1.0 INTRODUCTION, PURPOSE AND NEED

1.1 INTRODUCTION

The Port of Corpus Christi Authority (PCCA) is seeking to obtain a Clean Water Act Section 404 permit, and a Rivers and Harbors Act Section 10 permit for dredge and fill activities related to improvements to portions of the Corpus Christi Ship Channel (CCSC), hereinafter referred to as "the proposed project" or "the proposed action" (reference Permit Application SWG-2018-XXXX). Additionally, the PCCA is conducting studies as required by 33 U.S.C 408 for approval from the USACE prior to modification of an existing Federal project.

The proposed project requires dredging in navigable waters to deepen portions of the CCSC, and potential placement of fill in waters of the United States, both regulated activities under the jurisdiction of the United States Army Corps of Engineers (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 to the natural and human environment, and reasonable alternatives identified.

1.1.1 Project Location and Proposed Action

Project Location: The proposed project is located in the Gulf of Mexico and the CCSC as shown in Figure 1.1.1-1. The CCSC is located in Corpus Christi Bay on the south-central portion of the Texas coast, 200 miles southwest of Galveston and 150 miles north of the mouth of the Rio Grande River. The CCSC provides deep water access from the Gulf of Mexico to the Port of Corpus Christi (PCCA), via Port Aransas, through Redfish Bay and Corpus Christi Bay.

The waterway extends from deep water in the Gulf through the Port Aransas jettied entrance, and connects to marine terminals along the Inner Harbor and La Quinta Channel. The Inner Harbor starts at Harbor Bridge and includes five turning basins. The La Quinta Channel extends from CCSC near Ingleside, Texas, and runs parallel to the eastern shoreline of Corpus Christi Bay for (6.9 miles to the San Patricio Turning Basin). The proposed project will be completed within the limits of the CCSC from the Gulf of Mexico to Harbor Island. This segment is currently maintained to –48.4 feet Mean Lower Low Water (MLLW) along the Entrance Channel and to -46.4 feet MLLW between the Entrance Channel to 0.5 mile east of Harbor Bridge. It is federally authorized to be dredged -54 feet and -56 feet MLLW as explained in the next section, and dredging work to reach that depth is scheduled to begin in late 2018 or early 2019.

Proposed Action: In order to address the purpose and need described later in this section, PCCA proposes to deepen portions of the Corpus Christi Ship Channel beyond the current authorized project depth of -54 feet, from the Gulf of Mexico (approximate Station -770+00) to Harbor Island (approximate Station 54+00), to accommodate direct berthing of fully laden Very Large Crude Carriers (VLCCs) with draft of up to 70 feet. This is a length of approximately 12.8 miles. The new proposed depth for the applicable sections of the channel would be approximately -78 feet to -80 feet MLLW to account for underkeel clearances, and includes 2 feet of advanced maintenance and 1 foot of allowable overdredge depth. The design depth was based on a detailed review of the dimensions of Very Large Crude Carrier (VLCC's) expected to call at the Ports' existing and proposed crude oil export terminals, the predominant density of crude oil to be exported and associated vessel draft, environmental effects due to winds, waves and currents, required underkeel clearances, plus two feet of advanced maintenance and one foot of allowable overdredging depth. The proposed action does not include widening the channel. Deepening activities will be completed within the footprint of the authorized CCSC channel width. Incidental widening may however be needed to maintain side slope requirements and are expected to be minor.

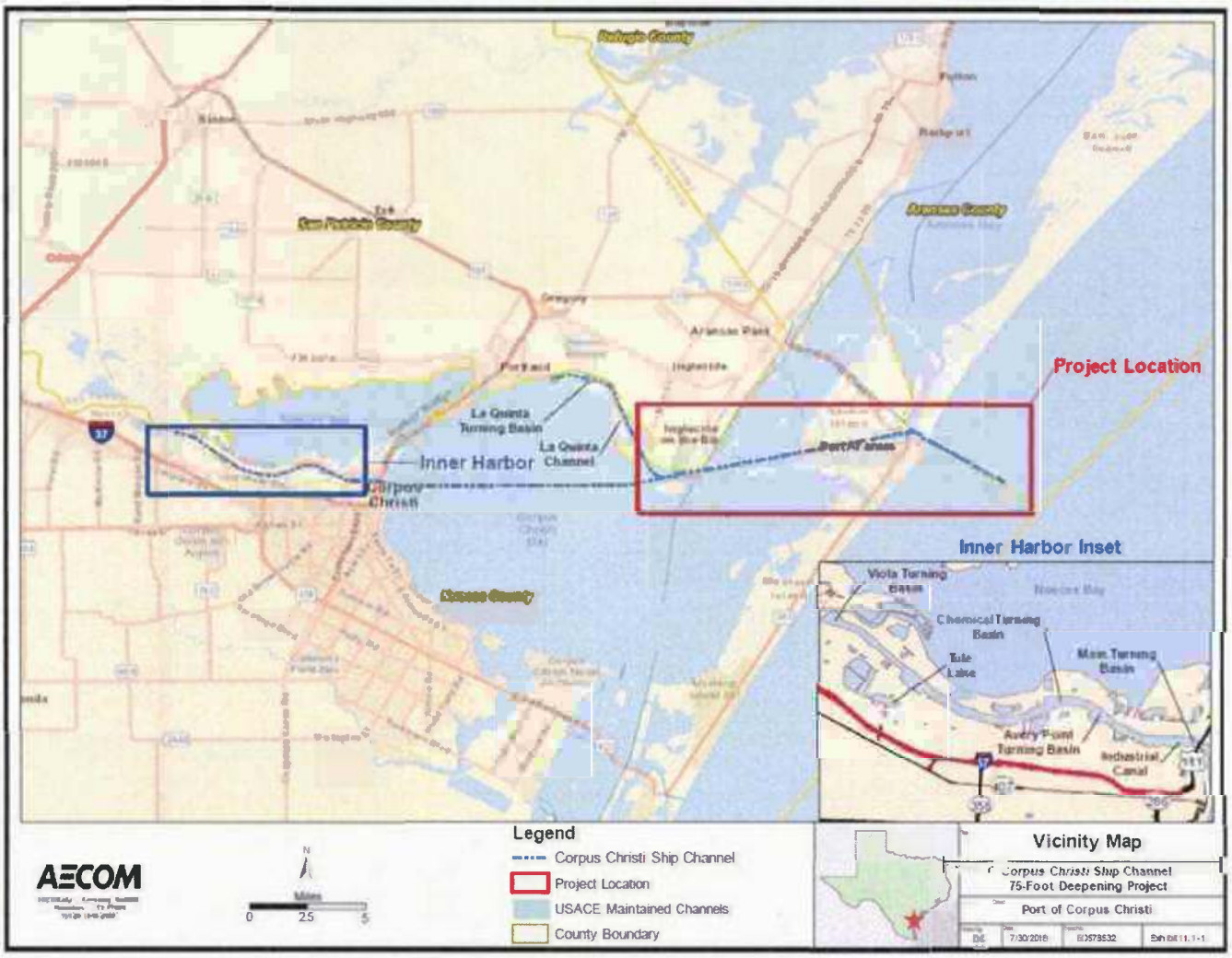

Figure 1.1.1-1 Vicinity Map

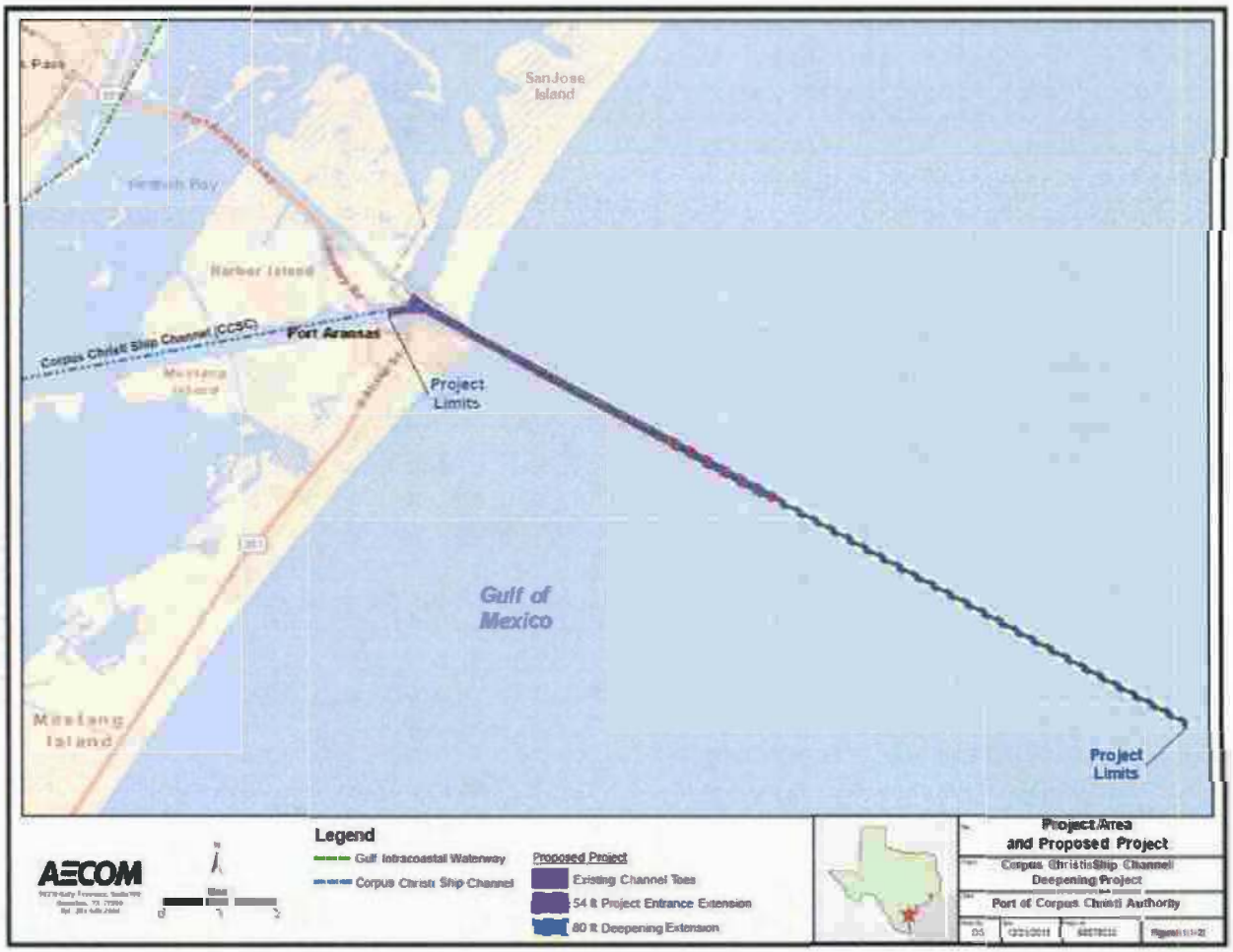

Figure 1.1.1-2 Proposed Project

1.1.2 Project Background

The PCCA has been incorporated as an official navigation district since 1926 (Port of Corpus Christi 2016). Navigation improvements began in Corpus Christi with the Federal authorization of a 12-foot channel through Aransas Pass in 1879, and a 12-foot deep, 100-foot wide channel all the way through Corpus Christi Bay in 1910 (USACE 2003). In 1920, U.S. Congress authorized the USACE to conduct a feasibility study for a deep water port in this area. U.S. Congress authorized channel construction in 1922 and from 1925-1926 the CCSC was dredged to 25 feet deep and had a bottom width of 200 feet. In 1926, PCCA opened and since then the channel has been routinely deepened over the years to accommodate the larger ships being used for transport as well as the type of commodities being shipped (Port of Corpus Christi 2018b). The major commodity at PCCA was initially cotton in the 1920's, and in the 1930's oil fields were discovered near the area and refineries began to locate around the Port. From 1930 to 1948, various portions of the main and tributary channels were deepened, widened, or modified with provision for turning basins up to a 38-foot depth and up to a 400-foot channel width. Following study and authorization in 1958, the CCSC was deepened to 40 and 42 feet deep along with other widening up to 400-feet and turning basin modifications in 1965. Following authorization in 1968, by 1989, the CCSC and La Quinta Channel were deepened to their existing depth of 45 feet and present channel widths varying from 700 feet in the Entrance Channel to 200 feet in the Inner Harbor (USACE 2003). Finally, a Federal feasibility study completed in 2003 and authorized in 2007 resulted in the currently authorized, to be constructed, depth of -54 to -56 feet MLLW, and modifications including the widening of the Bay reach up to 530 feet (USACE 2015).

The largest vessels accommodated by the currently authorized project are Suezmax vessels that are more fully-laden but not loaded to their maximum design drafts. Additionally, it would only accommodate very light-loaded VLCCs. The details of the currently authorized federal project are provided below:

a) Deepen the CCSC from Viola Turning Basin to the end of the jetties in the Gulf of Mexico (approximately 34 miles) to -54 feet MLLW; deepen the remainder of the channel into the Gulf of Mexico (approximately 2 miles) to -56 feet MLLW; and widen the Upper Bay and Lower Bay reaches (approximately 20 miles) to 530 feet.
b) Construct barge shelves (channels) 200 foot wide and 14 foot deep MLLW on both sides of the CCSC Bay from its junction with the La Quinta Channel to the entrance of the Inner Harbor (approximately Beacon 82 vicinity).
c) Extend the La Quinta Channel approximately 1.4 miles beyond its current limit at a depth of 41 feet MLLW. The channel will measure 400 feet wide and include a second turning basin. The turning basin will be constructed at the end of the proposed channel extension with a diameter of 1,200 feet, to a depth of -41 feet MLLW. The existing La Quinta Channel will remain at the existing depth. The creation of 15 acres of seagrass adjacent to the La Quinta Channel extension will mitigate for project impacts to approximately five acres of seagrass.
d) Construct two ecosystem restoration features, including rock breakwaters and geotubes to protect 1,200 acres of an existing high quality, complex wetland ecosystem that is comprised of a valuable mix of subtidal habitat, saltmarsh, blue-green algal flats, sandflats and associated uplands. Additionally, these features protect 40 acres of highly productive seagrass. Both components are adjacent to the CCSC in the Lower Bay reach of the channel.

The two ecosystem restoration features were completed in 2012, and extension of the La Quinta Channel was completed in 2013. The Project Partnership Agreement (PPA) for the deepening, widening, and barge lanes was signed in October 2017, and design and sediment testing for the first contract covering the entrance channel have been completed.

The Port of Corpus Christi has grown significantly over the years. Currently, it is the major exporter of crude oil in the United States. In 2017, approximately 200 million barrels of crude oil was exported from the Port, which accounted for 50% of all US exports. Other commodities moved through the Port include:

- Bulk commodities including coal, ore, petroleum coke, and other dry bulk commodities.
- Breakbulk are large goods that are transported individually and the Port supports cargo ships for these types of goods.
- Other liquid bulk including fuel oil, diesel, gasoline, and others.
- Wind energy and project cargo are accommodated by facilities including near dock laydown yards, accessible highway and rail yards including three Class-1 railroads directly connected to the Port interchange yard, and a direct connector to I-37 as well as access to US 181 and other major highways.

The Port of Corpus Christi had a record year in 2017. Major port-related events during this time period included:

- Became the #1 U.S. crude oil exporter port with approximately 200 million barrels in 2017 (roughly 50 percent of all U.S. exports).
- The Port became the 4th largest seaport in the U.S. by tonnage with greater than a million tons per year.
- Several crude oil pipeline projects to provide new or expanded capacity to transport crude oil from the Permian and Eagle Ford basins to the Port have become operational or have been planned. This is detailed in Section 1.3.
- Generated $150 billion of economic activity for the United States ($20 billion in economic activity for Texas, $4.7 billion in personal income, $353 million in state and local taxes, and 80,000 port related jobs).
- $50 billion in privately funded industrial projects underway in and near the CCSC generating tens of thousands of jobs and billions in economic output.
- Expected to become the largest exporter of Liquefied Natural Gas in the country by 2020.
- Successfully tested entry of a light-loaded VLCC into the Port.
- Surpassed the record for a single vessel load of crude oil. In April 2017, the Suezmax class tanker "Cap Romuald" was loaded with 930,000 barrels of crude oil at the Port. This amount is more than three times the total 2010 outbound crude oil volume from the Port of Corpus Christi.
- Faced its first hurricane in over 18 years and emerged as the largest refining hub in the Gulf Coast during recovery.

The Port Authority is also the regional economic engine promoting responsible and sustainable growth that is built on the following four pillars of success: Job Creation & Economic Growth; Environmental Stewardship; Educational & Workforce Development; and Safety & Corporate Social Responsibility.

During the first half of 2018, the Port set a record moving 52.2 million tons of products between January 1 and June 30, 2018. This represents an increase compared to the first half of 2017 by 926,000 tons, which is an overall two percent increase year over year. This can be partially credited to a nine percent growth in crude oil and a two percent increase in other petroleum products compared to the same time period in 2017. During this time period, the state of Texas recognized the Port with a prestigious Texas Environmental Excellence Award for its efforts and leadership in pollution prevention.

The lifting of the crude oil export ban in December 2015, has led to increased production from the Permian and Eagle Ford shale basins in Texas, and subsequent increase in exports from the Port using smaller vessels, which have traditionally been used only to import crude oil. As a result, demand for more efficient ways of exporting the rapidly increasing volumes of crude oil has materialized, starting with use of the larger VLCC class vessels within the existing CCSC. However, the VLCC's currently have to be reverse lightered in order to fully load them before export. This is discussed in further detail in Section 1.3 Need.

1.2 PURPOSE

The purpose of the project is to:

- Allow for more efficient movement of U.S. produced crude oil, to meet current and forecasted demand in support of national energy security and national trade objectives
- Enhance the Port of Corpus Christi's ability to accommodate future growth in crude oil movement
- Construct a channel project that the Port of Corpus Christi Authority can readily implement.

Currently, crude oil is exported using Aframax and Suezmax vessels. The Suezmax vessels are sometimes light loaded due to the depth restrictions in the existing Corpus Christi Ship Channel, and would continue to be light loaded when the current Federally-authorized project is completed. Reverse lightering translates into additional vessel trips, cost, manhours, operational risk, and air emissions. To efficiently and cost effectively move crude oil cargo, oil exporters are increasingly utilizing fully loaded vessels, including Very Large Crude Carriers (VLCCs). Non-liquid commodity movements are also trending toward larger, more efficient vessels. In order to fulfill its mission of leveraging commerce to drive prosperity in support of national priorities, the Port must keep pace with the global marketplace.

- Short Term Influences
  - The U.S. crude oil export ban was lifted in 2015.
  - Large supply of Permian crude oil for export.
  - Infrastructure at the Port is currently being upgraded to support the exporting of large volumes of crude oil.
  - Exports in the Gulf of Mexico, especially in Corpus Christi, have increased exponentially between 2015 and 2018.
- Long Term Influences
  - Future forecasted growth in crude oil commodities.
  - Use of larger vessels to export crude

These influences are discussed in more detail in the next section.

1.3 NEED

This project directly addresses the following priority needs:

i. Bolstering national energy security through the growth of U.S. crude exports
ii. Protecting national economic interests by decreasing the national trade deficit
iii. Supporting national commerce by keeping pace with existing and expanded infrastructure being modified or already under development to export crude oil resulting from the large growth in Permian and Eagle Ford oil field development which has helped the U.S. recently become the top oil-producing nation in the world.

iv. Ameliorating fundamental safety and efficiency challenges with water-borne freight movements

These considerations are further discussed in the following sections.

i. Bolstering National Energy Security through the Growth of U.S. Crude Exports

In geology, a play is a set of known or postulated oil or gas accumulations sharing similar geologic, geographic, and temporal properties ( ). The use of horizontal drilling in conjunction with hydraulic fracturing has significantly expanded the ability to profitably recover natural gas and oil from low-permeability geological plays, particularly the shale plays. By 2005, producers were confident of the profitability of large-scale gas production and expanded to numerous shale areas in the United States, including the Eagle Ford Shale in Southeast Texas, near Corpus Christi. In 2016, the largest continuous oil formation in the U.S. was discovered in West Texas in the Delaware and Midland sub-basins of the Permian Basin. The USGS estimates that the Wolfcamp shale in the Midland Basin portion of the Texas' Permian Basin contains approximately 20 billion barrels of crude oil, 16 trillion cubic feet of associated natural gas, and 1.6 billion barrels of natural gas liquids. This is nearly three times larger than the 2013 USGS Bakken-Three Forks resource which was the largest continuous oil accumulation at that time. This has led to great development of this field by many oil exploration and producing (i.e. "upstream") companies in the last few years. In response, many midstream companies, which are those that process, store, market and transport crude oil, are developing pipelines to move this crude oil to Gulf Coast refining and export centers, of which Corpus Christi and Houston are the major receiving centers for Permian and Eagle Ford crude oil.

U.S. export of crude oil-related products started in 2014 following a ruling by the Department of Commerce's Bureau of Industry and Security that minimal field processing of condensate derived from crude were sufficient to qualify condensate as a petroleum product eligible for export as a refined product. Crude oil exports remained prohibited through the Energy Policy and Conservation Act of 1975. This ban was in response to the 1973 OPEC oil embargo and prohibited the export of U.S. produced crude oil which was seen as a measure to make the U.S energy independent. Prior to the lifting of this ban, much of the Permian and Eagle Ford crude oil was distributed to the Gulf Coast refineries that could use the light (lower density), sweet (lower sulfur content) grade of crude oil produced by these formations, substituting for previous imported crude oil. This ban was lifted in December 2015 which has provided an enormous opportunity for the U.S. companies, the Texas region and the Port by enabling significant amount of crude oil exports and reducing U.S. Trade deficits. Most of the aforementioned substitution of imported oil by domestically produced oil has taken place, and export markets have been developed in Asia, Europe and South America in the last two years to create an exponentially growing demand for Permian and Eagle Ford oil.

As a result of the expanded oil exploration activities in Texas, the export ban being lifted by the U.S. Government, existing and planned construction of crude oil pipelines from the production centers to Corpus Christi, proposed infrastructure improvements at the Port, and overseas markets being developed; crude oil exports in the Gulf of Mexico, especially in Corpus Christi, have greatly increased between 2015 and 2018.

The infrastructure and proximity to the major Texas shale plays makes the Port of Corpus Christi a very attractive location for efficiently exporting crude oil by VLCC vessels. The Port of Corpus Christi has received extensive interest from new and existing customers for developing crude oil export terminals and facilities. Production and export of crude oil and natural gas has greatly increased over the years which are providing an economic boom to the Port and the region. According to U.S. Customs data shown in Figure 1.1.2-1, crude-related exports increased

380 percent in one year from 592,000 metric tons in 2013 to 2,900,000 metric tons in 2014. Once condensate exports were allowed, exports rose again by 128 percent to 6,500,000 metric tons in 2015 ([redacted]). Following the lifting of the export ban at the end of 2015, and the price of crude oil recovered from a depression in 2016, crude oil exports sharply increased from 4,500,000 metric tons in 2016 to 14,100,000 metric tons in 2017, a 211 percent change. As of June 2018, exports are on pace to reach 19,500,000 metric tons by the end of the year.

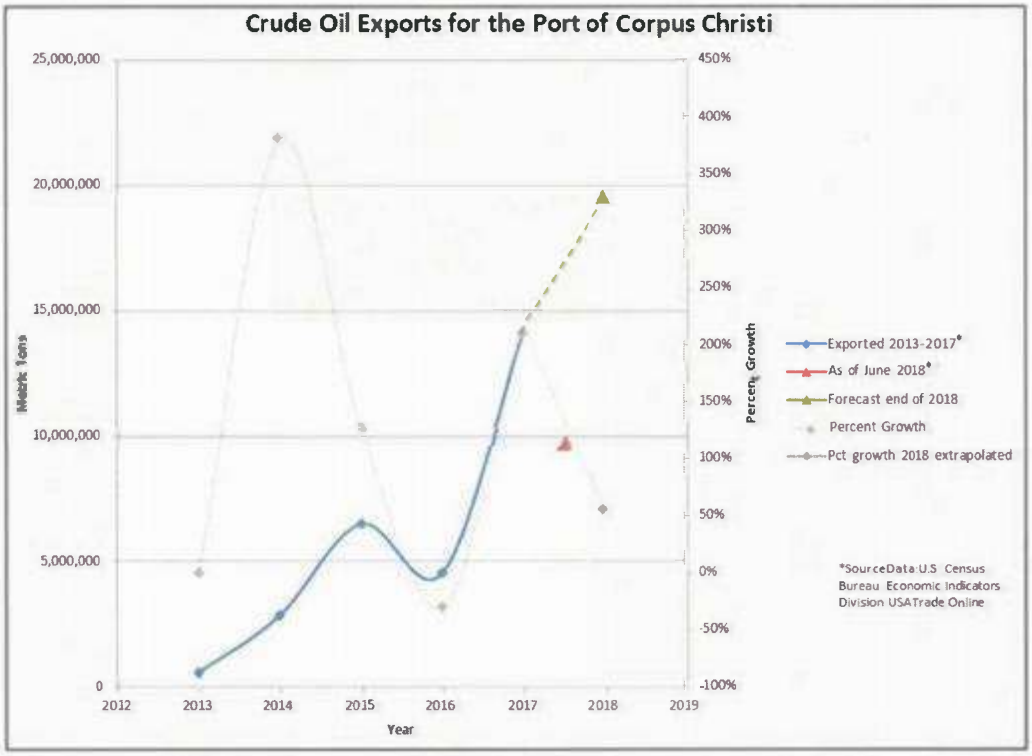

Figure 1.1.2-1 Crude Oil Exports for the Port of Corpus Christi from 2013-2018

Forecasted growth in crude exports vary; however, significant increases in annual tonnage are commonly predicted. Nationally, the Energy Information Administration's (EIA) 2018 Annual Energy Outlook (AEO) reference case projects 39 million metric tons (MT) in 2022. This is equivalent to approximately 750,000 barrels per day (BPD) and 61 million MT in 2032 (equivalent to 1.22 million BPD). Approximately 20 million MT have been historically exported via pipeline to Canada([redacted]). The AEO's high oil price case by contrast projects 1.8 million BPD by 2020 and a maximum growth to 2.6 million BPD in future years beyond 2025. It should be noted that the actual national export rate of 1.1 million BPD in 2017 has exceeded the reference case export rates through 2028, and it is anticipated the next AEO would be revised upward ([redacted]). Private industry projections from last year include anticipated export rates of 4 million BPD by 2022 ([redacted]) and 3 million BPD by 2025 ([redacted]). The International Energy Agency predicts that the U.S. will dominate the oil industry in the next 5 years, and the major pipeline and export infrastructure being planned will result in doubling of export capacity to 4.9 million BPD, with Corpus Christi becoming the main export hub in the Gulf Coast ([redacted]).

ii. Protecting National Economic Interests by Decreasing the National Trade Deficit

The trade balance of a nation is the net sum of the value exports (+) and imports (-), and when a country imports more goods than it exports, it is said to have a trade deficit. Assessments about the severity and nature of effects of trade deficits on the national economy vary, as factors such as whether the borrowing inherent in a deficit is going towards economic growth and productive investment, or towards more government spending, and the nature and magnitude of foreign investment and national savings are considered (Federal Reserve Bank of San Francisco 2007, McBride 2017, Gagnon 2018). However, long term deficits occurring through all economic cycles from growth to recession are generally considered negative. Since 1975, the U.S. has had a trade deficit, with a major hike occurring from 1997-2000 when the trade deficit widened from $181 billion to $436 billion, and has continued to widen, standing at $796 billion in 2017 (McBride 2017, U.S. Census Bureau 2018b). Maximizing crude oil exports would contribute to decreasing this deficit to help restore trade balance.

iii. Supporting National Commerce by keeping Pace with Infrastructure already under Development to Export Crude Oil

Both public and private infrastructure at the Port is currently being constructed and upgraded to support the exporting of crude oil. Recent and proposed crude-related improvements include:

- Installation of multiple loading arms to load VLCC's at Oxy, Buckeye Texas Partners /Trafigura terminal expansion (Dutta 2018, The Maritime Executive, LLC 2018)
- Approved deepening of the CCSC to -54' MLLW
- Improvement to existing docks for Eagle Ford Shale play exploration sand and liquids
- Strong interest in development of new crude oil export terminals at the Harbor Island.

Infrastructure upgrades include:

- Construction of new facilities to accommodate the increasing demand to export crude oil and condensates, which has resulted in the construction of new oil docks and upgrades to existing docks to support the large size tankers and barges
- Construction of additional barge mooring areas to serve the increase in movement of sand and liquid byproducts from the fracking industry
- Development of a barge unloading facility to import, clean, process, and truck over one million tons of sand per year for use in the hydraulic fracturing process.

Investments that are directly aimed at product from the Eagle Ford Shale at the Port are over $100M. In the latter part of July 2018, the Port sold more than $216 million in bonds to fund energy export products. A portion of this money will be used for the approved deepening and widening the CCSC, but also will help fund improvements which include a crude oil export terminal at Harbor Island that would be capable to accommodate VLCCs, which carry up to two-million barrels. As part of preparing for the larger ships (including Suezmax vessels), new oil export terminals are being planned at the Port such as Oil Dock 22, which will have loading arms, handling equipment, storage tanks, and other related facilities for larger ships. At Ingleside, three companies have plans to convert existing berths or construct new ones capable of handling VLCCs, including Oxy Ingleside Energy Center (now Moda), Flint Hills Resources, and Buckeye Texas Partners.

In addition, several major crude pipelines have been planned, expanded, or built to deliver oil from the Permian Basin to Corpus Christi/Ingleside. These include:

- EPIC Pipeline with a capacity of 590,000 BPD

- Buckeye South Texas Gateway project with a capacity of 440,000 BPD
- A project by Magellan with an ultimate capacity of 650,000 BPD
- Cactus 2 with 600,000 BPD
- Grey Oak under construction with 700,000 to 1 million BPD
- Jupiter Pipeline a 1 million BPD planned for 2020 that will have connection to Corpus Christi, Brownsville, and Houston via the Three Rivers Junction.

Except where noted above, most of these projects are expected to be operational in 2019. New or recent crude oil pipelines that are operational are Cactus 1 at 400,000 BPD, and Kinder Morgan's Double Eagle crude and condensate pipeline which became operational in 2013 but was expanded to other parts of the Eagle Ford basin in 2015.

With this planned infrastructure, Port officials expected in 2017 that the capacity to export crude could grow from 960,000 BPD in 2017 to 2.8 million BPD in the future (Lipow 2017).

iv. Ameliorating Fundamental Safety and Efficiency Challenges with Water-borne Freight Movements

As discussed in Section 1.1.2, since the ban was lifted, crude exports began with smaller Aframax and Suezmax vessels, which are mid-sized tankers that can use the current CCSC. Aframax vessels have a typical length overall (LOA) of 725 feet and a 106 feet beam (width) drafting 56 feet on average. Suezmax vessels are typically 900 feet LOA with an 158-foot beam, drafting 55.7 feet on average, 56.5 feet at the 90th percentile, and 64.3 feet for the largest vessels in the current world fleet. These vessels had been used at the Port primarily during a period when crude oil was only being imported and to move refined product, which involved lower volumes than crude exports. VLCCs are a larger class of vessel, with typical dimensions of 1,090 feet LOA, 200 feet beam, and maximum draft of 75.4 feet. VLCCs represent the next step up in economies of scale for shipping crude oil that results in more efficient transport. VLCC use with the existing CCSC has been initiated with a successful test entry to the Port at Oxychem, Ingleside, by the unloaded VLCC Anne in 2017 (Port of Corpus Christi 2017), however the tanker was only partially loaded and full economies of scale were not realized due to the current CCSC depth restriction.

More efficient transport of crude in greater volumes is the impetus for PCCA to deepen the channel to accommodate fully loaded VLCCs. Presently, the current channel depth requires that current crude carriers, whether VLCC or Suezmax do not depart fully loaded from the Port or that VLCCs remain offshore while smaller Aframax or Suezmax tankers transfer their cargo to the larger VLCC, a process known as *reverse lightering*. The inefficiency of this process is compounded by the fact that currently some of these smaller vessels cannot be fully loaded.

Reverse lightering significantly increases costs and air emission impacts as well as the potential of a collision, oil spill, or fire, leading to adverse environmental and safety consequences. Proposed channel deepening is needed to avoid both inefficiency and improve environmental outcome by reducing air emission and the risk of other adverse environmental and safety impacts associated with reverse lightering activities.

Production from the Permian and Eagle Ford basins is continuing to increase, and several of the major midstream companies are currently undergoing major expansions to facilitate the export of greater volumes of crude. As these exports increase, the number of lightering vessels and product carriers will also increase, adding to shipping delays and congestion inside and outside of the Port. These delays and congestion will increase the cost of

transportation which in turn will increase the cost of crude oil with the ultimate consequence of making U.S. crude less competitive in the global market.

The currently authorized CCSC will be 54 to 56 feet deep MLLW when constructed. Prior to receiving VLCCs, the largest bulk liquid carriers at the Port have been Suezmax vessels, for which the fully loaded draft is 55.7 feet on average and 64.3 feet at maximum. Therefore, the current authorized channel will not be able to accommodate fully loaded Suezmax vessels when considering underkeel clearance. Most of the growth in the size of the tanker class occurred from the 1960s to the 1980s progressing from various classes such as Panamax, Aframax, Suezmax, and VLCCs, and topping out with Ultra Large Crude Carriers (ULCC). Because of the outsized proportions of ULCCs compared to most liquid bulk ports, very few ULCCS were constructed, and today only four are in operation, three of which are being used as floating storage and offloading vessels. As previously mentioned, the VLCC is the next step up in size from the Suezmax class vessel, and they are critical to the crude oil shipping industry as they help transport large quantities of crude in single shipments. The use of these ships for transport will greatly reduce the cost of transporting crude oil which will provide significant economic benefits to PCCA, the CCSC and Port customers, and the entire petroleum industry in the region and the United States of America. Currently there is a strong need to accommodate the maximum loaded draft of the Suezmax vessels and the eventual principal crude carrying vessel, the VLCC.

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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 of the Corpus Christi Ship Channel). 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. 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.

The purpose of the project addresses the more immediate needs of exporting crude oil as discussed in Chapter 1. Maritime transport alternatives were identified, evaluated and compared to meet these needs. The immediate need of exporting crude oil stems from the exploration activity in the Permian Basin and Eagle Ford Shale, and the infrastructure already built and being built to export it through Corpus Christi, as discussed in Section **Error! Reference source not found.**. This infrastructure is being constructed in this area because of proximity to the shale plays, shortest pipeline routes to ocean waters, and already-existing and expandable pipeline and berth structures. Though there are other existing and planned pipelines to other Texas coastal areas for maritime export of Permian oil, namely the Houston area, Corpus Christi has been the top crude oil-exporting port since the lifting of the ban in 2015 according to US customs data (United States Census Bureau 2018a), and the aforementioned infrastructure into Corpus Christi already exists or is planned. Therefore, alternatives for shipping exported crude oil for the purpose of this project are limited to the general Corpus Christi area. For the long term need of future port cargo and tenants, other commodities moved at the Port are functions of factors that make Corpus Christi and its port system attractive for these commodities and specific tenants. To meet this need, alternatives would also have to focus on Corpus Christi and its port system.

Two suites of alternatives are discussed in this section. The first suite considers alternatives for maritime transport; alternatives to channel improvements were evaluated through a preliminary screening process. 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 USACE and World Association for Waterborne Transport Infrastructure [formerly Permanent International Association of Navigation Congresses] (PIANC) navigation channel design criteria using the selected design vessel dimensions, ship simulation, and input on navigation procedures and rules for CCSC as discussed with the Aransas-Corpus Christi Pilots Board (Pilots).

2.2 CHANNEL ALTERNATIVES

The Port Corpus Christi Authority (PCCA) and the Aransas-Corpus Christi Pilot Board (Pilots) have expressed a strong interest in deepening the CCSC from the intersection of the Channel Entrance to Harbor Island (Cut A) due to navigation concerns, potential associated vessel delays, and operational constraints resulting from the need to accommodate the projected fleet of VLCCs. The alternatives screened and selected consider the effectiveness of improving navigation efficiency by allowing the continued use of larger, more-efficient vessels and avoiding delays. The following describes the process by which channel alternatives were conceived, screened, and selected.

Please note that this study differs from the 1994 Safe Harbor Planning Study.

2.2.1 Initial Alternatives

The existing channel dimensions and the authorized channel dimensions are summarized as follows. As of July 2018, the CCSC has a dredged depth of 45 feet and plans are currently under way to dredge it to the authorized 54-foot depth which will constitute the "No-Project" condition for the proposed channel deepening project. The CCSC will also be extended into the Gulf of Mexico by 1.4 miles to the -56 feet MLLW contour as part of the Federally-authorized project. The width of the channel varies as follows. From the current outer limit of the dredged channel (in the Gulf) to the Port Aransas jetties, the CCSC Entrance Channel is 47 feet deep with a width of 700 feet, and is authorized to -54 ft MLLW with a width of 700 ft. From the jetties to Harbor Island, the CCSC Entrance Channel is 600-ft wide. The remainder of channel to the La Quinta Junction has a width of 500 feet and is authorized to a width of 530 feet. It was against the limitation of the existing and authorized channel dimensions that initial alternative concepts were developed.

2.2.1.1. Formulation and Description of Initial Alternatives

For the initial proposed channel deepening, the depth was set by examining existing VLCC fleet characteristics for maximum draft, length overall (LOA), and vessel beam (i.e. width), and navigation channel design guidelines. This is detailed in the Engineering Appendix of the Section 408 Report, but summarized here. The draft and other dimensions of a certain class of vessel can vary substantially among the world fleet. Therefore vessel registry data from the maritime industry market research source, IHS Fairplay, was analyzed to determine key percentile vessel sizes, including the 90^{th} and 99^{th} percentile draft vessels. Distribution data showed only a small difference between 90^{th} and 99^{th} percentile dimensions, and therefore the maximum draft of the 99^{th} percentile vessel was chosen to determine draft. The selected draft and local climatic data (e.g. wave, currents) were used to determine underkeel clearance using guidelines from EM 1110-2-1613 and PIANC guidelines. One-way transit of VLCCs was assumed in consultation with the Pilots. With this information, a required depth to accommodate draft and underkeel was 82 feet, and with two feet of advance maintenance and one foot of allowable overdredge depth, an 85 foot channel was initially assumed in the initial screening.

For alternatives to channel deepening, offshore options that pump crude oil from onshore storage to offshore loading facilities were considered. There are two basic types of such facilities: the simpler offshore single point mooring (SPM) buoy system, and the larger, more complex offshore platform or terminal system. An SPM system consists of onshore storage tanks (i.e. above ground storage tank farm) and pumps connected to pipelines leading offshore and terminating at an offshore buoy. The buoy is anchored to the seafloor that has floating loading hoses and mooring lines for the VLCC to hook up to and conduct loading operations. An SPM-based system can be built to provide loading abilities to a few vessels by adding SPMs, but would potentially require multiple pipelines depending on pipeline size and onshore pump capacity. An offshore platform or terminal

system similarly uses onshore storage and pumps like the SPM, but the pipeline terminates into a pile-driven platform with conventional manifolds, loading arms and pipe racks, often with berths for several vessels. It is more complex and expensive than SPMs but typically provides more loading capacity. For both these options, the SPM or platform would have to be located in sufficiently deep offshore waters to account for draft, underkeel and sea state. This would be between 10 to 12 miles offshore of Corpus Christi Bay.

The following were the initial alternatives considered:

- **Alternative A**– No Action. No channel improvements and maintaining the channel at its existing depth. This option is equivalent to continuing with lightering and reverse lightering operations to offload and top off large vessels including VLCC's.
- **Alternative B – Channel Deepening** – This alternative consists of deepening the CCSC to -80 feet MLLW from the Gulf of Mexico to Harbor Island, including the approximate 10 mile-extension to the Entrance Channel necessary to reach sufficiently deep waters. As a result of one-way transit assumed for VLCCs, the planned widths for the -54-foot currently authorized project are nominally sufficient. Therefore no widening other than the minor incidental widening to keep these bottom widths and existing channel slopes at the proposed deeper depths, would occur. Deepening would take place largely within the footprint of the currently authorized -54-foot channel. As discussed earlier, PCCA is studying the feasibility of developing an export terminal at Harbor Island. The Harbor Island terminal is being planned independently of this proposed deepening project. Therefore, there is a possibility that this terminal could be developed at Harbor Island to accommodate partially loaded VLCCs if the deepening project were not implemented.
- **Alternative** C **– Offshore Single Point Mooring Facility** – This alternative is an SPM-based system consisting of constructing onshore storage facilities, shore-to-SPM pipelines, and a series of SPMs to load several vessels simultaneously. Conceptually, the onshore storage could be those that would be installed in any one of the marine terminal facilities at Harbor Island or Ingleside if they were converted to offshore delivery, or it could be a new location on other undeveloped property. For purposes of the initial screening, it is assumed 3 to 4 SPMs, and the requisite onshore storage, pumps, and pipelines would be built to load 3 to 4 VLCCs. This number is in the range of facilities built in past offshore terminal projects such as the Louisiana Offshore Oil Platform (LOOP), Iraq's Al Basra Oil Terminal (ABOT), and Bulgarian/Greek Burgas-Alexandroupolis SPM facilities (Trans-Balkan Pipeline B.V.). This alternative would be located somewhere in the 10 to 12 miles offshore band shown in Figure xxxxx.
- **Alternative D - Offshore Platform** – This alternative would be similar to Alternative C, except it would be constructed as an offshore platform or terminal. With a more complex system of pile-driven structures and loading arms, it is assumed that pipelines, arms, and berths to service a minimum of 4 vessels simultaneously would be constructed. A four-berth terminal was the constructed capacity of the ABOT. Similar to Alternative C, this alternative would be located in the 10 to 12 miles offshore band shown in Figure xxxxx, and conceptually could rely on pumping from existing/planned storage either at Harbor Island or Ingleside, or a new location.

Alternatives Dismissed Prior to Initial Screening

Other alternatives have been discussed in past channel improvement studies or evaluated during previous crude terminal studies including channel widening only, and the construction of an artificial island. These alternatives do not warrant additional screening because they do not meet the project's purpose and need based on the following analyses:

- **Widening Only** – Widening of the channel only, would not increase the loaded draft of VLCCs. Although widening only has been discussed by different stakeholders as an alternative to deepening the channel, recent simulations conducted as part of the Waterway Planning Study along with discussions with the Pilots concluded that there would be no increase in navigation efficiency related to large vessels traffic because of one-way traffic restrictions enacted when large vessels enter the CCSC. In addition, widening the channel would increase the potential for adverse environmental impact because construction would not be limited within the footprint of the existing channel. Therefore, "widening only" option(s) without deepening do not substantially meet the purpose of the project.
- **Artificial Sea Island Terminal with Pipeline from Shore** – This would involve creating a terminal on land reclaimed from the sea in the Gulf of Mexico. It would involve a lot of dredging, at great cost and potential adverse environmental impact to create an island on which to construct a loading terminal. This alternative was contemplated as part of the 1994 Safe Harbor Planning Study; preliminary screening based on constructability, construction costs and potential environmental impact weighted heavily against this alternative. Therefore based on the previous study's findings on cost effectiveness and environmental impact, this option was eliminated from further study.

2.2.1.2. Preliminary Screening Criteria

Preliminary criteria were developed to evaluate how well the initial alternatives fulfilled the purpose and need of the proposed project. A criterion for minimizing environmental impact was also included, consistent with the PCCA's environmental precepts. Because the initial screening phase was focused on how the initial alternatives fulfilled he project purpose, criteria related to cost and constructability was used in the next phase of the evaluation. In summary, the initial alternatives were screened using the following general criteria:

1) **Increase Export Efficiency** – In this initial stage of screening, key factors that affected the ability to fully load vessels with crude oil due to constraints of the existing channel and authorized channel were considered. This included draft limitations along the CCSC segments between the Entrance Channel and Harbor Island. This criterion considered whether the alternative allowed a VLCC to be move more fully loaded and whether it eliminated or reduced lightering. Lightering would be eliminated for vessels using Harbor Island. For vessels using VLCC docks at other locations which are currently planned terminals at Ingleside, it is assumed that these vessels would light load crude oil on to VLCCs at Ingleside, and then would stop at Harbor Island to fully load their cargo tanks (i.e. "top off") before leaving port. This would also eliminate lightering but require some limited light loading of vessels.

   Due to recent exponential growth in crude oil export, the Port of Corpus Christi has seen an increase in vessel tonnage. Several stakeholders' forecasts indicate that this trend will continue for a foreseeable future and beyond. Because of sharp short term fluctuations in exports, stakeholders have not been capable of quantifying with certainty the long term effect of current market demands. However they generally expect the recent upward trend to continue. As a result of PCCA's past investments in marine infrastructure and available capacity, PCCA has been capable of accommodating the recent historical shift in oil traffic from import to export.

   This trend is expected to continue as long as the Port's infrastructure allows it. There are concerns about future limitation to U.S. oil exports due to lack of or insufficient infrastructure capable of handling the export volumes. Lack of adequate infrastructure at U.S. ports including the Port Corpus Christi may lead to inefficient shipping and ensuing crude price increase which may weaken the U.S.'s competitive edge (EIA 2018).

2) **Ability to Serve Multiple Tenants** – Part of the PCCA's mission is to meet the demand of commerce in the Coastal Bend region and throughout the world. To that end, PCCA plans its infrastructure to accommodate the needs of different stakeholders. PCCA has the ability to plan, fund, build and maintain marine infrastructures for common use such as navigation channels and dock infrastructure. PCCA owns and operates several public oil docks and bulk docks that are leased and used by different tenants. The ship channel is a common use infrastructure that is designed and operated to accommodate the different types of vessels used by PCCA's tenants. As cargo volume and vessel traffic increase, larger vessels are being used to improve shipping efficiency and reduce costs. To keep up with these trends, PCCA has undertaken several channel improvement programs. One is the dredging of the CCSC to a depth of 54-foot MLLW for which construction is imminent and will serve tenants all the way to the Inner Harbor. The other is this study to evaluate deepening up to the full depth required to accommodate fully loaded VLCCs. The terminal being planned by the PCCA at Harbor Island could be operated as a facility open for use to several users or companies. This criterion evaluates to what degree the alternative can benefit multiple tenants.

3) **Flexibility to Accommodate Future Growth/ Expansion** – This criterion considers the flexibility the alternative provides in being able to accommodate future growth in crude oil export tonnage, and future growth in other sectors as well. As discussed in Section **Error! Reference source not found.**, crude oil exports have greatly and exponentially increased in the last two years and are on pace to exceed the growth rate in 2018. Various long term projections predict much larger export tonnage if export infrastructure to present bottlenecks in the supply end. To that end, the ability to accommodate delivery to new terminals or add capacity for exporting crude oil is important. In addition to crude oil, PCCA seeks to anticipate and be ready to accommodate future cargo needs and long term growth.

4) **Minimize Environmental Impacts** – All alternatives considered are located in the open waters of Corpus Christi Bay and the Gulf of Mexico. Therefore, environmental impacts would be limited to open water marine habitat and would primarily not involve terrestrial, wetland, or near-shore (tidal flats, beach, dunes etc.) impacts. Potential impacts to the marine environment are discussed below:

   Impact to Marine Habitats: Existing marine habitat mapping information including seagrasses, tidal wetlands, and oyster reef from TPWD, NOAA and TGLO were obtained and used to gauge the potential for impacts. More detail on the nature of the oyster reef habitat and quantities can be found in Chapter 3, Affected Environment.

   As environmental marine field surveys were reviewed, preliminary site-specific habitat locations are being identified. Because the channel will be constructed within the footprint of an existing channel, no new impact to undisturbed habitat would occur within that footprint. The incremental widening that may be required to maintain the recommended design slope would be minimal and would limit undisturbed habitat impacts.

   Other environmental aspects that are considered for this criteria include potential impact of oil spills and air emissions from vessels and fuel transfer operations as described below. In conjunction with considerations of risk in #5 below, potential impacts to environmental resources considers the location of major habitat resources (coastal shore, seagrass etc.), climatic (e.g. prevailing wind), and spill response factors. Impacts on air emissions considers how the alternative reduces transit and loading emissions from what would occur during lightered crude oil transfer operations.

5) **Risk, Safety and Security** – Safety and security are primary concerns for all vessels operating at the Port of Corpus Christi. Safety and security concerns include risk and challenges associated with oil spills and ensuing responses, fire and fire suppression activities as well as worker safety as they relate to offshore and onshore operations. Security also considers vulnerability to challenges to physical and operational security such as sabotage, and vandalism. Vulnerability to weather related events including wave height, winds and hurricanes is considered as well.

6) **Ability to Contribute to Beneficial Uses** – The Port's environmental precepts include a) wildlife habitat development, improvements, and replacement when modification to existing habitat is necessary, and b) environmental sustainability in the development of port facilities and in ongoing port operations. Although this is normally in the context of executing projects in a manner that restores resources from the impacts of a project, the ability to contribute to resource restoration as a result of project actions regardless of project impact can be considered also. Continuing the practice of considering and incorporating BU where practicable in managing dredged material of its channel projects, as was done in the currently authorized -54-foot project, is desirable. The ability to do this under a given alternative is considered for this criterion.

2.2.1.3. Screening of initial Alternatives

The initial alternatives were screened using these six 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. These findings are also summarized in **Table 2.2.1-1** Summary of the Screening of Initial Alternatives.

Export efficiency – Increasing the export efficiency for crude oil is one of the key aspects of meeting the project purpose. Alternative A (No Action) will do nothing to increase that, and inefficient lightering would continue. If the export commodity growth rate keeps rising, more lightering vessels and unnecessary transits could eventually result in channel congestion. Alternative B (Channel Deepening) would accommodate fully loaded VLCCs and eliminate reverse lightering from facilities exporting crude oil from Harbor Island. The offshore options, Alternatives C (Offshore SPM) and D (Offshore Platform), would also accommodate fully loaded VLCCs and eliminate reverse lightering for vessels using those facilities. However, generally speaking, onshore loading (as would be used in Alternative B) is faster due to the greater flow rates of loading arms achievable at onshore berths compared to pumping 12 or more miles to SPM loading hoses under Alternative C. Channel access to facilities that allow faster loading and more berth availability would be enabled by Alternative B. Pumping and loading arms under Alternative D, offshore platform can be made to provide high capacity loading. However, this would be at considerably greater capital and operational cost compared to onshore pumping.

With 5 potential VLCC capable berths between Harbor Island and Ingleside, Alternative B ould provide sufficient capacity to handle up to 10 VLCCs per week, sufficient to handle the swiftly rising crude oil export demand from the Port of Corpus Christi. Alternative B also capitalizes on using all existing infrastructure in place at Ingleside to service VLCCs; it optimizes the construction of crude export terminals, their phasing and construction due to existing network of pipelines and crude oil storage tanks, thereby reducing the overall cost of exporting U.S. crude oil to international markets.

With either offshore Alternative C or D, a complete new infrastructure will need to be constructed to construct required 4 berths for servicing the market demand. More loading points/berths could be initially constructed, but

it would be anticipated to be limited to only a few, due to substantial added cost due to more separate pipelines being needed. Offshore Alternatives C and D are in the open Gulf of Mexico and would therefore, be more exposed to greater wind and waves that produce a high sea state. With Alternative B, there would probably be more redundancy and flexibility in meeting the required throughput demand via the 5 VLCC capable berths possible under Alternative B, due to being less prone to preemption of loading activity due to sea state, leeway for maintenance and downtime, and less reliance on maintaining a maximum throughput compared to Alternatives C andD.

Ability to Serve Multiple Tenants – Alternative A, No Action, does not contribute to the ability to serve more or multiple tenants. For Alternative B, Channel Deepening, an intrinsic feature of a deepened channel is its ability to accommodate multiple tenants with less limitation on the number of users that can take advantage of access afforded by the channel, except for the finite amount of water frontage. With the Harbor Island terminal being planned, Alternative B could provide access to different VLCC users if terminal use is arranged accordingly. Alternative B would bring the deepened channel to the vicinity of Harbor Island, where undeveloped or underused water frontage at Harbor Island could be developed with additional terminals by other entities to accommodate different tenants if future needs warrant, and extending the deepening would be made easier.

The number of tenants served by either offshore Alternatives C (SPM) or D (Offshore Platform) would depend on the arrangement made by the Port to provide or lease capacity. These could similarly be arranged to provide multi-user access. Typically, the Port's facility leases are arranged either with a single tenant per facility for a number years or through multi-use type lease agreements that accommodate several users in common use facilities. However, with fewer berths, these offshore alternatives would inherently be able to serve less tenants because of requirements for dedicated pipelines facilities. Multi-use type lease agreements would be less easily implemented. Also, Alternatives C and D would likely have less flexibility to serve more tenants in the future due to the cost of adding pumps, pipelines and loading points or platforms out in the Gulf after initial facilities are built. Also, Alternatives C and D would have less flexibility to accommodate different customers' grades of product. Different grades of crude oils (e.g. heavy vs sour, condensate vs crude etc.) are imported and exported, and because some cannot be mixed, the pipeline transporting these products would need to be flushed before the products are switched to avoid cross-contamination. Depending on the length of the pipeline, the quantity of product flushed can be substantial and may prohibit multiple grades of crude exports through one pipeline system. These steps restrict the efficiency of the offshore systems to change product grade compared to onshore loading.

Ability to Accommodate Future Growth/Expansion – Alternative A would accommodate no future growth or expansion. Similar to the previous two criteria, Alternative B, Channel Deepening, would bring a very deep channel to areas that could add some more VLCC berths to provide more loading capacity as crude export tonnage grows as projected if other entities seek more capacity. For offshore Alternatives C and D, expansion to additional tenants would be made more difficult by having to build more onshore storage, pipelines and either SPMs or platforms to accommodate more tenants and more throughput, and therefore more costly to implement.

Environmental Impacts – Alternative A would have no new environmental impacts to aquatic resources. However, it would leave lightering in place, with the associated risks and emissions. According to data from a TCEQ study of estimated emissions from offshore lightering, approximately 45 tons of volatile organic compound (VOC) and 0.5 ton of nitrogen oxides (NO_x) emissions per lightering event would be emitted, most of that through fugitive emissions released from tank headspace during product transfer and ballasting. At the current export rate in 2018 of 19.6 million metric tons per year and an assumed 7.3 barrels per metric ton, this would translate to approximately 71 lightering events in the year, and 3,181 tons VOC, and 38 tons of NO_x. Although, the Corpus Christi area is in attainment of the Federal ozone standard, both of these compounds are ozone precursors that contribute negatively to efforts to maintain the current air quality.

Alternative B Channel Deepening would largely be completed within the footprint of the existing 54-feet deep channel currently under construction. No substantial widening is anticipated as previously discussed. As a result, work will mainly be completed within areas that have been environmentally assessed as part of previous studies including, most recently, the FEIS that was approved for the CCSC-CIP. Construction would require dredging approximately 39 million cubic yards (CY) from within the existing and current Federally-authorized channel, and the necessary new extension of the entrance channel. Most of the channel dredging would convert current navigation channel bottom at 56 feet of depth to 80 feet of depth. The new extension would require dredging a 700-foot wide, 7 mile extension, which would temporarily disturb and convert approximately 594 acres of relatively deep Gulf ocean bottom at approximately 60 feet of depth to deeper Gulf bottom at approximately 80feet. The following impacts would result:

- In the existing/authorized channel and the new extension required, the channel and ocean bottom would not contain oyster reef, seagrass, or tidal marsh, and would consist of unvegetated, soft, sandy bottom, which is ubiquitous in the Gulf of Mexico.
- Temporary impacts to benthic organisms from dredging would subside as they recolonize the deepened bottom following cessation of construction dredging. The hydrodynamic impacts to currents, tidal range and salinity would be small as indicated by modeling. Current velocities would change by only 0.04 to 0.07 foot per second (fps), tidal range by 0.3 to 0.4 ft, and salinity by less than 1 part per thousand.
- Temporary impacts to water quality from turbidity generated during dredging would subside after cessation of dredging.
- Placement of dredged material would be placed at existing PAs or be used beneficially.
- Hydraulic dredging and use of operational windows would minimize potential impacts to Threatened and Endangered turtle species and Sargassum critical habitat in the Gulf.
- Approximately 3,181 tons VOC, and 38 tons of NO_x produced during lightering at the current export rate would be eliminated. More emissions would be eliminated in future years with increased export tonnage. Full loading of vessels at terminals would require some level of vapor recovery system to receive new source State air quality permit and would therefore have greatly reduced VOC fugitive emissions. Also, ship-to-shore power could be implemented to further reduce hoteling emissions.

Offshore Alternatives C and D would need to be evaluated for their environmental resources, because the new structures will likely be constructed away from existing shipping lanes, and therefore in areas not previously assessed for environmental impacts. Both alternatives would not require large scale dredging other than small amount along the route of pipelines from the onshore terminal facility to the platform, and at the platform to provide a level base. The following impacts would result:

- Onshore storage facilities would require development of new landside property which would impact terrestrial resources, and depending on where it is sited, palustrine wetlands, coastal prairie or other upland resources.
- Temporary impacts to a relatively small amount of undisturbed Gulf bottom from trenching to install 10 to 12 miles of 36-inch or 48-inch pipelines.
- A relatively small amount of Gulf bottom would permanently be converted to SPM or offshore platform.
- Air Emissions – Lightering emissions would be eliminated. However, loading of crude at the offshore facilities would be less likely to be done with any vapor recovery equipment as it would be impractical. Therefore, more fugitive VOC emissions would occur. Also, ship-to-shore power would not be readily available at service platforms or SPMs.

- The offshore locations of Alternatives C and D would have higher risk consequences from potential releases due to more habitats of high importance, such as those involving Threatened and Endangered species and critical habitat and high priority State coastal resources, being located in the path of prevailing winds. This is described further in the next criterion.

Risk, Safety and Security – Alternative A, No Action would do nothing to reduce the risks of incidents occurring during lightering. Although lightering has been conducted in a relatively safe manner with few major incidents, it involves coordination between the VLCC, the smaller lightering vessel, line handling/fendering vessels, and tugs in a series of vessel approach, lashing, and connection. With operations occurring in less sheltered seas, the risk of leaks from hose tears or disconnections (which have automatic shutoff capability) would be greater than onshore loading and would remain. Alternatives B, Channel Deepening, and the offshore Alternatives C and D, both reduce the risk from lightering operations. However, factors that impact the operational aspect of the alternatives with respect to risk and consequence of an incident are outlined below:

- *Vulnerability to Weather Conditions* – The offshore Alternatives C and D would be located outside of protected waters, and therefore environmental conditions such as wind speed, wave height and currents will more readily restrict their use compared to Alternative B.
- *Risk of spills* – Spills of crude oil or other petroleum products during transfer operations to and from the vessels can result in adverse environmental impacts. Although these concerns are also relevant to all loading operations onshore or off, the risks associated with spill responses at offshore facilities are heightened because the areas of impact are not contained within a secluded harbor and are more subject to wind and waves that are more prevalent offshore.
  - The risk of leaks from regional pipelines leading to onshore storage would be the same for Alternatives B, C, and D, and operations and maintenance (O&M) of these pipelines subject to the inspection ad safety standards under the Pipeline and Hazardous Materials Safety Administration (PHMSA) and Texas Railroad Commission (TxRRC). Alternatives C and D would have approximately 10 to 12 miles more of undersea pipeline that would be exposed to marine incidents, but properly installed (e.g. sufficient burial depth, stability) and maintained, would reduce such risks.
  - Alternatives C and D would eliminate approximately 11 to 22 miles of transit involved with channel use in Alternative B. However, VLCC transit into Corpus Christi Bay would occur at slow speeds (~6 knots) with 4 to 5 tugs escorting the vessel in a one-way transit, which would substantially reduce the risk for a transit-related incident.
  - Risks during loading can occur from connection failures under Alternatives B, C, and D. However, loading under Alternatives C and D occur in less sheltered conditions, subject to more wind and wave motion, which would tend to increase risk. In all Alternatives B, C and D, loading arms or hoses would be equipped with safety release systems that provide automatic shutoff in case of disconnects, which would reduce and limit the volume of incident releases.
- *Location of Incident* – Incidents, however rare, can vary in consequence and capability to contain a release, dependent on location. For Alternatives B, C, and D, leaks from the regional onshore pipeline or storage would essentially be the same, but incidents involving loading or offshore transmission would be different. The prevailing winds in the Corpus Christi area, which are from the Southeast, and daily tidal movement, would affects where a release is likely to travel spread.
  - Under Alternative B, loading incidents at terminals at Ingleside would be closer to seagrass and tidal marsh in Redfish Bay. Because of the orientation of terminals, the prevailing southeast wind would tend to drive releases shoreward against the loading terminal, which would tend to help control. A release would still be subject to tidal inflow and outflow to move away from terminal locations. Comparatively, conditions would be more sheltered against weather with respect to control.

- Under offshore Alternatives C and D, loading or offshore pipeline incidents would be closer to, and facing the Mustang Island and San Jose barrier islands. The prevailing southeast wind would tend to drive releases over the open Gulf, making controlling the spread lengthwise along these islands more difficult. A release would similar be subject to tidal current movement.
- The tidal marsh and seagrass in Redfish Bay and the coastal resources on Mustang Island and San Jose barrier islands are all ecologically sensitive habitat. However, the barrier islands contain nationally-important resources important to the local and State economy.
    - The barrier islands and beaches including the Padre Island National Seashore, and Mustang Island State Park, are of concern to the tourism business that fuel the economy of the Coastal Bend Region.
    - The barrier islands contain sensitive coastal habitats including State-designated Critical Dune Areas, Gulf Beaches and three large nationally designated Coastal Barrier Areas compared to two smaller ones on Shamrock Island in the Bay.
    - The Padre Island National Seashore, Mustang Island, and San Jose Island all provide nesting grounds for the Kemp's ridley sea turtle (*Lepidochelys kempii*) which is listed as an endangered species. These locations provided four of the top five nest counts in 2018 (National Park Service 2018).
    - A release out in the Gulf would be in an area designated as Loggerhead sea turtle (*Caretta caretta*) critical habitat when Sargassum macroalgae are abundant.

- *Spill Response* – Proximity to more spill response resources can impact the ability to contain incident releases and size of areas to clean up.
    - Under Alternatives C and D, comprehensive response to spills would be slower for offshore facilities because it would take these teams more time to mobilize than it would take to contain spills that occur within Corpus Christi Bay.
    - Under Alternative B, regional response resources external to terminal teams, would be closer to incidents.
    - Spill prevention procedures and spill response facilities are available at offshore service platforms; however they are not as readily deployable as at onshore facilities. Oil spill booms are sometimes operated at SPM's prior to loading/unloading operations to reduce the risk of any spills that do occur from spreading, but this is not usual practice.

- *Security* – The physical safety of facilities used to deliver crude oil against sabotage and other security incidents would depend on proximity to assets that provide vigilance and surveillance.
    - Alternative A would involve lightering practices carried out by vessels that either anchor or conduct transfer underway, but would not leave any unguarded facilities out there.
    - Alternative B would involve VLCCs steaming into onshore terminals where terminal staff and USCG presence would tend to deter security incidents.
    - Alternatives C and D would involve new offshore facilities, that if not staffed or subject to periodic security patrols or monitoring, would be subject to sabotage or vandalism.

Ability to Contribute to Beneficial Use – The ability to provide synergy with ecological restoration or the needs of other local projects (e.g. facility construction) varies among alternatives, notably through the availability of dredged material generated.

- Alternative A would not change either new work or maintenance dredging. The beneficial uses planned under the authorized -54-foot project would continue as before.

- Alternative B would generate approximately 38 million cubic yards (MCY) of varying types (sand, clay, silt) that could be used in a variety of beneficial sues such as shoreline restoration, rookery island construction, tidal marsh creation, and beach nourishment. Opportunities are available locally in Corpus Christi Bay, Redfish Bay, and along Mustang and San Jose Islands that could use dredged material.
- Alternatives C and D would not substantially generate any dredged material that would be practical to use in BU features.

2.2.1.4. Conclusion of Preliminary Screening

Alternative A, No Action, would not meet the purpose of the project, as it would neither provide for the short term need to more efficiently export crude oil, or provide the Port the capacity to respond to long term changes and future economic growth. However, it is retained only for NEPA purposes to compare and contrast action alternatives.

Alternative B, Channel Deepening, does respond to both the short term and long term aspects of the purpose. It improves the efficiency of crude transport by enabling full loading of VLCCs and eliminating or reducing lightering, and provides a deeper channel that could accommodate vessels for other commodities should tenants, cargo, and shipping needs change. The existing or planned terminals would provide more loading berths than the typical size of multiple point/berth offshore options, although offshore options that match the onshore berth numbers could be built at greater cost. The capacity to accommodate growth in crude is more flexible as new tenants or terminals can be developed on remaining water frontage along the channel. .

Offshore Alternatives C (SPM) and D (Offshore Platform) do respond to the short term need of the purpose by enabling full loading of VLCCs and eliminating lightering. However, they are limited in responding to the longer term needs of future economic growth and changes in port tenants and shipping needs, because they are limited to crude and petroleum products. The capacity to accommodate growth in crude would require building not only more onshore storage and pumps, but new pipelines and SPMs or platforms, which would tend to be more costly and difficult to add.

Potential for spills and impact to the environment exist for all alternatives. The degree of impact for both nearshore and offshore spills will vary with the type and proximity of the receptors. The ability to mitigate adverse impacts and the success of the mitigation will depend on the speed of response and distance to response teams as well as the environment where the spill occurred. PCCA and the US Coast guard (USCG) have successfully responded to past spills related to nearshore operations. Under Alternative B, spill risks from loading operations would be closer to Redfish Bay resources such as marsh and seagrass habitats. However, the response time to spills in these areas would be faster, wind and wave conditions more sheltered, and as a result spill containment would be easier.

By contrast, for Alternatives C and D, offshore operations in the Gulf would present more challenges. The main concern are proximity of these operations to sensitive receptors and coastal habitats such as the Padre Island National Seashore, San Jose Island, and the associated Kemp's ridley turtle nesting grounds, and greater exposure to wind and wave climate of the open Gulf, which would make spill containment more difficult.

In summary, comparison of Alternative B, Channel Deepening, with offshore Alternatives C and D, against the preliminary screening criteria results in the following key differences:

- Lightering and reverse lightering activities will be eliminated as Alternatives B, C, and D will be capable of accommodating fully loaded VLCCs. However, Alternative B would likely provide ultimately more loading berths and thus flexibility to meet the loading demand.

- Under Alternative B, PCCA can operate VLCC berths as public docks and service multiple tenants with use agreements between PCCA and each tenant. Under Alternatives C and D, SPMs and platform berths could also be operated by PCCA as common use facilities. A deepened channel to Harbor Island would serve more users. Under Alternatives C and D, the offshore facilities are more limited in their ability to accommodate as many users as one single channel. Multiple offshore facilities (e.g. SPM points, platform berths) would need to be built. Once built, these facilities cannot easily be expanded to accommodate additional users.

- Under Alternative B, multiple cargoes and commodities can benefit and be transported through the deepened channel including different types of crude oils. PCCA also wishes to maintain the flexibility to serve other crude customers and cargo types in the future. Alternatives C and D would be limited to pumping petroleum products, and more constrained to carrying crude oil, with less flexibility to accommodate different grades of crude if the need arises.

- Alternatives B, C and D would reduce VOC, NO_x, and CO_2 emissions associated with lightering operations. However, fugitive VOC emissions during loading would tend to be greater for offshore Alternatives C and D due to the impracticality of efficient vapor recovery systems available to onshore terminals.

- Under Alternative B, deepening the existing channel, would have temporary impacts to bay bottom associated with dredging. However, these would be limited because the channel will be dredged largely within the same footprint as the 54-foot channel with only incidental widening occurring. Hydrodynamic effects of the deepening would be limited. Alternative B would have the ability to contribute to beneficial uses to enhance existing habitats or create new habitats or features that attract birds and other wild life species.
- An incident or spill under offshore Alternatives C and D would be more difficult to control given the open Gulf wind and wave environment, and comprehensive response would likely take longer, compared to Alternative B, Channel Deepening. The consequences of a spill under Alternatives C and D would likely be to a wider area given the environmental and response factors, and would involve nationally-designated coastal resources and prime endangered sea turtle nesting habitat that are also very important to the Coastal Bend regional tourism economy.

Considering the more complete ability to meet the project purpose, the incident risk factors, while limiting environmental impact and affording an opportunity for BU, the Applicant selected Alternative B, Channel Deepening as the more desirable initial alternative to analyze in more detail, The PCCA could examine offshore options in the future as methods to supplement capacity if it is needed beyond more onshore export capacity developed in the future. However, Alternative B meets the Applicant's purpose more completely.

Table 2.2.1-1 Summary of the Screening of Initial Alternatives, present the screening results and comparison between the different alternatives.

Screening Criteria	OPTIONS			
	Alternative A No Action	Alternative B Channel Deepening Project	Alternative C Offshore SPM Facility	Alternative D Offshore Platform
		• Enables faster loading rates than SPM, reducing CO_2 emissions from hoteling vessels. • Ability to provide vapor recovery system and shore power to operate vessel systems for reduced emissions.	the platform increasing air emissions generated. • No technically feasible method for providing vapor recovery of vapour combustion systems for reducing emissions.	
5) Risk, Safety and Security	• More vessels in Harbor will make monitoring harder	• Severity of accidental spills would be reduced compared to offshore options as facilities and vessels are in a more controlled Port environment. • Environmental accidents better controlled at onshore facilities in protected waters. • Comprehensive spill response would be quicker than offshore options due to proximity to response resources • Incidents at onshore terminal can be more easily contained to avoid affecting other users. • Risk of in-channel vessel incident or allision present, but would be reduced greatly by slow vessel speed, multiple tug assist, and one way transit when bringing VLCCs in the Port. • Loading spill incident would be closer to Redfish Bay seagrass and marsh areas, but would not significantly expose National Seashore or San Jose Island beaches to impact – Prevailing SE winds directed towards terminal shore which would help containment – Tidal transport may vary however • Strong security presence within the port environment to protect against deliberate damage and sabotage.	• Damage to subsea pipelines or the platform will render the facility unusable until repaired • Environmental conditions such as high winds, high waves, and strong currents can be designed for, however potential is there for conditions that could restrict use of the facility. • Avoids potential for in-channel vessel incident, but trades it for more risk of pipeline failures due to miles of multiple necessary pipelines. • Comprehensive spill response times to address environmental accidents longer compared to onshore terminals • Loading spill incident would not significantly expose Redfish Bay seagrass and marsh areas to impact, but an offshore facility may be potentially expose National Seashore or San Jose Island beaches to impact depending on the location – Prevailing SE winds directed towards beaches which would hamper containment • More accessible by non-authorized persons; can lead to accidental damage, deliberate damage and sabotage. • Higher risk to human safety with offshore operations. • Response time to the facility by emergency services will be greater and more costly due to offshore location.	• Same as SPM for all attributes except where noted
6) Ability to Contribute to BU	• Beneficial use occurring under the -54 foot project would continue. As before, since there would be no change in dredging or other actions that could contribute.	• New work dredging would provide 38 MCY of varying sandy, clayey and some silty material some of which could be used for ecological or construction BU. Channel maintenance material could also be used long term for future BU such as restoring subsided or submerged marsh.	• Would require virtually no dredging, and therefore would not provide material that could be used to construct BU features.	• Would require virtually no dredging, and therefore would not provide material that could be used to construct BU features.

Table 2.2.1-1 Summary of the Screening of Initial Alternatives

Screening Criteria	OPTIONS			
	Alternative A No Action	**Alternative B Channel Deepening Project**	**Alternative C Offshore SPM Facility**	**Alternative D Offshore Platform**
1) Increase Export Efficiency	• No increase in export efficiency. Inefficient lightering process, involving more vessel calls, transit, and longer VLCC loading process will still occur • Would involve light-loaded VLCC transit on lower 3rd of CCSC • Increase in congestion with future growth from more lightering vessels	• Lightering can be eliminated or reduced, decreasing vessel traffic and shortening the duration of VLCC loading process • Would still require VLCC transit on lower 3rd of CCSC, but elimination or reduction of lightering transit would free up channel availability for future growth. • Multiple tenant accommodation discussed below would allow more fully loaded VLCC participation, increasing efficiency for more exporters	• Lightering can be eliminated or reduced, thereby reducing vessels involved and shorten VLCC loading process • Would eliminate VLCC transit. • Exporting participants would be more limited than channel option, and exporting nonparticipants who couldn't fully load VLCCs would resort to smaller vessels or lightered VLCCs, leaving this congestion component in place as growth occurs. See multiple tenant and future growth discussion below.	• Same as SPM for all attributes except where noted
2) Ability to Serve Multiple Tenants	• No Change	• Port can operate VLCC berths as public docks, servicing multiple tenants and shipping lines, encouraging healthy competition and raising revenue for the Port and local communities. • Centralized and integrated land use planning of developable land assets at Harbor Island. • Loading of different grades from onshore terminals would be easier compared to offshore options	• Difficult to plan multiple offshore SPMs connected individually to individual tank farms. • Accommodating different grades from different customers would be more cumbersome, requiring flushing of longer lengths of line to switch grades, compared to onshore terminals.	• Same as SPM for all attributes except where noted
3) Ability to Accommodate Future Growth/Expansion	• No accommodation of future growth • Vessel draft limitations • Increased vessel traffic due to large increase in reverse lightening	• Local and regional economy is enhanced as revenues are collected for ships calling at and products moving through the PCCA. • Efficient use of capital to achieve growth and meet overall crude export forecast for the nation • Allows for future growth within the PCCA under a single permitting process for deepening the channel	• Multiple single SPMs may need to be planned by the industry. Multiple permits required for each individual project. • Future expansion of offshore SPM facility more difficult to accommodate new users. Limited users can access the facility at any one time due to complex financing and project development challenges.	• Same as SPM for all attributes except where noted • Expansion of platform to add more users even more difficult and costly than SPM
4) Environmental Impact	• No habitat impact • Increase in air emissions due to increase from reverse lightering activities. • CO_2 emissions would be greater than other options due to continuing lightering activities	• Construction largely being undertaken within existing channel limits. • New entrance channel extension would temporarily disturb 770.3 acres of 60-ft deep Gulf bottom, convert it to deeper bottom, but benthos would recolonize within a year, and water column would remain. Amount of conversion to deeper bottom would be insignificant compared to available Gulf Habitat. • Dredged material will be evaluated for beneficial use and building resilient community. • Potential to reduce more than 485,000 MT of CO_2 emissions by eliminating or reducing reverse lightering when annual export rate averages additional 3.5 MMBPD. • Potential to eliminate 38-112 tons annual NOx and 2,200- 9,270 tons of VOC from elimination of some lightering activity	• Puts active loading facility and new pipelines in previously undisturbed part of Gulf of Mexico. • Permanent but negligible size (compared to available Gulf Habitat) of conversion of Gulf bottom and water column to SPM platform. • No potential beneficial use of dredged material • Similar potential to reduce CO_2, NOx, and VOC from eliminating or reducing lightering vessel emissions. • Spillages are more likely to happen and not as easily confined or cleaned up. • Potential for higher vapor emissions and higher CO_2 emissions from vessels hoteling due to reduced loading rates. • Tugs needed for hose tending and VLCC positioning during loading will have to transit over 30 miles (assuming support facilities are home based at Port Aransas) from the CCSC to service	• Same as SPM for all attributes except where noted • Permanent but negligible size of conversion of Gulf bottom and water column to SPM platform – larger than SPM, but still negligible

2.2.2 Screened Alternatives

At the end of the initial screening, the remaining action alternative is Alternative B which consists of deepening the channel. This alternative meets the main purpose and need of the project. This basic alternative is being evaluated for a range of depths for purposes of the Section 204(f) economic analysis. However, the performance of only one built alternative at the full depth will be evaluated against the No Action Alternative to determine which alternative is preferred. The built alternative that was evaluated against No Action alternative is the deepening of the channel to Harbor Island. As a result, the screened alternatives to analyze further are:

- **Alternative 0 – No Action**: No channel improvements and continued maintenance of the channel at its width and depth following the completion of the ongoing 54-foot deepening project.
- **Alternative 1 – Deepening to Harbor Island:** Deepening the CCSC to a depth of -80 feet MLLW from the Gulf of Mexico to Harbor Island

The channel deepening project alternative would be mostly completed within the footprint of the existing channel with the same channel bottom width with minimal incidental widening to maintain the required slope. These alternatives were compared with respect to their ability to meet the project purpose and evaluated with the previous relevant criteria. The following summarizes the comparison and evaluation.

Alternative 0 – No Action: This alternative would not meet the purpose of the project, as it would neither provide for the short term need to more efficiently export crude oil, or provide the Port the capacity to respond to long term changes and future economic growth. However, it will be retained for NEPA purposes to compare and contrast action alternatives.

Alternative 1 – Deepen to Harbor Island: This alternative would meet the Purpose & Need, because it would support crude export from new Harbor Island terminal(s). It would increase export efficiency by eliminating or reducing reverse lightering operations.

Based on these findings, Alternative 1 (Deepen Channel to Harbor Island) is the preferred alternative.

2.2.3 Channel Improvement Alternatives Advanced in this EA

As a result of the initial screening process and the alternatives' performance evaluation, the channel improvement alternatives described in the following subsections are carried forward for further evaluation in this EA: No Action and Full Depth Channel to Harbor Island. As a result the EA will only evaluate the Alternative 1 project as the build alternative. This is the Applicant's Preferred Alternative for purposes of the Department of the Army permit application, and the Requester's Preferred Alternative for purposes of the Section 408 approval being sought.

2.2.3.1. No Action

The No Action Alternative involves no channel improvements and consists of leaving the channel at the Federally-authorized width and depth for the -54 feet MLLW Federal project. Periodic maintenance of the authorized channel depth and width would continue.

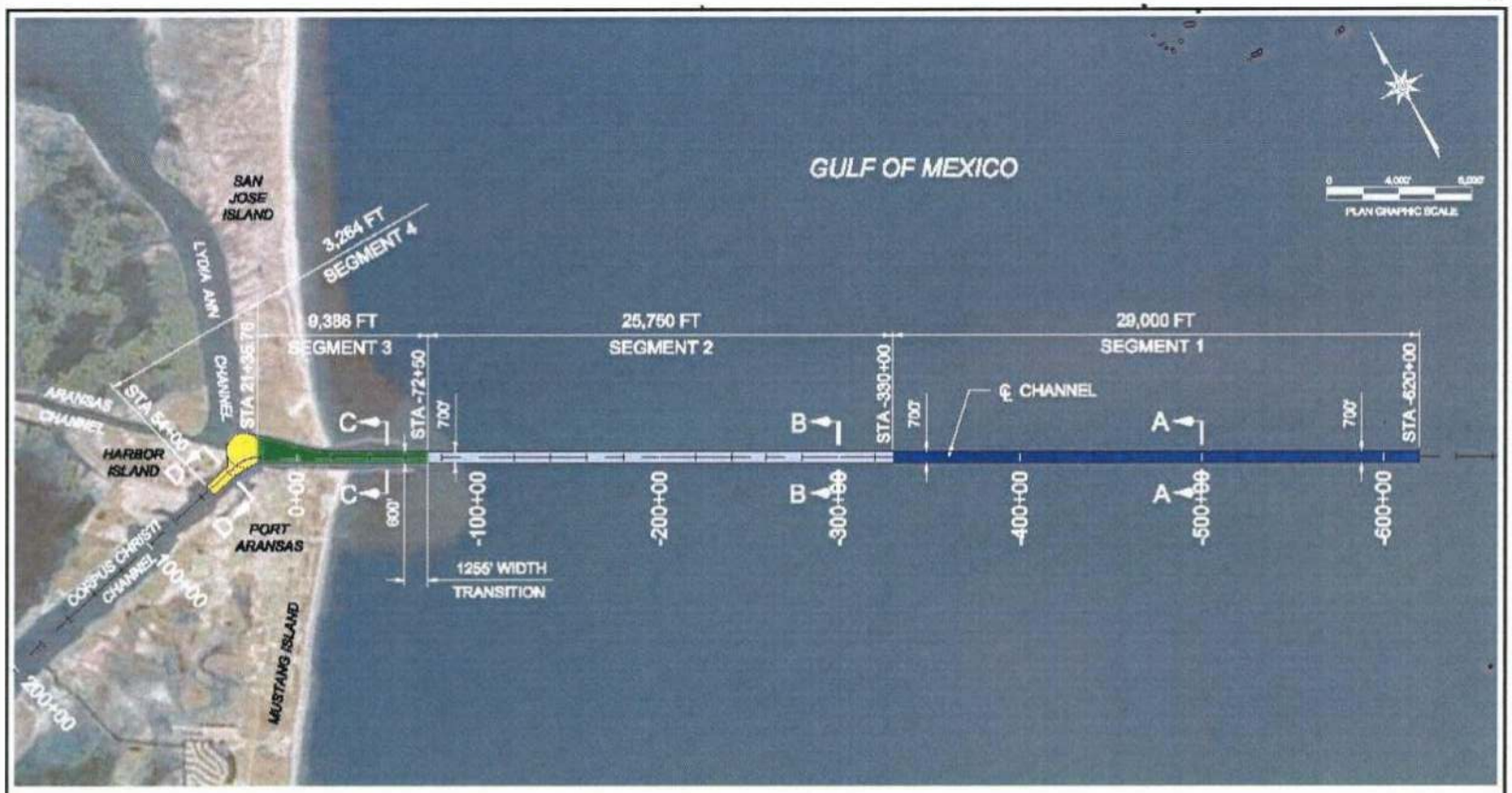
2.2.3.2. Applicant's Preferred Alternative

The preferred channel improvement alternative is Alternative 1: Deepen CCSC to Full Depth to Harbor Island. Improvements to the CCSC would consist of the features shown in Table 2.2.3-1 and Figure 2.2.3-1. As a result of further analysis and design, including geotechnical, navigation, and ship simulation, several variations of the channel deepening alternative to Harbor Island were analyzed. This included options to reduce side slopes, and alternate bottom widths that could reduce dredge volume. These variations will be discussed with USACE during the Section 408 approval process to ensure an adequate, operational channel. For purposes of the permit and NEPA documentation, the base option with the same bottom widths and side slope ratios as the -54 foot MLLW Federally-authorized project, has been selected, as it constitutes conservative dimensions. As data supporting alternate widths and side slopes are coordinated with the USACE Galveston District Operations Division, opportunities to reduce dredge volume will be examined. The Preferred Alternative includes a larger diameter turning basin at the existing Inner Basin to accommodate the length overall of the design VLCC. Also, as a result of ship simulations of the proposed project conducted at the Maritime Institute of Technology and Graduate Studies (MITAGS) with the Aransas-Corpus Christi Pilots, the need for a Flare (locally widened section) was identified in Segment 3 to allow better maneuvering approaching the Inner Basin Turning Basin prior to reaching Harbor Island terminal berths. The base option for the Preferred Alternative results in approximately 38.9 million cubic yards (MCY) of new work material that would be generated from initial construction, and approximately 400,000 CY of additional (incremental) maintenance material over the current Federal maintenance responsibility for the authorized CCSC 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.

Table 2.2.3-1 Description of the Applicant's Preferred Alternative

Segment	Stationing		Description	Length (ft)	Width (ft)	Base Depth (ft)	Depth+ 2 ft (Adv Maint) + 1 ft (OD) (ft)	Slope	Total Dredge Volume (CY)
	Start	End							
1	-620+00	-330+00	Outer Channel	29,000	700	-77	-80	10:1	9,672,226
2	-330+00	-72+50	Approach Channel	25,750	700	-77	-80	10:1	21,503,679
3	-72+50	21+35.76	Jetties to Harbor Island*	9,386	600	-75	-78	3:1	4,152,864
4	21+35.76	54+00	Harbor Island Junction	3,264	Varies	-75	-78	3:1	2,332,754
4	-	-	Turning Basin	1,953	-	-75	-78	-	1,221,730
								Dredge Volume*:	38,883,254

*Segment would include a Flare feature determined necessary for safe maneuvering approaching terminal docks.



DREDGING PLAN

SCALE: 1" = 8000'

SEGMENT	STATIONING (℄ CHANNEL CL) FROM	TO	*DEPTH (FT BELOW MLLW)	DESCRIPTION	PLAN VIEW LEGEND
1	STA -620+00	STA -330+00	-77.0	*Outer Channel*	
2	STA -330+00	STA -72+50	-77.0	*Approach Channel*	
3	STA -72+50	STA 21+35.76	-75.0	*Jetties to Harbor Island Turning Basin*	
4	STA 21+35.76	STA 54+00	-75.0	*Harbor Island Junction*	

* DESIGN DEPTH SHOWN. DOES NOT INCLUDE 2.0 FT ADVANCED MAINTENANCE DREDGING OR 1.0 FT ALLOWABLE OVER DREDGE.

Corpus Christi Ship Channel Deepening Project
Individual Permit Application SWG-XXXX-XXXX

Preferred Channel Alternative
Full Extent

County: Aransas and Nueces — State: Texas
Application By: Port of Corpus Christi Authority — Date: December 2018

Figure 2.2.3-1 Applicant's Preferred Alternative

2.3 DREDGED MATERIAL PLACEMENT ALTERNATIVES

The proposed action described in Section 2.2.3.2 involves deepening with incidental widening of CCSC, which would generate approximately 38.9 MCY of new work dredged material. Based on review of existing borings, approximately 23.7 MCY of the new work material would consist of sandy material (~61%), and 13.8 MCY would consist of clays, with the remainder comprised of other material types. 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 7.8 MCY or 390,000 cubic yards (CY) annually. The total channel maintenance, including the existing shoaling, from the project segment, is estimated at 21.7 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. In addition, the screened alternatives were further evaluated to determine whether dredged or fill material placement activities, either individually or cumulatively, would not result in unacceptable adverse effects on the aquatic ecosystem. This additional evaluation was conducted to assist in identifying the Least Environmentally Damaging and Practicable Alternative (LEDPA), provided that the LEDPA does not have other significant adverse environmental consequences.

2.3.1 Development of Placement Alternatives

Dredged material generated from the project is proposed to be placed within an ODMDS adjacent to the CCSC, and, for material judged by the project engineer to be suitable, would be placed in several locations along the coast and within Corpus Christi and Redfish Bays for beneficial use. The new work and maintenance dredge material from the proposed project would be placed in an environmentally acceptable and economically feasible manner, considering technical and logistical feasibility. The section below describes the process of the identification and evaluation of the dredge material placement alternatives that meet these requirements to identify the least environmentally damaging practicable placement alternative(s).

2.3.2 Initial Placement Alternatives

To help meet the planning objective of identifying practicable dredged material placement that considered engineering, economics and the environment, initial alternatives ranging from use of existing PAs and surrounding uplands, to potential beneficial use (BU) concepts were considered.

2.3.2.1. New Terrestrial Sites

New terrestrial sites are more constrained by available contiguous land and parcel size, easement and access across roads, properties etc. needed for hydraulic pipelines. During initial planning of the channel project, the project limits under consideration extended to the La Quinta Junction near Ingleside. Near Harbor Island, surrounding uplands are limited, as they consist of Mustang Island and San Jose Island. Mustang Island has no sizable contiguous tracts within 10 miles that are not developed or are not natural barrier island, State or National refuge/parks, or aquatic habitat. The preponderance of tracts is small waterfront parcels. San Jose Island is a privately owned island that is almost entirely undeveloped natural barrier island and beach. Along with the planned crude terminal, Martin Midstream, and Gulf Copper are located on Harbor Island at the channel entrance which leave no available tracts for placement of dredged material. Therefore, BU and offshore placement in this vicinity was planned.

The next nearest mainland with larger tracts of land is Ingleside, 8 miles farther in, where several crude oil export facilities are being planned on the land nearest water. Flint Hills Resources, OXY Ingleside Energy Center, Kiewit Offshore, Chemours, Oxychem, Ingleside Ethylene, Cheniere, and Voestalpine Texas are are existing facilities located along Ingleside. These limit upland placement options, and options to use material beneficially would be cost competitive due to the distance. Once the proposed channel project terminus was determined to be at Harbor Island, new terrestrial sites became even less likely to be cost effective or desirable. New upland sites would be less cost effective due to farther distances required to reach sizable contiguous tracts of land, could involve impacts to terrestrial wetlands, would require new property purchases, and routing and burial of temporary hydraulic pipelines across existing roads and properties. Depending on land elevation, pumping hydraulic pressure head limitations could be reached, which would force less cost effective transport by truck. These factors would complicate the usability and viability of terrestrial sites.

2.3.2.2. Initial Concepts

Therefore, initial planning focused on existing PAs and potential beneficial use, as new upland placement opportunities were limited. Initial BU concepts were generated by considering existing agency restoration plans such as TGLO's Texas Coastal Resiliency Master Plan, recent storm damage caused by Hurricane Harvey, and BU features implemented elsewhere on the Gulf Coast. Since the proposed action consists entirely of dredging the CCSC, practical limitations associated with placement of dredged material were a primary constraint. For dredged material placement, distance over which material must be pumped or transported by scow, required water depths for hopper or scow use, and access to stage and route hydraulic pipelines, all constrain where cost effective dredge material placement can be achieved. For hydraulic dredging, most cost effective dredging occurs within 5 miles, requiring one to multiple booster pumps beyond this distance, which rapidly diminishes the cost effectiveness. An initial cost effectiveness limit of 10 miles was considered. Use of hoppers and scows can achieve placement over greater distances, but this is primarily in water and requires minimum depths for vessel draft. These technological constraints factored in planning dredged material placement. The major component of dredging driving placement capacity needed is new work dredging to construct the Proposed Action. Initial planning focused on accommodating projected new work dredging volumes.

To help, further develop dredged material placement that considered environmental impact and BU opportunities, the Applicant conducted an initial agency coordination meeting held in Corpus Christi Texas on September 21, 2018 obtain the input of Federal, State and local resource agencies, including the USACE Galveston District. Representatives from the following agencies participated in the meeting and provided input on the initial planned PA use and preliminary BUs concepts presented during the meeting:

- University of Texas Marine Science Institute (UTMSI)
- UTMSI/Mission-Aransas National Estuarine Research Reserve
- Coastal Bend Bays and Estuaries Program
- Texas Parks and Wildlife Department (TPWD)
- Texas General Land Office
- Natural Resources Conservation Services
- U.S. Army Corps of Engineers (USACE)
- U.S. Environmental Protection Agency (USEPA) Region 6
- U.S. Fish and Wildlife Service (USFWS)

- Texas Department of Transportation

At the time of conception of initial placement alternatives, the new work quantities considered the additional new work quantities generated from the proposed project used to devise placement concepts. Figure 2.3.3-1 below, depicts the initial concepts presented during the agency coordination meeting. These concepts represented general categories of placement alternatives and the general vicinity where they would be located. Agency input generated a few more smaller initiatives, but did not result in major new BU sites being identified. However some concepts were reinforced and better defined based on discussions with agency representatives about site specific information and their knowledge of the ecosystem of Corpus Christi and Redfish Bays. These concepts were then analyzed in consideration of agency feedback, further conceptual development and volumetric analysis, and more research on constraints and impacts. The initial evaluation considered cost, existing technology, and logistics in light of the navigation purpose of the Propose Action. Inherent in cost and existing technology was consideration of the aforementioned dredging method constraints, and inherent in logistics was consideration of needed placement capacities. The following synopsizes the initial concepts, evaluation, and initial screening.

2.3.2.3. Existing PAs for the Current Federally-authorized CCSCIP

The Applicant is the Non-Federal Sponsor for the authorized Federal project, and is therefore aware of commitments and long-term capacity of existing upland PAs required for the authorized project. The following uses for existing PAs were considered

- Use of existing capacity– Most of the existing PA capacity is dedicated to accommodating the new work dredging and 50-year maintenance of the Federally-authorized -54 foot project. Due to lack of uncommitted capacity, only two existing PAs were identified for use: PA4 and PA6
- Expansion of existing PA – M3, M9, and M10 expand existing PAs by using dredged material beneficially. M3 would convert featureless bay bottom to approximately 330 acres of estuarine/aquatic habitat behind Pelican Island. M9 and M10 would convert featureless bay bottom to approximately 329 and 770 acres of estuarine/aquatic habitat behind PA9 and PA10, respectively.

2.3.2.4. Existing 54 Foot Project BU sites

Existing BU sites were examined for inclusion where possible. According to PCCA, only a handful of sites were available while others lack capacity especially with priority and consideration given to the placement needs for the CCSCIP which is expected to be constructed over the next three years. Therefore, focus was shifted to expanded existing sites by adding adjacent estuarine/aquatic habitat features or dike raisings. Open-water, unconfined BU sites were avoided completely.

2.3.2.5. Bird Islands

Rookery islands or bird islands serve as nesting, breeding, foraging and rearing areas for these birds because they are isolated from the mainland and are too small to sustain populations of predators. Dredged material is often used beneficially to construct or restore bird islands.

A recent study identified several existing or new bird islands in Aransas and Nueces counties. However, most were too small in regards to capacity or sited too far (more than 15 miles away) from the project to make construction economically feasible especially with the revised project footprint. The few options that were within the preferred pumping distance were surrounded by seagrass.

2.3.2.6. Oyster Pads

Beneficially using dredged material as a foundation elevated above the bay floor to provide beneficial relief to restore or create new for oyster reef was considered during initial planning. As identified in the TGLO's Texas Coastal Resiliency Master Plan, this option would provide vertical relief need for the restoration of oyster reefs. However, agency feedback indicated that the salinity in the area was not optimal for recruiting or supporting oyster growth.

2.3.2.7. Marsh Restoration at Mustang Island

Marsh restoration opportunities along the bayside of Mustang Island were examined during early planning. However, the area is too far away from the project to make construction economically feasible. Additionally, public feedback during open houses held in September 2018 indicated concerns regarding impacts to existing, established marsh habitat during construction.

2.3.2.8. 13A New BU Site

Creating a BU feature similar to existing BU 6 was contemplated adjacent to the existing PA13. Once the project terminus changed to Harbor Island, this became a less favorable option due to distance. It was reconfigured in the second stage of placement plan development as a contingency upland extension to PA13.

2.3.2.9. New Work ODMDS

Use of the portion of this site for new work placement that is not being used by the -54 foot Federal Project was proposed. This site is a dispersive site, and Multiple Dump Fate (MDFATE) modeling was conducted to analyze the capacity for project use.

2.3.2.10. San Jose and Mustang Island Feeder Berms or Shoreline Repair

The project team reviewed recent aerials and LiDAR data on San Jose Island to determine that there was a substantial amount of repair for dune breaches and foreshore erosion following Hurricane Harvey. Similarly, the Texas General Land Office (TGLO) identified areas of both Mustang and San Jose Islands that have experienced historical receding at the rate of 2 feet or more per year. The large amount of sand that would be produced by the project could be used to repair or indirectly nourish these islands.

2.3.3 Screening of Initial Concepts

Table 2.2.1-1 provides a summary of the screening of initial concepts. Some of these placement options have since been eliminated from further evaluation because of a change in project scope. The initial full built project, deepening the channel to La Quinta Junction, was eliminated from further consideration. The preferred alternative was determined to be deepening the channel to Harbor Island, a shorter reach, which requires less placement areas. As a result some of the concepts identified during the agency coordination meeting were also eliminated from further consideration. However, some of these were reconceived as different BU initiatives, such as expansion of existing PA and BU sites.

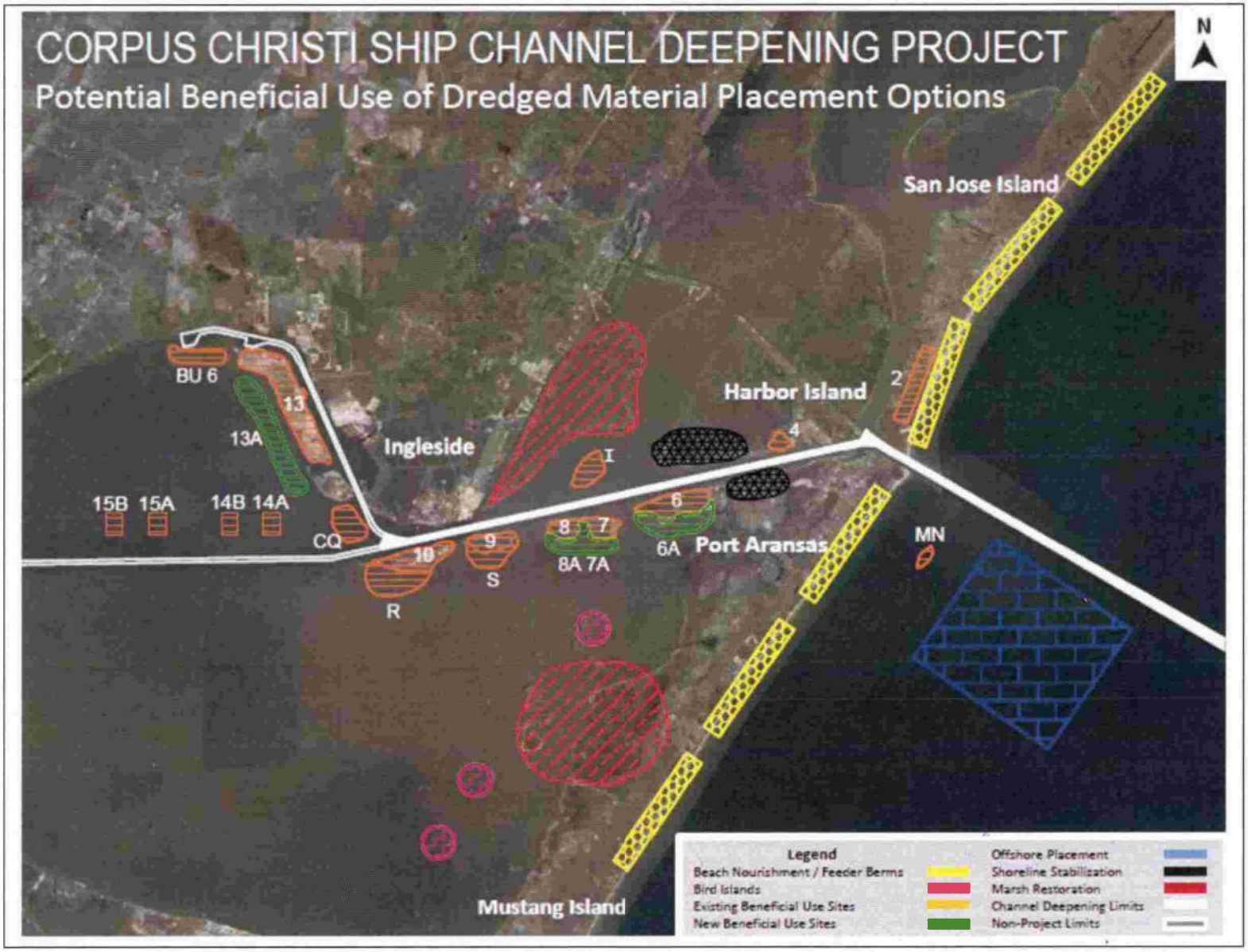


Figure 2.3.3-1 Initial Dredged Material Placement Concepts

Table 2.3.3-1 Initial Placement Area Screening

Concept	Logistics	Technology	Cost	Determination
New Terrestrial Upland Site	Too many issues involving infrastructure, distance, limited parcel size and availability	Pump distance and potential pumping constraints further inland	Logistics factors could make it costly to implement.	Eliminated
Existing PAs for the Current Federally-authorized -54 foot MLLW project	Limited available placement capacity	Feasible	Would be cost effective, but no capacity.	Eliminated for existing, but reconceived for expansion.
Existing 54 foot project BU sites	Limited available placement capacity	Feasible	Would be cost effective, but limited capacity.	Eliminated for existing, but reconceived for expansion.
Bird Islands	12 acre site size criteria limits capacity to place	Feasible	Would likely have higher unit implementation cost due to small size	Eliminated due to distance, and limited capacity
Oyster Pads	Distance from Harbor Island would be far.	Salinity in the area not optimal	Rock for cultch recruitment surface could be a major expense	Eliminated
Marsh Restoration at Mustang Island	Public concerns about impacting existing habitat	Feasible	Could be cost feasible	Eliminated
13A new BU Site	Distance from Harbor Island is far.	Feasible	Distance would make it more costly	Eliminated, but reconceived as contingency upland expansion site
NW ODMDS	Channel adjacent. Good option.	Feasible	Near channel. Minimal construction. Would be cost effective	Advanced
San Jose and Mustang Island Feeder Berms or Shoreline Repair	Channel adjacent. Good option.	Feasible	Near channel. Minimal construction. Would be cost effective	Advanced

2.3.4 Placement Alternatives Evaluated Further

The initial alternatives that were advanced or reconceived were refined. Given the large amount of materials that could be beneficially used, especially the large volume of sand in one the of the channel segments, and proximity of some of the desirable BU options, it became clear, a mix of existing offshore, expansion of existing BU sites and the Gulf side BU initiatives would be a viable, cost effective approach. Initial feedback during initial agency and public coordination, further input from PCCA, and refinement of the channel plan, were used to develop concepts that were retained. Of 11 initiatives further refined, 10 were BU features that aimed to achieve a variety of shoreline restoration, land loss restoration, marsh cell expansion, and Gulf-side shoreline initiatives. The following alternatives were developed.

- M3 – Creation of an estuarine/aquatic habitat extension at Pelican Island. This would bring the elevation of an extension at this BU site to an elevation suitable to restore either marsh or seagrass.
- M4 – Restoring historic land and marsh loss at Dagger Island. This is an ecosystem restoration measure included in USACE's Coastal Texas study and the TGLO Coastal Resiliency Master Plan. Design of project elements will be coordinated to support TPWD's existing permit for this project.
- M9 – Creation of an estuarine/aquatic habitat extension at PA9. This would bring the elevation of an extension at this BU site to an elevation suitable to restore either marsh or seagrass.
- M10 – Creation of an estuarine/aquatic extension at PA10. This would bring the elevation of an extension at this BU site to an elevation suitable to restore either marsh or seagrass.
- PA6 – Raising the existing dike by 2 feet and filling it with new work material at the existing PA6.
- SS1 – Restoring eroded shoreline and armoring to protect the very large seagrass area behind Harbor Island. This shoreline restoration is desired for a nature center located there.
- SS2 – Restoring a shoreline washout along the Port Aransas Nature Preserve as a result of Hurricane Harvey. Piping plover sand flat critical habitat located behind this breach would be protected again.
- PA4 – Reestablish eroded shoreline and land loss behind PA4. The shoreline has undergone major erosion over the last few decades, and if it continues, would eventually expose the Harbor Island seagrass area to erosion and loss.
- SJI – Dune & shore restoration at San Jose Island using new work sands to repair severe damage caused by Hurricane Harvey
- New Work ODMDS–Placement on part of the New Work ODMDS
- B1-B6–Feeder berms offshore of SJI and Mustang Island that would be located within the active transport zone in front of the depth of closure, and indirectly nourish these barrier islands.

The placement options were sized and located using constraint mapping with aquatic resource layers (e.g. reef, seagrass, wetlands), pipelines, existing PA and BU sites to help avoid or minimize impacts to these constraints. Combinations of bathymetry, LiDAR and NOAA depth chart data were used to help estimate volumes required for design templates of dikes, and marsh or seagrass foundation fill. Bay bottom displacement was assumed. Feeder berm positioning considered the depth of closure data to ensure positioning in active shoreward transport areas.

Placement Option	Description	Placement Capacity (CY)	Proximity to New Work Dredging Operations	Provides Environmental Benefit
	Preserve as a result of Hurricane Harvey			Preserve as a result of Hurricane Harvey.
PA4	Reestablish eroded shoreline and land loss behind PA4	3,020,000	Located approximately 2 miles from Harbor Island	This option does not create any environmental benefit.
SJI	Dune & shore restoration San Jose Island	7,000,000	Located directly next to Channel Dredging Operations	This option restores several miles of beach profile that was washed away as a result of Hurricane Harvey.
NW ODMDS	Place on part of New Work ODMDS	13,800,000	Located directly next to Channel Dredging Operations	This option does not create any environmental benefit.
B1-B6	Feeder berms offshore of SJI and Mustang Island	7,200,000	Located less than 10 miles from Channel Dredging Operations	This option will nourish beach shoreline by natural sediment transport processes.
Scenarios for new work placement capacity provided and needed.		56,731,500	Total Capacity Provided	
		49,731,500	Total capacity less SJI (should that option become unavailable)	
		38,926,000	Total NW placement capacity required for Channel Preferred Alternative – Base Option	
		10,805,500	Additional Capacity less SJI (should that option become unavailable)	

Shoaling estimates using USACE rapid, empirical methods were used to calculate changes in rates of deposition in the project segment of the CCSC and incremental maintenance placement needs. For the offshore section, the channel infilling parametric model developed by Rosati and Kraus (2009) was used. The estimation was supplemented by historical dredging records. The calculated amount of incremental shoaling over the existing -54-foot MLLW authorized project was approximately 390,000 CY. The current offshore section of the CCSC is maintained primarily by using the Maintenance ODMDS No. 1 offshore site, with an option to use PA2 located on San Jose Island, if the material is suitable for beneficial use. The existing dispersive capacity of the Maintenance ODMDS No. 1 appears to readily accommodate this estimated incremental increase. Given the relatively small amount of yearly shoaling and the capacity of these local maintenance PA features, the use of Maintenance ODMDS No. 1 with an option to place at PA2 when suitable material is generated is proposed for this CCSC deepening project. Another maintenance material initiative identified as desirable was using suitable maintenance material to rebuild feeder berms, as those sites are dispersive, during future maintenance cycles since the shoreline retreat along Mustang and San Jose Islands is long term.

2.3.4.1. Performance and Comparison Screened Placement Alternatives

All the proposed options would be viable due to proximity, material volume capacity, and need for material to achieve ecological restoration. The large volume of sands indicates that material placement would be better used for BU restoration of important coastal resources that were damaged by Hurricane Harvey and experience continuing erosion. The availability of other new work material such as clays could opportunely be used to stem land losses that would expose sensitive habitats to continual erosion. These materials would be better used in these initiatives than in upland placement that avoids the marine environment and provides no benefit. All options were selected, with M9 and M10 providing extra capacities as a contingency for unavailability of SJI. San Jose Island is a privately owned island, and coordination with the owner is ongoing to garner approval to conduct dune and beach restoration. Therefore, more capacity was identified to provide flexibility in the plan. Table 2.3.4-1 lists the selected placement plan elements, and Figure 2.3.4-1 illustrates them.

Table 2.3.4-1 Selected New Work Placement Plan

Placement Option	Description	Placement Capacity (CY)	Proximity to New Work Dredging Operations	Provides Environmental Benefit
M3	Estuarine/aquatic habitat creation adjacent to Pelican Island	4,328,400	Located approximately 6 miles from Harbor Island	This option will convert featureless bay bottom to approximately 330 acres of estuarine/aquatic habitat.
M4	Restoring historic land and marsh loss at Dagger Island	867,000	Located approximately 7 miles from Harbor Island	This option will restore eroding marsh habitat for native shorebirds and coastal wildlife. Design of project elements will be coordinated to support TPWD's existing permitted project.
M9	Estuarine/aquatic habitat creation adjacent to PA9	3,500,000	Located approximately 8 miles from Harbor Island	This option will convert featureless bay bottom to approximately 329 acres of estuarine/aquatic habitat.
M10	Estuarine/aquatic habitat creation adjacent to PA10	10,933,600	Located approximately 10 miles from Harbor Island	This option will convert featureless bay bottom to approximately 770 acres of estuarine/aquatic habitat.
PA6	2 foot dike raise and fill	3,704,900	Located approximately 4 miles from Harbor Island	This option does not create any environmental benefit.
SS1	Restoring eroded shoreline and armoring to protect Harbor Island seagrass area	1,682,000	Located approximately 3 miles from Harbor Island	This option restores an eroding shoreline to its historic profile.
SS2	Restore shoreline washout along Port Aransas Nature	695,600	Located approximately 2 miles from Harbor Island	This option restores two washouts of shoreline along the Port Aransas Nature

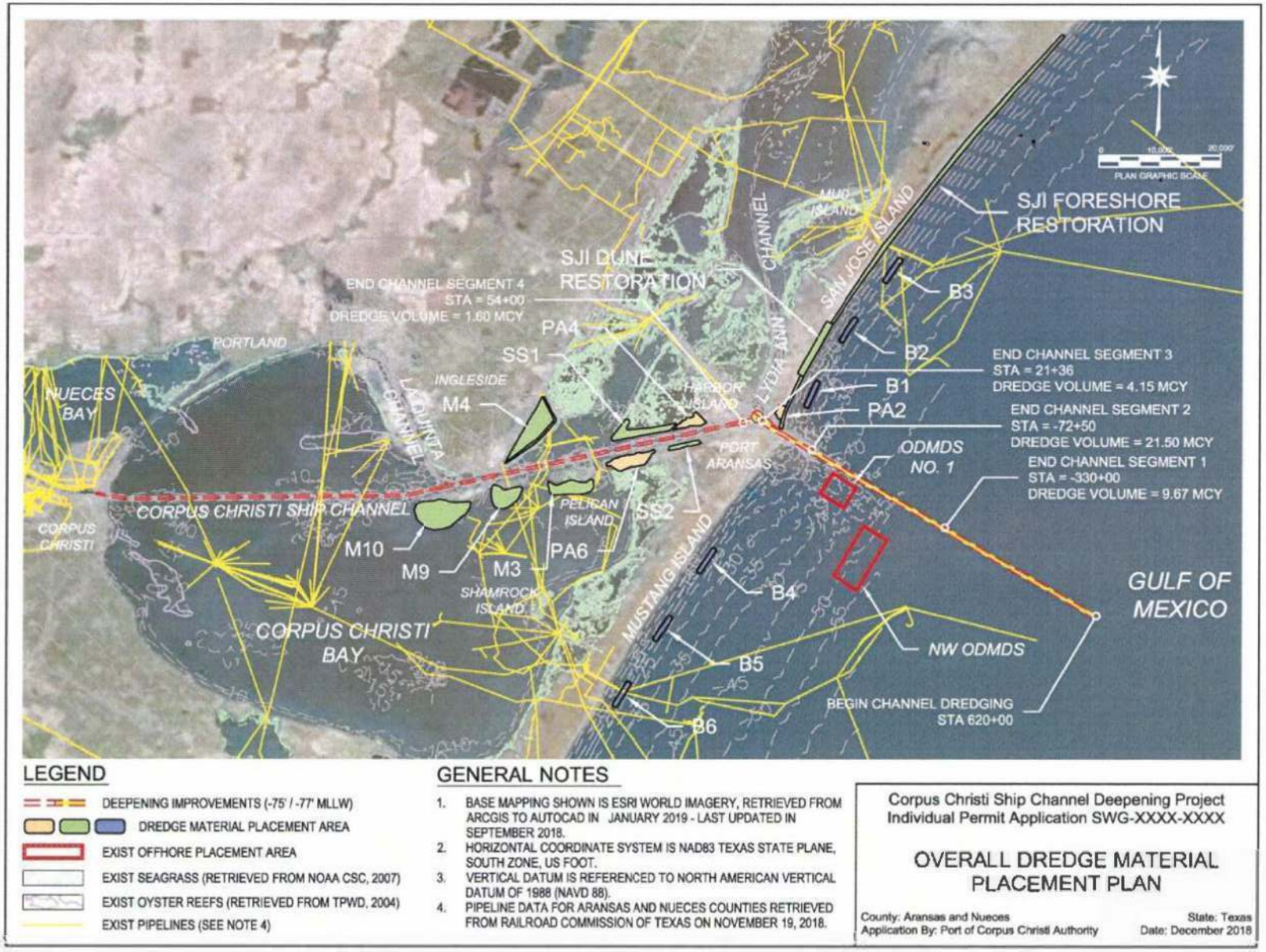


Figure 2.3.4-1 Selected Dredged Material Management Plan

2.4 ALTERNATIVES CARRIED FORWARD

The alternatives that have been selected to undergo more detailed NEPA evaluation are the following.

2.4.1 No Action Alternative

The No Action Alternative would consist of not deepening to 80 feet of depth and is essentially equivalent to the current Federally authorized project for the CCSC, since that plan has been approved and is undergoing implementation. It will be used to compare and contrast effects of the Preferred Alternative.

2.4.2 Preferred Alternative for Channel and Placement

Following initial screening and evaluation of channel and placement alternatives, the Applicant (PCCA) selected the channel plan that best fulfills the purpose and need for efficiently exporting crude oil. The Applicant considered a variety of placement options involving existing PA and BU sites, resource agency input, and BU needs in the estuary. The Applicant's Preferred Alternative to advance for full NEPA analysis consists of the following elements:

- Dredging a 5.5 mile extension to the 700-foot wide entrance channel of the CCSC to meet the -80 foot bathymetric contour.
- Deepening of the existing 700- feet wide Approach Channel of the CCSC from -54 feet MLLW to -77 feet plus 2 ft advanced maintenance and 1 ft allowable overdredge.
- Deepening of the Jetties Channel segment of the CCSC from -54 feet MLLW to -75 plus 2 ft advanced maintenance and 1 ft allowable overdredge, and dredging a Flare transitioning the channel to the Inner Basin to aid maneuverability when approaching the Harbor Island terminal.
- Dredging an expanded Inner Basin turning basin with a diameter of 1,953 feet from -54 feet MLLW to -75 ft plus 2 ft advanced maintenance and 1 ft allowable overdredge
- Dredging the Harbor Island Junction to -75 ft plus 2 ft advanced maintenance and 1 ft allowable overdredge
- Placement of new work dredged material at the following BU and PA sites
  - M3 – BU marsh or seagrass
  - M4 – shoreline restoration at Dagger Island
  - M9 – BU extension of PA9
  - M10 – BU extension of PA10
  - PA6 – 2-foot dike raise and fill
  - SS1 – shoreline restoration of Harbor Island west end
  - SS2 – shoreline breach repair at Salt Island, Port Aransas Nature Preserve
  - PA4 – shoreline and land restoration at existing PA4 on Harbor Island
  - SJI – dune and beach restoration on San Jose Island

  - NW ODMDS – new work material placement at approved new work ODMDS
  - B1-B6 – feeder berms to indirectly nourish Mustang Island and San Jose Island
- Placement of maintenance dredged material at the following BU and PA sites
  - Maintenance ODMDS #1
  - Placement at PA2 when suitable material is generated
  - Future placement on one of the feeder berms B1 through 6 when suitable material is generated