DEEPWATER PORT LICENSE APPLICATION FOR THE BLUEWATER SPM PROJECT

VOLUME II – ENVIRONMENTAL EVALUATION

Section 11 – Geological Resources

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ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
BOEM	Bureau of Energy Management
BSEE	Bureau of Safety and Environmental Management
CFR	Code of Federal Regulations
DWP	Deepwater Port
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
GLO	General Land Office
GOM	Gulf of Mexico
HDD	Horizontal Directional Drill
ID	Inner Diameter
IR	Inadvertent Return
LEI	Lloyd Engineering, Inc.
MHT	Mean High Tide
NRCS	Natural Resources Conservation Service
NTL	Notice to Lessees
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
PLEM	Pipeline Ending Manifold
ROW	Right-of-way
SPCC	Spill, Prevention, Control and Countermeasure
SWPPP	Stormwater Pollution Prevention Plan
SPM	Single Point Mooring
TPWD	Texas Department of Parks and Wildlife
TPDES	Texas Pollution Discharge Elimination System
TWEI	Tolunay-Wong Engineers, Inc.
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

11 Geological Resources

This section discusses the existing geological resources within the vicinity of the Proposed Bluewater SPM Project (Project) and the Alternative Project, and the anticipated environmental impacts associated with the construction, operation, and decommissioning of the Proposed Project and the Alternative Project. The detailed description of the Proposed and Alternative Project and the framework for the evaluation of environmental impacts is provided in Section 3: Project Description and Framework for Environmental Evaluation.

11.1 Applicable Laws and Regulations

11.1.1 State and Local

A portion of the Project will be constructed on lands within the jurisdiction of the State of Texas, and within the seabed of waters owned by the State of Texas. Within all parts of the State of Texas, the Texas Department of Licensing and Regulation regulates the use and exploitation of Texas aquifers. The Texas General Land Office (GLO) regulates the leasing of state lands for mining operations, including offshore oil and gas exploration, and the Texas Railroad Commission regulates the drilling and production of oil and gas wells, as well as the mining of coal. However, there are no state regulatory standards relating to geology and soils for the construction of an offshore facility.

The Dune Protection Act (Sections 63.001-63.181 of the Texas Natural Resources Code) requires that a dune protection line be established on the Gulf shoreline by the Commissioners Court of any county with public beaches bordering the Gulf of Mexico (GOM). This also applies to the Gulf shoreline of islands. The dune protection line can be established up to 1,000 feet landward of the mean high tide line. A permit is required from the City or County Commissioners Court for most activities seaward of the established dune protection line.

Pursuant to Chapter 86, Subtitle F, of the Texas Parks and Wildlife Code, The Texas Parks and Wildlife Commission shall manage, control, and protect marl and sand of commercial value and all gravel, shell, and mudshell located within tidewater limits of the state, and on islands within those limits, and within the freshwater areas of the state not embraced by a survey of private land, and on islands within those areas. A Marl, Sand, Gravel, Shell or Mudshell Permit from the Texas Parks and Wildlife Department (TPWD) must be obtained for removal of any of these sediments.

Sections 61.211 through 61.227 of the Texas Natural Resources Code regulate the removal of all sediments, such as marl, sand, gravel, and shell from islands, peninsulas, and all land within 1,500 feet of mainland public beaches outside corporate limits. A permit must be obtained from the relevant County Commissioners Court for the excavation of any of these materials unless it is to be moved by a landowner or with a landowner’s consent, from one location to another on the same property.

11.1.2 Federal and International

Beyond the jurisdictional waters of the state of Texas, the Project seabed is under the territorial jurisdiction of the federal government. The Bureau of Ocean Energy Management (BOEM) and its sister agency, Bureau of Safety and Environmental Enforcement (BSEE), both agencies within the Department of the Interior, are tasked under the Outer Continental Shelf Lands Act (OCSLA) and the Energy Policy Act of 2005 with managing the development of the seabed resources off the coast of the U.S. BOEM regulates the leasing and operation of sulfur, oil and gas, and other mineral mining operations on the Outer Continental Shelf (OCS). The Project extends into the Western Planning Area of the OCS Region Blocks, as designated by BOEM.

In addition, BSEE regulations (including Notices to Lessees [NTL]) that govern evaluation and protection of geological features, such as the Shallow Hazards Program (NTL No. 2008-G05), are covered in this section.

The Federal Emergency Management Agency (FEMA) classifies foredunes as falling within "high-velocity zones" (V-Zones). Foredunes are included in V-Zones because they absorb the brunt of storms, protecting the interior. FEMA imposes more rigorous construction standards in these areas and prohibits any "alteration of sand dunes…within zones V1-30, VE, and V within the community's Flood Insurance Rate Maps (FIRM) which would increase potential flood damage." (44 Code of Federal Regulations [CFR] 60.3[e][7]).

11.2 Proposed Project

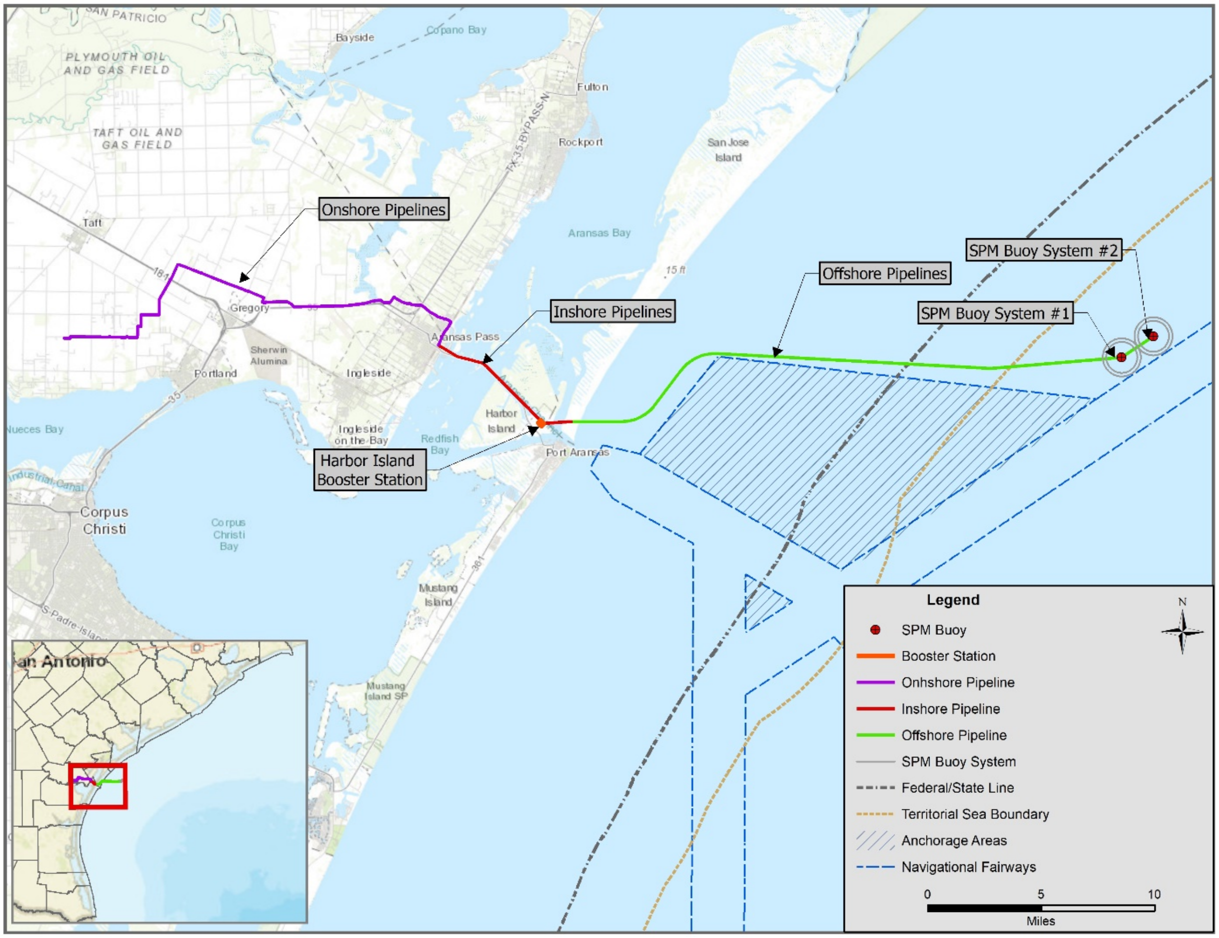
11.2.1 Proposed Project Area

The Proposed Project area considered for geological resources includes the geologic formations underlying the Onshore Pipelines, Inshore Pipelines, Offshore Pipelines, and two single point mooring (SPM) buoy systems (which make up the Deepwater Port [DWP]). Onshore components associated with the Proposed Project are defined as those components landward of the western Redfish Bay mean high tide (MHT) line, located in San Patricio and Aransas Counties, Texas. Onshore Project components include approximately 22.20 miles (mi) of two (2) new 30-inch-diameter crude oil pipelines extending from the landward side of the MHT line of Redfish Bay to a planned multi-use terminal facility located south of the City of Taft in San Patricio County, Texas. The onshore study area evaluated for natural resources investigations consisted of a 300-foot wide corridor along the length of the proposed pipeline, encompassing 812.74 acres.

Inshore components associated with the Proposed Project are defined as those components located between the western Redfish Bay MHT line and the MHT line located at the interface of San Jose Island and the GOM. Inshore Project components includes approximately 7.15 mi of two (2) new 30-inch-diameter crude oil pipelines, and an approximate 19-acre booster station located on Harbor Island. The inshore portion of the Proposed Project area includes the terrestrial portion of the pipeline corridor area including Lydia Ann Island, Harbor Island, Stedman Island, and a small segment leading into Aransas Pass.

Offshore components associated with the Proposed Project are defined as those components located seaward of the MHT line located at the interface of San Jose Island and the GOM. The Offshore Project components include approximately 27.13 mi of two (2) new 30-inch-diameter crude oil pipelines extending to two (2) SPM buoy systems. The proposed offshore pipelines would extend from the MHT line located at the interface of San Jose Island and the GOM to the proposed SPM buoy systems.

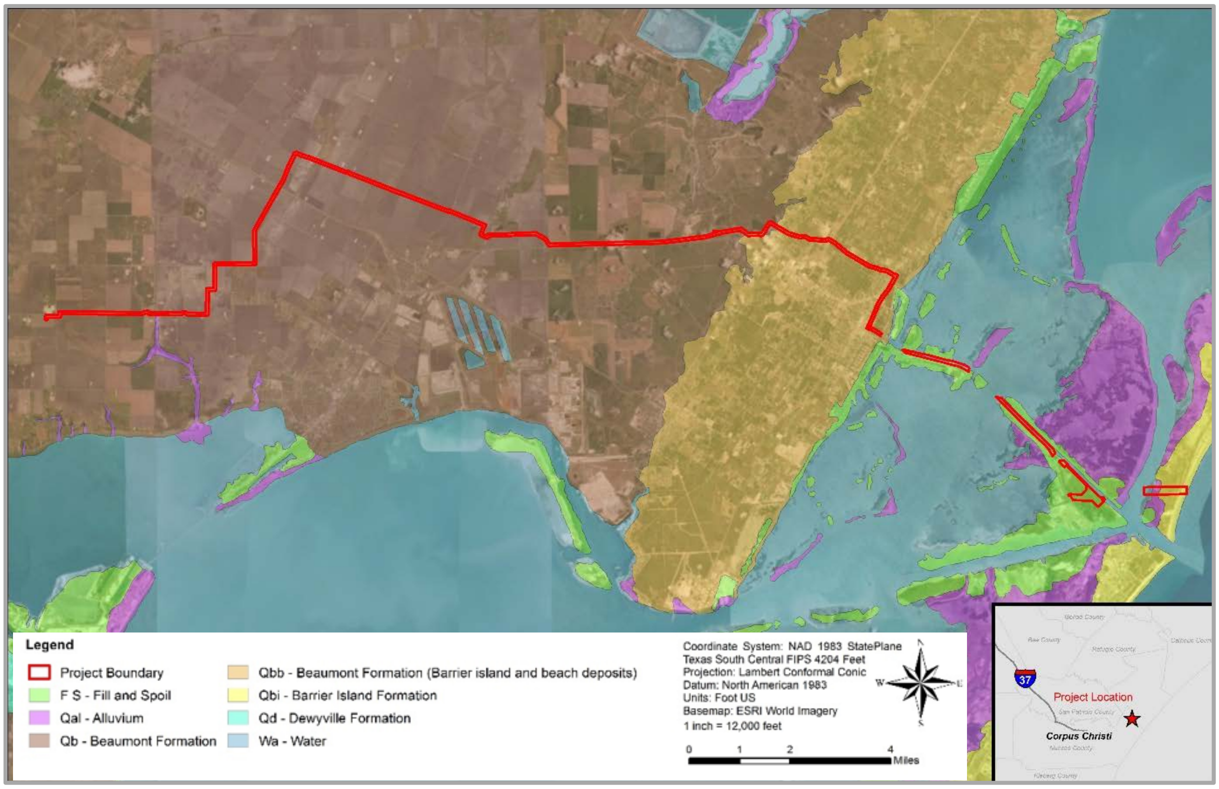
Figure 11-1: Proposed Project Vicinity Map



The Proposed Project area lies on the northwest edge of the GOM, within the Coastal Bend region of the Texas Gulf Coast. It is generally accepted that the GOM formed around the transition between the Triassic and Jurassic periods, ca. 200 million years ago (mya), as a result of the breakup of the supercontinent Pangea (Garrison and Martin 1973; Galloway 2008). By the end of the Mesozoic era (ca. 65 mya), the Gulf Coast region underwent dramatic change as the subsidence of the natural basin, along with an increase in sedimentation rates, caused large quantities of clastic sediments to form and overwhelm the cretaceous reefs in what is now Texas and Louisiana, filling the northern gulf. The Texas coastal plain then prograded steadily basinward throughout the majority of the Cenozoic era (c. 65-2 mya). Since then, sea levels have varied drastically in the GOM between glacial and interglacial periods, leading to varying levels of excursions and incursions of the shoreline and depositional sequences (Morton 1994; Freese and Nichols 2016).

It is generally accepted that the barrier islands in the Project vicinity began to form around 5,000 years ago, as the sea was rising to its current level from the lows of the Pleistocene epoch (Morton 1994; Freese and Nichols 2016). Small-scale and large-scale forces have shaped and continue to influence the barrier islands' formation, including daily astronomical tides, storms, and the late Wisconsian glacio-eustatic changes. The barrier islands are largely formed from reworked deltaic deposits from the series of rivers down the Texas coast. The barrier islands are located at a relatively consistent distance from the mainland, approximately 5 mi wide, due to the slightly lower sea level than the coastal plain, separated from the mainland by a series of bays and tidal lagoons.

Figure 11-2: Terrestrial geology map of Proposed Project area



11.2.1.1 Onshore

The Quaternary-age portion of the coastal plain consists of a series of terraces deposited during interglacial periods due to sea level changes, formed by alluvial and deltaic processes in an approximate 100 mi belt along the coast (Hosman 1996; USGS 2002; Davis 2013). The youngest of these terraces is the Beaumont formation along the eastern margin of the state, found along the mainland coast in the Project area (Figure 11-1). At its surface, this area is composed of late Pleistocene-aged clay and mud of the Beaumont formation, underlain by the Pliocene- and Miocene-aged Fleming formation (USGS 2015, Hosman 1996). In south Texas, the Fleming formation is composed predominantly of clay with sand content increasing eastwardly until it is mostly sand along the coast. Here, calcareous strata contain thin layers of chalky limestone and cross-bedded sands. Only 200 feet thick in the outcrop, the Fleming Formation actually extends thousands of feet below the surface (Hosman 1996).

From the end of the Pleistocene epoch, sea level along the Gulf coast has varied drastically in accordance with contemporary degrees of glaciation (Morton 1994; Davis 2013; Freese and Nichols 2016). The most recent transgression of the shoreline began approximately 17,000 years ago due to glacial melting, causing a sea level rise of approximately 300 feet. Many of the barrier islands that dot the Texas Gulf coast began to form on the present continental shelf as sea level moved slowly landward around 5,000-6,000 years ago, formed by a combination of alluvial deposits and reworking of relic deposits on the shelf. Storm systems, including tropical cyclones, and daily tides play a significant role in reshaping of the barrier islands in modern times (Morton 1994).

11.2.1.2 Inshore

The main islands of the Proposed Project area are part of the Harbor Island flood-tidal delta complex, which is a large, triangular, shallow depositional environment which has been bisected and bordered by dredged channels and dredged-material disposal sites (USGS 2002; Pulich 2007). The islands are comprised of Quaternary alluvium deposits along the lagoon-side of barrier islands and barrier island deposits along the sea-side of San Jose island (USGS 2002). Alluvium deposits primarily consist of clay, silt, sand, and gravel, with organic material abundant in localized areas. Barrier island deposits are comprised of well-sorted, fine-grained sand, abundant with shells and shell fragments. The eastern margin of San Jose island is comprised of foredunes, which effectively shield the fragile ecosystem of the interior grasslands from storm tide inundation and westward dune advancement. These dunes will be avoided during construction, as well as the adjacent beach, via Horizontal Directional Drilling (HDD). Stedman Island and Harbor Island have been significantly impacted by fill and spoil material from dredging activities. Material properties are highly variable, containing mixtures of mud, silt, sand, and shell materials.

The Proposed Project mostly follows Aransas Pass, crossing segments of Redfish Bay and the Gulf Intracoastal Waterway through Aransas Channel before crossing Lydia Ann Channel towards San Jose Island. The area contains historically dredged channels and dredged-material fill disposal sites to allow for ship navigation (Oppenheimer 1963; USGS 2002; Pulich 2007). Redfish Bay is one of a series of bays and tidal lagoons, formed as a consequence of the formation of the barrier island chain down the Texas Gulf Coast (Collier and Hedgepeth 1950; Morton 1994; Davis 2013). The bay is a designated TPWD State Scientific Area, created to protect sensitive marine habitats in the bay, particularly shallow seagrass flats, which have special protections in the bay (TPWD 2013).

11.2.1.3 Offshore

Beyond San Jose Island, the Proposed Project extends approximately 25.5 mi along the seafloor of the GOM until terminating at the proposed DWP, located approximately 18 mi east from the shoreline. From the east coast of Texas, the continental shelf ranges in width from approximately 60 mi at the southern tip of the state to 125 mi in the north of the GOM. The Texas shelf is marked by subtle relict features, such as stream channels and shorelines, formed when sea levels were lower due to glaciation (Freese and Nichols 2016). Structurally, this Northwestern Gulf Shelf has also been influenced by the presence of vast amounts of salt in the sedimentary sequence, which causes a high degree of tectonic mobility in an area that is otherwise relatively stable. Formations of the Neogene period have been arched by deep-seated salt pillows while sedimentary beds from the same period have been pierced by narrow columns of salt (Garrison and Martin 1973). These evaporite (salt-rich) deposits commonly form domes and other diapiric formations as the buoyant, evaporitic material upwells through the overlying sediment (Davidson and Mace 2006). It is generally accepted that these salts have their origin in the Jurassic period (ca. 200-145 mya). Although the Rio Grande Embayment, a significant inland depression extending through the majority of south Texas, is underlain by several salt domes, these features are located further inland and away from the Proposed Project area. The lateral migration of evaporitic material has also displaced and replaced clastic deposits via faulting, slumping, and local thickening or thinning of beds. In the strike-fault systems that pervade the northern Gulf Coastal Plain, faulting is normal and down-to-basin with the fault-plane being 35°-70°, flattening basin-ward with depth (Garrison and Martin 1973). Faults along the Texas Gulf Coastal Plain are known as growth faults-curved faults that are syndepositional and grow with depth of burial-and are commonly caused by the buoyant rise of materials such as salt or shale (Chowdhury and Turco 2006)

The GOM is host to various depositional environments made up of sediments primarily transported via fluvial processes from the mainland. The terrigenous sediment supply along the coastal bend of Texas is the second largest such supply (after the Mississippi-borne sediment supply) in the GOM due to the numerous rivers crossing the region’s coastal plain. After initial deposition, sediments migrate via wave, tidal, current, and gravitational forces, with some eventually arriving in the deep abyssal environment. Presently, Holocene sediments, especially those deposited since the recent stabilization of sea level, dominate coastal environments, with small amounts of locally-produced biogenic skeletal material contributing to a limited extent (Davis 2017). Due to the often-dense human populations in these environments, these sediments are typically polluted to some degree. Sediments arrive at the continental shelf via three significant modern drainage systems: the Mississippi River, the Rio Grande delta complex, and the Colorado-Brazos delta complex. These drainages deposit sediments in a rather thin blanket across the inner portions of the shelf, covering the fluvial-deltaic deposits laid down during the sea level lowstands of the Quaternary period (Davis 2017).

11.2.2 Proposed Project Existing Conditions

11.2.2.1 Geologic Hazards

11.2.2.1.1 FAULTS AND SOIL LIQUEFACTION

A belt of seaward-facing normal faults pervades the coastal areas around the northern GOM (Wheeler and Heinrich 1998; Chowdhury and Turco 2006). The portion of this belt in eastern and southern Texas consists of faults facing southeast, normal to the coast. In the early to middle Mesozoic age, the opening of the GOM formed a rifted, passive margin along southern North America which was then buried beneath the Louann salt in the Middle Jurassic period, as well as an overlying carbonate and clastic, marine sequence, still being deposited today. The post-rift sequence thickens seaward, with thickness exceeding 7.5 mi under coastal Texas. The thickness of these post-rift sediments caused them to collapse and spread toward the Gulf while buoyant evaporite materials pierced the overlying sediments extending on listric, normal, growth faults that flatten downward into detachments in the salt. Faults along the Gulf Coastal Plain have exhibited strikingly low historical seismicity, with slip rates estimated at less than 0.008 in/yr.

Faults can also be found extending out onto the continental shelf, paralleling the coastline and becoming increasingly younger as they progress basinward (Galloway 2008; BOEM 2017). The current proposed pipeline alignment begins near the town of Aransas Pass and extends eastward into the GOM, towards the Lunker and Clemente-Thomas fault systems. However, the DWP at the alignment's terminus lies a considerable distance west of these features, as the DWP extends only 18 mi from the coast.

Soil liquefaction can occur in sandy, unconsolidated soils as a result of high wave loads, which are normally induced by seismic activity or powerful storms, as solid sediment sequences essentially behave as a fluid (de Groot et al. 2006). This can cause great damage to standing structures as their rigidity fails to accommodate the shifting sediments below, resulting in fallen buildings or floating pipelines. Although seismic activity has been relatively low in the northwestern Gulf and coastal Texas for the last century (the nearest events over 45 mi southwest of the Project location in 2010 (3.9 magnitude) and in 1997 (3.8 magnitude)), the frequency of powerful tropical storms and hurricanes, as well as the unconsolidated, sandy character of seafloor sediment on the inner continental shelf, could be important considerations for hazard analysis (USGS 2019a, 2011). Pipelines, themselves, can contribute to localized liquefaction and deformation as their position redirects the loading of the sand around them (de Groot et al. 2006). Geotechnical consultation may provide Project specific methods of mitigation.

11.2.2.1.2 GAS HYDRATES

While gas hydrates occur naturally throughout the OCS of the GOM, the portion of the continental shelf crossed by the proposed pipeline is considered too shallow to support the natural formation of gas hydrates (Frye 2008). Although seafloor features such as faults and salt domes have been known to correlate with significantly shallower instances of gas hydrate formation, the current alignment does not cross any of these features (Beckman and Williamson 1990; Chowdhury and Turco 2006; Galloway 2008).

11.2.2.1.3 SUBSIDENCE

Seabed subsidence can occur in the Gulf Coast region due commonly to the erosion of salt diapirs or the collapse of karst structures (Garrison and Martin 1973). Although concentrations of salt domes and diapiric formations do persist throughout the coastal plain of Texas in areas further south within the Rio Grande Embayment, further north within the Houston Embayment, and further seaward into the GOM, the current alignment does not cross any known mineral deposits of this kind.

11.2.2.2 Mineral Resources

11.2.2.2.1 OIL AND GAS

The Proposed Project DWP lies at the eastern terminus of the Propose Project offshore pipeline alignment and is located approximately 11 mi into the OCS oil and gas resource play known as the Shelf Unit (BOEM 2019b). The inner continental shelf is primarily composed of clastic sediments deposited throughout the mid-to-late Cenozoic Age, the loading of which caused the deformation of the underlying Louann salt and produced many structures favorable for the entrapment of hydrocarbons (BOEM 2017). The Proposed Project alignment approaches the Lunker fault system (Upper Oligocene to Lower Miocene) and Clemente-Tomas fault system (Lower Miocene), which have been thoroughly explored for decades, although little exploration is currently taking place due to the maturity of the overall trend (BOEM 2017). OCS lease blocks intersected by the current alignment (695,696, 697, 698, and 699) do not contain any active BOEM oil and gas leases (BOEM 2019a, 2019b). The nearest active leases are located approximately 4 mi south of the Project in block 726 (lease number G20605) and approximately 11 mi northeast in block 654 (lease number G34671).

Data obtained from the Texas GLO via the Land and Lease Mapping Viewer was utilized to determine lease blocks intersected by the current alignment and the current and historical mineral explorations within the 10 mi of state-governed waters extending east from San Jose Island and waters within Redfish Bay and Aransas Pass. Intersected lease blocks offshore include 848, 849, 850, 845, 721, 839, 838, 837, 693, 694, and 695. There are no active leases in any of the intersected blocks, nor within a mile of the Proposed Project alignment (TXGLO 2019). Within one mile of the alignment, five active gas wells, three abandoned oil wells, six abandoned gas wells, and 23 dry holes are located in state waters. Intersected lease blocks within Redfish Bay and Aransas Pass include 306 and 1. There are no active leases in the intersected blocks, though there are several active leases in nearby blocks in Redfish Bay. A total of 17 active gas wells, three active oil wells, five temporarily abandoned gas wells, five abandoned gas wells, seven abandoned oil wells, and eight dry holes are located within 1 mile of this segment of the alignment. While areas surrounding the Project have historically been site to hydrocarbon resource exploration and extraction, development has slowed in recent years in the region as evident by the number of historic leases in the area, and thus the Project is not expected to impact nearby hydrocarbon resources.

11.2.2.2.2 OFFSHORE SEDIMENT SOURCES

As mentioned in Section 11.2.1.2, the Texas-Louisiana shelf is marked by subtle relict features, such as stream channels and shorelines, formed when sea levels were lower due to glaciation (Garrison and Martin 1973). Sediments deposited here as late as the early Holocene, arrived via fluvial transport. The relict sediment cover on most of the GOM inner continental shelf is limited to shore-parallel sand sediment bodies which are likely to be relict barrier islands, covered during rapid sea-level change during the Pleistocene epoch. Most of these relict barrier features date to the late Pleistocene or early Holocene (Davis 2017). A thin, modern sediment blanket can be found overlying the older, fluvio-deltaic sediments deposited during Quaternary minimum sea levels. These sediments are imported from three modern drainage systems: the Mississippi River, the south Texas intra-deltaic ramp, and the Rio Grande delta complex. Moving further east to the OCS, a thick blanket of mud (up to a couple hundred feet in depth) represents the second largest area of maximum deposition on the continental shelf after the Mississippi Delta. This blanket, mostly deposited in the late Holocene (last 3,000 years) is believed to have originated from the production of mud by the Brazos, Colorado, and Mississippi Rivers (Davis 2017).

11.2.2.3 Onshore Soil Series

Soils within the Proposed Project area formed in sand-dominated sediments deposited by the aeolian and alluvial processes at work since the stabilization of sea level during the late Holocene. Data from the Natural Resource Conservation Service (NRCS) was utilized to create a table and figure illustrating all soil units crossed by the Project area (Table 11-1; Figures 11-3 and 11-4). Soils in the coastal prairie surrounding Aransas Pass are primarily composed of vertisols with a higher presence of the mineral smectite in the clay fraction (NRCS 2019a). Typical soil series in the area consist of Mustang fine sands and Dianola soils further inland, Ijam clay loam, Mustang fine sand, and Tidal flats along Stedman and Harbor islands, and Psamments and Beaches along San Jose island (NRCS 2017, 2019b).

Table 11-1: NRCS Soil Descriptions intersected by the Project area.

County	Soil Map Unit	Primary soil components	Texture	Location	Description	Minor soil components	Prime Farm-land	Acres
Aransas	Beaches (By)	Beaches (90%)	Sand	Beaches	Slopes 0 to 2 percent. This component is on beaches derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is very poorly drained. This soil is frequently flooded.	Barrada (4%) Tatton (3%) Mustang (3%)	No	3.92
Aransas	Dianola Soils (Ds)	Dianola and similar soils (85%)	Loamy fine sand	Strand plains	Slopes are 0 to 1 percent. This component is on strand plains on low coastal plains. The parent material consists of loamy fluviomarine deposits of Quaternary age. The natural drainage class is poorly drained. This soil is frequently flooded. It is not ponded.	Dietrich (3%), Mustang (3%), Aransas (3%), Barrada (3%), Tatton (3%)	No	0.38
Aransas	Galveston-Mustang complex, 0 to 3 percent slopes, occasionally flooded, frequently ponded (GM)	Galveston and similar soils (50%) Mustang and similar soils (30%)	Fine sand	Foredunes	Slopes are 0 to 3 percent. This component is on foredunes. The parent material consists of sandy eolian deposits derived from igneous metamorphic and sedimentary rock. This soil is occasionally flooded and frequently ponded.	Barrada (5%) Dianola (5%) Dietrich (5%) Tatton (5%)	No	10.00
Aransas	Mustang fine sand, 0-1% slopes, occasionally flooded, frequently ponded (Mu)	Mustang (85%)	Fine sand	Barrier flats	Slopes are 0 to 1 percent. This component is on shallow depressions on barrier flats on barrier islands. The parent material consists of storm washover and sandy eolian deposits derived from igneous, metamorphic and sedimentary rock. The natural drainage class is poorly drained. This soil is occasionally flooded. It is frequently ponded.	Malaquite (4%), Padre (3%), Arrada (2%), Daggerhil (2%), Barrada (2%), Tatton (2%)	No	22.03
Aransas	Psamments, rarely flooded (Ps)	Psamments (80%)	Fine sand	Foredunes, dune fields	Slopes are 0 to 3 percent. This component is on foredunes on barrier islands. The parent material consists of sandy eolian deposits. The natural drainage class is well drained. This soil is rarely flooded. It is not ponded.	Tatton (5%), Mustang (5%), Dianola (5%)	No	1.14
Aransas	Water (W)	Water (100%)	-	-	-	-	No	250.58

Nueces	Ijam clay loam, rarely flooded (Ma)	Ijam and similar soils (85%)	Clay loam Clay	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of clayey dredge spoils derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is poorly drained. This soil rarely floods and does not pond.	Unnamed (15%)	No	40.29
Nueces	Mustang fine sand, 0 to 1 percent slopes, occasionally flooded, frequently ponded (Mu)	Mustang and similar soils (85%)	Fine sand	Barrier flats	Slopes 0 to 1 percent. This component is on barrier flats. The parent material consists of storm washover and sandy eolian deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is poorly drained. This soil occasionally floods and frequently ponds.	Malaquite(4%) Padre (3%) Arrada (2%) Daggerhill (2%) Barrada (2%) Tatton (2%)	No	56.51
Nueces	Tidal flats, occasionally ponded (Ta)	Tidal flats (70%)	Fine sand Loamy fine sand	Tidal flats	Slopes 0 to 1 percent. This component is on tidal flats. The parent material consists of loamy fluviomarine deposits. The natural drainage class is very poorly drained. This soil occasionally ponds.	Unnamed (30%)	No	0.02
San Patricio	Aransas clay, 0 to 1 percent slopes, slightly saline, moderately sodic, frequently flooded (As)	Aransas and similar soils (90%)	Clay	Flood plains	Slopes are 0 to 1 percent. This component is within floodplains. The parent materials consist of Holocene age clayey alluvium derived from sedimentary rock. The natural drainage class is poorly drained. The soil is frequently flooded. This soil does not pond.	Rhydolph (3%) Placedo (3%) Barrada (2%) Swan (2%)	No	8.27
San Patricio	Dianola Soils (Ds)	Dianola and similar soils (85%)	Loamy fine sand	Strand plains	Slopes are 0 to 1 percent. This component is on strand plains on low coastal plains. The parent material consists of loamy fluviomarine deposits of Quaternary age. The natural drainage class is poorly drained. This soil is frequently flooded. It is not ponded.	Dietrich (3%), Mustang (3%), Aransas (3%), Barrada (3%), Tatton (3%)	No	2.38
San Patricio	Dietrich loamy fine sand, 0 to 1 percent slopes, very rarely flooded (Dt)	Dietrich and similar soils (90%	Fine sand Sandy clay loam	Strand plains	Slopes are 0 to 1 percent. This component is on strand plains. The parent material consists of quaternary age loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is poorly drained. The soil is	Mustang (5%) Dianola (3%) Narta (2%)	No	11.18

					very rarely flooded and does not pond.			
San Patricio	Banquete clay, 0 to 1 percent slopes (Ec)	Banquete and similar soils (85%)	Clay Fine sandy loam	Flats	Slopes are 0 to 1 percent. This component is found on flats. The parent material consists of clayey fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock over loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is moderately well drained. The soil does not flood or pond.	Victoria (5%) Cranell (5%) Edroy (5%)	Yes (Farmland of statewide importance)	10.82
San Patricio	Galveston-Mustang complex, 0 to 3 percent slopes, occasionally flooded, frequently ponded (GM)	Galveston and similar soils (50%) Mustang and similar soils (30%)	Fine sand	Foredunes	Slopes are 0 to 3 percent. This component is on foredunes. The parent material consists of sandy eolian deposits derived from igneous metamorphic and sedimentary rock. This soil is occasionally flooded and frequently ponded.	Barrada (5%) Dianola (5%) Dietrich (5%) Tatton (5%)	No	16.52
San Patricio	Mustang fine sand, 0-1% slopes, occasionally flooded, frequently ponded (Mu)	Mustang (85%)	Fine sand	Barrier flats	Slopes are 0 to 1 percent. This component is on shallow depressions on barrier flats on barrier islands. The parent material consists of storm washover and sandy eolian deposits derived from igneous, metamorphic and sedimentary rock. The natural drainage class is poorly drained. This soil is occasionally flooded. It is frequently ponded.	Malaquite (4%), Padre (3%), Arrada (2%), Daggerhil (2%), Barrada (2%), Tatton (2%)	No	9.39
San Patricio	Narta loam, 0 to 1 percent slopes, rarely flooded (Na)	Narta and similar soils (90%)	Loam Clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is poorly drained. The soil rarely floods and doesn't pond.	Victine (5%) Aransas (4%) Dietrich (1%)	No	18.98
San Patricio	Orelia fine sandy loam, 0 to 1 percent slopes (Or)	Orelia and similar soils (90%)	Fine sandy loam Sandy clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is well drained. The soil does not flood or pond.	Wyick (5%) Greta (3%) Edroy (2%)	No	15.82

San Patricio	Calallen sandy clay loam, 0 to 1 percent slopes (Os)	Calallen and similar soils (85%)	Sandy clay loam Clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of late Pleistocene age loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is well drained. This soil does not flood or pond.	Cranell (10%) Edroy (5%)	No	15.12
San Patricio	Papalote fine sandy loam, 0 to 1 percent slopes (PaA)	Papalote and similar soils (85%)	Fine sandy loam Sandy clay Sandy clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of loamy fluviomarine deposits. The natural drainage class is moderately well drained. This soil does not pond or flood.	Unnamed (10%) Edroy (5%)	Yes	18.74
San Patricio	Raymondville clay loam, 0 to 1 percent slopes (RaA)	Raymondville and similar soils (90%)	Clay loam Clay	Meander scrolls	Slopes are 0 to 1 percent. This component is on meander scrolls. The parent material consists of loamy fluviomarine deposits of late Pleistocene age. The natural drainage class is moderately well drained. This soil does not pond or flood.	Edroy (5%) Unnamed (5%)	Yes	68.88
San Patricio	Raymondville clay loam, 1 to 3 percent slopes (RaB)	Raymondville and similar soils (90%)	Clay loam Clay	Meander scrolls	Slopes are 1 to 3 percent. This component is on meander scrolls. The parent material consists of loamy fluviomarine deposits of late pleistocene age. The natural drainage class is moderately well drained. This soil does not flood or pond.	Unnamed (10%)	Yes	29.91
San Patricio	Victoria clay 0 to 1 percent slopes (VcA)	Victoria and similar soils (97%)	Clay	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of clayey fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is well drained. This soil does not pond or flood.	Cranell (2%) Edroy (1%)	Yes	0.66
San Patricio	Victoria clay, depressional (Vd)	Victoria and similar soils (90%)	Clay	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of clayey fluviomarine deposits. The natural drainage class is well drained. This soil does not pond or flood.	Edroy (5%) Unnamed (5%)	No	137.91
San Patricio	Willacy fine sandy loam, 0 to 1 percent (WfA)	Willacy and similar soils (90%)	Fine sandy loam Sandy clay loam	Terraces	Slopes are 0 to 1 percent. This component is on terraces. The parent material consists of calcareous loamy alluvium. The natural drainage class is well drained.	Unnamed (10%)	Yes	38.37

					This soil does not flood or pond.			

Source: NRCS 2017, 2019b.

Figure 11-3 Soils map of the western portion of the Project area.

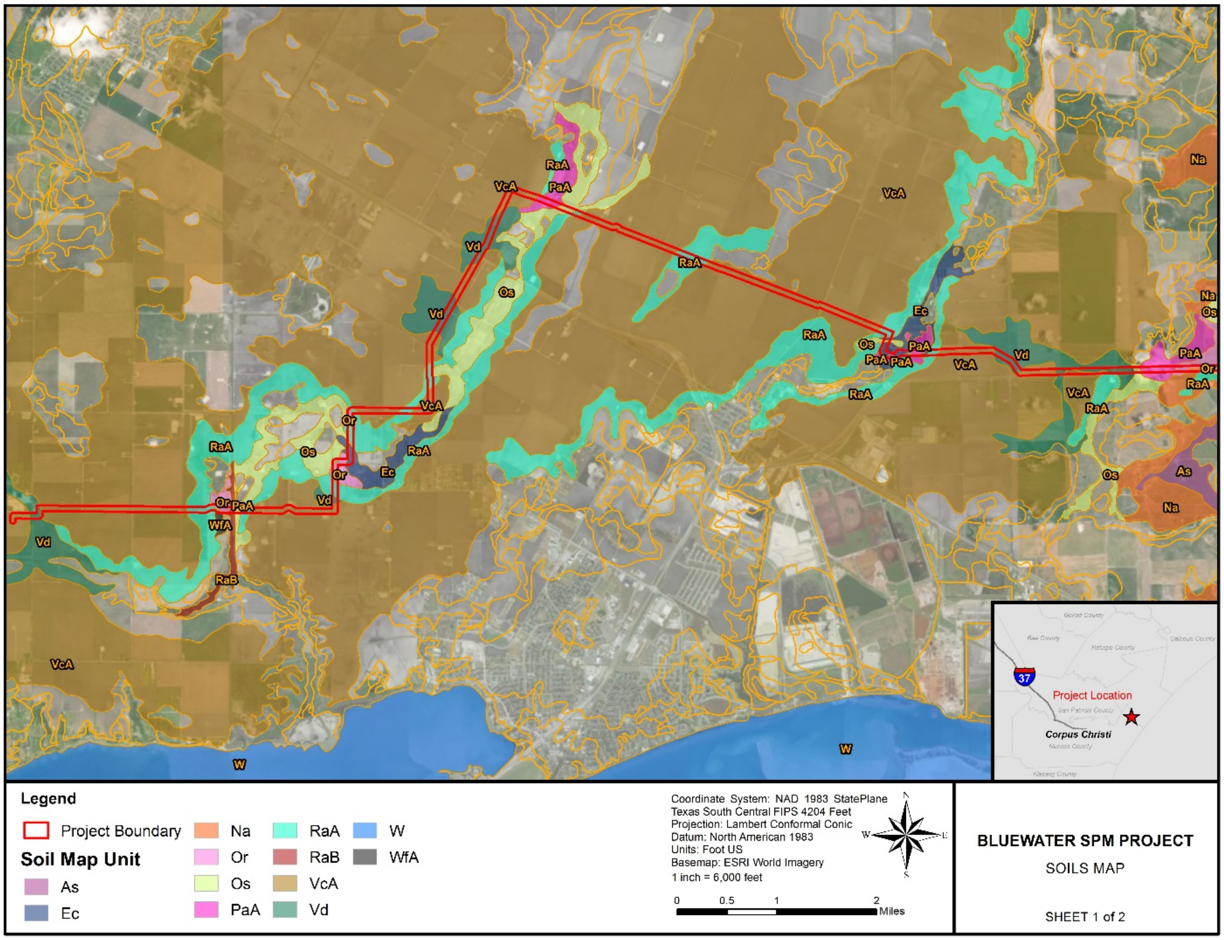
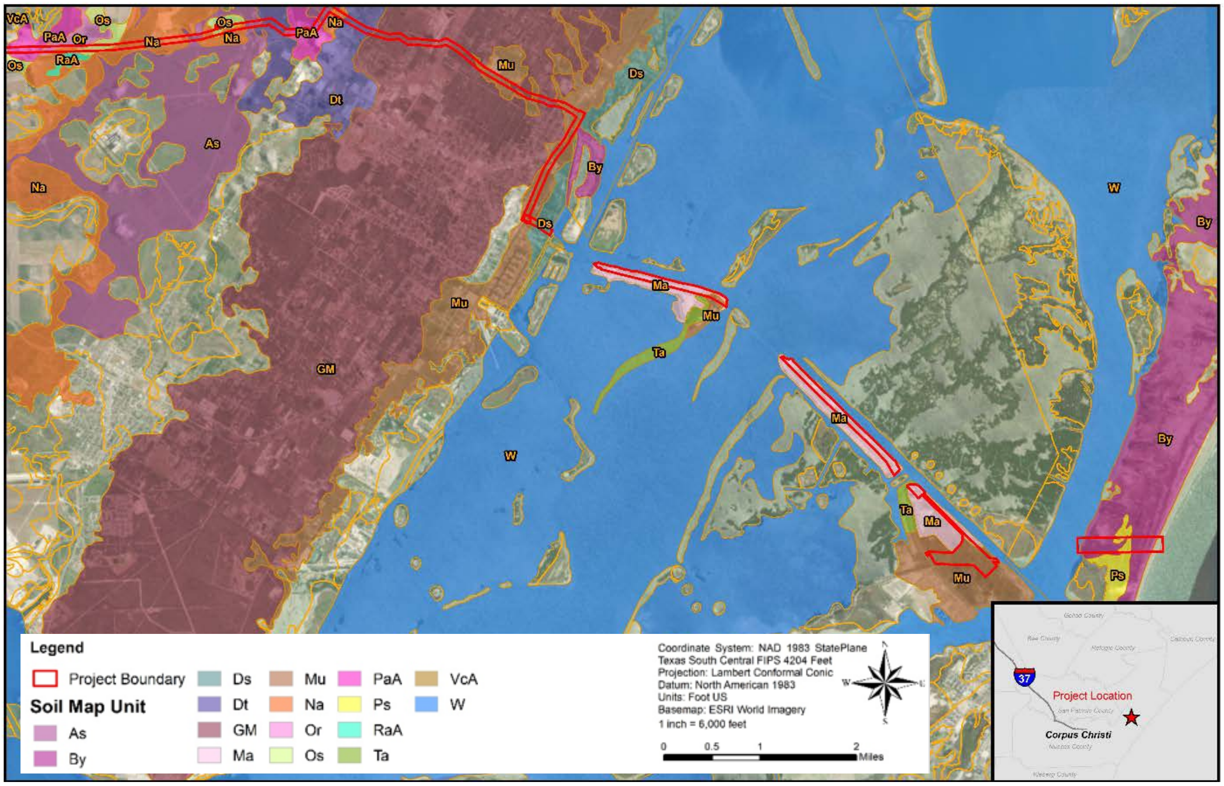


Figure 11-4: Soils map of the central portion of the Proposed Project area.



11.2.2.4 Prime Farmlands

By the NRCS definition of prime farmlands, 26 percent of soils within the project area are classified as prime farmland soils (NRCS 2007).

Prime farmland soils were determined to be present within the Proposed Project boundary located within San Patricio County. These soils include: Banquete Clay, 0 to 1 percent slopes (Ec) (which is recognized as prime farmland of statewide importance) and encompasses approximately 10.82 acres within the project area; Papalote fine sandy loam, 0 to 1 percent slopes (PaA), which encompasses 18.74 acres within the project area; Raymondville clay loam, 0 to 1 percent slopes (RaA) , which encompasses 29.91 acres within the project area; Raymondville clay loam, 1 to 3 percent slopes (RaB), which encompasses 0.66 acres within the project area; Victoria clay 0 to 1 percent slopes (VcA), which encompasses 137.91 acres within the project area; and Willacy fine sandy loam, 0 to 1 percent (WfA), which encompasses 0.33 acre within the project area (NRCS 2017).

11.2.2.5 Geotechnical Surveys

A geotechnical survey conducted for the Proposed Project provides detailed information regarding HDD construction impacts collected through geotechnical borings and cohesive soil sampling within the alignment area (Volume I)

Test borings were conducted by geotechnical engineering technicians who obtained soil samples at approximately 5-ft depth intervals for the full boring depths. Borings were then filled with a cement-bentonite grout. Push thin-wall tubes with an inner diameter (ID) of 2.87 inches were utilized to obtain cohesive soil samples. Thin-wall tubes were extruded in the field and intact specimens were wrapped in protective foil and placed in plastic tubes. Within areas of low cohesion silts and sands, sampling was performed utilizing standard penetration methods. Driving resistance was recorded while performing standard penetration tests. Samples were then delivered to the Tolunay-Wong Engineering, Inc. (TWEI) laboratory for analyzation (TWEI 2019).

Geotechnical considerations for this project were considered for HDD installations and mainly involve the identification of gravelly soils and loose granular deposits. These soils can be problematic to HDD operations and can result in hydraulic fracturing and loss of circulation. Test borings within the alignment generally yielded either sand or clay soils. Sandy soils have the potential to result in HDD impacts that include loss of circulation and borehole instability. Clay soils have the potential to result in HDD impacts that include increased viscosity of drilling muds, borehole swelling, and hydraulic fracturing.

11.2.2.6 Inshore and Offshore Sediments

Inshore and offshore sediment samplings obtained from the usSEABED database have been compiled to provide a representative picture of inshore sediments occurring near the Proposed Project area (Table 11-2; Figure 11-5) and for offshore sediments occurring near the Proposed Project area (Table 11-3; Figure 11-6).

Table 11-2: Inshore Sediments near Proposed Project Area (USGS 2006)

Site Name	Distance Offshore	Distanced from Proposed Project Area	Folk Code	Shepard Code
TBEG_1423	7.4	1.8	Slightly Gravelly Sand	Sand
TBEG_RFB21	0.8	0.9	Gravelly Mud	Gravelly Sediment
TBEG_RFB11	1.8	2.6	Gravelly Muddy Sand	Gravelly Sediment
TBEG_RFB15	1.5	1.4	Gravelly Muddy Sand	Gravelly Sediment
TBEG_AB3	3.2	3.1	Gravelly Sand	Gravelly Sediment
TBEG_RFB24	2.6	1.6	Gravelly Sand	Gravelly Sediment
LA93SR29	5.7	2	Muddy Sand	Sand
TBEG_RFB8	2.8	2.9	Sand	Sand
TBEG_RFB18	2.6	0.2	Sandy Mud	Clayey Silt
TBEG_RFB17	1.6	0.5	Slightly Gravelly Mud	Silty Sand
TBEG_RFB19	2.7	0.7	Slightly Gravelly Mud	Sand
TBEG_1423	7.4	1.8	Slightly Gravelly Sand	Sand

Figure 11-5: Bathymetric map of inshore Project area including seafloor sediment sample data

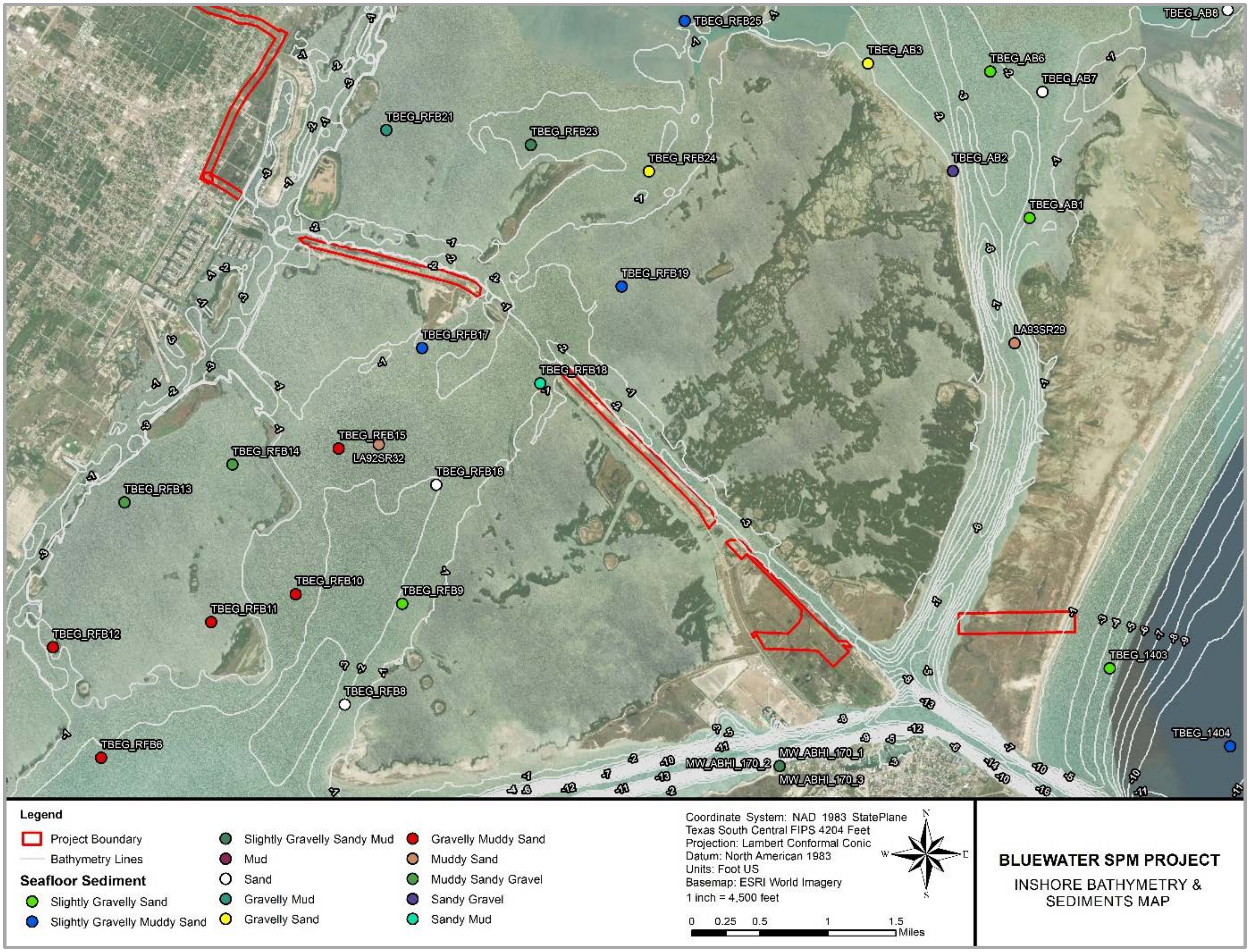
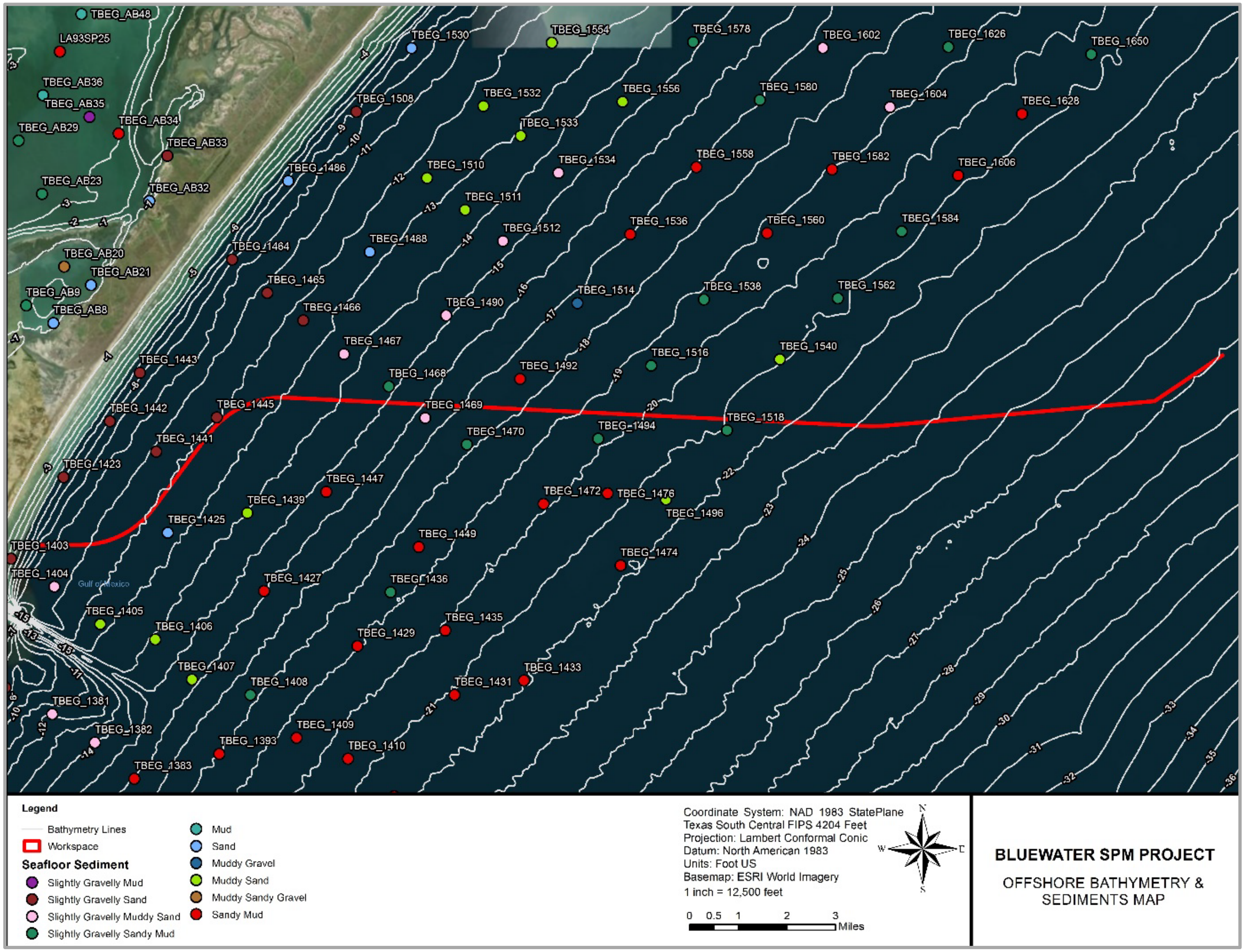


Table 11-3 Offshore Sediments near Project Area (USGS 2006)

Site Name	Distance Offshore	Distanced from Proposed Project Area	Folk Code	Shepard Code
TBEG_1403	0.4	0.4	Slightly Gravelly Sand	Sand
TBEG_1404	1.4	0.8	Slightly Gravelly Muddy Sand	Sand
TBEG_1425	3	0.5	Sand	Sand
TBEG_1435	9.1	4.6	Sandy Mud	Sandy Silt
TBEG_1445	2.5	0.1	Slightly Gravelly Sand	Sand
TBEG_1468	5	0.3	Slightly Gravelly Sandy Mud	Sandy Silt
TBEG_1469	6	0.3	Slightly Gravelly Muddy Sand	Sand
TBEG_1492	7.1	0.6	Sandy Mud	Sandy Silt
TBEG_1496	10.9	1.7	Muddy Sand	Silty Sand
TBEG_1514	7.1	2.2	Muddy Gravel	Gravelly Sediment

Figure 11-6: Bathymetric map of offshore Project area including seafloor sediment sample data



11.2.2.7 Inshore and Offshore Sediment Quality

Toxic substances and pesticides are discharged into GOM estuaries from industrial and municipal discharges, urban and agricultural runoff, accidental spills, and atmospheric deposition. These activities can often have adverse effects on estuarine and nearshore habitats. From 1991 to 1997, the U.S. Coast Guard received an annual average of 6,217 notifications of oil or chemical spills in GOM ports (USEPA 1999). Chemicals that enter estuaries are often bound to suspended particulate matter that eventually deposits on the sediment surface. Sediment deposition and accumulation rates in an estuary depend greatly on the rate of freshwater inflow and access to flushing from the GOM.

After deposition in the sediment, toxic chemicals may be available for uptake by benthic organisms. Bioavailability is dependent on sediment characteristics, including concentrations of total organic carbon and acid-volatile sulfide. Some chemicals are acutely toxic, resulting in death of the animal; others may have chronic toxicity effects, affecting growth or reproduction. Toxic chemicals can affect humans because they may become biomagnified as they are stored in animal tissue and transferred through the food chain. When sediment chemistry information is combined with sediment toxicity data and benthic health indicators, a better assessment of overall sediment quality can be accomplished.

Evaluation of the potential effects of contaminated sediments on estuarine organisms is difficult because few applicable state or federal regulatory criteria exist to determine “acceptable” sediment concentrations for most identified potential chemical compounds of concern. However, informal guidelines based on many field and laboratory studies have been suggested. These include benchmarks such as effects range-low and effects range-median values (Long et al. 1995), which enable environmental managers to determine whether contaminated sediments have the potential to adversely affect aquatic organisms.

A study conducted by Freese and Nichols, Inc. for the Texas GLO in 2016 provides data that illustrates levels of trace metals and contaminants within the Corpus Christi Bay Complex, a network of waterbodies that includes Redfish Bay. Sources of contaminants within the Corpus Christi Bay Complex include the Nueces River, urban and industrial runoff, and the GOM. Reportedly, sediments within the complex have shown high concentrations of heavy metals such as arsenic, barium, copper, mercury, nickel, and selenium. However, while these trace metals have been identified in widespread distribution, no hot spots for contaminants were detected. (Freese and Nichols 2016).

Moving offshore from the Texas coast, contaminant levels decrease rapidly (Kennicutt 2017). Natural oil and gas seepage are the primary contributors to traces of petroleum detected on the continental shelf and slope. Still, few human-caused releases of petroleum in the region make their way into the underlying sediments, except for metal-contaminated drill muds and cuttings and petroleum discharges from nearby platforms. The activity of currents normally aids in the dilution of these contaminated sediments with surrounding, uncontaminated sediments. These localized contaminated sediment deposits have been interpreted as having limited impact. In summary, concentrations of contaminants and trace metals are considerably lower in the offshore region, where pesticides and polychlorinated biphenyls are generally absent, than in coastal regions.

11.2.3 Proposed Project Impacts

Adverse impacts on geological resources may occur when an activity is likely to damage or disturb a unique geological feature, induce soil erosion, modify seafloor stability, affect sediments, or affect mineral resources. Unique geological features present within the Proposed Project area include dunes located on the eastern shoreline of San Jose Island and localized normal faults. The Proposed Project is likely to affect soils and sediments as a result of construction activities. Seafloor stability has been protected using through strategic route planning. Apart from affecting the sediment itself, sediment disturbance would likely result in temporary minor impacts on water quality and marine resources (see Section 4 – Water Quality). Construction, operation and decommissioning procedures and detailed maps can be referenced in Appendix A.

11.2.3.1 Seafloor Sedimentary Processes

Construction of the inshore and offshore pipeline segments may cause minor to negligible disturbance to seafloor sedimentary processes, resulting in sediment displacement and increased turbidity, as well as increased scour resulting from the presence of equipment and materials at or near the seafloor. Upon the completion of the Project, pipeline trenches are expected to backfill naturally, returning the sea floor to the pre-excavation contours and consequently, to the pre-floor seafloor sedimentary regime.

Seafloor sedimentary processes may be affected by operation of the DWP, as the SPM buoys will be anchored to the seafloor with prefabricated anchor pilings, and the Pipeline Ending Manifold (PLEM) will likely be set on a piled foundation to enhance stability. Connections from the anchor pilings to the SPM buoy will be constructed with chains, limiting hydrodynamic effects. In addition, the offshore pipelines will be connected to the PLEM, which will be connected to the SPM by flexible hoses. However, scour, or the removal of granular bed material by hydrodynamic forces, could occur when hydrodynamic stresses are greater than sediment shear stresses. Scour can cause changes in local turbidity concentrations and result in sediment disruption and movement due to changing tides and currents. Current forces in the GOM near the site and the local sediment types would determine the level of the scour effect. The relatively slow tidal/current speeds and soft-bottom sediments in the vicinity suggest that scour would be minor, short-term, and local.

Removal of the DWP should not affect seafloor sedimentary processes. Geologic impacts on the seafloor during decommissioning would be similar to installation, as all materials will be removed. This would involve the re-excavation of sediments deposited within the trench, and disturbance of sediments around the SPM buoy. Since the terminal would be in an area of sediment reworking, any scars are expected to be temporary and reversible, thereby resulting in negligible geologic impacts on the seafloor.

11.2.3.2 Mineral Resources

Based on review of available geologic data, no currently exploitable mineral resources are present within the Project area. A 2013 USGS study found that there are unlikely to be major new undiscovered oil accumulations in this region (Frio Expanded Fault Zone Oil and Gas AU) due to the geology of the region and because of the maturity of oil production in the area (Swanson et al. 2013). The potential for gas discoveries was slightly higher but still low, likely in deep deposits. While the DWP would be located in the western end of the Shelf Unit play, there are no proven or unproven reserves near the Project alignment (BOEM 2018). Should this play be developed, it would require horizontal directional drilling, thus access to these potential, unproven reserves could easily avoid the Project area. Therefore, there would be no impacts on mineral resources from the proposed Project.

11.2.3.3 Geologic Hazards

Geologic hazards within the Proposed Project area include faulting, soil liquefaction, gas hydrates, and subsidence (See section 11.2.2.1). Faulting in the vicinity is low and has exhibited a low degree of seismicity. Conditions in the vicinity are susceptible to soil liquefaction, especially during storms, and have potential to damage or destroy portions of the Project. Gas hydrates and subsidence are affected by the presence of faults and salt diapirs, neither of which are present within the Project area, limiting the risk of such hazards. The proposed Project would not affect the occurrence of faulting, gas hydrate formation, or subsidence. Soil liquefaction may be affected by the presence of the pipeline and DWP anchor and foundation pilings, but the effect would be minor to negligible.

11.2.3.4 Proposed Project Construction Impacts

11.2.3.4.1 ONSHORE

During construction, minor, adverse impacts on soils and sediments within the pipeline construction corridor can be expected. Disturbance of soils within the terrestrial portion of the Project area would result in the increased potential for erosion, compaction, and mixing of topsoil. These impacts would be temporary, minor, and reversible. On land, trench topsoil and subsoil would be segregated to prevent mixing, and would be returned to trenches in proper order, with the ground surface returned to pre-excavation contours. During construction, BMPs including but not limited to silt fencing, matting, and hay bales would be utilized to present erosion. The construction area would be allowed to re-vegetate naturally. The sensitive depositional environment of the seaside dunes would be avoided through an HDD beginning west of the dune protection line, 1,000 feet west of the mean high tide line. Erosion on tidal flats and beaches lacking vegetation would also be mitigated by use of HDD through these areas. Construction-related activities such as vehicle refueling, and hydraulic fluid storage/use, would pose a potential risk of spilling hydrocarbons onto native soils in the Project area. Adequate spill prevention, control and countermeasure (SPCC) planning would mitigate for this.

Potential impacts to soils may occur from an HDD drilling mud inadvertent return (IR) to the land surface (i.e., "frac out"). HDD drilling mud consists of approximately 96% bentonite, with the remainder including barium sulfate, detergents, and other proprietary additives. Drilling mud is considered non-toxic. In most instances, IRs can be cleaned up with vacuum trucks and hoses with no further action required. It is important for construction contractors to contain any IR which occurs, thereby preventing migration into adjacent waterbodies. Preparation and implementation of a comprehensive IR Contingency Plan would mitigate for potential negative IR impacts to soils.

11.2.3.4.2 INSHORE AND OFFSHORE

Disturbance of sediments and increases in turbidity within the submerged portions of the Project area can be expected by pipeline installation, anchor piling installation, and through the direct contact of anchors or supports from jack up work boats. These impacts would be temporary, minor, and reversible. Offshore portions of the proposed Project would be installed within a 75-foot-wide construction corridor using jet-sled techniques. Pipelines would be installed at a minimum of 3 feet below the mud line and would be allowed to backfill naturally as well as backfilled by the amphibious trencher. At the DWP location, the SPM would be anchored to the seafloor with prefabricated anchor pilings. Depth of impacts would be determined by the local refusal conditions. Piling installation may be expected to result in minor sedimentary mixing and increased local turbidity by forcing more deeply buried deep sediments to the surface. Local, minor, temporary effects could be expected to sediments and turbidity within the Project area. Use of an adequate, comprehensive IR Contingency Plan would mitigate for potential negative impacts to Inshore sediments (see above).

11.2.3.5 Proposed Project Operation Impacts

11.2.3.5.1 ONSHORE

Terrestrial impacts to soils and sediments would be negligible during pipeline operation. Vegetation clearing would be required along some portions of the pipeline corridor and the resulting pipeline ROW would be maintained following pipeline construction. Maintenance-related activities would include mowing and maintaining the project ROW and impacts to local soils would be negligible. Maintenance activities such as vehicle refueling, and hydraulic fluid storage/use, would pose a potential risk of spilling hydrocarbons onto native soils. These spills could be adequately mitigated through adequate implementation of adequate controls on the location of fuel and fluid storage and refueling locations, as described in the operational SPCC and spill response plans.

11.2.3.5.2 INSHORE AND OFFSHORE

Due to the lack of anchorage at the DWP, no seafloor disturbing impacts would be expected from the operation of the DWP. However, scour, or the removal of granular bed material by hydrodynamic forces, could occur when hydrodynamic stresses are greater than sediment shear stresses. Scour can cause changes in local turbidity concentrations and result in sediment disruption and movement due to changing tides and currents. Current forces in the GOM near the site and local sediment types would determine the level of the scour effect. The relatively slow tidal/current speeds and soft-bottom sediments in the vicinity suggest that scour would be minor, short-term, and local.

11.2.3.6 Proposed Project Decommissioning Impacts

11.2.3.6.1 ONSHORE

No impacts to geologic resources including soils and vegetation would occur during decommissioning as the Proposed Project onshore components would be decommissioned in-place according to industry standards and practices.

11.2.3.6.2 INSHORE

No impacts to geologic resources including soils and vegetation would occur during decommissioning as the Proposed Project inshore components would be decommissioned in-place according to industry standards and practices.

11.2.3.6.3 OFFSHORE

Removal of the DWP should not affect seafloor sedimentary processes. Geologic impacts on the seafloor during decommissioning would be similar to installation, as all materials will be removed. This would involve the re-excavation of sediments deposited within the trench, and disturbance of sediments around the SPM buoy. Since the terminal would be in an area of sediment reworking, any scars are expected to be temporary and reversible, thereby resulting in negligible geologic impacts on the seafloor.

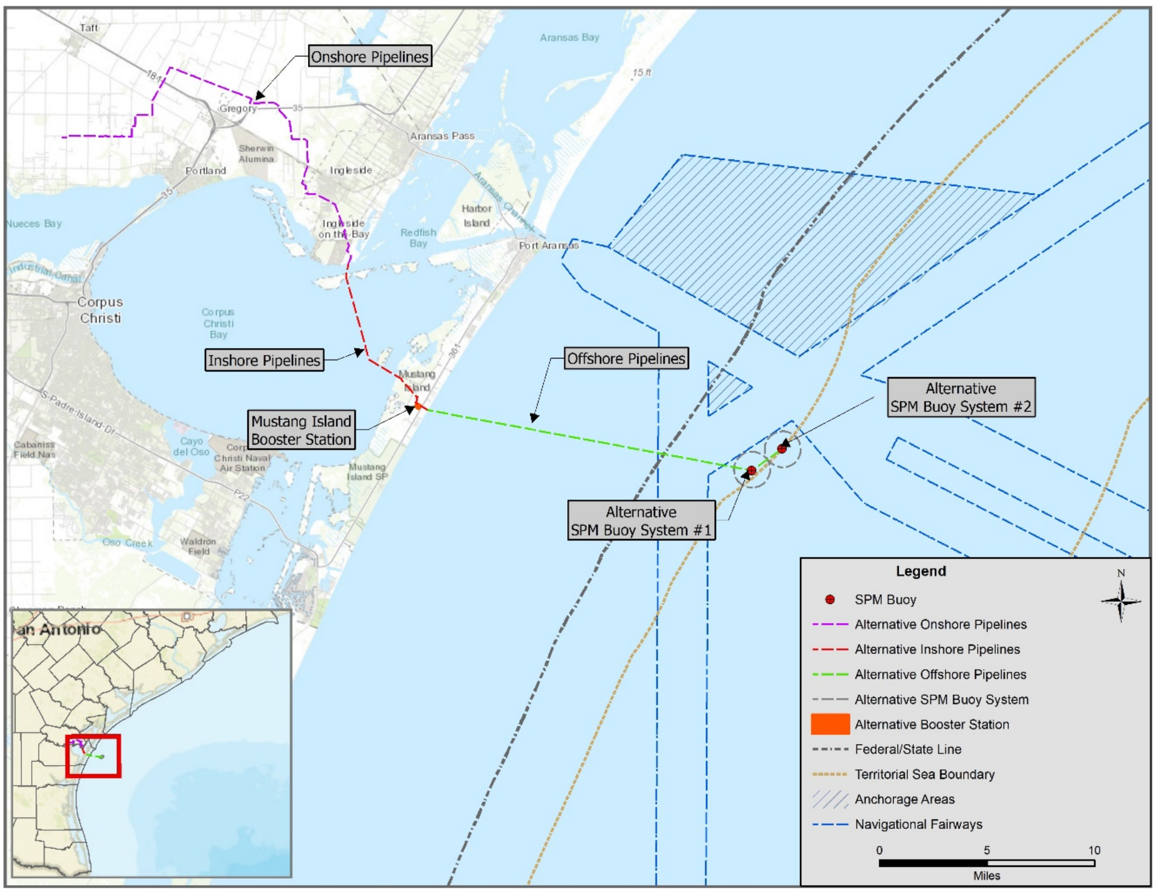
11.3 Alternative Project

11.3.1 Alternative Project Area

An alternative route assessment was considered in which to construct approximately 56.48 mi of pipeline infrastructure as well as a booster station (Alternative Project) within the State of Texas that continues into the GOM (Figure 11-7). The Alternative Project is comprised of three segments: Offshore, Inshore, and Onshore.

Offshore components associated with the Alternative Project are defined as those components located seaward of the mean high tide (MHT) line located at the interface of Mustang Island and the GOM. The Offshore Alternative Project components include approximately 17.07 mi of two (2) new 30-inch-diameter crude oil pipelines extending to two (2) SPM buoy systems.

Figure 11-7: Alternative Project Vicinity Map



Inshore components associated with the Alternative Project are defined as those components located between the northern Corpus Christi Bay MHT line and the MHT line located at the interface of Mustang Island and the GOM. Inshore Alternative Project components includes approximately 8.45 mi of two (2) new 30-inch-diameter crude oil pipelines, and an approximate 19-acre booster station located on Mustang Island.

Onshore Alternative Project components includes approximately 23.10 mi of two (2) new 30-inch-diameter crude oil pipelines extending from the landward side approximately 2.5 mi north of Nueces Bay to the MHT line of the Corpus Christi Bay located south of Ingleside in San Patricio County, Texas.

Due to the proximity of the Alternative Project to the Proposed Project, similar geologic conditions exist throughout the project setting. See section 11.2.1. for a description of the geological setting of the region.

11.3.2 Alternative Project Existing Conditions

11.3.2.1 Geologic Hazards

11.3.2.1.1 FAULTS AND SOIL LIQUEFACTION

The Alternative Project alignment is not located near any major fault systems and has a similar susceptibility to soil liquefaction as the Proposed Project (Wheeler and Heinrich 1998; Chowdhury and Turco 2006; Galloway 2008). See section 11.2.2.1.1. for a further description of the geologic setting relating to faults and soil liquefaction for the region.

11.3.2.1.2 GAS HYDRATES

Similar to the Proposed Project, the Alternative Project route does not cross any gas hydrates (Frye 2008), nor any faults or salt domes (Beckman and Williamson 1990; Chowdhury and Turco 2006; Galloway 2008). See section 11.2.2.1.2.

11.3.2.1.3 SUBSIDENCE

Similar to the Proposed Project, the Alternative Project does not cross any known salt diapirs or karst structures and is unlikely to be susceptible to subsidence (Garrison and Martin 1973). See section 11.2.2.1.3.

11.3.2.2 Mineral Resources

11.3.2.2.1 OIL AND GAS

There are more active oil and gas leases near the Alternative Project than the Proposed Project.

The DWP location for the Alternative Project lies at the eastern terminus of the current alignment and is located approximately 1.4 mi into the OCS oil and gas resource play known as the Shelf Unit (BOEM 2019b). The one OCS lease block intersected by the current alignment (770) does not contain any active BOEM oil and gas leases and there are no active leases nearby (BOEM 2019a, 2019b).

Data obtained from the Texas GLO via the Land and Lease Mapping Viewer was utilized to determine lease blocks intersected by the current alignment and the current and historical mineral explorations within the 10 mi of state-governed waters extending east from Mustang island and waters within Corpus Christi Bay. Intersected lease blocks offshore include 885, 884, 883, 748, 772, 771, 770, and 769. There are five active leases in the intersected blocks of the Alternative Project alignment, located in blocks 748 and 772: MF119348, MF117233, MF117235, MF119349, and MF119347 (TXGLO 2019); there are several other leases within a few miles of the proposed Alternative Project as well. There are five active gas wells, two abandoned gas wells, seven dry holes, and no active oil wells in the intersected blocks of the Alternative Project alignment. Within one mile of the alignment, four additional active gas wells, and ten dry holes are located in state waters. Intersected lease blocks inshore include 417, 416, 415, 414, 422, 423, 424, 425, 426, 441, 440, 439, 438, 437, 436, 435, 434, and 228. There are 67 active oil wells, nine active gas wells, two abandoned oil wells, six temporarily abandoned wells, five dry holes, one injection well, and no abandoned gas wells in the intersected blocks (TXGLO 2019). An additional 65 active oil wells, 22 active gas wells, one injection well, three abandoned gas wells, two abandoned oil wells, and six dry holes are located within 1 mile of this segment of the alignment.

There are more active oil and gas leases within the Alternative Project route, when compared to the Proposed Project route. While areas surrounding the Project have historically been site to hydrocarbon resource exploration and extraction, development has slowed in recent years in the region as evident by the number of historic leases in the area, and thus the Project is not expected to impact nearby hydrocarbon resources.

11.3.2.2.2 OFFSHORE SEDIMENT SOURCES

Offshore sediment sources for the Alternative Project are similar to those for the Proposed Project. See section 11.2.2.2.2. for a description of the offshore sediment sources for the area.

11.3.2.3 Onshore Soil Series

Soils within the Alternative Project area formed in sand-dominated sediments deposited by the aeolian and alluvial processes at work since the stabilization of sea level during the late Holocene. Data from the NRCS was utilized to create a table detailing all soil units crossed by the Alternative Project area (Table 11-4). Soils in the coastal prairie surrounding Corpus Christi Bay are primarily composed of vertisols with a higher presence of the mineral smectite in the clay fraction (NRCS 2019a). Typical soil series in the area consist primarily of Banquete clay, Galveston-Mustang complex, Papalote fine sandy loam, and Victoria clay further inland, and Costal dunes, Mustang fine sand, Spoil banks, and Tidal flats along Mustang island (NRCS 2017, 2019b).

Table 11-4: NRCS Soil Descriptions intersected by the Alternative Project area

County	Soil Map Unit	Primary soil components	Texture	Location	Description	Minor soil components	Prime Farm-land	Acres
Nueces	Coastal Dunes (Cs)	Dune land, coastal (100%)	-	-	-	-	No	5.52
Nueces	Mustang fine sand, 0 to 1 percent slopes, occasionally flooded, frequently ponded (Mu)	Mustang and similar soils (85%)	Fine sand	Barrier flats	Slopes 0 to 1 percent. This component is on barrier flats. The parent material consists of storm washover and sandy eolian deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is poorly drained. This soil occasionally floods and frequently ponds.	Malaquite (4%) Padre (3%) Arrada (2%) Daggerhill (2%) Barrada (2%) Tatton (2%)	No	9.92
Nueces	Spoil banks (Sb)	Spoil banks (85%)	-	-	-	-	No	4.52
Nueces	Tidal flats, occasionally ponded (Ta)	Tidal flats (70%)	Fine sand Loamy fine sand	Tidal flats	Slopes 0 to 1 percent. This component is on tidal flats. The parent material consists of loamy fluviomarine deposits. The natural drainage class is very poorly drained. This soil occasionally ponds.	Unnamed (30%)	No	0.05
W	Water	Water (100%)	-	-	-	-	No	50.72
San Patricio	Barrada-Tatton association, 0 to 1 percent slopes, occasionally ponded (Bt)	Barrada and similar soils (49%) Tatton and similar soils (45%)	Clay Silty clay Fine sand	Deflation flats, wind-tidal flats	Slopes are 0 to 1 percent. This component is on wind-tidal flats on barrier islands. The parent material consists of clayey alluvium and sandy eolian deposits and storm washover sediments of Holocene age. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. This soil is not flooded. It is occasionally ponded.	Aransas (2%) Unnamed (2%) Mustang (2%)	No	0.01
San Patricio	Banquete clay, 0 to 1 percent slopes (Ec)	Banquete and similar soils (85%)	Clay Fine sandy loam	Flats	Slopes are 0 to 1 percent. This component is found on flats. The parent material consists of clayey fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock over loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is moderately well drained. The soil does not flood or pond.	Victoria (5%) Cranell (5%) Edroy (5%)	Yes (Farmland of statewide importance)	17.00

San Patricio	Galveston-Mustang complex, 0 to 3 percent slopes, occasionally flooded, frequently ponded (GM)	Galveston and similar soils (50%) Mustang and similar soils (30%)	Fine sand	Foredunes	Slopes are 0 to 3 percent. This components is on foredunes. The parent material consists of sandy eolian deposits derived from igneous metamorphic and sedimentary rock. This soil is occasionally flooded and frequently ponded.	Barrada (5%) Dianola (5%) Dietrich (5%) Tatton (5%)	No	42.29
San Patricio	Narta loam, 0 to 1 percent slopes, rarely flooded (Na)	Narta and similar soils (90%)	Loam Clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is poorly drained. The soil rarely floods and doesn't pond.	Victine (5%) Aransas (4%) Dietrich (1%)	No	9.39
San Patricio	Nueces fine sand (Nu)	Nueces and similar soils (85%)	Fine Sand Sandy clay loam	Strand plains	This component is on strand plains on low coastal plains. The parent material consists of eolian sands over eolian deposits and/or alluvium. The natural drainage class is moderately well drained. This soil is not flooded. It is not ponded.	Unnamed (15%)	Yes (Farmland of statewide importance)	2.48
San Patricio	Oil-waste land (On)	Oil-waste land (100%)	-	-	-	-	No	6.73
San Patricio	Orelia fine sandy loam, 0 to 1 percent slopes (Or)	Orelia and similar soils (90%)	Fine sandy loam Sandy clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is well drained. The soil does not flood or pond.	Wyick (5%) Greta (3%) Edroy (2%)	No	16.07
San Patricio	Calallen sandy clay loam, 0 to 1 percent slopes (Os)	Calallen and similar soils (85%)	Sandy clay loam Clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of late Pleistocene age loamy fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is well drained. This soil does not flood or pond.	Cranell (10%) Edroy (5%)	No	15.85
San Patricio	Papalote fine sandy loam, 0 to 1 percent slopes (PaA)	Papalote and similar soils (85%)	Fine sandy loam Sandy clay Sandy clay loam	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of loamy fluviomarine deposits. The natural drainage class is moderately well drained. This soil does not pond or flood.	Unnamed (10%) Edroy (5%)	Yes	8.78

San Patricio	Raymondville clay loam, 0 to 1 percent slopes (RaA)	Raymondville and similar soils (90%)	Clay loam Clay	Meander scrolls	Slopes are 0 to 1 percent. This component is on meander scrolls. The parent material consists of loamy fluviomarine deposits of late Pleistocene age. The natural drainage class is moderately well drained. This soil does not pond or flood.	Edroy (5%) Unnamed (5%)	Yes	59.50
San Patricio	Raymondville clay loam, 1 to 3 percent slopes (RaB)	Raymondville and similar soils (90%)	Clay loam Clay	Meander scrolls	Slopes are 1 to 3 percent. This component is on meander scrolls. The parent material consists of loamy fluviomarine deposits of late pleistocene age. The natural drainage class is moderately well drained. This soil does not flood or pond.	Unnamed (10%)	Yes	0.66
San Patricio	Victoria clay 0 to 1 percent slopes (VcA)	Victoria and similar soils (97%)	Clay	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of clayey fluviomarine deposits derived from igneous, metamorphic, and sedimentary rock. The natural drainage class is well drained. This soil does not pond or flood.	Cranell (2%) Edroy (1%)	Yes	131.79
San Patricio	Victoria clay, depressional (Vd)	Victoria and similar soils (90%)	Clay	Flats	Slopes are 0 to 1 percent. This component is on flats. The parent material consists of clayey fluviomarine deposits. The natural drainage class is well drained. This soil does not pond or flood.	Edroy (5%) Unnamed (5%)	No	28.19
San Patricio	Willacy fine sandy loam, 0 to 1 percent (WfA)	Willacy and similar soils (90%)	Fine sandy loam Sandy clay loam	Terraces	Slopes are 0 to 1 percent. This component is on terraces. The parent material consists of calcarerous loamy alluvium. The natural drainage class is well drained. This soil does not flood or pond.	Unnamed (10%)	Yes	0.33

Source: NRCS 2017, 2019b.

11.3.2.4 Prime Farmlands

By the NRCS definition of prime farmlands, 54 percent of soils within the Alternative Project area are classified as prime farmland soils (NRCS 2007). There are more prime farmland soils that would be affected by the Alternative Project, when compared to the Proposed Project.

Prime farmland soils were determined to be present within the project boundary located within San Patricio County. These soils include: Banquete Clay, 0 to 1 percent slopes (Ec) (which is recognized as prime farmland of statewide importance) and encompasses approximately 17.00 acres within the project area; Nueces fine sand (Nu) (which is recognized as prime farmland of statewide importance), which encompasses 2.48 within the project area; Papalote fine sandy loam, 0 to 1 percent slopes (PaA), which encompasses 8.78 acres within the project area; Raymondville clay loam, 0 to 1 percent slopes (RaA) , which encompasses 59.50 acres within the project area; Raymondville clay loam, 1 to 3 percent slopes (RaB), which encompasses 0.66 acres within the project area; Victoria clay 0 to 1 percent slopes (VcA), which encompasses 131.79 acres within the project area; and Willacy fine sandy loam, 0 to 1 percent. (WfA), which encompasses 0.33 acre within the project area (NRCS 2017).

11.3.2.5 Inshore and Offshore Sediments

Inshore and offshore sediment samplings obtained from the usSEABED database are similar to those for the Proposed Project. Nearby sediment samples indicate inshore components to contain a mix of muddy sand, gravelly muddy sand, slightly gravelly mud, and slightly gravelly sandy mud along the proposed Alternative route; offshore components include sand and slightly gravelly muddy sand which progresses into muds, and gravelly muds further offshore. See section 11.2.2.6. for details of inshore and offshore sediments for the Proposed Project.

There would be more impacts to inshore sediments for the Alternative Project, when compared to the Proposed Project, due to the crossing of Corpus Christi Bay. There would be more impacts to offshore sediments for the Proposed Project, when compared to the Alternative Project, due to the crossing of more seafloor bed.

11.3.2.6 Offshore Sediment Quality

Offshore sediment quality is similar for the Alternative Project as the Proposed Project. See section 11.2.2.7. for a description of sediment quality for the Corpus Christ Bay Complex and surrounding offshore area.

11.3.3 Alternative Project Impacts

Impacts to geological resources from the Alternative Project components are similar in nature as described for the Proposed Project due to the location of the Alternative Project in the same geological area as the Proposed Project. Construction, operation and decommissioning procedures and detailed maps can be referenced in Appendix A.

Adverse impacts on geological resources may occur when an activity is likely to damage or disturb a unique geological feature, induce soil erosion, modify seafloor stability, affect sediments, or affect mineral resources. It is anticipated that subsea blasting activities would not be required for the proposed Alternative Project. Unique geological features present within the project area include dunes located on the eastern shoreline within the Alternative Project area and localized normal faults. The Alternative Project is likely to affect soils and sediments within the Alternative Project area. Seafloor stability will be protected using careful Alternative Project siting. Apart from affecting the sediment itself, sediment disturbance would likely result in minor impacts on water quality and marine resources (see Volume II, Section 3 – Water Quality).

Construction of the Alternative Project would have a higher impact on prime farmland soils and inshore sediments; the proposed alternate route crosses more of these two geological resources. Construction of the Alternative Project would have a higher potential impact on oil and gas well leases; there are more oil and gas wells/leases in the vicinity of the Alternative Project route. Construction of the Proposed project would have higher impact on offshore sediments; the Proposed Project crosses more sea floor than the Alternative Project.

11.3.3.1 Seafloor Sedimentary Processes

The Alternative Project is expected to have similar impacts as the Proposed Project to seafloor sedimentary processes. Construction of the inshore and offshore pipeline segments may cause minor to negligible disturbance to seafloor sedimentary processes, resulting in sediment displacement and increased turbidity, as well as increased scour resulting from the presence of equipment and materials at or near the seafloor. Upon the completion of the Project, pipeline trenches are expected to backfill naturally, returning the sea floor to the pre-excavation contours and consequently, to the pre-floor seafloor sedimentary regime.

Seafloor sedimentary processes may be affected by operation of the DWP, as the SPM buoy will be anchored to the seafloor with prefabricated anchor pilings, and the PLEM will likely be set on a piled foundation to enhance stability. Connections from the anchor pilings to the SPM buoy will be constructed with chains, limiting hydrodynamic effects.

In addition, the sub-seafloor pipeline will be connected to the PLEM, which will be connected to the SPM by flexible hoses. However, scour, or the removal of granular bed material by hydrodynamic forces, could occur when hydrodynamic stresses are greater than sediment shear stresses. Scour can cause changes in local turbidity concentrations and result in sediment disruption and movement due to changing tides and currents. Current forces in the GOM near the site and the local sediment types would determine the level of the scour effect. The relatively slow tidal/current speeds and soft-bottom sediments in the vicinity suggest that scour would be minor, short-term, and local.

Demolition of the DWP should not affect seafloor sedimentary processes. Geologic impacts on the seafloor during decommissioning would be similar to installation, as all materials will be removed. This would involve the re-excavation of sediments deposited within the trench, and disturbance of sediments around the SPM buoy. Since the terminal would be in an area of sediment reworking, any scars are expected to be temporary and reversible, thereby resulting in negligible geologic impacts on the seafloor.

11.3.3.2 Mineral Resources

There are more oil and gas leases located near the Alternative Project route than the Proposed project, and thus there is a higher potential for impacts to mineral resources. See section 11.3.2.2.1. for a description of oil and gas leases in or near the proposed Alternative Project route; See section 11.2.3.2 for a description of mineral resource impacts to the Proposed Project.

11.3.3.3 Geologic Hazards

Geologic hazards within the Alternative Project area include faulting, soil liquefaction, gas hydrates, and subsidence (See sections 11.2.2 and 11.3.2.). The Alternative Project has similar risks to geologic hazards as the Proposed Project. Faulting in the vicinity is low and has exhibited a low degree of seismicity. Conditions in the vicinity are susceptible to soil liquefaction, especially during storms, and have potential to damage or destroy portions of the Alternative Project. Gas hydrates and subsidence are affected by the presence of faults and salt diapirs, neither of which are present within the Alternative Project area, limiting the risk of such hazards. The proposed Alternative Project would not affect the occurrence of faulting, gas hydrate formation, or subsidence. Soil liquefaction may be affected by the presence of the pipeline and DWP anchor and foundation pilings, but the effect would be minor to negligible.

11.3.3.4 Alternative Project Construction Impacts

11.3.3.4.1 ONSHORE

Onshore impacts during construction for the Alternative Project are anticipated to be similar as those for the Proposed Project. During construction, minor, adverse impacts on soils and sediments within the pipeline construction corridor can be expected. Disturbance of soils within the terrestrial portion of the Project area would result in the increased potential for erosion, compaction, and mixing of topsoil. These impacts would be temporary, minor, and reversible. On land, trench topsoil and subsoil would be segregated to prevent mixing, and would be returned to trenches in proper order, with the ground surface returned to pre-excavation contours. During construction, BMPs including but not limited to silt fencing, matting, and hay bales would be utilized to present erosion. The construction area would be allowed to re-vegetate naturally. The sensitive depositional environment of the seaside dunes would be avoided through an HDD beginning west of the dune protection line, 1,000 feet west of the mean high tide line. Erosion on tidal flats and beaches lacking vegetation would also be mitigated by use of HDD through these areas.

11.3.3.4.2 INSHORE AND OFFSHORE

Inshore and offshore impacts during construction for the Alternative Project are anticipated to be similar as those for the Proposed Project. Disturbance of sediments and increases in turbidity within the submerged portions of the Project area can be expected by pipeline installation, anchor piling installation, and through the direct contact of anchors or supports from jack up work boats. These impacts would be temporary, minor, and reversible. Offshore portions of the proposed would be installed within a 75-foot-wide construction corridor using jet-sled techniques. Pipelines would be installed at a minimum of 5 feet below mud line and would be allowed to backfill naturally as well as backfilled by the amphibious trencher. At the DWP location, the SPM would be anchored to the seafloor with prefabricated anchor pilings. Depth of impacts would be determined by the local refusal conditions. Piling installation may be expected to result in minor sedimentary mixing and increased local turbidity by forcing more deeply buried deep sediments to the surface. Local, minor, temporary effects could be expected to sediments and turbidity within the Project area.

11.3.3.5 Alternative Project Operation Impacts

11.3.3.5.1 ONSHORE

Onshore impacts during operations for the Alternative Project are anticipated to be similar as those for the Proposed Project. Terrestrial impacts to soils and sediments would be negligible during pipeline operation. Vegetation clearing would be required along some portions of the pipeline corridor and the resulting pipeline right of way (ROW) would be maintained following pipeline construction. Maintenance related activities would involve mowing the resulting project ROW and impacts would be negligible.

11.3.3.5.2 INSHORE AND OFFSHORE

Inshore and offshore impacts during operations for the Alternative Project are anticipated to be similar as those for the Proposed Project. Due to the lack of anchorage at the DWP, no seafloor disturbing impacts would be expected from the operation of the DWP. However, scour, or the removal of granular bed material by hydrodynamic forces, could occur when hydrodynamic stresses are greater than sediment shear stresses. Scour can cause changes in local turbidity concentrations and result in sediment disruption and movement due to changing tides and currents. Current forces in the GOM near the site and local sediment types would determine the level of the scour effect. The relatively slow tidal/current speeds and soft-bottom sediments in the vicinity suggest that scour would be minor, short-term, and local.

11.3.3.6 Alternative Project Decommissioning Impacts

11.3.3.6.1 ONSHORE

Onshore impacts during decommissioning for the Alternative Project are anticipated to be similar as those for the Proposed Project. Geologic impacts on soils and vegetation during decommissioning would be similar to installation, as all materials will be removed. Adverse impacts would be minor, temporary, and reversable, and similar measures to minimize impacts as during construction would be implemented.

11.3.3.6.2 INSHORE AND OFFSHORE

Inshore and offshore impacts during decommissioning for the Alternative Project are anticipated to be similar as those for the Proposed Project. Geologic impacts on the seafloor during decommissioning would also be similar to installation impacts. This would involve the re-excavation of sediments deposited within the trench, and disturbance of sediments around the SPM buoy. Since the terminal would be in an area of sediment reworking, any scars are expected to be temporary and reversible, thereby resulting in negligible geologic impacts on the seafloor.

11.4 Summary of Impacts

A summary of impacts for the proposed Project and Alternative Project are presented in Table 11-5.

Table 11-5: Summary of Impacts

		Construction	Operation	Decommissioning
Proposed Project	**Onshore**	Temporary soil disturbance due to pipeline installation	None	Temporary soil disturbance due to pipeline decommissioning
	Inshore	Temporary Seafloor and sediment disturbance due to pipeline installation	Long term minor scour may occur due to presence of pipeline and SPM buoy system	Temporary seafloor and sediment disturbance due to pipeline decommissioning
	Offshore	*Temporary Seafloor and sediment disturbance due to pipeline installation	Long term minor scour may occur due to presence of pipeline and SPM buoy system	*Temporary seafloor and sediment disturbance due to pipeline decommissioning
Alternative Project	**Onshore**	Temporary soil disturbance due to pipeline installation. *Higher potential impact to prime farmland soils.	None	Temporary soil disturbance due to pipeline decommissioning. *Higher potential impacts to prime farmland soils.
	Inshore	Temporary Seafloor and sediment disturbance due to pipeline installation. *Higher potential impacts to inshore sediments (crossing of Corpus Christi Bay) and oil and gas leases.	Long term minor scour may occur due to presence of pipeline and SPM buoy system	Temporary seafloor and sediment disturbance due to pipeline decommissioning.* Higher potential impacts to inshore sediments (crossing of Corpus Christi Bay) and oil and gas leases.
	Offshore	Temporary Seafloor and sediment disturbance due to pipeline installation. Less impact to offshore sediments	Long term minor scour may occur due to presence of pipeline and SPM buoy system	Temporary seafloor and sediment disturbance due to pipeline decommissioning. Less impact to offshore sediments.

*indicates an environmental consequence that is significantly more impactful as compared to the other project alternative.

11.5 Mitigation of Proposed Project Impacts

Effects on soils, sediments, and sedimentary processes from the pipeline and terminal installation and decommissioning would be the only activities with respect to geological resources that could warrant mitigation. Proper siting and HDD procedures will avoid geologic hazards and mineral resources within and near the Project area. Although the proposed activities would impact soils, sediments, and sedimentary processes, the geologic impacts would be negligible since the ground surface would be returned to the original contours, the terrestrial pipeline scar would be revegetated, and alterations to the seafloor would recover naturally.

The following BMPs will be employed to reduce the potential impacts to soils:

- Temporary erosion/sediment controls including but not limited to silt fencing, matting, and hay bales. These controls are designed to keep sediment from flowing off the Project site and into waterbodies, wetlands and other sensitive environments. These temporary erosion controls will be properly placed and maintained throughout construction and will be reinstalled as necessary until they are replaced by permanent erosion/sediment controls or until construction activities have ceased and permanent vegetation has become established.
- Preparation and implementation of a comprehensive IR Contingency Plan would mitigate for potential negative IR impacts to soils.
- The potential effect of fuel and fluid spills on soils during construction, operation and decommission could be adequately mitigated through adequate implementation of adequate controls on the location of fuel and fluid storage and refueling locations, as described in the appropriate SPCC and spill response plans.
- During construction and decommissioning, a Stormwater Pollution Prevention Plan (SWPPP) will be implemented to minimize soil erosion and impacts on surface waters. LEI will conduct all work in accordance with a Texas Pollutant Discharge Elimination System (TPDES) General Permit No. TXR150000 for stormwater and TPDES General Permit No. TXR050000 for industrial waste water meeting all provisions within the respective permit.
- As part of Project restoration, all portions of the pipeline ROW impacted, including wetlands and floodplains, will be returned to preconstruction conditions and contours.

11.6 References

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