- Bayport Ship Channel Container Terminal (BSCCT) – This is an ongoing project to build a container and cruise ship terminals with the first phase completed in 2007 providing three berths. The terminal is located on the south shore of the BSC within the land cut.

- Bayport Ship Channel – This project involved the dredging of the current BSC, originally dredged in the mid 1960's and deepened in the 1970's.

- Odfjell Bulk Liquid Terminal – This project involved the construction of 2 large vessel wharves and 3 smaller barge docks to service bulk petrochemical liquid vessels on the BSC TB, west of the BSCCT.

- LBC Bulk Liquid Terminal – This project involved the construction of 3 large vessel wharves and 5 smaller barge slips to service bulk petrochemical liquid vessels on the BSC TB, west of the BSCCT. Some of these facilities were originally built by Celanese and sold to LBC in 2000.

- Texas City Channel Deepening – This project involves deepening the Federal navigation channel, which was recently completed. The Texas City Channel is approximately 17 miles southeast of the BSC in the lower part of the Galveston Bay near its outlet to the GOM. This project is interrelated with the Shoal Point Container Terminal project, as it assumed the responsibility to deepen the channel from the Shoal Point project.

- Clear Lake Channel – An approximate 7-ft deep channel running the length of Clear Lake and emptying to Galveston Bay at a draft of 10 to 12 ft. It receives periodic maintenance to maintain this draft for recreational users.

- Expansion of PAs 14 and 15 – This project involves expanding the existing PAs 14 and 15 by filling the gap between them with an upland PA connection and creating adjacent BU marsh cells M10 and a future cell M11. Mitigation for impacts to the saline marsh and tidal flats in the connection were achieved by construction of 88 acres of marsh at the Bolivar BU Marsh site, which is reflected under the HGNC project. This is the project that the BSC Improvements Project has plans to provide levee construction material for in addition to raising the levees to increase capacity under the Preferred Alternative of the EA. PAs 14 and 15 are just to the east and north of the HSC-BSC confluence.

- Transportation Improvement Program (TIP) – This plan outlines the transportation infrastructure improvements planned for the region, the mobile source air emissions modeling required to demonstrate the TIP's effect, and the commitments required to achieve transportation conformity. The HGAC serves as the HGB NAA's Metropolitan Planning Organization (MPO), and periodically produces the TIP. The plan contains projects primarily managed and implemented by the Texas Department of Transportation (TxDOT) to improve highways and roads, but also those sponsored by local governments and entities to improve local roads, airports, mass transit, and other transportation modes to relieve congestion. The 2013-2016 TIP is the current version. Recent versions have included projects such as expanding the capacities of IH-10, U.S. 290, and IH 45, which have been constructed, or had construction initiated, or are in final phases of planning. Some actions in the current plan include Segments C-2 and I-2 of the SH 99 lane expansion, the Southeast Light Rail Corridor, and adding lanes to Almeda Road and Scott Street. Other actions include the construction of park-and-ride mass transit stations, railroad grade separations,

- SH1 146 to Port Road Direct Connector – This local road improvement consists of a direct connection overpass that circumvents signaled intersections, connecting the southbound SH 146 mainlanes with Port Road, which leads to the BSCCT, to relieve current congestion, and avoid future congestion as the projected growth in container traffic serviced at the BSCCT comes to fruition. Construction was completed in 2012.

- Port Road Widening – Port Road, the road connecting the BSCCT to the highway system will be widened to a six-lane divided road from Todville Road to SH 146. The project is currently under the construction, engineering, and right-of-way (ROW) acquisition phases for various segments of the project.

5.3.5 Reasonably Foreseeable Actions

This section presents the other part of the actions that affect the resources, ecosystems, and human communities of concern. No specific timeframe was selected as this is dictated by the long-term project planning information available used to identify foreseeable projects. Table 5.3.5-2 summarizes the projects constituting the reasonably foreseeable actions. Data from publicly available environmental documents (i.e. EAs, EISs), Federal feasibility studies, and related documents were mostly used for project information and impacts. In a few cases, such as for the new BSC Flare Widening, internal project information or communication was used. Private docks and berthing areas were considered. As explained in 5.3.4, the existing type of facilities in the Upper Bay are all small piers and docks for recreational or small commercial fishing vessels with shallow drafts. The USACE Galveston District regulatory permit database was searched for projects from 2009 to 2013 that were located on

Upper Galveston Bay, including Trinity Bay. The majority of permits in the location of Upper Galveston Bay were of this type. Due to the small-scale dredging to provide the relatively shallow depths near the docks and shoreline, the effects on turbidity from these projects would be very localized and small, and the amount of bay bottom affected would also be small by comparison to the larger navigation or industrial berth projects. These types of projects were not considered further.

Of the issued permits reviewed, there were also approximately two industrial/commercial ones involving nationwide permits (NWP) for wetlands near a terrestrial activity such as parking lot construction adjacent to the Upper Galveston Bay. Since NWPs can only be used for cases up to about 0.5 acres of tidal wetlands impacted, these projects, if they had any wetlands, would have a relatively small impact. Since wetlands aren't being carried forward in the cumulative analysis, and since these types of actions would not directly impact bay bottom, they were not considered further. The following permits were found to be associated with the private liquid bulk cargo tenants on the BSC, and are discussed for whether these actions would be expected to have impacts on the resources carried forward in the cumulative analysis:

- Odfjell
  - SWG-2002-02976: Amend Permit No: 20671(04) to add disposal area – Amendment would be to allow another disposal area to be used for their maintenance dredging permit.
  - SWG-2010-00616: NWP for bulkheads at terminal – Action would be for repair or installation of bulkheads, and would comparatively involve only a very small amount bay bottom in the current turning basin.
- LBC
  - SWG-2010-00794: NWP and Regional General Permit for 8-Inch Diameter HDPE Pipeline, Taylor Bayou, Harris County, Texas – Action would be in Taylor Bayou, and
  - SWG-2002-01382: Permit 20679(04), Water Injection Dredging Method, Bayport Ship Channel Turning Basin, Harris County – Permit extension and modification allow water injection method for existing maintenance dredging permit.

Considering that the permit actions are not adding any substantial new areas of dredging beyond what they periodically maintained, these actions were not carried forward in the analysis. The following synopsizes the individual reasonably foreseeable actions considered further in the cumulative impact analysis.

- Bayport Ship Channel Flare Easing – This is a project to ease (or widen) the existing Bayport Flare to a larger turning radius. The Flare is essentially a turning lane for ships between the BSC and HSC. Also included in this project is a channel straightener (bend widening) on the HSC just south of the BSC-HSC confluence. The BSC Improvements project would further deepen the Flare widening to the required depth for the improved BSC after the Flare Easing project is done.

- Barbours Cut Terminal and Channel Modernization – This is a project in the preliminary planning stages to modernize the terminal facilities and shift the channel to accommodate the larger, more modern container vessels at the existing berths with wider setbacks from the channel. It would involve upgrading of the 6 existing wharves, the associated cranes, and other terminal facilities to better handle the larger vessels already calling at the Port of Houston.

- Shoal Point Container Terminal – This is a project to build a container terminal on the existing Shoal Point PA Island on the Texas City Channel, and dredge the required berths and turning basin. This project had some related elements, namely the channel deepening and some PAs, which became part of the Texas City Channel Deepening Federal project, whose impacts are reflected under that project.

- MMKP Exploration – SWG-2010-00293: Cedar Point Prospect Well #1 & Pipelines, Galveston Bay, Chambers County – No further information available. Assumed to be offshore well and associated servicing pipeline installation based on latitude/longitude information. Though permit was issued in 2010, it is not known if project was implemented. For purposes of analysis, it is conservatively assumed not to have yet occurred.

Cumulative Impacts

Table 5.3.5-1 Summary of Direct and Indirect Impacts of the Proposed Action

Current Status and/or Health of Resource	Direct Impacts	Indirect Impacts*	Resource/Issue to be Included in Cumulative Effects Analysis
Physical Resources			
Topography, Soils, Geology, Bathymetry			
• The alteration of Galveston Bay for navigation and dredged material placement has been an ongoing activity since the mid to late 19th Century.	• Permanent, relatively small changes to topography, soils, geology, and bathymetry within channel deepening and widening areas and at dredged material placement areas would be negligible compared to size and regional nature of these attributes in Galveston Bay. • Negligible effects on the water circulation patterns of Galveston Bay are expected. No impacts expected to daily tidal exchange.	• No indirect impacts are expected.	No
Water and Sediment Quality			
• TCEQ water quality segment within BSC listed as impaired for dioxin and PCBs in edible fish tissue, and for bacteria concerns; no PCBs have exceeded limits in sediment.	• Temporary and localized impacts to water quality expected during dredging and disposal activities.	• Temporary and indirect impacts to water and sediment quality (outside of excavation and placement areas) and immediate project vicinity could occur as a result of increased turbidity, sedimentation, and vessel activity during the construction period.	Yes
• Of many constituents analyzed, only oil and grease was repeatedly above screening levels in BSC sediment. • Dioxin present in BSC and in Galveston Bay sediments.	• No impacts from chemical constituents expected from construction since new work material is expected to be native, uncontaminated clays and sands. • Temporary, localized dispersal of sediments during maintenance dredging and placement. • Long-term impacts during maintenance dredging not expected, considering similarity of levels between dredged and placement areas, the maintenance dredging that already occurs under No Action, and greater surface sediment movement from storms, floods, and tides.	• No indirect impacts are expected.	Yes
Biological Resources			
Terrestrial Vegetation and Wildlife			
• Only periodically disturbed volunteer upland vegetation is present on existing upland PAs within project footprint.	• Only minor direct impacts to disturbed volunteer upland vegetation around levee edges during construction.	• Only disturbed volunteer upland vegetation would be affected.	No
• Existing PAs function primarily as temporary colonial water bird foraging habitat. • Other terrestrial species present are common.	• Temporary disturbance of foraging and nesting similar to maintenance dredging expected during construction. • Temporary impacts would be avoided/ minimized through similar measures implemented during maintenance dredging and previous projects, such as scheduling around migratory or nesting season windows.	• No indirect impacts are expected.	No
Wetlands			
• Channel in open water; no wetlands impacted. • Historically, about 33,000 acres of marsh lost in Galveston Bay from 1950's-1989 per GBNEP analysis.	• Approximately 9.2 acres of impacts to salt marsh would occur. • Only temporary vegetation impacts expected in construction corridor.	• No indirect impacts to wetlands	Yes

Current Status and/or Health of Resource	Direct Impacts	Indirect Impacts*	Resource/Issue to be Included in Cumulative Effects Analysis
Aquatic Wildlife and Essential Fish Habitat			
• Project footprint comprised primarily of unvegetated shallow bay bottom. • Galveston Bay supports productive commercial and recreational finfish and shellfish fisheries. • No submerged aquatic vegetation (SAV) observed during benthic survey of project footprint or listed in previous mapping.	• Permanent alteration of bay bottom habitat would occur in dredged areas of the channel and dredged material placement areas. • No impacts to SAV are expected as a result of this project. • Temporary effects to benthic species from dredging and placement through impingement, entrainment, and burial, but would be expected to quickly recover, and are common throughout Galveston Bay. • Temporary effects to fish species through impingement, entrainment, and burial would largely be avoided by species mobility.	• Temporary and indirect impacts to aquatic life within the project area and immediate project vicinity could occur as a result of increased turbidity, sedimentation, noise, light, and vessel activity during the construction period. • Temporary and indirect impacts to wildlife species that feed on benthic organisms or other fish could be indirectly and temporarily impacted but, it is likely they would move to other areas to look for food.	Yes
• Oyster reef found along BSC, primarily on south edge. • EFH is located within the project area for several fishery species and oysters.	• The majority of impacts to managed species and their associated EFH would be limited to the estuarine benthic environment as well as temporary impacts to the water column as a result of increased turbidity. • Approximately 4.6 acres of oyster habitat would be impacted by preferred channel alternative.	• Temporary and indirect impacts to oyster reefs near the project area as a result of temporary increased turbidity during dredging and placement operations. • Accretion of oyster reefs in areas adjacent to the BSC modifications is probable considering the high occurrence of this habitat within close proximity of other anthropogenic activity in Galveston Bay.	Yes
Threatened and Endangered Species			
• Sea turtles and piping plover are most likely to occur within the project area due to the available habitat type but piping plover habitat is not present in the specific project footprint. • No designated critical habitat for any listed species is located in the project area.	• The proposed project will not affect sea turtles and piping plover. • The project would have no effect on any other federally-listed threatened and endangered species or their critical habitat.	• Negligible temporary and indirect impacts are expected to endangered species because of temporary impacts to fish, benthic or other food sources during the dredging and disposal operations.	No
Invasive Species			
• Shipping operations throughout the Galveston Bay System currently result in ballast water discharges in Galveston Bay. In addition, invasive plant species are present on existing PAs and on surrounding shoreline.	• No direct impacts on invasive species propagation would occur.	• No additional potential created for introduction and spread of invasive marine species. No indirect impacts are expected.	No
Coastal Zone Management Resources			
• The entire project is located within the limits of the Coastal Management Zone.	• The proposed project is not expected to impact or significantly degrade natural resources or water quality.	• No indirect impacts are expected.	No
Human Environment			
Socioeconomics			
• The proposed project area is in open water, but lies within a 5-census tract area, with a population of approximately 19,000 people.	• Communities within or near the project area would continue to have the same population trends.	• No indirect impacts are expected.	No
Environmental Justice			

Current Status and/or Health of Resource	Direct Impacts	Indirect Impacts*	Resource/Issue to be Included in Cumulative Effects Analysis
• Study area is not considered a high minority or low-income area. The EJ Index study showed a very low potential for EJ impacts based on the populations that currently exists in the Bayport Community Study Area.	• Continued economic benefit from shipping activity and jobs generated at BSCCT. No impacts on environmental justice populations expected.	• No indirect impacts are expected.	No
Community and Recreational Resources			
• No terrestrial community or recreational resources in project footprint. • Houston Yacht Club (HYC) operates sailing/race course close north of BSC. • Upper Bay area used for recreational boating, wind surfing and fishing.	• Temporary localized disruption to recreation activities during construction not expected to be substantial.	• Eventual reduction in vessel transit frequency allowed by proposed channel improvements would reduce frequency of recreational/commercial vessel interactions; however this has not been identified as critical problem and events are too randomized to reliably predict consequences.	No
Visual and Aesthetic Resources			
• The study area for visual and aesthetic resources consists of viewsheds within the project area looking out from the existing shoreline in residential areas or public parks.	• Long-term visible changes to horizon view would not be substantially perceptible by shoreline residents due to distance and low profile.	• No indirect impacts are expected.	No
Existing Infrastructure			
• No municipal infrastructure located in project footprint. • Pipelines and other existing infrastructure are within the proposed project area. Six oil/gas pipelines cross the proposed project area.	• No impacts would occur from channel improvements. • Pipelines crossing PAs 14/15 would have access for existing oil and gas facility but would need to be relocated once there area is filled.	• No indirect impacts are expected.	No
Traffic and Transportation			
• No surface transportation in project footprint. • Navigation channel used by container and bulk liquid petrochemical terminals and traffic.	• No impacts to existing surface transportation, roadways, or rail. • Navigation efficiency would be improved in the BSC.	• No indirect impacts to surface transportation or traffic would occur, as induced growth from the channel improvements would not be anticipated. • Fewer, larger, more fully loaded ships would eventually replace current smaller, light-loaded fleet to carry same projected tonnage with reduced delays. The proposed project would reduce number of ships required to carry same amount of tonnage.	No
Hazardous , Toxic, and Radioactive Waste (HTRW)			
• Several HTRW sites are primarily large industrial sites along the BSC, and spills/releases associated with shipping in the BSC and HSC. • No sites found within project footprint.	• No direct impacts on HTRW sites expected. Probability of encountering contaminated sites or toxic substances during project construction is considered low.	• The increase in efficiency in the channel is likely to help reduce potential for spills and other releases within the BSC and HSC. • No other indirect impacts are expected.	No
Noise			

Current Status and/or Health of Resource	Direct Impacts	Indirect Impacts*	Resource/Issue to be Included in Cumulative Effects Analysis
• Existing noise environment varies from residential to heavy industrial and is influenced by numerous noise generating sources, many of which are transportation-related (i.e. waterways, roadways, etc.). • Waterborne activities that contribute to project vicinity's ambient noise environment include operation of ships, barges, commercial fishing vessels, and recreation boats.	• Temporary impacts during construction during dredging within land cut would be similar to what currently occurs during periodic maintenance dredging. • Dredge placement would take place more than 1/2 mile away from mainland, so would be much less, if at all perceptible. • Change in channel centerline would not result in perceptible loudness difference from change in vessel sound proximity.	• No net increase in terminal activity above that already projected would result from channel improvement; therefore, associated sound would not be expected to change. • Increase in efficiency of ship entry/exit and reduced number of tugs required for transiting the channel would reduce sounds levels some, but vessel transit sound levels not substantial contributor to sound above ambient levels. • Fewer, larger ships to carry same tonnage would reduce in-channel noise events.	No
Air Quality			
• Project is in HGB nonattainment area currently classified as "severe" nonattainment" for 8-hour ozone standard. • Air quality in HGB region has been steadily improving since last decade. • Marine vessel emissions are expected to improve due to recent changes in national and international marine emission standards.	• Temporary emissions of diesel exhaust containing ozone precursors NO_x, and VOCs, and other pollutants during construction. . NO_x emissions would exceed de minimis thresholds, but would be demonstrated in a General Conformity Determination coordinated with TCEQ to be in conformance with the SIP to ensure emissions do not jeopardize State CAA ozone compliance. • Reduction of inefficiency of transit into/out of BSC would result in minor reduction of current vessel transit emissions.	• Long-term decrease in air emissions with the increase of newer, larger, more fuel efficient, but fewer, container ships adhering to most recent and impending emission standards for marine engines. • Reduction in tug assist and hoteling emissions by increasing navigation efficiency and removing daylight navigation restrictions. • No net increase in terminal activity or the associated emissions expected as maximum tonnage that BSCCT can process would not change and since maximum tonnage was already projected in BSCCT FEIS to occur with current channel and planned facilities.	Yes
Cultural Resources			
• No known historic or archeological resources are within area of proposed channel improvements or existing PAs proposed under the Preferred Alternative.	• No effects to cultural resources are anticipated.	• No indirect impacts are expected.	No

Table 5.3.5-2 Summary of Past and Present; and Reasonably Foreseeable Actions

					Dredged Material Placement						
					Location		Type		Status		
Project	**Action**[1]	**Year Built/Projected to Start Building**[2]	**Construction Status**[3]	**Placement Area**	**Terre-strial**	**Bay**	**Upland**	**Marsh**	**Com-pleted**	**Being Filled**	**Future**
Past and Present Actions											
Houston-Galveston Navigation Channels (HGNC)	Deepen/widen existing 53 mi HSC to 45-ft X 535-ft Deepen existing 2.2 mi GSC to 45-ft	1998-2005 (HSC complete), 2011 (GSC complete)	Maintenance	Existing & future upland - See Table 5.3-3	X	X	X	X	X	X	X
Cedar Bayou Federal Navigation Channel (FNC)	Dredge 5 mi 15-ft X 105-ft barge channel	1931, 1975	Maintenance	Existing upland terrestrial PA 6 at Mi 5 (~4 mi upstream of Galveston Bay)	X		X			X	
Barbours Cut Terminal and Channel	Build container terminal - Dredge 1.6 mi 45-ft X side channel	1977	Maintenance	Spilmans Island		X	X			X	
Clear Lake Channel	Shallow draft recreational channel	Unknown	Maintenance	Unknown							
Bayport Ship Channel Container Terminal (BSCCT)	Build container & cruise terminals, dredge 7 container & 3 cruise berths, dredge cruise TB	2007 - ongoing	In progress – 4 container & 1 cruise berths, cruise terminal & TB built	Bayport Terminal DMPA #1 and #2	X		X				
				PA 14 & 15		X	X			X	
				200-acre BU marsh adjacent to PA 14		X		X			X
Existing Bayport Ship Channel (BSC)	Dredge 4 mi 45-ft X 305-ft side channel	1977	Maintenance	Atkinson Demo Marsh		X			X		
				PA 14 & 15		X	X			X	
				Mid Bay		X	X	X		X	
Odfjell Bulk Liquid Terminal	Petrochemical terminal with 2 wharves and 3 barge docks	1980-1989	Maintenance	Private upland placement site,	X		X			X	
				PA 14 & 15		X	X			X	
LBC Bulk Liquid Terminal	Petrochemical terminal with 3 wharves and 5 barge docks	1978-late 1990's	Maintenance	Private upland placement site	X		X			X	
				PA 14 & 15		X	X			X	
Expansion of PAs 14 and 15	Expand existing PAs by building new cells	2010-2012	N/A	Upland PA 14/15 connection		X	X			X	
				Marsh Cells M7/8/9		X		X		X	
				Marsh Cells M10		X		X		X	
				Marsh M11		X		X			X
HGAC TIP	Regional transportation improvements, includes roads/highways, rail, mass transit	2013-2016 (current TIP)	Various projects under construction or still in planning phases	N/A							
SH1 146 to Port Road Direct Connector	Direct connecting overpass between SH 146 and Port Road	2012	Completed	N/A							
Port Road Widening	Widening to 6-lane facility	2013 - ongoing	Construction, engineering, ROW acquisition	N/A							
Texas City Channel Deepening	Deepen channel from 45-ft to 45-ft (requires nominal widening)	2011	Maintenance	Shoal Point PA (SPPA) 2,3,4,5		X		X			
				Pelican Island PA		X		X		X	
				PA 2C		X		X			X
Reasonably Foreseeable Actions											
Bayport Flare Easing	Widen Bayport Flare to 4005-ft radius Dredge 235-ft channel straightener	2013	Future	PAs 14, 15, other Atkinson Island cells (M7/8/9, M10 etc.), and Mid Bay		X	X				X
Barbours Cut Modernization	Upgrade terminal facilities and enlarge channel	2014	Future	Spilmans Island		X	X				X
Shoal Point Terminal	Construct container terminal, berths, & TB	unknown	Future	Swan Lake		X		X			X
				SPPA 1		X		X			X
MMKP Exploration Cedar Point Prospect Well #1 & Pipelines	No detailed info available, but assumed to be exploration well and service pipeline installation	unknown	N/A	N/A							

1. Abbreviations: HSC = Houston Ship Channel, GSC = Galveston Ship Channel, TB = turning basin, PA = placement area
2. Denotes year construction and new work dredging to build channel, berth, terminal, or placement feature was completed or projected to start
3. Denotes construction status. For channels, maintenance means new work dredging is done and channel is being maintained.

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5.4 CUMULATIVE EFFECTS ANALYSIS

The third step in the general approach suggested in the CEQ guidelines is to determine the environmental consequences of the cumulative effects of the projects identified. This step involves the following four sub-steps:

- Identify the important cause and-effect relationships between human activities and resources, ecosystems, and human communities.
- Determine the magnitude and significance of cumulative effects.
- Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.
- Monitor the cumulative effects of the selected alternative and adapt management.

The first two sub-steps are carried out and discussed in this cumulative effects analysis, and the last two are discussed in the conclusions to this chapter. The following sub-sections provide the details of the cumulative effects analysis.

5.4.1 Results

5.4.1.1. Water and Sediment Quality

Water

As discussed in the scoping, the primary water quality concern of the proposed action carried forward in the analysis with respect to cumulative effects was the temporary effect of turbidity caused by dredging and placement. The past actions would not continue to have effects on turbidity since they have been constructed and dredging has long since ceased, though periodic maintenance dredging for these projects would. The present projects that still have berths to dredge, or placement areas to be constructed to accommodate channel maintenance material, would have effects from the berth or maintenance dredging and placement, and PA construction. The reasonably foreseeable projects would have effects from dredging berths and channel improvements, and the associated placement to create new PAs. For the Expansion of PAs 14 and 15 project, mining to provide levee material would have turbidity effects.

As previously discussed in Section 4.1.4, the temporary effect from dredging lasts a few hours and extends typically a few hundred meters (a few thousand-ft). Therefore, the most important cause and effect relationship of concern to turbidity from these projects is the timing and spacing of the projects and whether their effects would spatially or temporally overlap. Considering this, only the following projects would be close enough spatially for effects to overlap with the BSC Improvements Project: HGNC, BSCCT, Odfjell Terminal, LBC Terminal, Existing BSC, Bayport Flare Widening, and PA 14 and 15 Expansion. The other projects are located at least several miles away, outside the range of interest (<1,000 meters or 3,281-ft). As discussed in Sections 5.3.4 and 5.3.5, the existing and planned private berth and dock facilities in the Upper Bay are all associated with small, private piers and docks, that would only involve small, very localized dredging for shallow draft maintenance. Their effects would be expected to negligible. For the MMKP Exploration Cedar Point Prospect Well project, a single wellhead is expected to cover only a small area (>10 meters square), and the associated pipeline would temporarily impact a small linear area, but would be buried at least 3 ft below the bay bottom surface in accordance with marine pipeline regulatory standards. Therefore, benthic substrate impacted would be small or only temporarily impacted. Also, this project is located substantially farther than 1,000 m away on the other side of Atkinson Island.

For the remaining projects under consideration (HGNC, BSCCT, Odfjell, etc.), the turbidity effects would not overlap. Several dredging, scheduling, and planning factors were considered for these projects to determine if their effects were likely to overlap spatially or temporally. These factors included practicalities of dredging operations, Pilots and USCG safety spacing restrictions, recently completed dredging, and USACE planned work and dredging forecasts, Because of these factors, it was determined that turbidity effects from the proposed action was unlikely to overlap spatially or temporally with those from the past, present, or reasonably foreseeable actions. For example, even if the BSC Flare Easing were scheduled to occur around the same time window as the proposed project, spacing restrictions of 3 to 5 miles between dredges, and limited availability of suitable dredges, makes it unlikely these projects would be dredged simultaneously. Therefore, the proposed action's temporary localized effects from turbidity would likely not have cumulative effects with the past, present, or reasonably foreseeable actions since their effects would not overlap due to either timing or distance. With respect to the dredging frequency of the proposed action, as explained in Section 2.4.2, the dredging frequency is not expected to increase as indicated in the shoaling analysis. Therefore, the frequency of dredging events is not expected to increase. It should be noted, that because the turbidity increases only last a few hours, water quality effects of multiple dredging events for the BSC will not overlap temporally, and will therefore not exhibit such effects cumulatively.

Sediment

The sediment quality results discussed in Section 3.1.4 indicated that for contaminants with published thresholds, exceedances have been isolated and not persistent. Therefore cumulative effects from these contaminants are not expected. Because the other contaminants have been primarily below levels of concern, and because dioxin in marine sediment does not yet have published national thresholds, the discussion of sediment impact must include dioxins. Dredging for the cumulative projects would involve temporary disturbance and permanent movement of bay bottom surface sediments into dredged material PAs. This would occur mainly during maintenance dredging, which removes bay bottom surface sediments. The most important cause and effect relationship of concern from these projects is the further dispersal of these sediments to unimpacted or less impacted parts of the Galveston Bay, permanent placement to areas not yet impacted, and the potential for dredging activities to increase the potential exposure to aquatic fauna and in turn potentially increase bioaccumulation or impacts to wildlife. As discussed for water quality, the increase in turbidity associated with hydraulic dredging is localized and temporary, lasting a few hours and ranging a few hundred meters; often no greater than that caused by turbidity produced by commercial shipping or severe storms. The water quality cumulative impact analysis also demonstrated that the turbidity effects of the cumulative projects would likely not overlap. Therefore, although the temporary dispersal of sediments during dredging to implement and maintain these projects would continue to occur, this would be localized and, the effects would not overlap. Consequently, no cumulative effect is expected from the temporary, localized dispersal of sediments during dredging.

As the 2009 study results indicate, a linearly decreasing sediment concentration was observed going south down the Galveston Bay along the HSC towards the Gulf, consistent with dispersal from an upstream source. This pattern would mean dredging in a more northern location, then transporting (via hydraulic pipeline, hopper etc.) then placing material in a southern location would transfer sediments to an area that could have lower concentrations and vice versa. The maintenance dredging associated with the cumulative projects were reviewed to determine if sediment movements, particularly those from north to south, would continue to occur and disperse higher concentration sediments to areas with lower concentrations. All projects, except the HGNC, were found to involve maintenance dredging and placement that would move sediments from and to areas with similar or slightly higher concentrations, due to east-west channel orientation and PA location, or would involve new work dredging of uncontaminated native clay layers. Therefore, these projects would not involve movements of sediment with higher concentrations to areas exposed to lower concentrations.

The HSC, which is part of the HGNC project, is the principle channel oriented north and south in the Galveston Bay, and would be involved in north-south sediment movements via dredging, transporting, then placement during routine channel maintenance. Maintenance of some segments involve dredging sediments from a north location, where higher levels may be observed, and placing them in PAs to a location south of where it was dredged, where lower concentrations may be observed, while other segments involve the opposite movement. However, the amount of sediment involved compared to the sediment volume of the Bay is very small, and natural forces from high stream outflows from the HSC and San Jacinto River during storm events, tidal fluctuations, and bay currents, would be expected to be larger forces for dispersal and net impact on sediment transport in the Bay. These natural forces would be expected to continue dispersal of impacted sediments already present in the bay. The dredging and placement actions for HSC maintenance would involve moving sediments from the bay bottom, where they are exposed to the natural dispersive forces in the open bay, and moving them to more confined upland marsh or PA cells where they would be less exposed to movement and migration over the long-term since they are surrounded by levees designed and built to retain sediments. The long-term effect would be to reduce the migration of a small portion of the impacted sediments down the Galveston Bay.

Though no national marine sediment guidelines for dioxin are currently available, other regional authorities have published thresholds. As discussed in Section 4.1.4, a review of the lab data from the 2009 USEPA Study showed that 5 out of the 7 samples along the HSC were below the Oregon DEQ SLVs for all compounds, and only 1 out of 17 compounds in the 2 other samples exceeded the SLV. Both of these exceedances were for 2,3,7,8- TCDD exceeding the 0.56 ppt threshold by 1.5 to 3.3 times, and were associated with the two northern-most points in the Upper Bay. All of the other compounds were orders of magnitude below their thresholds. Therefore, it does not appear that collectively these sediments would have a high bioaccumulation potential given these results.

As previously discussed in Section 4.1.4, the USACE Seattle District published thresholds following a bioaccumulation/bioassay study, where dioxin concentrations below 10 ppt are acceptable for open-water disposal as long as the volume-weighted average in material from the entire dredging project does not exceed 4 ppt for PAs designed to retain material, which are the type of PAs used in Galveston Bay. All of the 2009 USEPA study results were below 10 ppt, and half were above 4 ppt. With regard to the proposed action, the most recent BSC results indicate a decrease in levels, which were all below the Oregon DEQ and Seattle District thresholds published, and most importantly, with no detection of TCDD. Therefore, maintenance dredging of the BSC would not appear to have a minimal effect.

Bioaccumulation has already occurred in Galveston Bay's aquatic species, which is the reason fish consumption advisories have been instituted for the Upper Bay. It would be expected to continue despite the major use of the subject compounds (PCBs and dioxins) having largely ceased, or sediment levels in an area being below risk thresholds. Maintenance dredging for the HSC has occurred and would continue to occur. The USACE has a maintenance dredging sampling program that ensures the quality of sediments is acceptable for placement. This would continue through the 20 years of maintenance and beyond as long as the maintenance is a Federal responsibility. The PHA also has a conservative sediment sampling program that has included testing for dioxin since 2009, and is at least as stringent as the USACE sampling program. The PHA would apply this program to dredging required for the BSC, and any maintenance that would be a non-Federal responsibility. In summary, the following is observed in consideration of the potential for significant cumulative effects from the dredging of bay sediments:

- Of the past, present and reasonably foreseeable actions, sediment movements from dredging, transport and placement to another location would have negligible effects on the net transport of bay sediments compared to the natural dispersive forces.

- Natural dispersive forces such as tidal exchange, storm water flows, and bay currents, tidal would be expected to continue to cause migration of these sediments down the Galveston Bay.

- The HGNC dredging and placement would move impacted sediments out of the open bay where it is more exposed to the natural dispersive forces and to more confined PAs less exposed to these forces, reducing the potential for further migration down the Galveston Bay and HSC.

- The dioxin levels are predominantly below available bioaccumulation screening thresholds with only one compound involved, and limited to the upper-most part of the Galveston Bay and HSC.

Considering the above, the past, present, and reasonably foreseeable actions would not be expected to result in a cumulative impact to aquatic species or sediment quality.

5.4.1.2. Wetlands

The most important cause and effect relationship of concern to wetlands from these projects in terms of cumulative effects are impacts leading to permanent losses of wetlands. This discussion focuses on estuarine marsh, as it is the relevant wetland type for the Galveston Bay environment. As discussed previously, wetlands, specifically marsh around Galveston Bay, have been a resource that has been historically in decline. The HGNC's dredged material BU placement plan identified creation of marsh that with recent changes to the plan and the other past, present, and reasonably foreseeable actions' plans to use dredged material to create marsh, would offset approximately 16.5 percent of the historic losses of 33,000 acres of marsh in the Galveston Bay. Some of these projects had wetlands impacts that were separately compensated for through mitigation.

The proposed action will result in the use of subsequent maintenance material to help construct several of the planned HGNC BU marshes. The incremental maintenance of 4.2 MCY over 20 years would be equivalent to providing fill for approximately 260 acres of marsh, assuming that 10 ft of marsh fill would be needed for the typical 8-ft deep bay depth to achieve intertidal marsh elevation.

Since compensatory mitigation of wetlands under CWA was instituted, the trend of net losses of bay marsh from direct project impacts would be reduced or halted, because estuarine marsh would be subject to CWA regulation. Losses from subsidence would still occur, but since HGSD requirements were instituted in the Houston metropolitan area to reduce or eliminate groundwater use that was implicated in the problem, subsidence has been largely curtailed along the shoreline. There could be future losses to climate change-induced sea level rise. However, the expected trend for this resource is one of a general halt or reduction of decline. The more recent estimates indicate a small increase of estuarine emergent wetlands between 1996 and 2005 (HARC 2013). Given that the reasonably foreseeable actions or the proposed action would not be expected to result in net losses of wetlands, given that some of the present and reasonably foreseeable actions would result in marsh creation, the cumulative effect of these projects would be a small gradual recovery of some of the historic losses of marsh in the Galveston Bay. Considering the small proportion of marsh impacted and the contribution to building BU marsh by the proposed action, the proposed action contribution to any cumulative effect would be minimal.

5.4.1.3. Aquatic Fauna and EFH

Each of the past, present, and reasonably foreseeable actions that continue to have dredging or placement activity associated with it would have the same type of localized short-term effects to aquatic fauna and EFH as the proposed action, including direct impacts such as impingement, entrainment, and burial, and indirect temporary impacts from increased turbidity, sedimentation, noise, light, and vessel activity during the construction period. The most important cause and effect relationship of concern to aquatic fauna from the cumulative effects of these temporary impacts is one of overlapping of these effects leading to a greater or more long-lasting effect. Of these temporary effects, the most far-reaching effect would be from turbidity as the other effects would be more localized to the immediate vicinity of the dredge and cutterhead. Given that the effects of turbidity from these actions would not overlap, due to distance and timing, then the temporary effects to aquatic fauna and EFH would not either. Therefore, the proposed action's temporary localized effects to aquatic fauna and EFH would likely not have significant cumulative effects with the past, present, or reasonably foreseeable actions due to either timing or distance. Because maintenance dredging would occur once every few years, the same dredge distance limitations would apply and the same effects during those activities would also be expected to temporary in nature, and not cumulative.

The permanent direct impacts include conversion of bay bottom, water column and oyster reef habitat to other forms that would either not be useful or less useful by aquatic species and EFH (e.g. deeper navigation channel,), or would be useful to the same or different species, but in a different life stage. Therefore, the most important cause and effect relationship of concern to aquatic fauna from the cumulative effects of these permanent impacts is one of the additive natures of these effects compared to the availability of these types of habitat.

The bay bottom and known oyster reef impacts of the cumulative projects, as well as the proposed action are listed in Table 3-4 of Appendix E, and are summarized in this section. Data from publicly available environmental documents (i.e. EAs, EISs), Federal feasibility studies, and related documents were mainly used. Quantities summarizing the bay bottom impacts are for impacts to undisturbed bay bottom and do not include channels artificially excavated out of land, or new areas of open water created by a project as they represent areas of high vessel traffic and disturbance from their inception. Galveston Bay is approximately 600 square-miles (384,000 acres) in area, with all of this providing water column, and most of the bay bottom consisting of unvegetated shallow bay bottom, and a smaller percentage covered by oyster reef. The cumulative projects impact water column and shallow bay bottom habitats in two principle ways: by deepening the shallow bottom when navigation channel, berths, and turning basins are excavated, and by filling in most or all of the water column and converting shallow bay bottom to upland or marsh when dredged material placement areas or other terminal facilities are built. The total excavation impacts from past, present and reasonably foreseeable actions are approximately 1,017 acres, or about 0.26% of the Galveston Bay area. The total impacts of placement and fill from past and present, and reasonably foreseeable actions are 9,584 acres, or 2.5% of the Galveston Bay area. Therefore, the total of all past, present, and reasonably foreseeable impacts to bay bottom from excavation and placement are approximately 10,601 acres, constituting 2.76% of the Galveston Bay area, a relatively small proportion. Up to 163 acres of bay bottom and 4.6 acres at most of oyster habitat would be impacted by the proposed action and 20 years of maintenance dredge disposal. These impacts are negligible compared to the unaffected bay bottom of the 600 square-mile Galveston Bay habitat and the approximately 5,942 total acres of oyster habitat within the Upper Bay. The cumulative impacts of all projects change negligibly when adding BSC channel improvement impacts, increasing only a few hundredths or few tenths of a percent from 2.76% to 2.88% for the Preferred Alternative. Therefore, the cumulative impact of the proposed action can be characterized as a negligible contribution to a small impact on water column and bay bottom habitat.

Data from previous mapping of oyster reef by the Galveston Bay National Estuary Program (GBNEP) in 1994 indicate approximately 28,000 acres identified in all of Galveston Bay. The known oyster impacts for the past, present and reasonably foreseeable actions have either been mitigated (HGNC) or have plans and requirements to do so, as the TPWD manages the impacts for this resource, and requires reef creation or restoration for impacts. Therefore, there would be no net loss expected from these actions. In the historical context of this resource, analysis of the reef acreage trends and growth patterns observed in the GBNEP data compared to previous TPWD data indicated oyster reef acreage grew rather than declined, with most of the increase attributed to accretion along the HSC and other channels, evident in the mapping (Powell et al., 1994). Considering the negligible percentage impacted, the mitigation for those impacts, the accretion that has been attributed to navigation channels, and the general trend for the resource, a cumulative impact to oyster reef would not be expected to occur from the past, present, reasonably foreseeable and proposed actions.

Considering the negligible contribution by the proposed action to a small cumulative impact on water column and bay bottom habitat and the discussion above about the nature of these impacts, and considering the negligible impact to the Galveston Bay's oyster reef acreage, a cumulative effect to aquatic fauna and EFH would not occur from the past, present, reasonably foreseeable, and proposed actions, including 20 years of O&M for the proposed action.

5.4.1.4. Air

The cumulative projects discussed in Section 5.3.4 and the proposed action would produce air emissions, including NO_x, VOCs, SO_x, CO, and particulates, during dredging activities to maintain channels, dredge berths and channel improvements, build terminals, and construct planned placement areas. These emissions would be temporary and intermittent. As discussed in Table 5.3.5-1, the proposed action construction emissions for NO_x would have to be demonstrated to be in conformance with the SIP since the project area is in the HGB NAA for ozone. Since all of the other cumulative projects are also located in the HGB NAA, they would also have to coordinate with TCEQ and demonstrate project emissions comply with the SIP to ensure they do not affect the State's ability to continue improvements to air quality to meet the ozone standard.

Since the geographic scope selected for this resource was the 8-county HGB NAA, consideration of actions within this area would include projects and activity beyond the individual dredge projects in the Galveston Bay listed in Section 5.3.4. These actions would include projects associated with transportation improvement, industrial facilities, commercial and residential development, municipal infrastructure improvement, and other forms of construction occurring in the HGB NAA. Other emissions sources and activity in the HGB NAA that could contribute to NO_x, VOCs, and other pollutants include mobile sources such as cars, trucks, and other vehicles used during the normal commuting and transportation activity in the area, and emissions from daily operation of stationary sources such as power plants, refineries, other industrial facilities, and buildings. While it is not practical to list, discuss, and analyze individual actions across all these categories, a discussion of the HGB's trend in air quality and the regulatory framework in place that addresses these categories provides an indication of the expected cumulative effect of these actions.

The CAA has resulted in a variety of regulations promulgated through the USEPA in the last two decades, which address control or reduction of emissions from the mobile on-road and non-road sources, and stationary industrial sources, and residential and nonresidential construction sources. Most of these controls are implemented or regulated within the State through the SIP. Examples of these regulations include the General Conformity Rules for general construction projects involving Federal projects or funding, or other projects if they involve Federal planning assistance or permit approval, Transportation Conformity for the regulation of transportation planning that affects mobile source, and New Source Review (NSR)/Prevention of Significant Deterioration (PSD), New Source Performance Standards (NSPS), and National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for the daily operation of stationary sources such as power plants, refineries, other industrial facilities, and buildings. All of the categories of regulations (conformity, mobile on-road, non-road, NSR etc.) include some form of regulating either ozone, or its precursors, which include NO_x and VOCs.

As mentioned, a regulation that has the potential for major effects on mobile source emissions is Transportation Conformity, which sets requirements for metropolitan transportation planning in NAAs. As discussed in Section 5.3.4, the HGAC, acting as the regional MPO, issues the TIP periodically to demonstrate transportation conformity for the transportation projects of the area. As the purpose of the program is to produce a plan for financing and executing priority transportation infrastructure projects, and must demonstrate conformity, it can be assumed that these projects would reduce emissions from relieving traffic congestion. The local TIP past project of relevance, the direct connector from SH 146 to Port Road, has relieved semi-truck congestion along SH 146 trying to access the BSCCT, and will continue to reduce this congestion and the associated local emissions, compared to congestion and emissions without the project. The present project of the widening of Port Road would also be expected to relieve congestion and emissions compared to without the project

All of the aforementioned types of projects and sources producing emissions in the HGB NAA have been occurring under this regulatory framework, amid the growth in population and development that the HGB area has experienced. Despite this growth, the air quality data has indicated a decreasing trend in ozone levels. A variety of indicators corroborate this, including the following (TCEQ 2011a, HGAC 2010a):

- The HGB area was one of four sites in the country showing the greatest improvement in reducing ozone in a comparison between the 2001-2003 period and the 2005-2007 period.
- The HGB area experienced a reduction in exceedance days of approximately 48% from year 2006 (64 total days) to 2009 (31 total days).
- Since 2000, the number of days rated “Good” under the USEPA’s Air Quality Index (AQI) has increased and the number of days rated “Unhealthy” and “Unhealthy for Sensitive Groups” has decreased in the HGB area.
- A comparison of fourth highest ozone concentrations (a statistic used in determining standard attainment) for Houston reveals a downward linear trend for Houston for 2000-2010.
- The design value, which is a multi-year average of measured concentrations used to quantify the degree to which the level of an air quality standard has been exceeded, has decreased for the HGB for ozone, making the HGB area tied for seventh lowest design value out of 13 major NAAs in 2010, whereas in 2000, it had some of the highest values.

- The HGB area had the second largest decrease of the 13 major NAAs in eight-hour ozone design values from 2000 to 2010.

- Eight-hour ozone design values steadily decreased from 1999 to 2009 with 2009 values below the 1997 standard.

Therefore, the trend for the resource is one of steady improvement, despite the growth that has occurred in the HGB area. The decreasing ozone trend indicates that the cumulative effect of past and present actions has not compromised the ability for air quality to improve in the HGB NAA. With more stringent standards being phased in for several categories of regulated sources, the trend would be expected to continue. Therefore, the dredging emissions from past, present, and reasonably foreseeable actions, and the proposed action are not expected to have a cumulative effect on air quality.

The long-term impact of the proposed action is a positive one as discussed in Section 5.3.3, primarily by allowing and providing incentive for shippers to use larger, newer, fewer, more fuel efficient OGVs to use the BSC. The other potentially substantial impact is channel improvements helping to ensure that container cargo movement into Houston continues to occur via OGV instead of by truck or rail, which would produce more emissions to move the same cargo. The other impacts, such as reduced tug assist, and reduced hoteling, would be positive, but they would be expected to be smaller than those associated with the OGV transit emissions. Although the specific reductions have not been quantified in full, the relative reductions discussed in Section 0, and emissions inventory information, help frame the magnitude. The relative reductions, information from the PHA's detailed, comprehensive inventory of port-related emissions, and information from the SIP, were used to gauge the general percentage that these BSC-related reductions could represent of total regional commercial marine emissions (Starcrest Consulting Group LLC, 2009). With Bayport containership emissions constituting approximately 0.7% (at its current throughput with 3 berths), and total OGV emissions constituting 2.3% of the HGB commercial marine emissions budget, a relative reduction of NO_x emissions of 27% solely through increased cargo conveyance efficiency by reducing light loading would represent a modest reduction of 0.2% to 0.6% of the HGB commercial marine emissions budget. If it is assumed that use of more fuel efficient, more stringent emissions standard engines encouraged by the channel improvements would reduce a substantial portion, for example 80 percent, of the 2.3% of the budget, a still-relatively modest reduction of 1.8% would be possible. If it is assumed that BSCCT emissions increase in proportion to the number of berths (increase of 2.33 times to 7 berths), and other OGV emissions remain relatively the same, the percent represented by Bayport OGVs could rise to approximately 5.4%, and an 80-percent reduction would affect about 4.3% of the regional commercial marine SIP emissions.

Another positive effect that could further help reduce emissions would be the assurance that cargo movement into Houston would be maintained by OGV instead of by truck or rail, which would avoid extra emissions that less efficient truck or rail movement would have. If the relative efficiencies discussed in Section 4.3.8.2 for OGV, rail and truck are considered, rail and truck would consume 3 and 7 times as much energy, and this relative increase is applied to the percent of emissions representing future build-out traffic (about 3%), the emissions from movement by rail or truck could constitute on the order of 9% to 21%, respectively of the commercial marine SIP emissions. Movement by OGV instead could reduce this portion. The ultimate benefit would depend on the percent shipped by rail versus truck, though information from the BSCCT FEIS air quality impact analysis indicated alternate movement by truck would be more likely. Even if 10% of these emissions could be avoided by maintaining OGV shipment, it would represent a substantial portion of the regional marine emissions. Although this scenario is a general indicator of the magnitude of potential impact and not a detailed analysis, it illustrates that the scale of positive impact could be meaningful to regional marine emissions.

Although ozone has continued to trend downward, the HGB area does still not meet the ozone standard, which has become more stringent. Regional air quality planners remain concerned about the ability to keep reducing emissions after major controls and initiatives have been implemented. This has spurred several ozone formation monitoring and modeling studies to understand root causes of remaining exceedances. Past gains in ozone reduction have been attributed to a reduction of VOCs, one of the major precursors. More studies, including a 2002 Department of Energy monitoring study, now indicate that the HGB area has become more NO_x-limited; that is ozone formation now depends more on the availability of atmospheric NO_x instead of VOCs (Daum et al., 2002). This could shift the focus for further reduction strategies on reducing NO_x sources. The proposed action could have meaningful positive impact on regional marine NO_x emissions. Although commercial marine emissions represent a small portion of the total emissions for all sources in the HGB NAA, the NO_x-limited nature of ozone formation would increase the significance of any measurable positive contribution towards further reducing NO_x emissions. Considering that the cumulative effect of regional emissions sources and projects has been a downward trend in ozone, the proposed action would contribute positively to this cumulative effect. Therefore, the proposed action would have a positive cumulative impact with the other past, present, and reasonably foreseeable actions.

5.5 CONCLUSIONS

The final sub-steps for the third step in the general approach of the cumulative impact analysis are to modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects, and to monitor the cumulative effects of the selected alternative and adapt management for their mitigation. Since the proposed action would not result in cumulative impacts, these sub-steps are not implemented. The proposed action would include mitigation for oyster reef impacts, and monitoring and adaptive management actions to respond to results compared to success criteria are part of the mitigation plan. However, these impacts were shown to be cumulatively minor.

The cumulative impacts due to past, present, and reasonably foreseeable actions, along with the Applicant's proposed action, are not expected to have effects to resources in the study area. The majority of cumulative impacts associated with these projects would either be localized and temporary, or result in positive impacts. The permanent impacts would not be significant, given the scale of the non-impacted resource available. Existing Federal and State regulations, and the goals and coordination of community planning entities such as the HGAC, address the issues that influence impacts to the resources analyzed. The coordination of the numerous stakeholder groups, local organizations, and State and Federal regulatory agencies, and regulations such as the CWA and the CAA, provide some protection for these resources in the area. These measures should continue to prevent, minimize, or in some cases, improve negative impacts that could threaten the general health and sustainability of these resources in the region.

Most of the projects included in the analysis involve dredging and placement operations, which result in temporary impacts such as increased turbidity and air emissions, and permanent impacts such as impacts to shallow bay bottom. The cumulative effect of the projects, that have implemented the measures required in the regulatory framework, has resulted in positive impacts to air quality, despite growth in regional population and development. The long-term positive impact of the proposed action would contribute to continuing this positive cumulative effect.

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6.0 COMPLIANCE WITH STATUTES AND REGULATIONS

6.1 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

This EA has been prepared in accordance with CEQ regulations to aid in complying with NEPA. The environmental and socio-economic consequences of the proposed action have been analyzed in accordance with the NEPA and presented in this report.

6.2 FISH AND WILDLIFE COORDINATION ACT OF 1958

The Fish and Wildlife Coordination Act directs Federal agencies to consult with USFWS, NMFS, and state agencies before authorizing alterations to water bodies, for any purpose, including navigation, and by any public or private agency under Federal permit or license.

The Applicant's proposed action has been coordinated with the USFWS, NMFS, TPWD and other State and Federal resource agencies through the BUG and additional coordination and consultation. Additionally, the USFWS, NMFS and TPWD are being provided copies of this Draft EA for review and comment. The USFWS provided a July 2, 2012 comment letter during the DA Section 10/404 permit application public and agency review period, and listed no concerns for T&E species, or other wildlife concerns. The comment letter was also provided for purposes of the Fish and Wildlife Coordination Act. A copy of the letter is provided in Appendix D.

6.3 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (PUBLIC LAW 104-297)

The MSFCMA (PL 94-265), as amended, establishes procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. Regulations codifying the Act in 50 CFR Sections 600.805–600.930 specify that any Federal agency that authorizes, funds, or undertakes, or proposes to authorize, fund, or undertake, an activity that could adversely affect EFH, is subject to the consultation provisions of the Act and identifies consultation requirements. EFH consists of habitat necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils (RFMC) in a series of FMP. The GMFMC is the RFMC applicable to the project location.

Informal consultation with NMFS has been initiated regarding EFH in the project area. Subsections 3.2.3.2 and 4.2.3 of the Draft EA were prepared to summarize the existing EFH in the project area and the potential impacts. Per the recommendation of NMFS, a separate EFH Assessment containing all the elements required in the EFH Final Rules for an assessment has been prepared for this project and is available upon request. NMFS also provided comments on the DA Section 10/404 permit application during the public and agency review period via a July 6, 2012 email, and listed no ESA or EFH concerns. A copy of this correspondence is provided in Appendix D.

6.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966

Compliance with the National Historic Preservation Act of 1966, as amended, requires identification of all NRHP-listed or NRHP-eligible properties in the project's Area of Potential Effect (APE) and development of mitigation measures for those resources adversely affected in coordination with the Texas State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP). As indicated in Section

4.3.10, surveys of the channel, including those for potential submerged cultural resources, were completed in coordination with the SHPO, and in accordance with the Texas State Antiquities Code. No NRHP listed or NRHP-eligible properties were identified in the project's APE. Only two anomalies warranting further investigation or avoidance were identified in an area associated with the USACE Flare Widening Project. The SHPO concurred with these results, contained in a draft report for the survey, in a June 28, 2012 letter, and accepted the final report in an October 24, 2012 letter, copies of which are provided Appendix D. Therefore, the channel improvements of the proposed action would not have any impacts on historic properties, and no additional surveys are planned for this area. In accordance with regulations in 36 CFR 800.2, promulgated for Section 106 of the NHPA, the ACHP consults with and comments to agency officials on individual undertakings and programs when they affect historic properties. Since no historic properties were found in the APE, consultation or review by the ACHP was not initiated.

6.5 CLEAN WATER ACT

Section 404 of the Clean Water Act (CWA) regulates dredge and/or fill activities in U.S waters. The proposed action would require dredging in U.S. waters. The PHA's application for a DA Section 10/404 permit from the USACE Galveston District for construction of the proposed BSC Improvements Project was submitted and initiated the NEPA process. This Draft EA was prepared to support the decision-making process regarding that permit application, and the discussion of the impacts of the proposed action has taken into consideration the guidelines developed under the CWA Section 404(b)(1).

The TCEQ is responsible for conducting Section 401 certification reviews of USACE Section 404 permit applications for the discharge of dredged or fill material into waters of the U.S., including wetlands, for the purpose of determining whether the proposed discharge would comply with State water quality standards. The DA Section 10/404 permit application included a completed TCEQ Tier II 401 Certification Questionnaire and Alternative Analysis Checklist. A copy of the permit application was sent to the TCEQ. CWA compliance for the Section 408 permit will be demonstrated through the evaluation of Section 10/404 permit application (SWG-2011-01183). Issuance of the Section 10/404 permit will be required prior to project construction.

6.6 CLEAN AIR ACT

The Clean Air Act (CAA) contains provisions under the General Conformity Rule to ensure that actions taken by Federal agencies in air quality nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality. Under the General Conformity Rule (the Rule), Federal agencies must work with state, Tribal and local governments in a nonattainment or maintenance area to ensure that Federal actions conform to the air quality plans established in the applicable state or tribal implementation plan. The regulations codifying the Rule under 40 CFR Part 93, Subpart B, specify that no Federal agency shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity which does not conform to an applicable implementation plan.

Section 4.3.8.1 of this EA discusses the conformity demonstration requirements in more detail, and the construction emissions estimate conducted to determine if the de minimis thresholds for the ozone precursors NO_x and VOCs under this rule would be exceeded. The estimated construction emissions indicated these emissions would be above the de minimis threshold applicable to the HGB Non-attainment Area for NO_x and VOCs, indicating a General Conformity Determination (GCD) would be required. To support the General Conformity process for USACE consultation with the TCEQ and the USEPA, a Draft GCD was prepared to help determine if emissions that would result from construction of the proposed action are in conformity with the Texas State Implementation Plan (SIP) for the HGB Non-attainment Area. The Draft GCD, and the results and details of the air conformity threshold analysis are presented in Appendix C.

The Applicant coordinated the results of this analysis with the TCEQ, the agency responsible for the SIP for Texas, via a letter dated February 7, 2013. The TCEQ responded in a February 20, 2013 letter and determined that the emissions would not exceed the emissions budget in the most recent SIP approved by the USEPA. A copy of this letter is provided in Appendix D. The USACE-SWG issued a Draft GCD based on the analysis on March 11, 2013, which preliminarily determined the proposed action is consistent with the SIP. The USACE-SWG sent copies of the Draft GCD to the USEPA Region 6, and the HGAC, the designated Metropolitan Planning Organization (MPO) for the HGB Nonattainment Area, on March 11, 2013. The USACE-SWG also published a public notice of availability of the Draft GCD on March 11 and 12, 2013 in the Houston Chronicle. A copy of the Draft GCD and the public notice is provided in Appendix C. The Draft GCD public comment period ended on April 10, 2013 and 3 comment letters were received. The Applicant provided responses to the comments on May 3, 2013. Issuance of the Final GCD is pending, but anticipated by August 2013.

As discussed in Section 4.3.8.1., the proposed action includes two changes from the project configuration documented in the Draft GCD. These changes are the removal of the further deepening of the Bayport Flare Easing, and the deletion of the use of some the PA 14 and 15 expansion features and needing only to use PA 15 for new work material placement due to geotechnical reasons. Neither of these results in a need to reanalyze channel or levee construction emissions because they do not change the estimated emissions or would only result in decreasing them. However, as discussed in 4.3.8.1, additional emissions from constructing the marsh mitigation, anticipated to be minor, will be estimated and coordinated with the TCEQ prior to the issuance of the Final GCD. Therefore, the change will be documented in the Final GCD.

Regarding coordination with the USEPA, the Draft GCD was coordinated with the USEPA Region 6 office as discussed in the previous paragraph, and the USEPA Region 6 office provided comments on the permit application during the public and agency review period via a letter dated July 5, 2012, provided in Appendix D. Only suggestions for best construction practices were provided by the USEPA on the Draft GCD

6.7 COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act (CZMA) of 1972, as amended, provides for the effective management, beneficial use, protection, and development of the resources of the nation’s coastal zone. The CZMA directs Federal agencies proposing activities or development projects, within or outside of the coastal zone that could affect any land or water use or natural resource of the coastal zone, to assure that those activities or projects are consistent, to the maximum extent practicable, with the approved State programs. Requirements in the CZMA include demonstration of consistency with the objectives of the CZMA for Federal actions. The Texas Coastal Management Program (TCMP) is the State entity that participates in the Federal Coastal Zone Management Program (CZMP) created by the CZMA. The TCMP designates the coastal zone and coastal natural resource areas (CNRA) requiring special management in that zone, including coastal waters, waters under tidal influence, coastal wetlands, submerged lands and aquatic vegetation, dunes, coastal historic areas, and other resources. The Coastal Coordination Council (CCC), composed of several State agencies and local officials, administers the TCMP for the coordination of local, State, and Federal programs for the management of Texas coastal resources. The TCMP reviews all Federal actions that may affect natural resources in the coastal zone for consistency with the Federal goals and objectives. The DA Section 10/404 permit application would automatically prompt a review by the TxGLO for consistency with the TCMP.

A completed Statement of Compliance with the TCMP was included in the permit application submitted to the USACE. The TGLO provided a comment letter dated July 26, 2012 during the permit application public and agency review period, pursuant to the Coastal Coordination Act, reviewing the proposed action for consistency with the TCMP (reference Appendix D). Because the proposed action exceeded TCEQ thresholds for referral to the Coastal Coordination Council, the determination of consistency with the TCMP was deferred to determination by the TCEQ under its Section 401 State Water Quality Certification of the proposed action. The TCEQ submitted comments on the permit application during the public and agency review period via a letter dated May 24, 2012. The Applicant met with the TCEQ at their headquarters on August 14, 2012 to discuss the comments, questions, and additional request for information, and to provide preliminary coordination for Section 401 purposes. The Applicant submitted responses to TCEQ comments and the additional information requested, on August 21, 2012 via File Transfer Protocol (FTP). TCEQ indicated on September 27, 2012 via phone and email that the responses and information provided were sufficient to address their questions and comments, and indicated that there should be no issues to delay or preclude Section 401 Water Quality Certification. The TCEQ will provide State Water Quality Certification as part of the DA Section 10/404 permitting process.

6.8 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) provides a program to conserve threatened and endangered plants and animals, and the habitats in which they are found. The lead agencies for implementing and administering the ESA are the USFWS and the NMFS. The Act requires Federal agencies to consult with the USFWS and NMFS, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of designated critical habitat of listed species. The Act also prohibits any action that causes an avoidable "taking" of any listed species of endangered fish or wildlife.

The evaluation of the presence of threatened and endangered (T&E) species is summarized in Section 3.2.4, and the potential project impacts discussed in Section 4.2.5 of this EA. A Draft BA was prepared and is presented at Appendix B for coordination and consultation with USFWS and NMFS. The listed species included in the BA were various species of sea turtles. Turtles that may occur in the bay waters in or near the project area include green, Kemp's ridley, and loggerhead sea turtles, but no suitable nesting habit is found in the project area. The proposed action is not likely to result in impacts to listed species, and the Draft BA concludes that the proposed action would have no effect on the listed species.

The USFWS provided a comment letter, dated July 2, 2012, during the permit application public and agency review period, but listed no concerns for T&E species, or other wildlife concerns, which is provided in Appendix D. The comment letter was provided pursuant to USFWS review and consultation obligations under several statutes, including the ESA. The Draft BA was sent to NMFS. NMFS also provided comments on the DA Section 10/404 permit application during the public and agency review period via a July 6, 2012 email, and listed no ESA or EFH concerns. A copy of this email is provided in Appendix D.

6.9 MARINE MAMMAL PROTECTION ACT OF 1972

The Marine Mammal Protection Act (MMPA) was passed in 1972 and amended through 2007. It establishes a moratorium on the taking and importation of marine mammals and marine mammal products, with certain exceptions. It is intended to conserve and protect marine mammals and it established the Marine Mammal Commission, the International Dolphin Conservation Program, and a Marine Mammal Health and Stranding Response Program. While the Act itself does not specify requirements for Federal activities, including permitting, the regulations for the USACE regulatory policies under the CWA contained in 33 CFR Part 320 contain review provisions applicable to the MMPA. These regulations identify the various Federal statutes which require that Department of the Army (DOA) permits be issued before the CWA-regulated activities can be undertaken, and the related Federal laws, including the MMPA, and general policies applicable to the review of those activities. Review and consultation for the MMPA is also triggered via the ESA when actions involve marine mammals.

The only marine mammals covered under the MMPA expected to regularly be present in Galveston Bay are bottlenose dolphins (*Tursiops truncatus*). These are highly mobile species that would be able to readily avoid dredging activities and vessels. Therefore, the Applicant believes the proposed action would not impact marine mammals and would be consistent with the requirements of this act.

6.10 NOISE CONTROL ACT

The Noise Control Act (NCA) of 1972 established a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. To accomplish this, the Act established a means for the coordination of Federal research and activities in noise control, authorized the establishment of Federal noise emissions standards for products distributed in commerce, and for the provision of noise emission and noise reduction information and labeling of such products. The Act directed Federal agencies to consult the USEPA whenever they developed noise control standards or regulations. The Act also directed Federal agencies engaged in any noise emitting activity to comply with Federal, state, interstate, and local requirements regarding environmental noise control and abatement to the same extent that any person is subject to such requirements. The Act did not establish requirements related to project planning, permitting or NEPA analysis. Apart from the requirement to follow existing Federal, state, interstate, and local noise-related regulations, there are no other relevant requirements under this Act applicable to this EA or the permit requested.

The Applicant's proposed action is not expected to have impacts on the sound environment as discussed in Section 4.3.9.

6.11 EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

This EO directs Federal agencies to avoid undertaking or assisting in new construction located in wetlands, unless no practical alternative is available, and the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use. The EO directs agencies to take such actions in carrying out its responsibilities in (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing federally undertaken, financed, or assisted construction and improvement; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities. The proposed action would permanently impact 9.2 acres of salt marsh and temporarily impact 4.7 acres of salt marsh from using dredged material to raise the PA 15 levee. However, it is not practical or desirable to decrease the potential placement capacity further by avoiding this marsh by constructing the needed stability berm to the PA interior, as explained in Section 2.3.3.3, considering the placement capacity shortages and need of the HGNC system, and that other levee segments will require construction towards the interior due to engineering constraints. Considering that the proposed levee raising will preserve as much of the expanded capacity of the existing PA as practicable, make use of an existing PA, and delay the need for a new PA that could result in new aquatic impacts, no practical alternative is considered available. The proposed construction includes a 50 ft construction corridor to limit temporary construction impacts on the marsh outside of the proposed levee footprint to that practicable, to further minimize impacts to this marsh.

6.12 EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE IN MINORITY POPULATIONS AND LOW INCOME POPULATIONS

This EO directs Federal agencies to determine whether their programs, policies, and activities would have a disproportionate impact on minority or low-income population groups within the Project Area. The Applicant believes this includes permitting activities.

As documented in Section 3.3.2, the latest demographic data for the area surrounding the land cut portion of the proposed project illustrates that only a low percentage of the population is low-income or minority, and is well below the percentages for the general population, indicating a low potential for any EJ impacts or issues. Therefore, the Applicant's proposed action is not expected to have any disproportionately high or adverse effect on low-income or minority population groups.

6.13 EXECUTIVE ORDER 13186, THE MIGRATORY BIRD TREATY ACT

This EO directs Federal agencies to increase their efforts under the Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Acts, Fish and Wildlife Coordination Act, the ESA of 1973, NEPA of 1969, and other pertinent statutes to avoid or minimize impacts on migratory bird resources. The 2006 Memorandum of Understanding (MOU) between the Department of Defense (DoD) and the USFWS developed pursuant to this EO does not explicitly specify permitting under the list of activities covered under the purpose and scope of the MOU, but does list natural resource management activities. The EO directs DoD to encourage incorporation of comprehensive migratory bird management objectives in the preparation of DoD planning documents, including NEPA analyses. The EO also directs DoD to, prior to starting any activity likely to affect migratory birds populations, 1) identify the species likely to occur in the area of the proposed action and determine if any species of concern could be affected by the activity, 2) assess and document the effect of the proposed action on species of concern through the NEPA process when applicable, and 3) engage in early planning and scoping with the USFWS to proactively address conservation, and initiate appropriate actions to avoid or minimize the take of migratory birds.

The proposed action is not expected to permanently impact migratory bird populations. As discussed in Section 3.2.2, PAs 14 and 15 are part of the TPWD Atkinson WMA which has been a historical nesting site for colonial water birds, and are mapped by the USFWS as part of a colonial waterbird rookery. Several of the species documented in Section 3.2.2 as having been recorded at PAs 14 and 15 are on the USFWS's 2008 Birds of Conservation Concern (BCC) for the Gulf Coast Bird Conservation Region (BCR) 37, including Reddish Egret (*Egretta rufescens*), Sandwich Tern (*Sterna sandvicensis*) and Black Skimmers (*Rynchops niger*) (USFWS, 2008). The most recent BCC defines the species of concern for the purposes of EO 13186. While migratory birds commonly have been observed on these PAs foraging, nesting, and roosting, they are active placement areas, and the timing of construction would be coordinated to avoid impacts to migratory and nesting birds. Options to avoid migratory and nesting bird impacts may include adjusting the construction timeline to accommodate the nesting season or re-sequencing construction activities to work in areas where no active nests are present.

Maintenance dredged material placement cycles in these and other PAs have been conducted successfully with minimal disturbance to migratory species. Similar construction practices and timing would be implemented for the proposed action if the existing PAs are used for dredged material placement.

6.14 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT OF 1980 (CERCLA)

As amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, CERCLA provides for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and cleanup of inactive hazardous substances disposal sites. The HTRW investigation discussed in Section 3.3.7 did not identify any potential CERCLA sites within the project footprint for the proposed channel improvements or the existing PAs that would be used for dredged material placement under the Preferred Alternative.

Regarding coordination with relevant agencies, both the TCEQ and USEPA have been given opportunities to comment on the proposed action during the permit application agency and public review process, and during the CAA Conformity review process. No CERCLA comments were provided in the permit application comment letter dated July 5, 2012 from the USEPA, or May 24, 2012 from the TCEQ. Comments related to sediment quality in these letters were addressed in responses provided by the Applicant to USACE-SWG. A copy of the letters and relevant excerpts of the responses to these comments furnished to the USACE-SWG are provided in Appendix D.

6.15 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

This Federal law governs the management and disposal of solid waste. RCRA may impose substantial requirements on Federal projects that manage even small amounts of hazardous waste. The HTRW investigation discussed in Section 3.3.7 did not identify any RCRA sites within the project footprint for the proposed action under the Preferred Alternative.

Regarding coordination with relevant agencies, both the TCEQ and USEPA have been given opportunities to comment on the proposed action during the permit application agency and public review process, and during the CAA Conformity review process. No RCRA comments were provided in the permit application comment letter dated July 5, 2012 from the USEPA, or May 24, 2012 from the TCEQ. Comments related to sediment quality in these letters were addressed in responses provided by the Applicant to USACE-SWG. A copy of the letters and relevant excerpts of the responses to these comments furnished to the USACE-SWG are provided in Appendix D.

6.16 EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

This EO directs Federal agencies to avoid possible impacts associated with the modification of floodplains and to avoid support of floodplain development wherever there is a practicable alternative. In carrying out the activities described above, each agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain associated with the one percent annual chance event. The EO also directs agencies to include adequate provision for the evaluation and consideration of flood hazards in the regulations and operating procedures for the licenses, permits, loan or grants-in-aid programs that they administer.

The land cut portion of the proposed action is in area mapped by the Federal Emergency Management Agency (FEMA) as subject to inundation by the one percent annual chance event. However, the Applicant's proposed action is located in open water, would deepen and widen the channel, and, therefore, not fill in the floodplain. The dredged material placement option is located outside of any area mapped as a one percent floodplain. Therefore, the proposed action would not impact the one percent annual chance floodplain.

6.17 FARMLAND PROTECTION POLICY ACT OF 1981 AND PRIME OR UNIQUE FARMLANDS

The purpose of the Farmland Protection Policy Act (FPPA) is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. The act requires among other things, agencies to identify and take into account the adverse effects of Federal programs on the preservation of prime and unique farmlands, and consider alternative actions, as appropriate that could lessen such adverse effects. The CEQ issued a memorandum "Analysis of Prime and Unique Agricultural Lands in Implementing the National Environmental Policy Act" that supplemented NEPA procedures to include analysis of these impacts in NEPA documents. The regulation codifying the Act in 7 CFR Part 658 specified procedures and criteria for the analysis of these impacts. The definitions in this regulation specify that farmland does not include land already used as water storage, which would include open water, and that the term "Federal program" does not include permitting for activities on private or non-Federal lands.

No terrestrial resources are impacted by the proposed action, and therefore, no prime or unique farmlands would be affected.

6.18 GALVESTON BAY NATIONAL ESTUARY PROGRAM

The National Estuary Program (NEP) was established under Section 320 of the 1987 Clean Water Act (CWA) Amendments as an USEPA place-based program to protect and restore the water quality and ecological integrity of nationally significant estuaries. Section 320 of the CWA calls for each NEP to develop and implement a Comprehensive Conservation and Management Plan (CCMP) that contains specific targeted actions designed to address water quality, habitat, and living resources challenges in its estuarine watershed over the long-term.

The Galveston Bay National Estuary Program was established in 1989 as one of twenty-eight NEPs in the U.S. It has continued as a non-regulatory program administered by the TCEQ under the name "Galveston Bay Estuary Program" (GBEP). It is charged with implementing the Galveston Bay Plan, the CCMP for Galveston Bay. Functions of the GBEP include acquiring, managing, and dispersing funds, coordinating activities, reviewing Federal projects, providing for coordination with the TCMP and the CCC, tracking and monitoring, public and agency outreach and education regarding the Galveston Bay, and advocacy.

Although this program is non-regulatory, the Galveston Bay Council established under this program performs an advisory role to the TCEQ during consistency reviews of eligible Federal projects. The Galveston Bay Plan contains numerous goals addressing water/sediment quality improvement, habitat/living resource conservation, and balanced human uses. In the highest priority categories of "Very High" and "High", increasing the quantity and quality of wetlands for fish and wildlife, eliminating or mitigating conversion of wetlands to other uses, and reversing the declining population trend for affected marine and bird species and maintaining populations of economic and ecologically important species, are goals of the plan. The priority ranking of management actions for the plan also include "Restore, Create, and Protect Wetlands", and "Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands" as the top two management actions. The proposed project impacts wetlands within the beneficial use site M-7/8/9 for the proposed dredged material placement alternative, that would be mitigated by the proposed marsh construction at BNC as discussed in Section 4.4.2.

6.19 MEMORANDUM OF AGREEMENT (MOA) WITH THE FAA TO ADDRESS AIRCRAFT WILDLIFE STRIKES

Several Federal agencies, including the Department of the Army, signed a 2002 Memorandum of Agreement (MOA) with the Federal Aviation Administration (FAA) to adopt coordination procedures in order to minimize the risk that project features create the potential for aircraft-flight strike hazards. Project features that might attract wildlife include wetland mitigation, such as those administered by the USACE under the CWA Section 404, or ecosystem restoration habitat. The memorandum recognizes the USACE's expertise in protecting and managing jurisdictional wetlands and their associated wildlife. It also directs signatory agencies to cooperatively review proposals to develop or expand wetland mitigation sites, or wildlife refuges that may attract hazardous wildlife, and diligently consider the siting criteria and land use practice recommendations stated in FAA Advisory Circular (AC) 150/5200-33 when planning such sites.

The FAA recommends separations when siting any of the wildlife attractants, to accommodate aircraft movement. The recommended separation distance between the airport (typically applies to the edge of the airport's air operations area) and the attractant (i.e., mitigation feature) varies between 5,000-ft and 6 miles, depending on the type of aircraft served and attractant.

The proposed project does not currently involve creating new PAs that would serve as wildlife attractants; only the use of existing ones. Therefore, no specific evaluation of attractant distances from area airports is necessary for this channel improvements and dredged material placement.

The proposed mitigation is located in an existing and large restored wetland complex (Baytown Nature Center) which already actively attracts avian wildlife, and is essentially adjacent to an existing restored marsh. The nearest airports within the range of distances discussed in FAA AC 150/5200-33 from the marsh mitigation area is the La Porte Municipal Airport and Baytown Airport. These airports service multi-engine turbine engine aircraft, according to FAA information. The prescribed distance for this type of airport is 10,000-ft. The nearest edge of the permit area requested for the proposed mitigation is located approximately 22,900-ft from the edges of the active airfield (runway, taxiway, apron etc.), well outside the 10,000-ft radius prescribed, and is not expected to impact aircraft movement.

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7.0 CONCLUSIONS

This chapter summarizes the impacts of the proposed action and presents the adverse environmental impacts that cannot be avoided, and the irreversible or irretrievable commitments of resources that would occur if the proposed action is implemented. The chapter concludes with the Applicant's assessment of the impact of the proposed action.

7.1 SUMMARY OF IMPACTS

The proposed action includes dredging to deepen and widen the existing BSC placement of new work dredged material to raise levees at existing PA 15, and placement of maintenance material at existing PAs 14, 15, other Atkinson Island PA cells, and Mid Bay. Construction of the proposed action is not anticipated to result in substantial direct, indirect, and cumulative impacts to the environment. The following summarizes the findings of this EA regarding those impacts:

- Only minimal impacts to the physical environment including topography, geology, soils, bathymetry, and water and sediment quality are anticipated.
  - The proposed action would take place only in open water and existing PAs; therefore, terrestrial impacts would not occur. Changes to topography, geology, and bathymetry would be negligible compared to the regional nature and character of these attributes in the Galveston Bay.
  - Only temporary, localized impacts to water quality during dredging and placement would result from temporary turbidity and other more localized and minor water quality impacts.
- No long-term impacts to biological resources including both terrestrial and aquatic vegetation and wildlife, EFH, T&E species, and invasive species are anticipated.
  - Permanent impacts to 9.2 acres of marsh would be mitigated by marsh creation at the BNC. Temporary impacts to 4.7 acres marsh vegetation in the construction corridor would be replanted and monitored until successfully recovered to pre-construction productivity.
  - Localized, temporary effects to aquatic fauna and EFH would occur during dredging and placement from turbidity, impingement, entrainment, and burial, but would not be significant due to regrowth/repopulation, size of impact compared to available like habitat, and avoidance. These effects are further summarized in Section 7.2.
  - Permanent effects to oyster from removal of reef during dredging would be mitigated by restoring (or rehabilitating) 4.6 acres of oyster reef at Fisher Reef's that were damaged by sedimentation as a result of Hurricane Ike. The compensatory mitigation plan is discussed in detail in Section 4.4.1. These unavoidable impacts to oyster reef as a result of project implementation are further summarized in Section 7.2.
  - Permanent effects to shallow, unvegetated, bay bottom from dredging the channel improvements would occur.

    - The loss of associated benthic habitat and EFH would not be permanent for channel impacts, but would likely be perpetually or periodically degraded within the navigation channel footprint.

    - The size of both impacts is negligible compared to the available similar habitat in Galveston Bay. These effects are further summarized in Section 7.2.

- No long-term substantial impacts to the human environment including socioeconomic, community, recreational, visual and aesthetic, infrastructure, traffic, transportation, HTRW, air, noise and cultural resources. No impacts to safety or national security are expected.

  - No induced development is expected from the proposed action, and therefore no indirect impacts from this development are expected.

  - Information and data collected for this EA have not identified active infrastructure such as pipelines, or HTRW sites, such as sites undergoing environmental cleanup, in the proposed project footprint. No direct impacts would occur.

  - Substantial effects to marine recreation such as fishing and boating are not expected.

    - Channel improvements would be expected to reduce the size of ship waves from vessel transit in the BSC through changes in geometry and bathymetry.

  - Substantial effects to air quality are not expected.

    - Temporary effects from emissions during construction estimated to exceed the NO_x and VOC de minimis threshold for the HGB NAA, requiring a GCD. The Draft GCD has indicated that these emissions are minor enough compared to the SIP emissions budget, so as to not jeopardize the State's ability to meet CAA standards and SIP commitments. Therefore project construction emissions would not be significant to regional air quality.

    - Potential long-term positive effects to air quality would be expected from reductions to operational emissions through navigational improvements allowing use of newer, larger, fewer, more fuel-efficient, and less-emitting vessels, reduction of tug assist, and reduction of hoteling. This would also allow future container cargo to arrive by OGV, instead of by road or by rail, which are transportation modes with greater emissions to move the same cargo tonnage.

    - The proposed action would not result in a net increase in terminal activity or the associated emissions, since the maximum tonnage that the BSCCT can process would not be changed by the proposed action, and because that tonnage was already projected in the BSCCT FEIS to occur with the current channel and planned facilities.

    - The Applicant has implemented several measures to reduce current terminal equipment and vehicle, and vessel air emissions that would be continued after the proposed action is implemented. These are described in more detail in Section 4.3.8.2.

  - Substantial effects from noise are not expected.

- Temporary localized impacts to the nearest receptors in the land cut during construction dredging would be similar to maintenance dredging that already occurs periodically.

- No perceptible sound level increases to the nearest receptors in the land would occur from changes in the proximity of vessel transit due to channel changes.

- The channel improvements would allow fewer, more modern, larger vessels to carry the same tonnage, reducing the number of transit noise events from vessels and reduced tug assist, although previous data has not shown vessel transit to be a substantial contributor to sound levels at the nearest receptors above ambient levels.

- Terminal operation sound levels would not be increased by the allowance of larger vessels, as no terminal facilities, equipment or vehicles would be altered, and loading/unloading operations of the current largest vessels already last more than 24-hours, the longest period over which sound levels are averaged for comparison to thresholds.

- The proposed action would not result in a net increase in terminal activity or the associated sound levels, for the same reasons discussed above for air quality regarding terminal activity.

- The Applicant has implemented several measures to reduce current terminal equipment and vehicle, and vessel sound levels that would be continued after the proposed action is implemented. These are described in more detail in Section 4.3.9.

– No impacts to cultural resources are expected.

- Submerged marine cultural resources were not identified in the footprint of the channel improvements or existing PAs being considered for placement.

– National security and safety would not be impacted by the proposed action. Changes to the channel centerline would be coordinated with the USCG to ensure the proper changes, if any, to the current restricted zone boundary in the land cut need to be made.

7.2 ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED

The Applicant's proposed project would result in the following minor, localized, and temporary impacts during dredging and dredged material placement:

- Impacts to benthos and fish (and associated EFH) from turbidity and other more minor water quality changes within the dredge footprint and typically less than a few hundred meters away for turbidity.

- Impacts to fish and unvegetated bay bottom benthos (and associated EFH) from entrainment, impingement, and burial within the dredge and placement footprint.

Because the organism populations are common throughout the bay and would be expected to recover quickly, or the organisms would avoid these effects through their mobility, and considering the small percentage of like habitat affected, the effect would be considered minor and temporary. These effects cannot be avoided because dredging is necessary to excavate below water.

The Applicant's proposed action would result in the following permanent impacts during dredging and dredged material placement:

- Removal of oyster reef within the dredged channel improvement footprint impacting 4.6 acres.
- Conversion of approximately 68 acres of natural shallow unvegetated bay bottom to deeper, navigation channel bottom and side slopes subject to more vessel activity and periodic maintenance dredging.
- Filling in of 9.2 acres of salt marsh within the proposed stability berm needed to raise levees under the selected placement plan.

Though the amount of oyster acreage impacted is small compared to the amount in Upper Galveston Bay, this is an EFH resource of general greater productivity for the Galveston Bay requiring mitigation if impacted. Therefore, a significant resource would be impacted, albeit to small extent, if not mitigated. Considering the proportion of existing oyster reef affected, the impact would be minimal. Mitigation consisting of reef restoration at Fisher's Reef is planned and being coordinated with TPWD and other resource agencies. The impact cannot be avoided because the channel configuration selected minimizes the impacts compared to any widening alternative that provided sufficient navigational efficiency improvement, which is the project's purpose.

The conversion of natural shallow unvegetated bay bottom to navigation channel and upland levee is negligible compared to the amount of unvegetated bay bottom in the Galveston Bay. The cumulative effects to this type of habitat were not shown to be significant in the cumulative impact analysis. Therefore, no effects are expected. Impacts from conversion to navigation channel cannot be avoided as improving the BSC to increase navigation efficiency, the project's purpose, necessitate modifying the existing channel located in the bay bottom.

Though the amount of marsh that would be impacted by the proposed action is small compared to the amount in Galveston Bay, this is a historically declining resource, and one regulated by many statutes. Therefore, a significant resource would be impacted, albeit to a small extent, if not mitigated. Considering the proportion of existing estuarine wetland affected, the impact would be minimal. Mitigation consisting of constructed intertidal marsh at the Baytown Nature Center is proposed. The impact cannot be avoided because of the constraints and practicality of using existing PAs as much as practicable versus constructing new PAs, maximizing the available capacity in a capacity-constrained dredged material placement system, and using the new work materials in a capacity-beneficial manner, which is consistent with part of the project's purpose.

7.3 APPLICANT'S CONCLUSION OF IMPACTS TO THE ENVIRONMENT

The Applicant recommends implementation of the Preferred Alternative which consists of the preferred channel alternative and the existing PAs dredged material placement option. The channel would be deepened from the Bayport Turning Basin (TB) at Station 25+58 through the Flare at the confluence of the BSC with the HSC at Station 239+04. The depth would be increased from -40-ft MLT to -45-ft MLT, plus 2 ft of advanced maintenance, and an allowance for 2 feet of standard practice overdepth dredging. The channel would be widened by 100-ft to the north, from Station 214+00 to the land cut at Station 115+00, and by 50-ft to the north from the land cut (Station 115+00) to the TB (Station 25+58). Maintenance dredged materials would be placed into existing placement areas during construction. New work dredged material would be used beneficially in existing Placement Area15 to raise levees to increase capacity. This form of BU would not directly be beneficial ecologically, but would eliminate the need to mine new bay bottom to supply levee building clays. Maintenance material would be placed in existing HGNC upland or beneficial use PAs in the vicinity of BSC including PAs 14, 15, Mid Bay, and Atkinson Island. The increased levee height at PA15 and resulting increased capacity of PA15 from new work levee raising would offset the decrease in overall system maintenance capacity that would otherwise result from this proposed project. This alternative is recommended based on meeting the purpose of and need for the proposed action and the criteria used to identify it (discussed in Chapter 2), and the detailed environmental analysis contained in this EA. The proposed action would have no significant social, economic, or environmental impacts of a level that would warrant an EIS.

The Applicant understands that this EA will be evaluated by the USACE to determine if it adequately and accurately discusses the need, environmental issues, and impacts of the proposed action and the appropriate mitigation measures. The Applicant also understands that as a result of the decision process, the USACE may issue the DA Section 10/404 permit, deny the permit, or issue the permit for the proposed action with modifications or conditions; and approve or deny the Section 408 permit application. It will also serve the basis of Section 204(f) of the Water Development Act (WRDA) of 1986, as amended in WRDA 1990, for evaluation the Applicant's request for Federal Assumption of Maintenance for the completed project, if constructed.

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8.0 LIST OF PREPARERS

This chapter provides the list of personnel responsible for preparation of this EA, and a listing of agencies and persons consulted during its preparation.

8.1 LIST OF PREPARERS

The PHA Project Manager for the BSC Improvements Project is David Casebeer. This EA was prepared for the PHA by the Joint Venture of Turner Collie & Braden Inc. and Gahagan & Bryant Associates, Inc. (GBA) [abbreviated as JV hereon] with key personnel responsible for review and preparation of the document listed below. The JV consists of personnel from AECOM Technical Services, Inc. (AECOM) and GBA. Subcontractors used by the JV are also listed.

Topic/Area of Responsibility	Name/ Title	Years of Experience
JV		
AECOM		
Project Management and Quality Assurance Review	Rod McCrary, P.E. Project Director Vice President	34 Years Project Management
Project Management; Alternatives Analysis; Technical Review; Air Quality and Noise; Water and Sediment Quality; Compliance with Statutes	Carl Sepulveda, P.E. Engineer III	18 Years Environmental Impact Assessment, Compliance, Air, Water, Noise, and HTRW Monitoring, Water Resources Engineering
Quality Assurance Review	Patty Matthews Project Director Associate Vice President	32 Years NEPA Compliance and Impact Assessment Natural Resources and Environmental Planning
Water and Sediment Quality	Ralph Calvino Senior Project Manager	20 Years Water Quality/Aquatic Resources
Affected and Impacted Biological Resources; Aquatic Resources; Oyster Reef Surveys	Brent Courchene Scientist	10 Years Marine Habitat Characterization
Section 404 and Section 10 Permitting and Coordination	Roy Knowles Environmental Specialist	22 Years Identification and Delineation of Federal Waters
Community and Recreational Resources; Existing Infrastructure; Traffic and Transportation	Charlotte Jallans-Daly Environmental Specialist	10 Years Environmental, Social, Health Assessment and Environmental, Impact Analysis
Section 404 and Section 10 permitting; Technical Review	Ashley Judith Project Manager	8 Years Coastal Engineering and Survey Experience
Air Quality	Kelly Krenz Professional Geologist	30+ Years NEPA Air Quality/Conformity and Impact Assessment
AECOM continued		
Section 404 and Section 10 permitting; Wildlife and Habitat; Threatened and Endangered Species	Timothy Love Professional Wetland Scientist	21 Years Environmental Assessment and Impact Analysis
Socioeconomics; Environmental Justice; Visual and Aesthetic Resources;	Miranda Maldonado Environmental Specialist	12 Years Environmental Planning

Topic/Area of Responsibility	Name/ Title	Years of Experience
Hazardous, Toxic and Radioactive Waste		
Affected and Impacted Biological Resources; Aquatic Resources; Oyster Reef Surveys	Pam Neubert Aquatic and Fisheries Ecologist	21+ Years Marine Habitat Characterizations
Affected and Impacted Biological Resources; Aquatic Resources; Essential Fish Habitat	Paula Winchell Marine Biologist	26+ Years Marine Habitat Characterizations
GBA		
Section 404 and Section 10 permitting; Quality Assurance Review; Alternatives Analysis	Dana Cheney Vice President	15 Years NEPA Compliance, Environmental Impact Statements, Environmental Assessments, Agency Coordination and Permitting
Engineering and Design	Kevin Kremkau, P.E. Coastal Engineer	16 Years Coastal Engineering and Survey Experience
Section 404 and Section 10 permitting; Technical Review	Sara Halpin	4+ Years Surveying, AutoCAD drafting and Permitting
Engineering and Design Assistance	Jayne McClure, EIT	5+ Years Surveying, AutoCAD drafting and Technical Documentation Review
Subcontractors		
HRA Gray and Pape, LLC		
Cultural Resources Survey	Lee Cox Principal Investigator	29 Years Marine Archaeology
Cultural Resources Survey	Tony Scott Archeologist	17 Years Terrestrial Archaeological Survey, Permitting, Planning, Documentation
Cultural Resources Survey	Melissa Madrigal Marine Archeologist	13 Years Terrestrial & Maritime Archaeological Survey, Permitting, Planning
Starcrest Consulting Group, LLC		
Air Conformity Emissions Estimate, Draft General Conformity Determination, Operational Air Emissions Estimate	Joseph Ray Principal Starcrest Consulting Group, LLC	30 Years Air Emissions Estimates, General Conformity Evaluations, Regulatory Applicability Review

8.2 LISTING OF AGENCIES AND PERSONS CONSULTED

NEPA regulations for content of an EA require a listing of agencies and persons consulted. This section provides a list of agencies and persons contacted and consulted by the preparers of this EA. Appendix D also contains copies of key Federal resource and other agency correspondence for coordination conducted thus far for this EA.

The Federal and State agencies consulted were primarily through the BUG where the project alternatives were presented and input sought for them, especially dredged material placement alternatives. Chapter 2 discusses the agencies involved and their involvement. Subject matter input was sought from some of these agencies for existing resource data, and survey methodology involving T&E species, existing resource mapping, oyster habitat surveillance and mitigation, and EFH requirements. These are described in Chapters 3 and 4, and in related appendices. The representatives were from the local districts, regions, and field service offices pertinent to the project area. The following lists the Federal and State agencies consulted:

Federal Agencies

U.S. Army Corps of Engineers (USACE), Galveston District
U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS)
National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS)
U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)
U.S. Environmental Protection Agency (USEPA)

State Agencies

Texas Parks and Wildlife Department (TPWD)
Texas Commission on Environmental Quality (TCEQ)
Texas General Land Office (TxGLO)
Texas Historical Commission (THC)

Specific personnel with subject matter knowledge on terminal and port activity pertinent to the project area were also consulted. The following lists those persons:

Persons Consulted

Roger Guenther, Vice President, Container Terminals, PHA
Ryan Mariacher, Manager, Analysis and Planning, PHA

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