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EAST TIMBALIER ISLAND RESTORATION PROJECT (TE-118)

DRAFT ENVIRONMENTAL ASSESSMENT FOR ISSUANCE OF A NON-COMPETITIVE NEGOTIATED AGREEMENT FOR THE USE OF OUTER CONTINENTAL SHELF SAND

Lafourche Parish, Louisiana

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF OCEAN ENERGY MANAGEMENT

On Behalf of

COASTAL PROTECTION AND RESTORATION AUTHORITY
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EXECUTIVE SUMMARY

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LAFOURCHE PARISH, LOUISIANA

PROJECT OVERVIEW AND PURPOSE

On behalf of the Bureau of Ocean Energy Management (BOEM) and the Coastal Protection and Restoration Authority (CPRA), the Environmental Assessment (EA) for the East Timbalier Island Restoration Project (TE-118) (hereinafter referred to as the Project) has been prepared in support of the Project permitting and coordination of a Non-Competitive Negotiated Agreement with BOEM for use of an Outer Continental Shelf (OCS) sand resource located in federally-owned waters. The Project includes restoring the geomorphic and ecological form and function (GEFF) of East Timbalier Island and West Belle Headland through beach and dune fill placement utilizing offshore sand resources located in Federal waters, as well as constructing back-barrier marsh using mixed sediment from nearshore sources located in State waters. In addition, the Project includes a Feeder Beach along West Belle Headland, which would provide sediment to nourish the shoreline, as well as a renourishment component at the site of the previously completed West Bell Headland Project (TE-52). The U.S. Army Corps of Engineers (USACE) requires a permit for all other aspects of the Project, including dredging of any borrow areas located on State-owned water bottoms, as well as conveyance and placement of sand resources. The operative Federal authorities for USACE permitting are Section 10 of the Rivers and Harbors Act of 1899, which regulates dredging and filling of federally owned waters and water bottoms, and Section 404 of the Clean Water Act, which regulates the discharge of dredged sediment into federally owned waters. BOEM and USACE are working collaboratively to ensure effective implementation of the required National Environmental Policy Act (NEPA) process, the required Endangered Species Act (ESA) Section 7 consultations, the Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat consultation (Section 305) the National Historic Preservation Act Section 106 process, and the Coastal Zone Management Act Section 307 consistency determination.

The Project is needed because the combination of land subsidence, sea-level rise, coastal erosion, storm damage, and lack of replenishing sediment have led to habitat loss and ecosystem degradation across the entire Terrebonne Basin barrier shoreline. For the past century, East Timbalier Island has experienced significant land area change and, in recent

years (2006-2014) that land area reduction has continued at an average rate of approximately 25 acres per year (Stantec, 2017).

The purpose of the Project is to restore the GEFF of East Timbalier Island and West Belle Headland. Benefits of the restoration include protecting and sustaining significant and unique coastal habitats. The restored barrier shoreline would reduce wave energy and salt-water intrusion from the Gulf of Mexico into back-barrier environments, including marshes and mangrove wetlands. This Project is synergistic with implemented and future restoration projects and is an identified goal of the 2017 Louisiana Coastal Master Plan.

Restoring the GEFF of the degraded barrier system involves introduction of sand to construct beach and dune habitat. In addition, it includes providing a marsh platform to capture sand that is overwashed during major storm events, serving as a "rollover" platform as the islands migrate landward. Restoration of ecologic form and function includes vegetating both the restored dunes and back-barrier marsh platforms with native plants, providing wetland habitat for a diverse number of plant and animal species, and helping to retain sediment.

PROJECT LOCATION

The Project area includes the Restoration Area on East Timbalier Island; the Restoration Area extending the West Belle Headland; a Feeder Beach along West Belle Headland, westward of the West Belle Pass Jetties; a Renourishment Area on the West Belle Headland Project; four (4) borrow areas located in the Gulf of Mexico, including two (2) sand sources located in the OCS and two (2) mixed sediment sources, two (2) sediment pump-out areas, and three (3) conveyance corridors connecting the borrow areas to the restoration areas. The two (2) sand sources are located approximately 23 nautical miles (NM) west-southwest of East Timbalier Island, referenced as the South Pelto Borrow Area, located in the South Pelto Area OCS Lease Block 13 and the Ship Shoal Borrow Area, located in the South Pelto Area OCS Lease Blocks 12 and 13. One of the mix sediment sources is located approximately 9.1 NM west-southwest of East Timbalier Island and the other mix sediment borrow area is located 2 NM south of West Belle Pass Headland. The two (2) pump-out areas are referenced as the East Timbalier Pump-Out Area, which is located approximately 3.3 NM south of East Timbalier Island in the South Timbalier Area OCS Lease Block 20, and the West Belle Pump-Out Area located approximately 2.5 NM south of West Belle Headland.

The Restoration Areas on East Timbalier and along the West Belle Headland are all located in Lafourche Parish. The present subaerial land on East Timbalier Island is approximately 2.0 miles long and composed of two (2) degraded segments of land.

PLANNING AND PERMITTING PROCESS

The 2017 Coastal Master Plan for Louisiana (CPRA, 2017) contains five objectives that reflect the key issues affecting the people and environment in and around Louisiana's coast. Those five (5) objectives are as follows: (1) Flood Protection (reduce economic losses from storm surge based flooding to residential, public, industrial, and commercial infrastructure); (2) Natural Processes (promote a sustainable coastal ecosystem by harnessing the natural processes of the system); (3) Coastal Habitats (provide habitats suitable to support an array of commercial

and recreational activities coastwide); (4) Cultural Heritage (sustain the unique cultural heritage of coastal Louisiana by protecting historic properties and traditional living cultures and their ties and relationships to the natural environment); and (5) Working Coast (promote a viable working coast to support regionally and nationally important businesses and industries).

Restoration of barrier island habitat is specifically listed as one of the types of projects included in the 2017 Coastal Master Plan. The CPRA spent hundreds of millions of dollars over the past 20 years restoring the Terrebonne and Barataria barrier shorelines and will continue to fund Louisiana's barrier island program (CPRA, 2017). The project area delineated in the Timbalier Islands 2012 Master Plan project included Timbalier Island, East Timbalier Island, and the West Belle Headland.

As noted above, the proposed restoration plan will be evaluated by the USACE as part of the 10/404 permitting process. BOEM will prepare an independent EA to determine the least damaging, most practicable Project alternative. BOEM and USACE are working collaboratively to ensure effective implementation of the required NEPA process.

PROPOSED ACTION

East Timbalier Island

East Timbalier Island is approximately 2 miles long and lies east of Little Pass Timbalier and southwest of Port Fourchon. East Timbalier Island has decreased in size, from more than several hundred acres to approximately 150 acres, and continues to erode exponentially due to the effects of erosion. Recent storm events have caused a breach in the island and it is now composed of two (2) degraded segments of land. East Timbalier Island is occupied by a major oil and gas operation at the inshore Timbalier Bay Field. There are numerous oil well platforms, storage tanks, and abandoned waste pits on and near East Timbalier Island, along with numerous pipelines and wellheads. A Phase I Environmental Site Assessment of East Timbalier, in accordance with the scope and limitations of ASTM E 1527-13 *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*, was conducted and the results of samples analyzed in conjunction with the assessment were found to be all below regulatory levels (CTC-GEC, 2017).

The East Timbalier Island restoration template extends the length of the island and includes the construction of beach, dune, and two marsh components. These features on East Timbalier Island will result in the restoration of a total of approximately 516 acres of dune habitat (elevation > +5.0 ft North American Vertical Datum of 1988 [NAVD88]), supratidal habitat (elevation between +2.0 ft and +5.0 NAVD88), and intertidal marsh habitat (elevations between 0.0 ft and +2.0 ft NAVD88). The beach and dune features are approximately 13,600 linear feet long and requires placement of approximately 6.6 million cubic yards (MCY) of sand. The dune will be constructed at a target elevation of +7.5 ft NAVD88, with fore and back-slopes of 1V:25H and a width of 100 ft at the crest. The target elevation of the beach will be +5.0 ft NAVD88, with a slope of 1V:25H from the beach berm crest extending seaward to the intersection with the existing grade and a width ranging from 170 to 400 ft.

The two marsh components are approximately 6,800 linear feet in combined length, north of the beach and dune, and requires placement of approximately 1.3 MCY of mixed sediment to create the marsh platform at a target elevation of +3.0 ft NAVD88. Assuming a 1.6:1 cut to fill ratio and being conservative in the Preliminary Design Phase, the recommended cut volume requirements for the mixed sediment source for the marsh platform were calculated at 2.1 MCY. The marsh containment dike dimensions are +5.3 ft NAVD88 crest elevation, 30-ft crest width, with 1V:25H side slopes. The East Timbalier Island marsh containment dikes will be constructed from sediment dredged from the Ship Shoal and/or South Pelto Borrow Areas, requiring approximately 0.45 MCY in place and a cut volume of approximately 0.6 MCY.

West Belle Headland

The West Belle Headland restoration template will begin at the terminus of the existing TE-52 Project and would extend approximately 10,000 linear feet westward. These features on West Belle Headland will result in the restoration of approximately 819 acres of dune (elevation >+5.0 ft NAVD88), supratidal (elevation between +2.0 ft and +5.0 NAVD88), and intertidal marsh habitat (elevations between 0.0 ft and +2.0 ft NAVD 88).

The dune will be constructed at a target elevation of +7.5 ft NAVD88, with fore- and back-slopes of 1V:25H and a typical width of 100 ft at the crest (Figure 2-5). The target elevation of the beach will be +5.0 ft NAVD88 with a slope of 1:25 from the beach berm crest extending seaward to the intersection with the existing grade and a width of 290 ft. The West Belle Headland beach and dune features involve placement of approximately 2.2 MCY of sand to create both beach and dune habitat.

The West Belle Headland marsh feature will also extend approximately 10,000 linear feet westward from the existing TE-52 Project, north of the beach and dune, and involves placement of approximately 1.3 MCY of mixed sediment (sand, silt and clay) to create intertidal marsh habitat. The marsh platform target elevation is +3.0 feet (ft) NAVD88 with a minimum width of 1,145 ft. Containment dikes will be constructed from sediment excavated in situ. The marsh containment dike dimensions are +5.3 ft NAVD88 elevation, 10-ft crest width, with 1V:10H side slopes. Primary (interior) and secondary (exterior) containment dike borrow channels are proposed as the sources of in situ sediment for dike construction.

In addition, a Feeder Beach will be constructed along West Belle Headland extending approximately 4,000 linear feet from the west jetty to provide sediment that would nourish the remaining shoreline. The modeling effort highlighted a vulnerable area within the West Belle Headland that would benefit significantly from coarser sand nourishment and result in a more robust overall restoration template for the area. The 68-acre Feeder Beach would be constructed to an elevation of +1.0 ft NAVD88, with a length of approximately 4,000 linear feet, a width ranging from 420 to 920 ft, and a seaward slope of 1V:25H. The volume of sand from Ship Shoal and/or South Pelto Borrow Area required to construct the Feeder Beach feature would be approximately 0.41 MCY.

West Belle Headland Renourishment

After reviewing recent Barrier Island Comprehensive Monitoring Program Survey data, the Project team determined that the previously restored template of the CWPPRA TE-52 West Belle project (CPE, 2009 and 2013) may require a renourishment event; therefore, the West Belle Headland Renourishment Area is included in the permit application for this action. The proposed activity would add new sediment to existing beach, dune, and marsh habitat as needed.

The beach and dune features include the dune, which is approximately 8,400 linear feet in length, constructed at a target elevation of +7.5 ft NAVD8, with fore- and back-slopes of 1V:25H and a typical width of 100 ft at the crest. The target elevation of the beach will be +5.0 ft NAVD88 with a slope of 1:25 from the beach berm crest extending seaward to the intersection with the existing grade and a typical width of 292 ft. The volume of sand from Ship Shoal and/or South Pelto Borrow Area required to construct the beach and dune would be approximately 0.6 MCY.

The marsh feature for the West Belle Headland Renourishment Area is approximately 7,200 linear feet in length north of the beach and dune, and involves placement of approximately 0.4 MCY of mixed sediment to create intertidal marsh habitat. The marsh platform target elevation is +3.0 ft NAVD88 with an average width of approximately 1,500 ft. Containment dikes will be constructed from sediment excavated in situ. The marsh containment dike dimensions are +5.5 ft NAVD88 elevation, 10-ft crest width, with 1V:10H side slopes. An exterior containment dike borrow channel is proposed as the source of in situ sediment for dike construction

Borrow Areas

South Pelto Borrow Area

The South Pelto Borrow Area design is based on prior geophysical and geotechnical investigations in South Pelto Lease Blocks 13 and 14. Within the identified available borrow resource not utilized for Caminada Headland projects (BA-45 and BA-143), there are two (2) areas referred to as Expansion Areas A and B, which are located on the southwest and northern borders of the BA-143 borrow area. Area A is the larger of the two, and the surface area is approximately 190 acres. Area B has a surface area of approximately 63 acres. Preliminary Design cut volume estimates of suitable sediment within the South Pelto Borrow Areas A and B is approximately 4.7 MCY, including a 1,000-ft offset from active and abandoned pipelines.

Material from this borrow area may be used for containment dike construction at East Timbalier Island and beach and dune construction at East Timbalier and West Belle Headland, as well as the East Timbalier marsh platform construction.

Ship Shoal Borrow Area

The Ship Shoal Borrow Area is located within South Pelto Lease Blocks 12 and 13 on the east-central portion of the Ship Shoal sand body on the Outer Continental Shelf (OCS). The Ship Shoal Borrow Area is located approximately 23 NM west-southwest of East Timbalier Island. The surface area is approximately 584 acres. The sand thickness is up to 17 ft. The

average percent sand and grain size were computed to be 95 percent and 0.166 mm, respectively. A 3-ft zone of allowable disturbance is included between the sand and the lower sediment horizons. The Preliminary Design cut volume for Project Construction is estimated to be 6.5 MCY, including a 1,000-ft offset from active pipelines.

Material from this borrow area may be used for containment dike construction at East Timbalier Island and beach and dune construction at East Timbalier and West Belle Headland, as well as the East Timbalier marsh platform construction.

East Timbalier Marsh Borrow Area

The East Timbalier Marsh Borrow Area is located on the Little Pass Timbalier Ebb Tidal Delta approximately 9.1 NM west-southwest of East Timbalier Island, contiguous to the beach restoration borrow area utilized for the West Belle Pass Barrier Headland Project (TE-52). The surface area is approximately 441 acres. The sediment ranged from silty sand, varying in thickness between 2.1 and 6.6 ft, overlying mixed sediment comprised of silt and clay. The Preliminary Design cut depth was set to -27 ft NAVD88 with a 3-ft limit of disturbance. The preliminary design cut volume is estimated to be 7.2 MCY.

Material from this borrow area may be used for the East Timbalier and West Belle Headland marsh platform construction.

West Belle Marsh Borrow Area

The West Belle Marsh Borrow area was previously analyzed for the West Belle Pass Barrier Headland Project (TE-52) and was estimated to contain approximately 4 MCY of marsh material (silt and clay). The TE-52 Marsh Borrow Area was permitted and partially used to construct the TE-52 project, but it was not completely exhausted in the construction of the project, leaving marsh borrow material available for cost-effective excavation. Both the TE-40 and TE-52 projects evaluated the impacts of mining sediment from this area. The West Belle Marsh Borrow Area is located approximately 2.5 NM south of the West Belle Headland. The surface area is approximately 113 acres. The West Belle Marsh Borrow Area has marsh-compatible sediment ranging in thickness from 10 to 20 ft. The Preliminary Design cut depths range from -31.0 ft to -50.0 ft NAVD88 along with a 3-ft limit of disturbance. The Preliminary Design cut volume is estimated to be 1.7 MCY.

Material from this borrow area may be used for the East Timbalier and West Belle Headland marsh platform construction.

Excavation and Conveyance

The use of both hopper and cutterhead suction dredge alternatives for excavation, transportation, and placement were considered for conveying sediment from the Ship Shoal and South Pelto Borrow Areas to the Restoration Areas. Sufficient depths are needed to support efficient utilization of hopper dredges or scow barges from the Ship Shoal and South Pelto Borrow Areas to the proposed Pump-Out Areas. Hopper dredges would resuspend the sand within the hoppers and directly pump the sand to the Restoration Areas, with assistance of a

booster pump and sediment pipeline. Alternatively, a conventional cutterhead dredge would excavate the sand mechanically using a rotating cutter and a large suction pump to pump it to the surface to be transferred through a spider-barge distribution system into multiple scow barges. These scow barges would be towed to a pump-out area where a hydraulic resuspension system connected to a booster pump and sediment pipeline would offload the scows and pump the sand to the Restoration Areas.

The preferred method for conveying sediment from the West Belle and East Timbalier Marsh Borrow Areas to the Project Areas would likely be a hydraulic cutterhead dredge in combination with a sediment pipeline and booster pumps. Two conveyance corridors, one (1) from each marsh borrow area, were selected to avoid pipelines and production structures. Both were surveyed for cultural resource targets and other potential hazards, and their alignments refine to minimize crossing of oil and gas pipelines and provide buffers from potential cultural resource targets. The construction specifications will require the contractor to independently verify the accuracy of the reported intersection data and use best industry practices to mitigate impacts from the temporary dredge discharge pipeline placement. Their pipeline placement plan must be approved by the Project Engineer prior to Project implementation. No excavation is required for conveyance corridors.

For the East Timbalier Island beach, dune, and marsh containment Project features requiring sand, a pump-out area has been delineated with an associated sediment delivery corridor located in Federal waters approximately 3.3 NM south of the Island. For the West Belle Headland beach and dune Project features requiring sand, the West Belle Pass Marsh Borrow Area has been delineated as a pump-out area with an associated sediment delivery corridor located in State waters approximately 2.4 NM south of the Headland.

The East Timbalier Marsh Conveyance Corridor was designed to convey mixed sediment from the East Timbalier Marsh Borrow Area to both of the Restoration Areas. The East Timbalier Marsh Conveyance Corridor to the East Timbalier Island Restoration Area extends from the northeast end of the East Timbalier Marsh Borrow Area, east to the intersection with the East Timbalier Conveyance Corridor. The width of the corridor is approximately 600 ft. The East Timbalier Marsh Conveyance Corridor also connects to the West Belle Headland Restoration Area extending from the northeast end of the East Timbalier Marsh Borrow Area, east past East Timbalier Island, and then north to the existing shoreline on the western end of the Headland.

Once the sediment has reached the Island it will be handled in the normal manner. The discharge pipeline will be extended the length of the beach and dune template using pipe-handling loaders and bulldozers, and the sand will be graded to conform to the plan dimensions using bulldozers, front-end loaders, and other earth moving equipment. The marsh fill sediment will be discharged into the cells created by the marsh fill containment dikes and interior training dikes. The marsh fill will not be mechanically graded. Design elevation will be achieved by the construction contractor monitoring dredge discharge locations and dredged material settlement.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

As required by NEPA, a broad range of resources and natural processes, from physical and biological processes and resources, as well as critical biological resources to cultural and

socioeconomic resources, are described for East Timbalier Island, West Belle Headland, and where relevant, the borrow areas, pump out areas, and conveyance corridors. Of particular interest are the faunal assemblages on Ship Shoal utilized by both estuarine and oceanic species assemblages; the threatened and endangered (T&E) species, particularly the avifauna (West Belle Headland is designated as critical habitat for wintering piping plover); and the potential for cultural resource targets in the location of proposed Project features, borrow areas, and conveyance corridors. The consequences of both implementation of the No-Action and Restoration Alternatives as they apply to East Timbalier Island, West Belle Headland, the borrow areas, and conveyance corridors are described and discussed for each relevant Project feature including dredging operations, borrow area geometry, and fill placement in both beach/dune and marsh templates, and the physical, biophysical, critical biological, cultural, and socioeconomic resources and features. The Project will have either no effect or short-term negative effects on most of the features and resources, followed in the mid- to long-term by positive effects as the affected environments recover from initial disturbance and the additional habitats created mature and reach equilibrium. Recent research (Schupp et al., 2012) has reinforced the importance of long-term maintenance of overwash features to support the piping plover population.

The Project will provide additional beach, dune, and marsh habitat for marine and estuarine fisheries resources and their forage species, as well as for a wide variety of avian communities including shorebirds, wading birds, colonial nesting birds, and migratory songbirds. A shorebird protection and bird abatement plan will be developed cooperatively by CPRA and the U.S. Fish and Wildlife Service (USFWS) to protect avian resources during construction. Benthic resources on the borrow areas and at East Timbalier and West Belle Headland will be disturbed by both excavation and fill placement during construction. These disturbances are unavoidable and the habitats recover over time. The cumulative impact of Project implementation will create nearly 1,335 acres of beach, dune, and back-barrier marsh habitat. A positive cumulative impact will also accrue to the ecological benefits, including pelagic and benthic estuarine productivity, wildlife habitat, Essential Fish Habitat, migratory bird habitat, and habitat for T&E species into the future.

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Glossary of Terms

Term	Definition
ACHP	Advisory Council on Historic Preservation
AHPA	Archeological and Historic Preservation Act
APEs	Areas of Potential Effect
AWOIS	Automated Wreck and Obstruction Information System
BA	Biological Assessment
bbl	Barrel(s)
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CPRA	Coastal Protection and Restoration Authority (formerly OCPR – Office of Coastal Protection and Restoration)
CRT	Louisiana Department of Culture, Recreation & Tourism's
CUP	Coastal Use Permit
CWPPRA	Coastal Wetlands Planning, Protection and Restoration Act
DOHP	Division of Historic Preservation
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FSA	Farm Service Agency
GEFF	Geomorphic and Ecologic Form and Function
GIWW	Gulf Intracoastal Waterway
GMFMC	Gulf of Mexico Fisheries Management Council
Gulf Fund	The Gulf Environmental Benefit Fund
HAPCs	Habitat Areas of Particular Concern
HTRW	Hazardous, Toxic and Radioactive Waste
LAC	Louisiana Administrative Code
LADOA	Office of Cultural Development's Division of Archaeology

LCRP	Louisiana Coastal Resources Program
LCWCRTF	Louisiana Coastal Wetlands Conservation and Restoration Task Force
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife & Fisheries
MCY	Million Cubic Yards
MHW	Mean High Water
NAVD	North American Vertical Datum
NER	National Ecosystem Restoration
NFWF	National Fish & Wildlife Foundation
NHPA	National Historic Preservation Act
NM	Nautical Miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NRHP	National Register of Historic Places
OCM	Office of Coastal Management
OCS	Outer Continental Shelf
PDES	National Pollutant Discharge Elimination System
REC	Recognized Environmental Condition
SAV	Sub-Aquatic Vegetation
SEDAR	Southeast Data, Assessment and Review
SHPO	State Historic Preservation Office
SONRIS	Strategic Online Natural Resources Information System
T&E	Threatened & Endangered
TBBSR	Terrebonne Basin Barrier Shoreline Restoration
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency

USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WCRA	Wetlands Conservation and Restoration Authority
WQC	Water Quality Certification
YBP	Years Before Present
YOD	Year of Disappearance

1.0 - INTRODUCTION

1.1 Project Authority

The Coastal Protection and Restoration Authority (CPRA) serves as applicant for a Non-Competitive Negotiated Agreement with the Bureau of Ocean Energy Management (BOEM) for use of an Outer Continental Shelf (OCS) sand resource located in federally managed waters. This Project is one (1) of several that the State of Louisiana has proposed to address the impacts of the *Deepwater Horizon* oil spill on the natural resources in the area through the Gulf Environmental Benefit Fund, which is administered through the National Fish and Wildlife Foundation (NFWF). On April 20, 2010, an explosion on the Deepwater Horizon Mississippi Canyon Block 252 (MC252) drilling platform occurred, releasing an estimated 4.9 million barrels of oil. Approximately 820,000 barrels (bbl) were directly recovered at the well site and approximately 4.1 million bbl of oil were released into the Gulf of Mexico over a period of 87 days (BOEM, 2012). This adversely affected large coastal areas of Louisiana (Lubchenco et al., 2010), including the TE-118 East Timbalier Restoration Project Area. The Gulf Environmental Benefit Fund (Gulf Fund) was established by NFWF in accordance with plea agreements between BP Exploration & Production, Inc., Transocean Deepwater, Inc. (January 3, 2013), and the United States of America following the 2010 *Deepwater Horizon* explosion, oil spill, and response. The plea agreements direct a total of $2.544 billion to NFWF to fund projects that benefit resources that were impacted by the 2010 *Deepwater Horizon* explosion, oil spill, and response. Approximately $1.2 billion of the funds directed to NFWF is dedicated to targeting Louisiana impacts by using the funds solely for barrier island restoration or river diversion projects on the Mississippi and/or Atchafalaya Rivers for the purpose of creating, preserving, and restoring coastal habitat (NFWF, 2017). Funding for engineering and design of the Project was provided by NFWF in November 2013.

The Project includes restoring the geomorphic and ecological form and function (GEFF) of East Timbalier Island and the West Belle Headland through beach and dune fill placement utilizing offshore sand sources from Ship Shoal Block 88 and restoring marsh habitat using nearshore mixed sediment borrow areas.

The Consulting Team consists of Stantec Consulting Services (Stantec), New Orleans, Louisiana, and their subconsultants: Coastal Engineering Consultants (CEC), Baton Rouge, Louisiana, and Naples, Florida; Coastal Technology Corporation (CTC), Vero Beach, Florida; GeoEngineers (GEO), Baton Rouge, Louisiana; John Chance Land Surveys (JCLS), Lafayette, Louisiana; Ocean Surveys (OSI), Metairie, Louisiana, and Old Saybrook, Connecticut; and R. Christopher Goodwin & Associates (Goodwin), New Orleans, Louisiana, and Frederick, Maryland.

1.2 Project Purpose and Scope

The Project's overarching goals are to restore GEFF on East Timbalier Island and the West Belle Headland as a component of the Terrebonne Basin Barrier Shoreline system. The barrier system separates the 1.7 million acres of the Terrebonne and Timbalier Bays from the Gulf of Mexico (GOM), regulating estuarine conditions within the Barataria Terrebonne National Estuary

including expansive diverse wetlands that transition from saltmarsh to freshwater marsh. Robust barrier islands are critical for this estuarine system to continue to function as productive nursery areas for numerous species of commercially and recreationally important fishes and invertebrates. Without such projects, the barrier islands will continue to disintegrate and convert to shoals, compromising biological, physical, and chemical estuarine gradients and accelerating estuarine wetland loss, leading to reductions in both environmental and commercial benefits.

To achieve the above-referenced goal of GEFF restoration, the overarching purpose of the Project is to restore historical conditions by enlarging the existing barrier islands, both in width and in dune crest elevation, and by reducing the number of breaches. The barrier islands are typically low lying and composed primarily of three (3) physical subaerial features: the beach, dune, and back-barrier marsh. They act as a buffer to reduce the full force and effects of wave action, saltwater intrusion, storm surge, and tidal currents on associated estuaries and wetlands. To restore their GEFF and to provide this buffer involves reinforcing the shoreline through beach and dune restoration. In addition, it includes providing a marsh platform to capture overwash sediment during episodic events; sediment that would otherwise be carried into back-bay areas to form shoals or be lost into deeper waters. The marsh also serves as a "rollover" platform as the islands migrate landward. Restoration of ecologic form and function includes vegetating both the restored dunes and back-barrier marsh platforms with native plants to provide wetland habitat for a diverse number of plant and animal species, and to help anchor or retain sediment. Barrier islands protect the interior coastal wetlands, which also have high fish and wildlife value, as well as significant economic value to commercial and recreational fisheries. The estuaries of Timbalier and Terrebonne Bay are productive oyster habitat and have traditionally supported important fisheries. Restoration of the barrier islands will protect these national assets from further degradation.

Based on a regional evaluation for the surroundings of East Timbalier Island, the Project comprises not only restoration at East Timbalier Island but also restoration at the adjacent West Belle Headland. Therefore, the Project involves restoring approximately 516 acres of beach, dune, and intertidal marsh habitat on East Timbalier Island and approximately 819 acres of beach, dune, and intertidal marsh on the West Belle Headland, for a combined total of 1,335 acres. The Project includes offshore borrow areas for beach and dune habitat referred to herein as the South Pelto Borrow Area in South Pelto Area OCS Lease Block 13 and the Ship Shoal Borrow aAea in South Pelto Area OCS Lease Blocks 12 and 13. The offshore borrow areas for beach and dune fill sediment are located in Federal waters and are under the jurisdiction of BOEM. Preliminary design cut volume estimates of suitable sediment within the South Pelto Borrow and Ship Shoal Borrow Areas are approximately 4.7 and 6.5 MCY, respectively. Two pump-out areas, East Timbalier Pump-Out and West Belle Pump-Out, have been delineated with an associated sediment delivery corridor to hydraulically unload via hopper dredge or scow barges. The nearshore borrow areas for marsh habitat are referred to herein as the East Timbalier Island Marsh Borrow Area and West Belle Marsh Borrow Area. Preliminary design cut volume estimates of suitable sediment within the two nearshore borrow areas are approximately 7.2 and 1.7 MCY, respectively. The West Belle Marsh Borrow Area connects to the West Belle Headland via a previously permitted sediment delivery pipeline conveyance corridor. The corridors do not require any excavation for pipeline installation as the weighted sediment discharge pipelines will be placed directly on the seafloor.

1.3 Project Location

The Project area (Figure 1-1) includes the Restoration Areas on East Timbalier Island, extending the West Belle Headland,westward from the previously constructed West Belle Pass Headland (TE-52) project site through beach and dune fill placement utilizing offshore sand resources located in Federal waters, as well as constructing back-barrier marsh using mixed sediment from nearshore sources located in State waters. In addition, the Project includes a Feeder Beach along West Belle Headland, westward of the West Belle Pass Jetties, which would provide sediment to nourish the shoreline, relying on normal coastal processes, as well as a renourishment component at the site of the previously completed TE-52 project. The Project area also includes two (2) sources referenced as the Ship Shoal and South Pelto Borrow Areas located approximately 23 nautical miles (NM) west-southwest of East Timbalier Island on the OCS; two (2) mixed sediment sources referenced as East Timbalier Marsh Borrow Area located approximately 9.1 NM west-southwest of East Timbalier Island and West Belle Marsh Borrow area located approximately 2.5 NM south of West Belle Headland; two (2) pump-out areas referenced as East Timbalier Pump-Out Area located approximately 3.3 NM south of East Timbalier Island in South Timbalier OCS Block ST20 and the West Belle Pump-Out Area located approximately 2.5 NM south of West Belle Headland; and three (3) conveyance corridors connecting the borrow and pump-out areas to the Restoration Areas (Figure 1-2). The length of the East Timbalier Island conveyance corridor to East Timbalier Island is approximately 9.1 NM, the length of the East Timbalier Pump-Out Area Conveyance Corridor to East Timbalier Island is 3.3 NM, and the length of the West Belle Marsh Borrow Area and Pump-Out Area to West Belle is 2.5 NM. The corridors were aligned to avoid potential cultural resources and oil and gas infrastructure as well as to minimize oil and gas pipeline crossings.

The Restoration Areas are located in Lafourche Parish, Louisiana, and are part of the Terrebonne Basin. The Terrebonne Basin consists of four (4) contiguous water bodies, from west to east, named Caillou Bay, Lake Pelto, Terrebonne Bay, and Timbalier Bay, separated from the open Gulf of Mexico by a series of barrier islands. East Timbalier Island and the West Belle Headland are located in the easternmost area of the Terrebonne Basin.

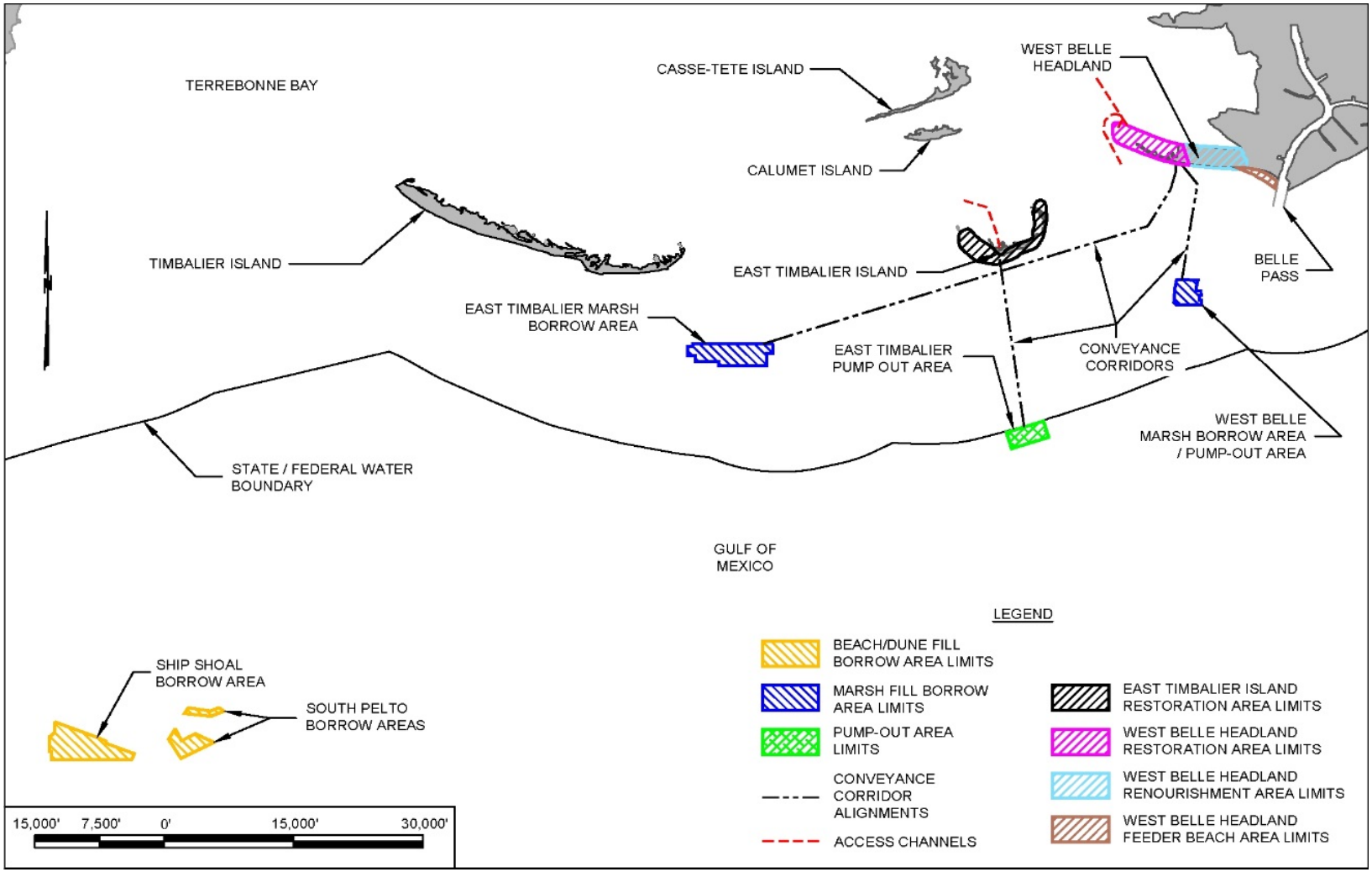

Figure 1-1. Project Area Map

1.4 Project History

1.4.1 East Timbalier Island

East Timbalier Island has been the subject of considerable study and numerous shoreline protection and restoration efforts since the middle of the last century. An anonymous, undated report (Anonymous, undated) states that Gulf Oil Company had several hundred wells in Timbalier Bay behind East Timbalier Island (Figure 1-2) and that by the mid-1960s the facility had witnessed 30 years of island erosion. In the early 1960s the company constructed an earthen levee "…generally to the northern side of the island" (Anonymous, undated). The levee provided overwash protection from storms attacking from both the Gulf and Bay sides, with the latter contributing significantly to land loss. In 1966 Gulf Oil constructed rock groins in two breach areas, and between 1967 and 1974, they constructed a shore-parallel revetment with equally spaced shore-normal groins the length of the island and concurrently armored sections of the aforementioned earthen levee. Both the revetment/groin field and the levee were severely damaged by Hurricane Carmen in September 1974. Much of the damage was repaired in subsequent years, including the 1980 installation of a 5,000-foot concrete mat revetment and six T-groins. In addition, in 1975, a 2,000-foot experimental rock "seawall" was constructed by the State of Louisiana.

Figure 1-2. Oil and Gas Infrastructure in Terrebonne Bay North of East Timbalier Island.

The island stabilization efforts failed to prevent the gradual loss of island area, and Hurricane Andrew, which struck the Louisiana coast in August 1992, breached the island in several places, the largest being an approximately 4,500-foot breach near the eastern end of the island, isolating the eastern petroleum processing facility from the rest of the island. To repair the damage, two (2) Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA)

projects were proposed. The first was East Timbalier Island Sediment Restoration, Phase 1 (TE-25) to address restoration of the central portion of the island in the vicinity of the west petroleum processing facility, and the second was East Timbalier Island Sediment Restoration, Phase 2 (TE-30) to close the large eastern breach.

The projects were combined and engineering design was completed in 1997. The proposed design included containment dikes, dune, and back-barrier marsh constructed from dredged sediment and sections of rubble-mound revetment to protect the dune. The borrow area utilized for the project, referenced as C-3, was located approximately 3 miles southwest of East Timbalier Island in Little Pass Timbalier. Three (3) dredges were used to remove approximately 2.7 million cubic yards of sediment. The project was ended approximately mid-way through the completion of the TE-30 template when it became obvious that the unconfined fill placement in the breach was not feasible within the project budget. The original project design goal was to restore approximately 225 acres of island. A total of 217 acres of habitat were created, including 161 acres of intertidal marsh habitat and 55 acres of beach and dune habitat (Picciola & Associates, 2000; LDNR, undated).

Analyses of aerial photographs of East Timbalier Island, dating back to the Gulf Oil Company era, show that the island gradually migrated north away from the shore protection structures, with the shore-parallel revetment functioning as a quasi-breakwater until it sank below mean low water. Concurrently, the land area beneath and around the petroleum processing facility and its array of catwalks gradually converted to open water, as the island area diminished.

Krewe Energy currently owns the well field, but ownership of the Timbalier Bay well field and the processing facilities at East Timbalier Island has changed several times since Gulf Oil Company withdrew operations. Old wells have been taken out of service and new wells have been drilled. Along with this activity has been the creation of a sprawling web of pipelines and dredged access channels to the east, west, and north of the island (Figure 1-3). This petroleum processing infrastructure posed difficulties during all phases of the TE-25/TE-30 Project (Picciola & Associates, 2000).

Since 2000, East Timbalier Island has been affected by the passage of five (5) significant hurricanes that have diminished the island footprint and left much of its petroleum processing infrastructure standing in open water. However, the Timbalier Bay well field is still in production, and the processing and collection infrastructure is still actively operated and in need of protection.

A recent analysis of land area change indicated that the previously projected Year of Disappearance (YOD) for East Timbalier Island, 2014, had benefitted from the TE-25/TE-30 projects but that benefit had been tempered by hurricanes in 2002, 2005, and 2008 to a projected YOD of 2020 (Stantec, 2017). Recent storm events have caused a breach in the island and it is now composed of two (2) degraded segments of land (Figure 1-4).

Based on the literature, site visits, aerial photographs, and bathymetric survey data from CPRA monitoring efforts, three separate lines of submerged rock exist in the nearshore along East Timbalier Island. Further, portions of the shoreface have been armored with rock.

Figure 1-3. Access Channel Map for Oil and Gas Infrastructure in the Vicinity of East Timbalier Island.

Figure 1-4. Breach of East Timbalier Island

1.5 Planning Process

1.5.1 Goal and Planning Objectives

The 2017 Coastal Master Plan for Louisiana (CPRA, 2017) contains five objectives that reflect the key issues affecting the people and environment in and around Louisiana's coast. Those five (5) objectives are (1) Flood Protection (reduce economic losses from storm surge based flooding to residential, public, industrial, and commercial infrastructure); (2) Natural Processes (promote a sustainable coastal ecosystem by harnessing the natural processes of the system); (3) Coastal Habitats (provide habitats suitable to support an array of commercial and recreational activities coast wide); (4) Cultural Heritage (sustain the unique cultural heritage of coastal Louisiana by protecting historic properties and traditional living cultures and their ties and relationships to the natural environment); and (5) Working Coast (promote a viable working coast to support regionally and nationally important businesses and industries).

Restoration of barrier island habitat is specifically listed as one of the types of projects included in the 2017 Coastal Master Plan. The CPRA spent hundreds of millions of dollars over the past 20 years restoring the Terrebonne and Barataria barrier shorelines and will continue to fund Louisiana's barrier island program (CPRA, 2017). The project area delineated in the Timbalier Islands Master Plan project included Timbalier Island, East Timbalier Island, and the West Belle Headland.

The specific objectives of the Project is "…the restoration of dune, supratidal, and intertidal habitat on East Timbalier Island" (NFWF, undated). The Project's overarching goals are to restore the geomorphic and ecologic form and function (GEFF) of East Timbalier Island and the West Belle Headland as a component of the Terrebonne Basin Barrier Shoreline system. The barrier system separates the Terrebonne and Timbalier Bay estuarine system marshes and forested wetlands from direct influence from the open waters of the Gulf of Mexico, allowing them to continue to function as productive nursery areas for numerous species of commercially and recreationally important fishes and invertebrates. Without such projects, the barrier islands will continue to degrade, with ever-widening breaches leading to loss of estuarine wetlands and reduction of their environmental and commercial benefits.

Restoring the geomorphic form and function to provide a functional barrier system involves introducing new sand to the coastal system through beach and dune restoration. In addition, it includes providing a marsh platform to capture overwash sediment during episodic events – sediment that would otherwise be carried into back-bay areas to form shoals or be lost into deeper waters. This overwash onto the marsh platform helps to maintain island integrity as they migrate landward. Restoration of ecologic form and function includes vegetating both the restored dunes and back-barrier marsh platforms with native plants to provide wetland habitat for a diverse number of plant and animal species and to help retain sediment.

The protection offered by East Timbalier Island to the existing oil and gas infrastructure reduces environmental risks and supports the viability of an existing economic resource. Without the barrier island, the existing oil and gas facilities would be exposed to open Gulf conditions, making it vulnerable and increases the risk of spills. Also, having a working facility in close proximity to the wells and pipelines allows the operator and their local crews increased capacity

to identify and respond to spills quicker than if they were located several miles inland. East Timbalier Island has provided protection for the infrastructure for over 80 years. Past attempts to stabilize the island and maintain a protective buffer utilized hard structures that interrupted natural sediment transport pathways, hindering natural island recovery after hurricanes, accelerating island disintegration, and compromising the island's natural ability to maintain geomorphic and ecologic form and function (Penland and Suter, 1988).

The scope of the Project Area for the alternatives analysis included evaluation of alternatives on East Timbalier Island, West Belle Headland, and Casse Tete and Calumet Islands. Based on the regional evaluation, it was determined that placement of sand along the shoreline updrift of East Timbalier Island, in addition to direct placement on the island, had greater benefits to the island over the long term than only placing sand on the island. Therefore, the proposed Project comprises restoration at East Timbalier Island and at the updrift West Belle Headland. Approximately 1,335 acres of beach, dune, and intertidal back-barrier marsh habitat will be restored, including 516 acres on East Timbalier Island and 819 acres on the West Belle Headland. In addition, the Project includes a Feeder Beach along West Belle Headland, westward of the West Belle Pass Jetties, which would provide sediment to nourish the shoreline, as well as a renourishment component at the site of the previously completed TE-52 project. Refer to Figure 1-1 for an overview of the Project's features.

1.5.2 Problems and Opportunities

The problems specific to East Timbalier Island and West Belle Headland included the following:

- land loss due to erosion threatens the geomorphic and hydrologic barrier systems;
- longshore sediment are significantly reduced, limiting the ecosystem's ability to be self-sustaining; and
- loss of barrier island/headland ecosystem habitat.

The opportunities specific to East Timbalier Island and West Belle Headland included the following:

- restore diversity of the barrier island/headland habitats;
- increase longevity of the barrier island/headland geomorphic function;
- increase sediment into the long-shore process; and
- improve the beach, dune, and marsh habitat.

1.5.3 Formulation of Alternative Plans

During the Preliminary Design Phase, multiple alternatives were evaluated. The Project team developed 3 levels of alternatives ranging from "No-Action" to "Low Sediment Restoration Template" and "High Sediment Restoration Template" with various combinations of islands and scale of sediment input. Based on the results of the analysis, the preferred alternative included restoration on East Timbalier Island and the West Belle Headland, which provides benefits to beach, dune, and intertidal marsh habitat within the context of the anticipated budget and consistent with the goals of the Louisiana Coastal Master Plan.

The alternatives evaluated included individual island restoration plans or combinations thereof that could be constructed within the budget and would most effectively fulfill the Louisiana Coastal Master Plan objectives. A variety of templates considered individually and/or in combination included restoration options at East Timbalier, East Timbalier Shoal, Casse-Tete and Calumet Islands, and West Belle Headland. The elevations, widths, and configurations of landforms created for the conceptual plans were informed by previous work performed on the Louisiana Coastal Area (LCA) Terrebonne Basin Barrier Shoreline Restoration Feasibility Study (USACE, 2012) and recent barrier island modeling and planning work done to support the development of the 2017 Coastal Master Plan (CEC, 2015). Factors considered in determining the preferred alternative included habitat acres created and sustained, effectiveness in achieving the Louisiana Coastal Master Plan objectives, synergy with completed and planned projects within the system, promoting a viable working coast including protection of infrastructure and/or coastal activities, and stakeholders. During the conceptual plan development, emphasis was placed on the avoidance and minimization of fill placement over active wells to mitigate risks associated with construction activities near existing, active infrastructure. Specifically, the planforms for the beach, dune, and marsh features were designed to avoid concentrations of active wells.

Details of the alternatives considered and screening, including numerical modeling conducted to inform alternatives screening can be found in the East Timbalier Island Restoration Project (TE-118) Preliminary Design Report and Section 2 of this EA.

1.5.4 Regulatory Issues

The nature of the Project, involving excavating (dredging) sediment from waters of the United States and the State of Louisiana, and discharge (fill placement) of that dredged material in waters of the United States and the State of Louisiana, triggers the requirements to comply with two (2) Federal administered by the U.S. Army Corps of Engineers (USACE). Section 10 of the Rivers and Harbors Act of 1899 requires USACE permission to excavate or place fill in navigable waters. Section 404 of the Clean Water Act regulates discharge of dredged material into waters and wetlands, and it too requires a permit for such activities. The basis for the former regulation is protection of navigation, and the basis for the latter is protection of the environment. Both regulations require the Project to be advertised to the public, with a period for public comment, and review and consideration of the comments. In addition, NEPA sets certain standards for public input and review. The NEPA requirements were satisfactorily met during the Terrebonne Basin Barrier Shoreline Restoration (TBBSR) Feasibility Study (USACE, 2010). Additional NEPA compliance will be carried out by BOEM. Chapter 6 has detailed information herein regarding permits and commitments for the Project.

2.0 - ALTERNATIVES ANALYSIS

2.1 Proposed Actions

The proposed actions for the Project components, as well as the conveyance corridors for the transport of sediment between the borrow areas and the Island and Headland, are summarized in the following sections. Detailed descriptions of the Project components are presented in the Preliminary Design Report (Stantec, 2017).

2.1.1 Restoration Areas

East Timbalier Island Restoration Area

The East Timbalier Island restoration template extends the length of the island and includes the construction of beach, dune, and two marsh components (Figure 2-1). These features on East Timbalier Island will result in the restoration of a total of approximately 516 acres of dune habitat (elevation > +5.0 ft NAVD88), supratidal habitat (elevation between +2.0 ft and +5.0 NAVD88), and intertidal marsh habitat (elevations between 0.0 ft and +2.0 ft NAVD88).

The East Timbalier Island beach and dune features are approximately 13,600 linear feet long and requires placement of approximately 6.6 MCY of sand. The dune will be constructed at a target elevation of +7.5 ft NAVD88 with fore and back-slopes of 1V:25H and a width of 100 ft at the crest (Figure 2-2). The target elevation of the beach will be +5.0 ft NAVD88, with a slope of 1V:25H from the beach berm crest extending seaward to the intersection with the existing grade and a width ranging from 170 to 400 ft. Assuming a 1.3:1 cut to fill ratio and being conservative in the Preliminary Design Phase, the recommended cut volume from South Pelto and/or Ship Shoal requirements for the sand source to construct the beach and dune features is approximately 8.6 MCY.

The two East Timbalier Island marsh components are approximately 6,800 linear feet in combined length, extending from Stations 110+00 to 140+00 and from Stations 190+00 to 220+00 north of the beach and dune, and require placement of approximately 1.3 MCY of mixed sediment to create the marsh platform at a target elevation of +3.0 ft NAVD88. Assuming a 1.6:1 cut to fill ratio and being conservative in the Preliminary Design Phase, the recommended cut volume requirements for the mixed sediment source for the marsh platform were calculated at 2.1 MCY. The East Timbalier Island marsh containment dikes will be constructed from sediment dredged from the Ship Shoal and/or South Pelto Borrow Areas requiring approximately 0.45 MCY in place and a cut volume of approximately 0.6 MCY. The marsh containment dike dimensions are +5.3 ft NAVD88 crest elevation, 30 ft crest width, with 1V:25H side slopes.

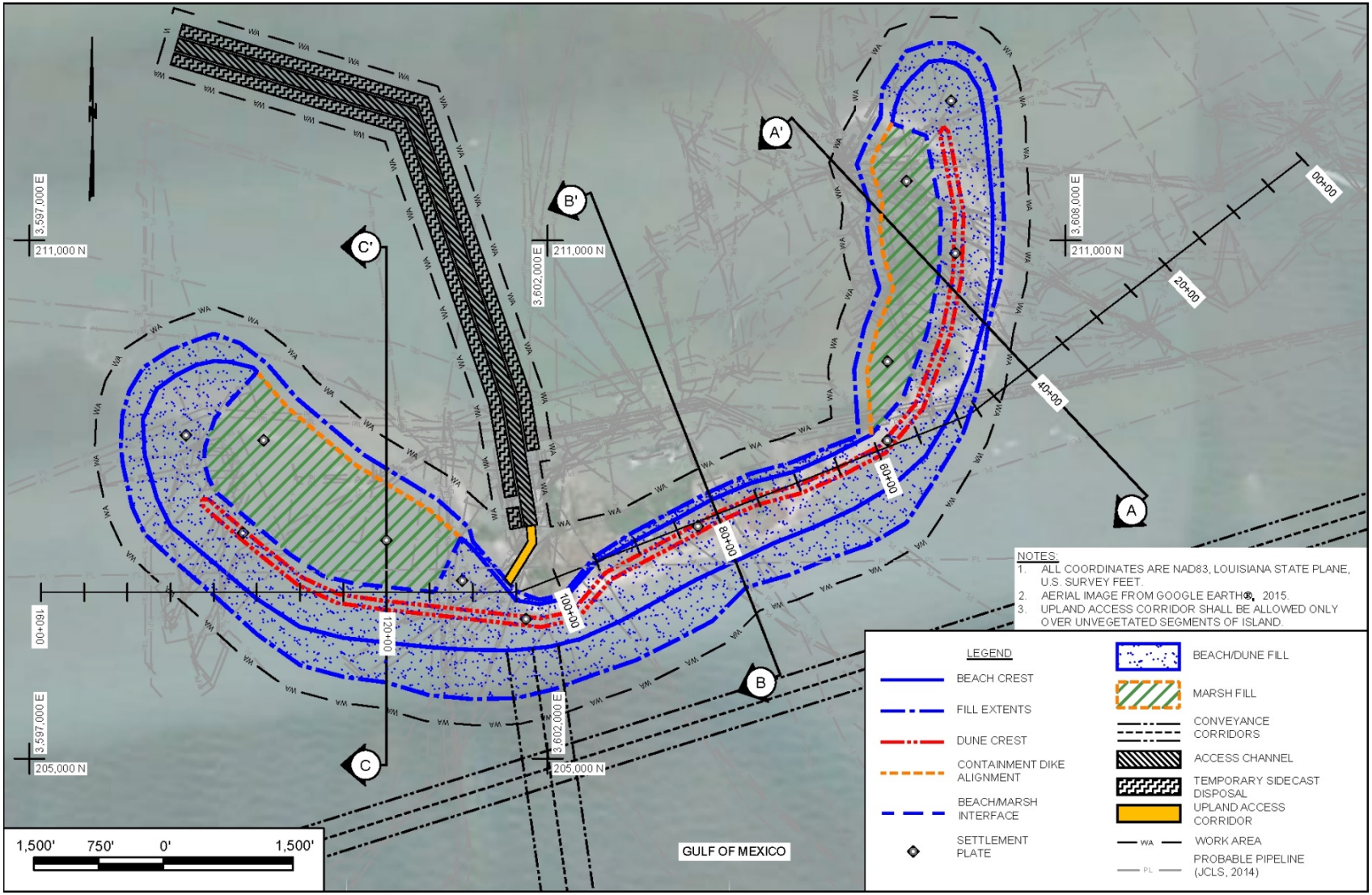

Figure 2-1. East Timbalier Island Restoration Plan View

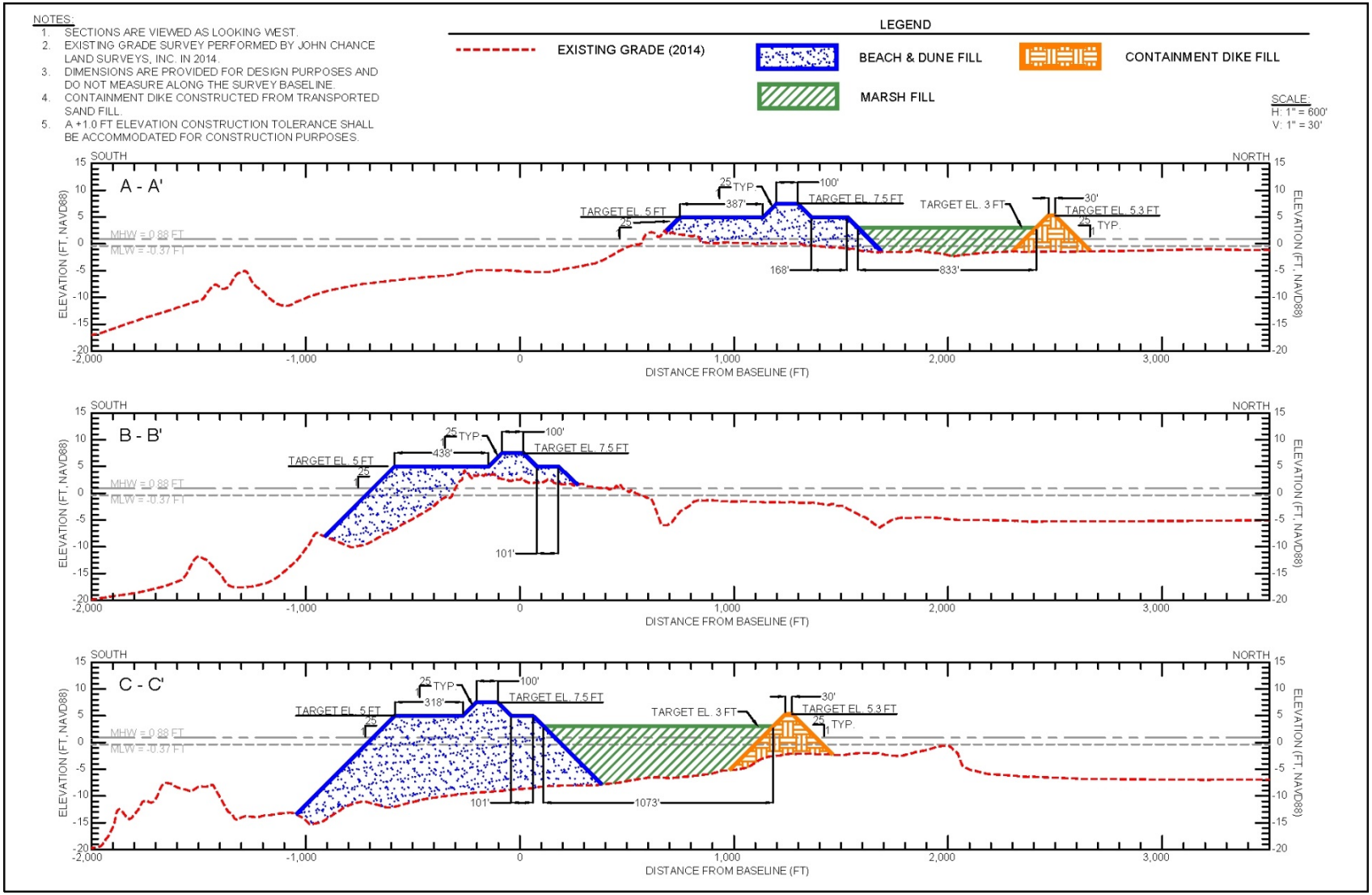

Figure 2-2. East Timbalier Island Restoration Typical Cross Section

West Belle Headland Restoration Area and Feeder Beach

The West Belle Headland restoration template will begin at the terminus of the existing TE-52 Project and extend approximately 10,000 linear feet westward. Station 0+00 to Station 100+00 will include construction of beach, dune, marsh, and feeder beach (Figure 2-3). These features on West Belle Headland will result in the restoration of approximately 819 acres of dune (elevation > +5.0 ft NAVD88), supratidal (elevation between +2.0 ft and +5.0 NAVD88), and intertidal marsh habitat (elevations between 0.0 ft and +2.0 ft NAVD 88).

The West Belle Headland beach and dune features involves placement of approximately 2.2 MCY of sand to create both beach and dune habitat. The dune will be constructed at a target elevation of +7.5 ft NAVD88, with fore- and back-slopes of 1V:25H and a typical width of 100 ft at the crest (Figure 2-4). The target elevation of the beach will be +5.0 ft NAVD88, with a slope of 1:25 from the beach berm crest extending seaward to the intersection with the existing grade and a width of 290 ft. Assuming a 1.3:1 cut to fill ratio and being conservative in the Preliminary Design Phase, the recommended cut volume from Ship Shoal and/or South Pelto Borrow Area requirements for the sand source were calculated at 2.9 MCY.

The West Belle Headland marsh feature will also extend approximately 10,000 linear feet westward from the existing TE-52 Project, north of the beach and dune, and involves placement of approximately 1.3 MCY of mixed sediment (sand, silt and clay) to create intertidal marsh habitat. The marsh platform target elevation is +3.0 ft NAVD88 with a minimum width of 1,145 ft. Containment dikes will be constructed from sediment excavated in situ. The marsh containment dike dimensions are +5.3 ft NAVD88 elevation, 10 ft crest width, with 1V:10H side slopes. Primary (interior) and secondary (exterior) containment dike borrow channels are proposed as the sources of in situ sediment for dike construction (refer to Figures 2-4 and 2-5). Assuming a 1.6:1 cut to fill ratio and being conservative in the Preliminary Design Phase, the recommended cut volume from the West Belle Marsh Borrow Area requirements for the mixed sediment source is approximately 2.1 MCY.

In addition, a Feeder Beach will be constructed along West Belle Headland extending approximately 4,000 linear feet from the west jetty to provide sediment that will nourish the remaining shoreline (Figure 2-5). The modeling effort highlighted a vulnerable area within the West Belle Headland that will benefit significantly from coarser sand nourishment and result in a more robust overall restoration template for the area. The 68-acre Feeder Beach will be constructed to an elevation of +1.0 ft NAVD88, with a length of approximately 4,000 linear feet, a width ranging from 420 to 920 ft, and a seaward slope of 1V:25H (Figure 2-6). The volume of sand from Ship Shoal and/or South Pelto Borrow Areas required to construct the Feeder Beach feature will be approximately 0.41 MCY. Assuming a 1.3:1 cut to fill ratio and being conservative in the Preliminary Design Phase, the recommended cut volume requirements for the sand source were calculated at 0.53 MCY.

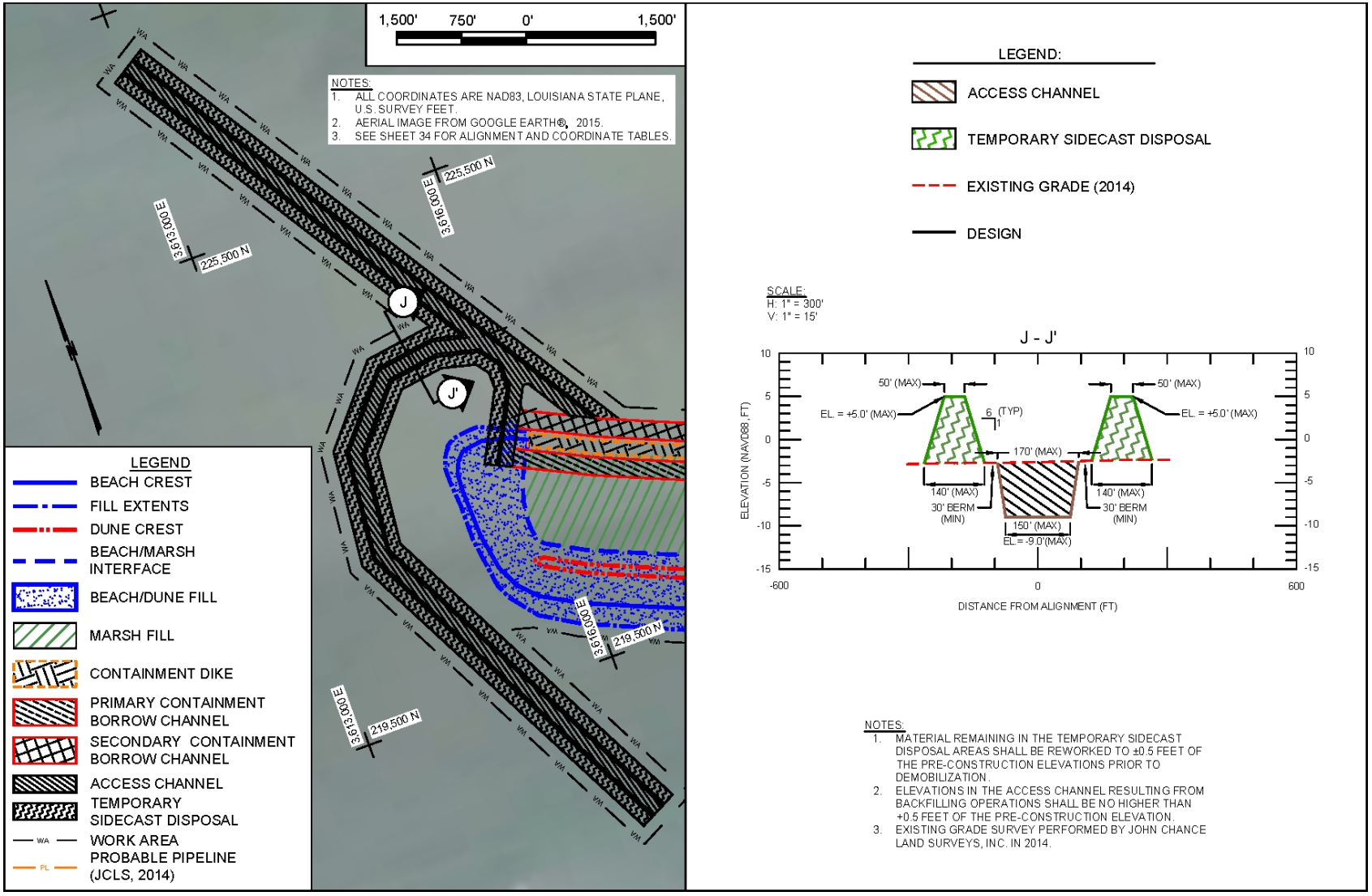

Figure 2-3. West Belle Headland Restoration Plan View

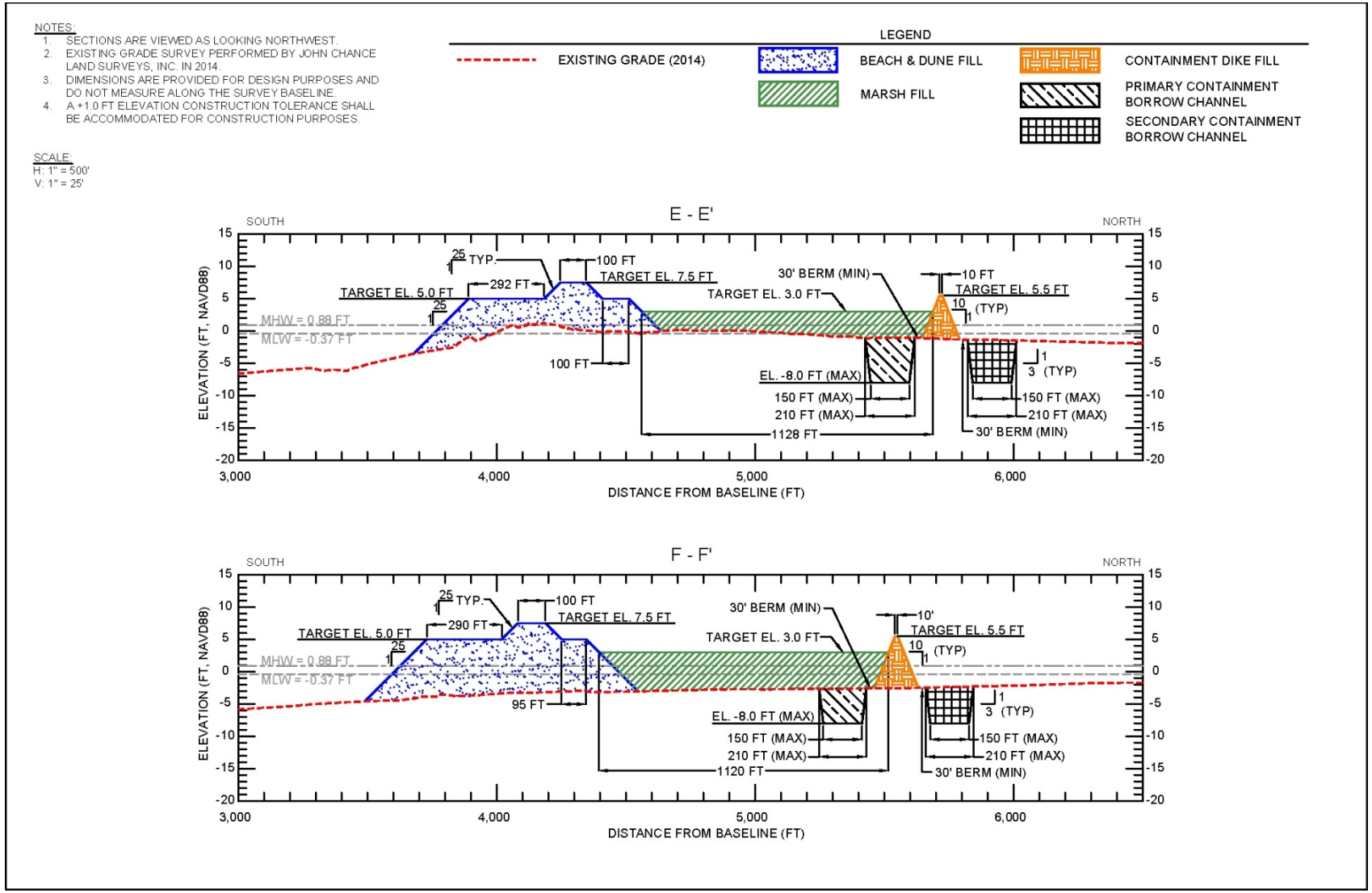

Figure 2-4. West Belle Headland Restoration Typical Cross Sections

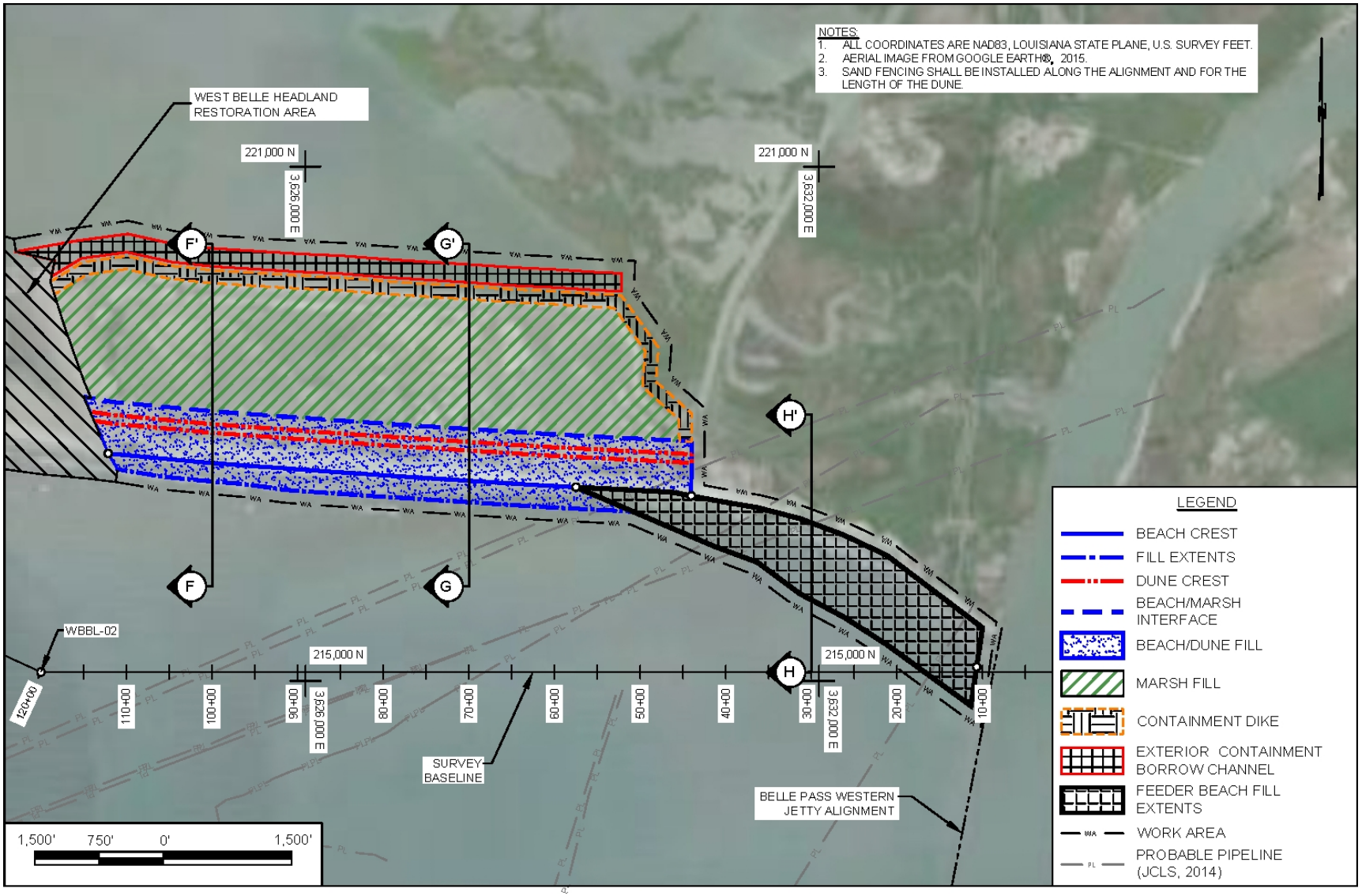

Figure 2-5. West Belle Headland Renourishment and Feeder Beach

NOTES:
1. SECTIONS ARE VIEWED AS LOOKING WEST.
2. EXISTING GRADE SURVEY PERFORMED BY JOHN CHANCE LAND SURVEYS, INC. IN 2015.
3. DIMENSIONS ARE PROVIDED FOR DESIGN PURPOSES AND DO NOT MEASURE ALONG THE SURVEY BASELINE.
4. A +1.0 FT ELEVATION CONSTRUCTION TOLERANCE SHALL BE ACCOMMODATED FOR CONSTRUCTION PURPOSES.

SCALE:
H: 1" = 500'
V: 1" = 25'

LEGEND
EXISTING GRADE (2015)
DESIGN
FEEDER BEACH FILL

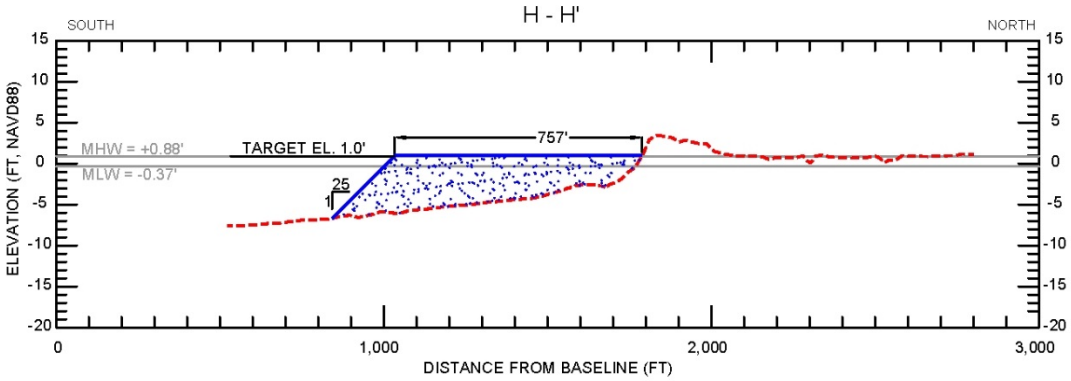

Figure 2-6. West Belle Headland Feeder Beach Typical Cross Section

West Belle Headland Renourishment Area

After reviewing recent Barrier Island Comprehensive Monitoring Program Survey data, the Project team determined that the previously restored template of the CWPPRA TE-52 West Belle project (CPE, 2009 and 2013) may require a renourishment event; therefore, the West Belle Headland Renourishment Area is included in the permit application for this action. The proposed activity will add new sand to existing beach, dune, and marsh habitat (Figure 2-7).

The beach and dune features include the dune which is approximately 8,400 linear feet in length, constructed at a target elevation of +7.5 ft NAVD88, with fore- and back-slopes of 1V:25H and a typical width of 100 ft at the crest, Figure 2-7. The target elevation of the beach will be +5.0 ft NAVD88, with a slope of 1:25 from the beach berm crest extending seaward to the intersection with the existing grade, and a typical width of 292 ft. The volume of sand from Ship Shoal and/or South Pelto Borrow Area required to construct the beach and dune will be approximately 0.6 MCY. Assuming a 1.3:1 cut to fill ratio and being conservative in the permitting, the recommended cut volume requirements for the sand source are 0.8 MCY.

The marsh feature for the West Belle Headland Renourishment Area is approximately 7,200 linear feet in length, north of the beach and dune, and involves placement of approximately 0.4 MCY of mixed sediment to create intertidal marsh habitat. The marsh platform target elevation is +3.0 ft NAVD88 with an average width of approximately 1,500 ft. Containment dikes will be constructed from sediment excavated in situ. The marsh containment dike dimensions are +5.5 ft NAVD88 elevation, 10 ft crest width, with 1V:10H side slopes. An exterior containment dike borrow channel is proposed as the source of in situ sediment for dike construction. Assuming a 1.6:1 cut to fill ratio and being conservative in the Preliminary Design Phase, the recommended cut volume from Ship Shoal and/or South Pelto Borrow Area requirements for the mixed sediment source were calculated at 0.6 MCY.

Sand Fencing and Vegetative Plantings

The dune platforms on the Restoration Areas will have a single row of sand fencing installed to promote deposition of windblown sand placed within the fill template. The sand fencing will be constructed of wooden slats, appropriately spaced laterally, and secured with fence wire to untreated wooden posts to form a porous barrier constructed 4 ft in height above the dune platform.

Vegetative planting of the dune and marsh is a vital component of barrier island habitat restoration. The Project includes vegetation of the entire length of the dune and marsh platform at a planting density and composition similar to recent barrier island restoration planting projects in Louisiana. The dune platform will be planted over 100 percent of the area immediately following construction using a mixture of native dune plants. The vegetative plantings on the dune would include a mixture of some or all of the following herbaceous species: Bitter Panicum (*Panicum amarum* var. *amarum* "Fourchon"), Seashore Paspalum (*Paspalum vaginatum* "Brazoria"'), Seacoast Bluestem (*Schizachyrium maritimum* "Timbalier"), Seashore Dropseed (*Sporobolus virginicus*), Sea Oats (*Uniola paniculata* "Caminada"'), Marshhay Cordgrass (*Spartina patens* var. "Gulf Coast"), and Gulf Cordgrass (*Spartina spartinae*). Woody

species would be planted landward of the restored dune and supratidal back-berm area, at a panting density of 15 percent to mimic the sparsely vegetated native vegetative assembly that typically occurs in this area. After construction and consolidation, the newly created marsh platform will be planted with Smooth Cordgrass (*Spartina alterniflora* var. “Vermilion”) and other appropriate species.

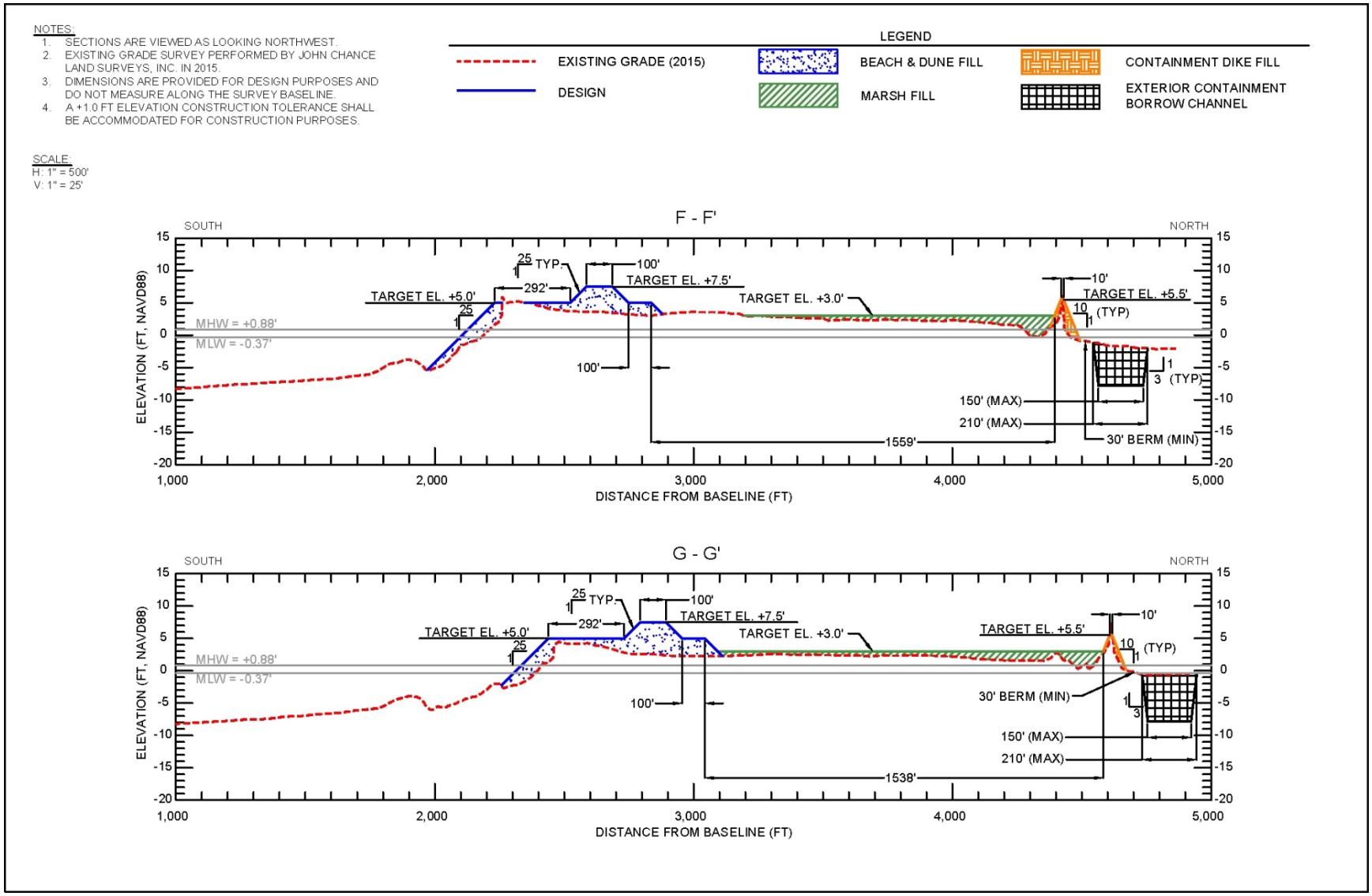

Figure 2-7. West Belle Headland Renourishment Typical Cross Sections

2.1.2 Borrow Areas

2.1.2.1 Sand Source

South Pelto Borrow Area

The South Pelto Borrow Area is located in South Pelto Lease Block 13 and is based on prior geophysical and geotechnical investigations in South Pelto Lease Blocks 13 and 14. Within the identified available borrow resource not utilized for Caminada Headland projects (BA-45 and BA-143), there are two (2) areas referred to as Expansion Area A and B, located on the southwest and northern borders of the BA-143 borrow area, as shown on Figure 2-8. Area A is the larger of the two and has a maximum length of 4,243 ft and a maximum width of 3,478 ft. The surface area is approximately 190 acres. The sand thickness is up to 14 ft. Area B has a maximum length of 4,712 ft and maximum width of 807 ft, with a surface area is approximately 63 acres. The sand thickness is up to 18 ft. A 3-ft zone of allowable disturbance is included between the sand and the lower sediment horizons. The preliminary design cut volume is estimated to be 3.2 MCY and 1.5 MCY for Areas A and B, respectively. Preliminary Design cut volume estimates of suitable sediment within the South Pelto Borrow Areas A and B is approximately 4.7 MCY including a 1,000 ft offset from active and abandoned pipelines located to the west, north, and east of the proposed borrow area. Material from this borrow area may be used for containment dike construction at East Timbalier Island and beach and dune construction at East Timbalier and West Belle Headland, as well as the East Timbalier marsh platform construction.

Ship Shoal Borrow Area

The Ship Shoal Borrow Area is located within South Pelto Lease Blocks 12 and 13 on the east-central portion of the Ship Shoal sand body on the OCS. The Ship Shoal Borrow Area is located approximately 23 NM west-southwest of East Timbalier Island. Within the Ship Shoal Borrow Area, the seafloor elevations range from less than -27 ft to deeper than -34 ft NAVD88. The Ship Shoal Borrow Area is trapezoidal in form as shown on Figure 2-9. The dimensions vary with a maximum length of 9,600 ft and maximum width of 4,400 ft. The surface area is approximately 584 acres. The sand thickness is up to 17 ft. The average percent sand and grain size were computed to be 95 percent and 0.166 mm, respectively. A 3-ft zone of allowable disturbance is included between the sand and the lower sediment horizons. The Preliminary Design cut volume is estimated to be 6.5 MCY for Project construction, including a 1,000-ft offset from active pipelines located to the east and north. Material from this borrow area may be used for containment dike construction at East Timbalier Island and beach and dune construction at East Timbalier and West Belle Headland, as well as the East Timbalier marsh platform construction.

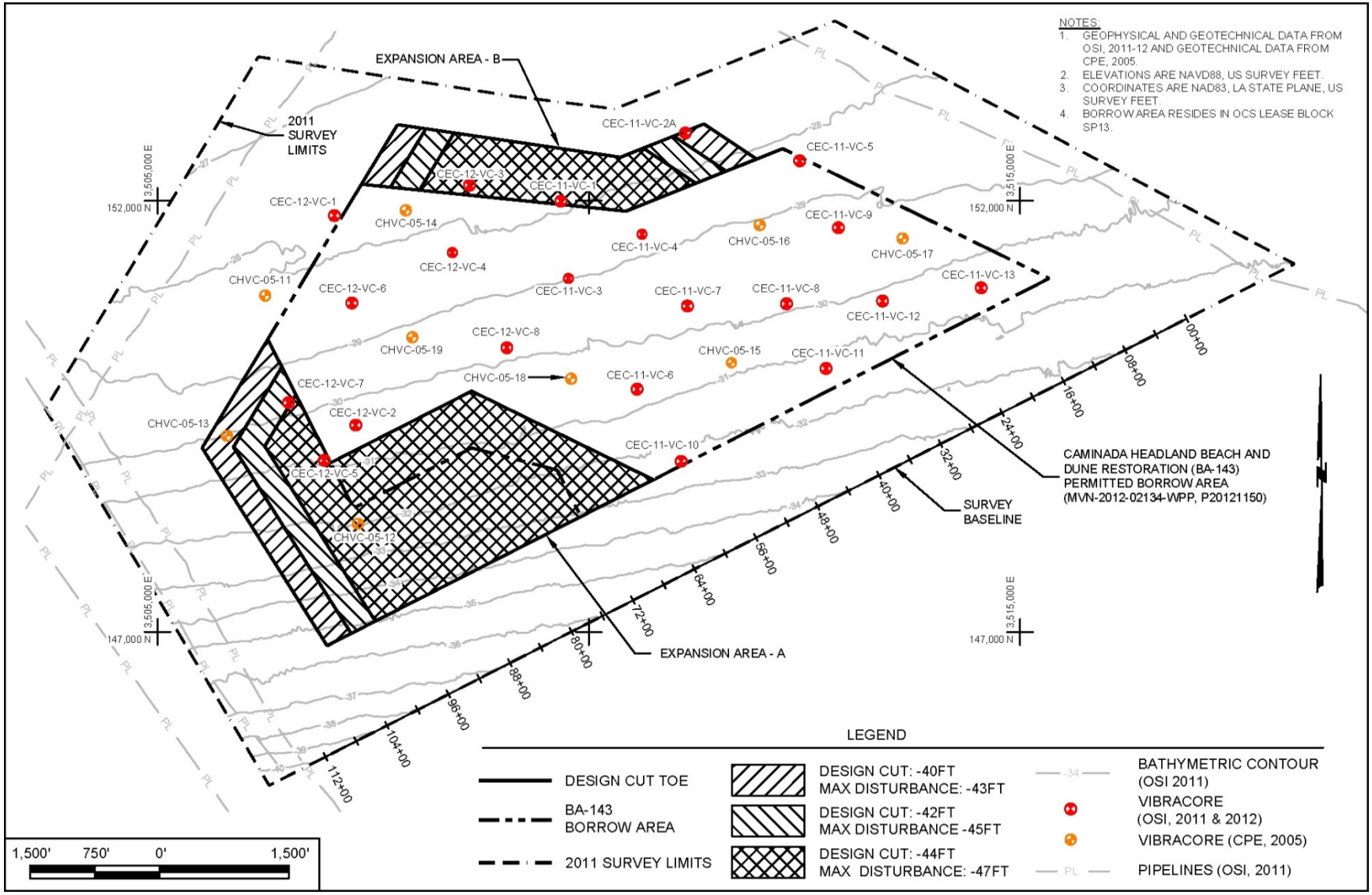

Figure 2-8. South Pelto Borrow Area

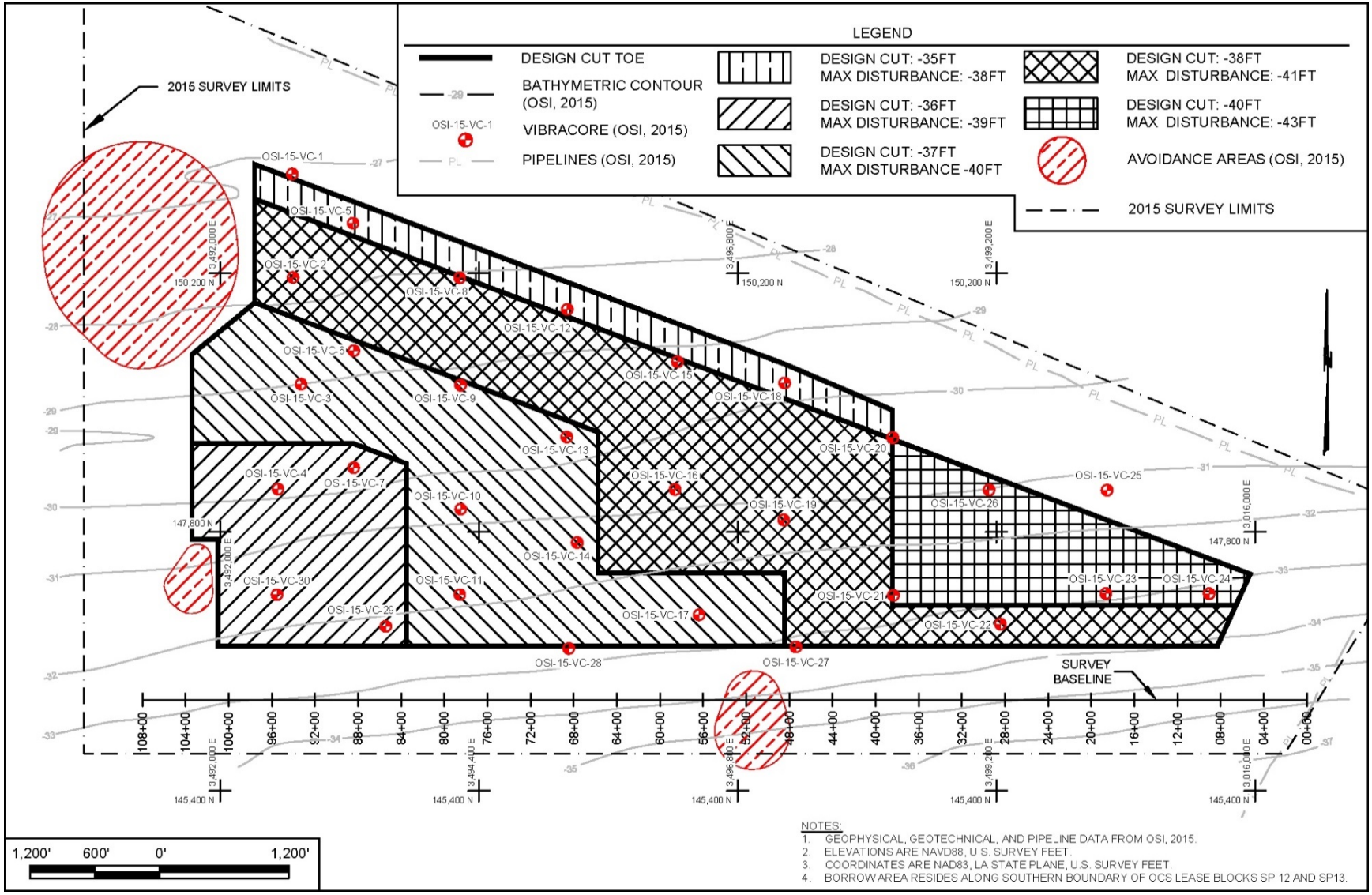

Figure 2-9. Ship Shoal Borrow Area

2.1.2.2 Mixed Sediment Source

East Timbalier Marsh Borrow Area

The East Timbalier Marsh Borrow Area is located on the Little Pass Timbalier Ebb Tidal Delta approximately 9.1 NM west-southwest of East Timbalier Island, contiguous to the beach restoration borrow area utilized for the West Belle Pass Barrier Headland Project (TE-52). The East Timbalier Marsh Borrow Area is rectangular in form, as shown on Figure 2-10. The dimensions vary with a maximum length of 9,700 ft and maximum width of 2,300 ft. The surface area is approximately 441 acres. Water depths within the borrow area range from approximately 15 to 21 ft below NAVD88. The sediment ranged from silty sand varying in thickness between 2.1 and 6.6 ft overlying mixed sediment comprised of silt and clay. Subsamples of the surficial sediment had a mean grain size of 0.096 mm and averaged greater than 75 percent sand. The mixed sediment was generally described as very soft silty clay or clay with a high water content averaging greater than 50 percent, which typically increased with depth. The Preliminary Design cut depth was set to -27 ft NAVD88 with a 3-ft limit of disturbance. The preliminary design cut volume is estimated to be 7.2 MCY. Material from this borrow area may be used for the East Timbalier and West Belle Headland marsh platforms construction**.**

West Belle Marsh Borrow Area

The West Belle Marsh Borrow Area is rectangular in form; however, it is separated into three subareas based on the previously excavation limits as shown on Figure 2-11. The West Belle Marsh Borrow area was previously analyzed for the West Belle Pass Barrier Headland Project (TE-52) and was estimated to contain approximately 4 MCY of marsh material (silt and clay). The TE-52 Marsh Borrow Area was permitted and partially used to construction the TE-52 project but it was not completely exhausted in the construction of the project, leaving marsh borrow material available for cost-effective excavation. Both the TE-40 and TE-52 projects evaluated the impacts of mining sediment from this area. A summary of the TE-52 modeling stated that "the numerical model simulations of waves, currents, sediment transport, and morphology presented in this section show that borrow area dredging caused no measurable impacts on the hydrodynamics, erosion, or deposition trends on the adjacent barrier islands (CPE, 2009; Appendix B - Delft3D Modeling). The proposed East Timbalier Island marsh borrow area is seaward of both of the previously mined TE-40 and TE-52 borrow areas. The proposed borrow area is well seaward of the depth of closure. Therefore, modeling of the impacts of mining sediment from this borrow area was not conducted due to the results of the previous modeling efforts. The West Belle Marsh Borrow Area is located approximately 2.5 NM south of the West Belle Headland. The overall dimensions have a maximum length of 3,050 ft and a maximum width of 3,150 ft. The surface area is approximately 113 acres. The West Belle Marsh Borrow Area has marsh compatible sediment ranging in thickness from 10 to 20 ft. The Preliminary Design cut depths range from -31.0 ft to -50.0 ft NAVD88, along with a 3-foot limit of disturbance. The Preliminary Design cut volume is estimated to be 1.7 MCY. Material from this borrow area may be used for the East Timbalier and West Belle Headland marsh platforms construction.

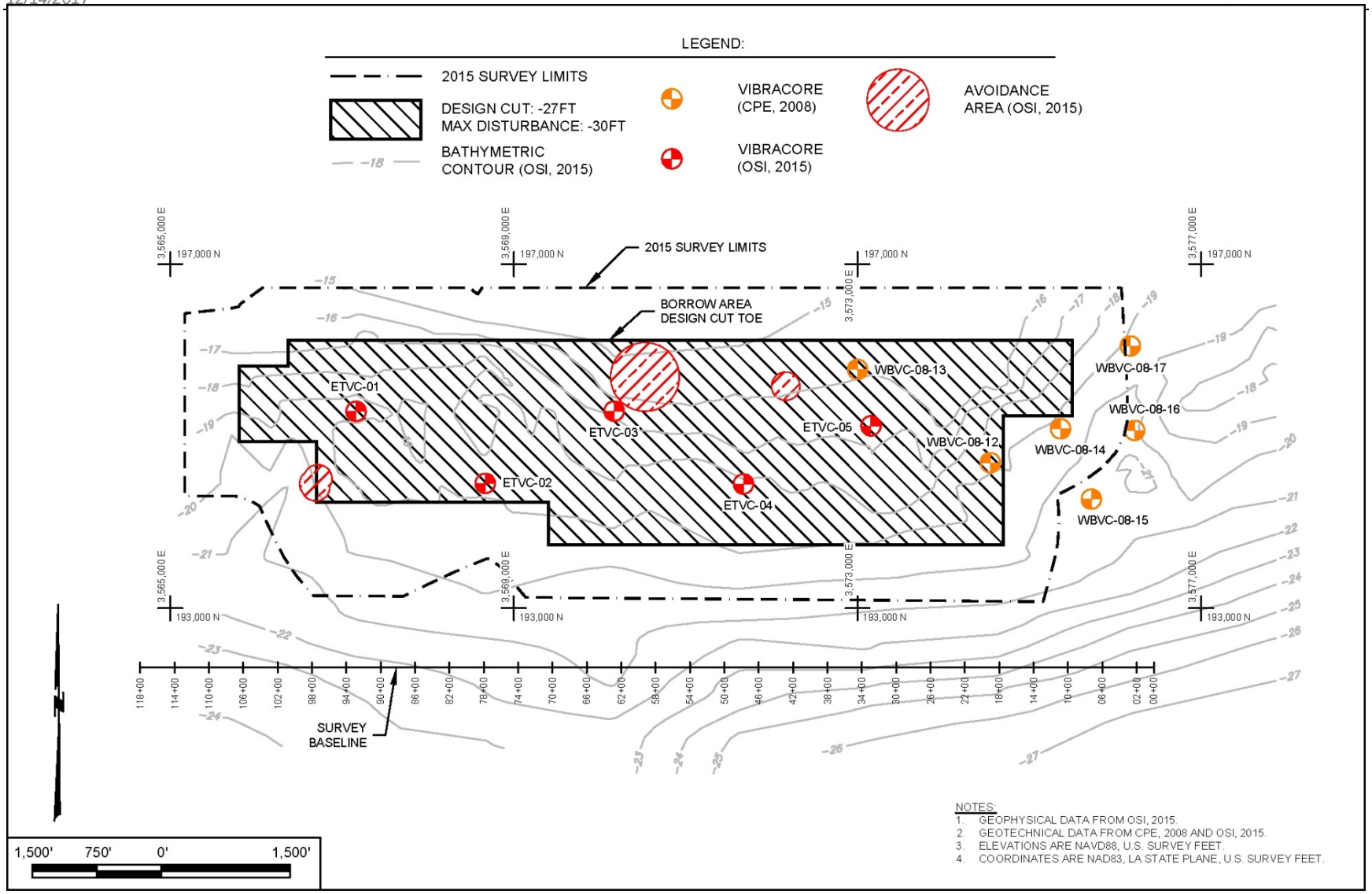

Figure 2-10. East Timbalier Marsh Borrow Area

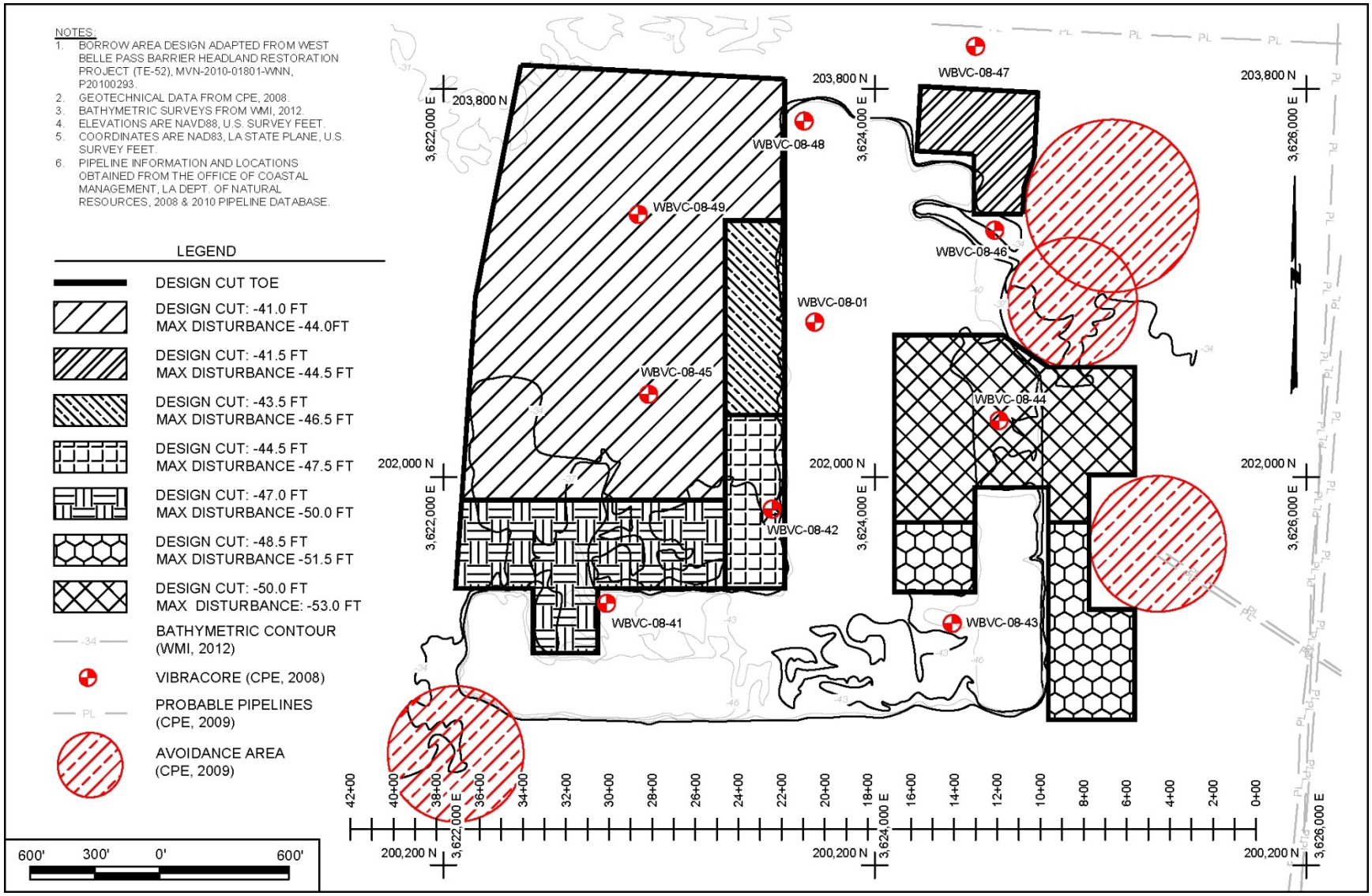

Figure 2-11. West Belle Headland Marsh Borrow Area

2.1.3 Sediment Pump-Out and Conveyance Corridors

Two (2) sediment pump-out areas were designed to convey the sand from the hopper dredges or scow barges to the Project templates, i.e., the East Timbalier Island Pump-Out Area (Figure 2-12) and the West Belle Pump-Out Area (Figure 2-13). Also, two (2) conveyance corridors were designed to connect the East Timbalier Marsh Borrow Area and the West Belle Marsh Borrow Area to the Project templates (Figures 2-12 and 2-13, respectively).

The East Timbalier Pump-Out Area selected for conveyance of the sand from the hopper dredges or scow barges to East Timbalier Island Restoration Area is located in Federal waters in South Timbalier (ST) Block 20, approximately 3.3 NM south of the Island. It is noted that an Anchorage Area has been proposed by Port Fourchon that overlaps with the East Timbalier Pump-Out Area. Representatives from CPRA have coordinated with the U.S. Coast Guard and representatives from Port Fourchon to alleviate potential conflicts between the Pump-Out Area and proposed Anchorage Area. The combination of sailing distances and discharge pipeline lengths from the Ship Shoal and South Pelto Borrow Areas to the Restoration Area are approximately 23 NM and 20 NM, respectively. The East Timbalier Pump-Out Area is designated for direct pump-out only. No bottom dumping from hopper dredges or scow barges and resuspension of sediment by cutterhead dredge will be allowed in this pump-out area. The East Timbalier Conveyance Corridor extends ~3.3 NM from the north end of the East Timbalier Pump-Out Area, north to the existing shoreline on the western end of the Island. The width of the East Timbalier Conveyance Corridor is 600 ft. A plan view of the East Timbalier Pump-Out Area and Conveyance Corridor is presented in Figure 2-12.

The West Belle Pump-Out Area selected for conveyance of the sand from the hopper dredges or scow barges to the West Belle Headland Restoration Area is located in State waters approximately 2.4 NM south of the Headland. The sailing distances from the Ship Shoal and South Pelto Borrow Areas to the Restoration Area are approximately 26 NM and 23 NM, respectively. This area was previously permitted in 2010 (MVN-2010-01801-WOO, P20100293) as a borrow area for the West Belle Pass Barrier Headland Restoration Project (TE-52). The West Belle Conveyance Corridor extends from the north end of the West Belle Pump-Out Area, north to the existing shoreline on the western end of the Headland. The width of the West Belle Conveyance Corridor is approximately 300 ft. The West Belle Conveyance Corridor corresponds to the previously permitted corridor for the TE-52 project and the conveyance corridor is also used for the West Belle Marsh Borrow Area. A plan view of the West Belle Pump-Out Area and Conveyance Corridor is presented in Figure 2-13.

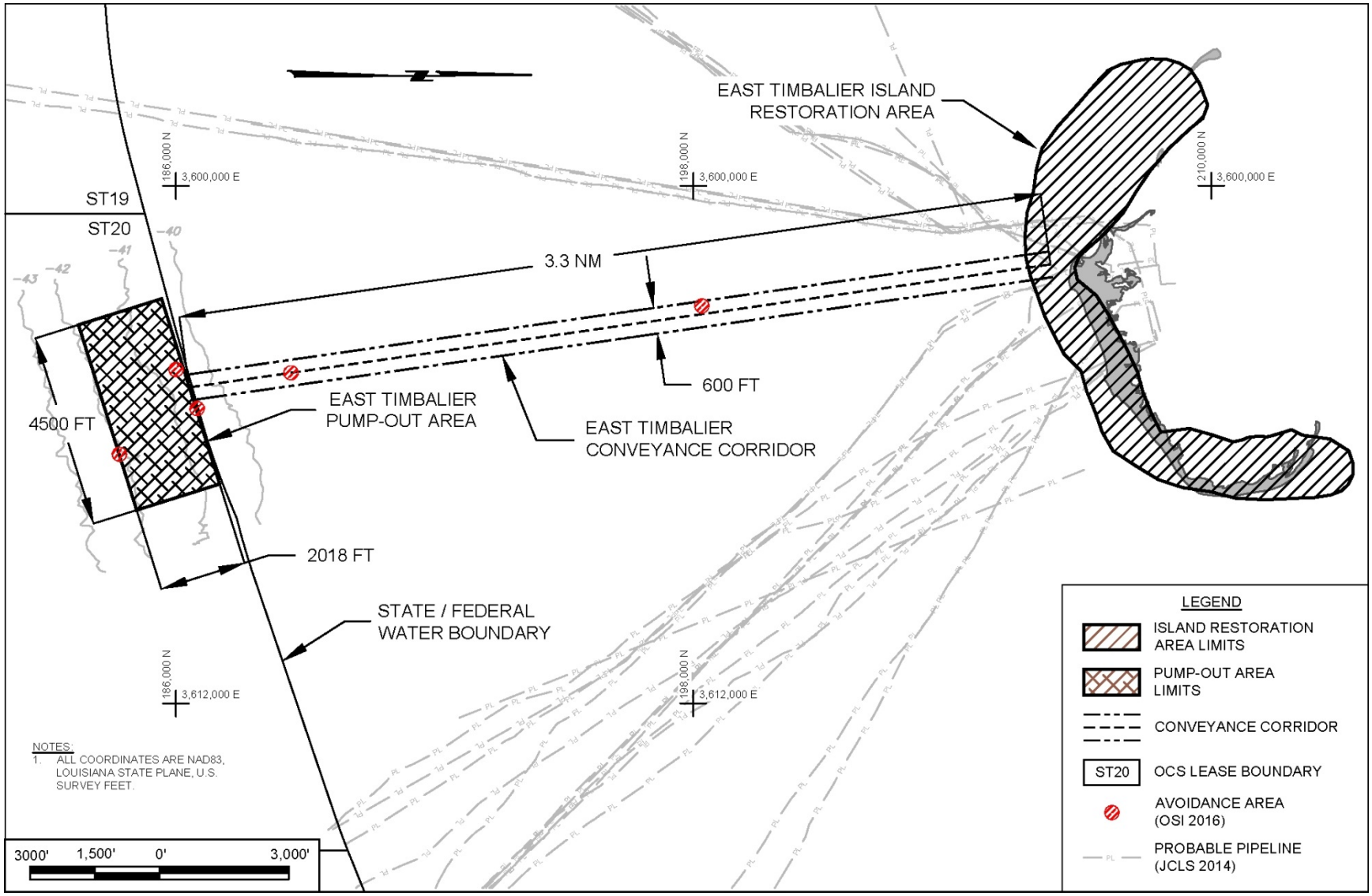

Figure 2-12. East Timbalier Island Pump-Out Area

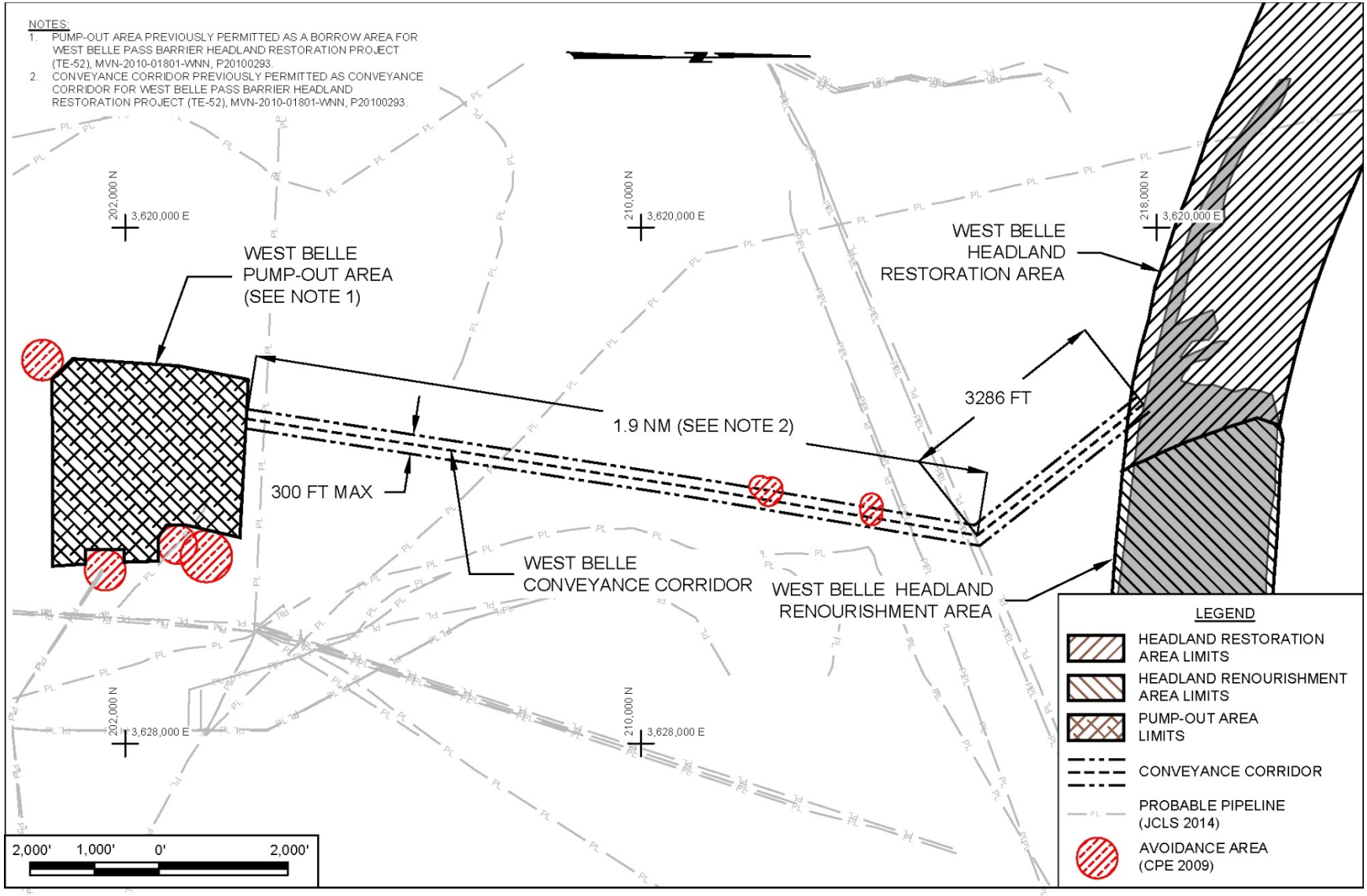

Figure 2-13. West Belle Pump-Out Area and Conveyance Corridor

The East Timbalier Marsh Conveyance Corridor was designed to convey mixed sediment from the East Timbalier Marsh Borrow Area to both of the Restoration Areas (Figure 2-14). The East Timbalier Marsh Conveyance Corridor to the East Timbalier Island Restoration Area extends from the northeast end of the East Timbalier Marsh Borrow Area, east to the intersection with the East Timbalier Conveyance Corridor. The width of the corridor is approximately 600 ft. The East Timbalier Marsh Conveyance Corridor also connects to the West Belle Headland Restoration Area extending from the northeast end of the East Timbalier Marsh Borrow Area, east past East Timbalier Island and then north to the existing shoreline on the western end of the Headland. The width of the conveyance corridor varies from approximately 400 to 600 ft. A plan view of the East Timbalier Marsh Conveyance Corridor is presented in Figure 2-14.

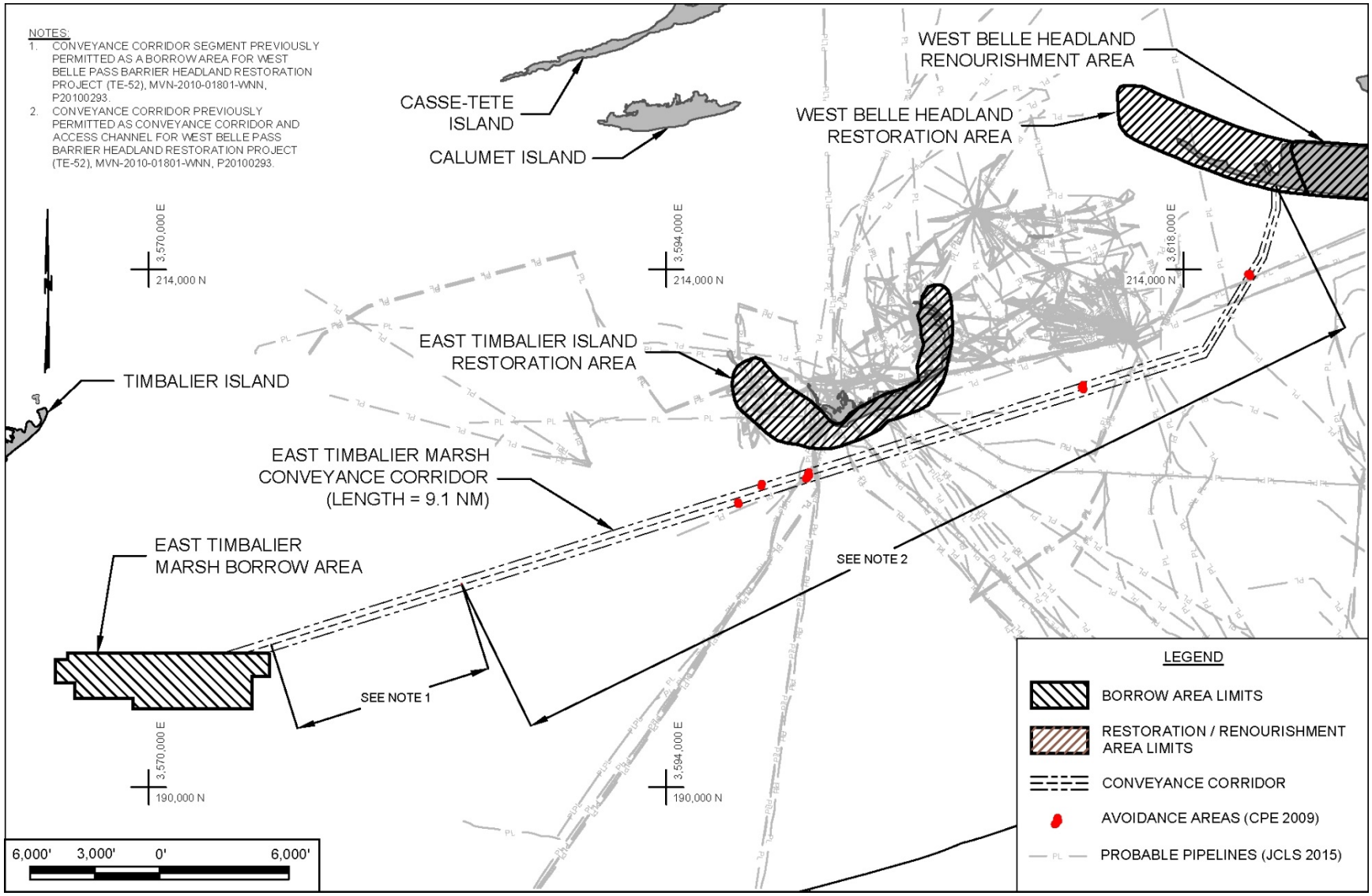

Figure 2-14. East Timbalier Marsh Conveyance Corridor

2.1.4 Temporary Access Corridors

Temporary access corridors have been designed for construction access to both the East Timbalier and West Belle areas.

The temporary access channel to the East Timbalier Restoration Area (refer to Figure 2-2) will approach from the northwest within Timbalier Bay. The location and dimensions of the temporary access channel was designed based on the existing water depths identified during the design survey (JCLS, 2015) to avoid existing infrastructure, minimize pipeline crossings, and connect to the existing channel directly behind East Timbalier Island. This existing channel is currently utilized and maintained by the local oil and gas operator, and utilizing it to the maximum extent possible for construction access on this project will reduce risk associated with removing sediment over buried pipelines.

Temporary access channel segments requiring dredging would be cut to a maximum elevation of -9 ft NAVD88 and a maximum bottom width of 150 ft. Dredged material would be placed in temporary storage areas a minimum of 30 ft from the top of cut on both sides of the channel and have a maximum footprint width of 140 ft. For the temporary storage areas, the maximum height was set at +2.0 ft NAVD88, maximum crest width at 45 ft, and side slopes at 1V:6H. The total length of the access channel inclusive of the existing channel maintained by the oil and gas operations is approximately 8,500 ft. Once access to East Timbalier Island is no longer required via the dredged channel, backfilling operation shall commence and post-construction elevations shall be no higher than 0.5 ft above the pre-construction elevations.

Two temporary access channels were designed for the West Belle Headland (Figure 2-3). The first option begins northwest of the Restoration Area and extends southeast approximately 10,800 ft to align with the exterior marsh containment dike borrow channel. Approximately 360,000 cubic yards (CY) of material may have to be dredged and side-cast adjacent to the temporary access channel for this option. The second option begins in the GOM south of the Restoration Area, loops around the western end of the restoration template, connects to the first option, and then extends south to connect to the beach and dune fill at the western end of the containment dike. The length of this access option is approximately 13,400 ft. Approximately 448,000 CY of material may have to be dredged and side-cast adjacent to the temporary access channel for this option. For both options, the access channel segments requiring dredging would be cut to a maximum elevation of -9.0 ft NAVD88 and a maximum bottom width of 150 ft. Dredged material would be placed in temporary storage areas a minimum of 30 ft from the top of cut on both sides of the channel and have a maximum footprint width of 140 ft. For the temporary storage areas, the maximum height was set at +2.0 ft NAVD88, maximum crest width at 45 ft, and side slopes at 1V:6H. Once access to the island is no longer required via the dredged channels, backfilling operation shall commence and post-construction elevations shall be no higher than 0.5 ft above the pre-construction elevations.

2.1.5 Sediment Mining and Conveyance to the Project Areas

Two (2) Borrow Areas containing beach compatible sand, i.e., the Ship Shoal and South Pelto Borrow Areas, are proposed for utilization for constructing the beach and dune fill templates. It

is anticipated that the preferred method of mining these two Borrow Areas and conveying the sand to the East Timbalier Island and West Belle Headland Restoration Areas will be one of two methods. The first method is by hopper dredge. The excavated sand will be discharged into hoppers within the hull and transported to designated pump-out areas and hydraulically unloaded. If the hopper dredge method is used, sea turtle relocation trawling, paint test inspection, and all appropriate mitigation measures will be employed as specified in the Biological Opinion, Consultation Number SER-2003-1247 (NMFS, 2005). The second method involves the use of a cutterhead dredge, which will excavate the sand and transfer it through a spider barge distribution system into scow barges. The scows will be towed to the designated pump-out areas and hydraulically unloaded directly from the scow barges to the Restoration Areas.

Cutterhead dredges utilize a rotary excavating bit to loosen the sediment. The bit or cutter is located on the end of an arm (the ladder) that is hinged off the forward end of the dredge. The ladder can be maneuvered vertically to control its depth, and the dredge and ladder can be maneuvered laterally and fore/aft using anchors deployed off the forward quarters and stern. The loosened slurry is pumped up the ladder to a large suction pump in the dredge hull, which also pumps it ashore through a submerged pipeline, often aided by the booster pump.

Sediment delivery pipeline conveyance corridors have been delineated to connect the pump-out areas and the marsh borrow areas to the Restoration Areas. The conveyance corridors have been surveyed for depth, sonar targets, and magnetic anomalies and sited to avoid as many pipelines, production facilities, and cultural resource targets as possible. The conveyance corridors do not require any excavation for pipeline installation, as the weighted sediment discharge pipelines will be placed directly on the seafloor. Details on pipeline crossings, floating pipe to submerged pipe transitions, and U.S. Coast Guard (USCG) safety lights and signage will be addressed in Final Design.

Two (2) Borrow Areas containing sediment for marsh creation, the East Timbalier Marsh and West Belle Marsh Borrow Areas, are proposed for utilization for constructing the marsh platform. It is anticipated the preferred method of mining the marsh borrow areas and conveying the mixed sediments to the East Timbalier Island and West Belle Headland Restoration Areas for marsh creation is a hydraulic cutterhead dredge and booster pumps. Sediment delivery pipeline conveyance corridors have been delineated to connect the marsh borrow areas to the Restoration Areas. The dredged material will be discharged into the Restoration Areas.

2.1.6 General Construction Methods

The proposed method to construct the beach and dune platforms on East Timbalier Island and the West Belle Headland would entail the placement of sediment pumped through pipelines to the Restoration Areas through the conveyance corridors. Bulldozers would be used to move and place the pipeline and to shape the sand for the dune and beach portions of the project. Bulldozers would shape pumped sand to create training dikes to help retain hydraulically dredged and placed sediment. Survey crews would place grade stakes to locate the Project features' horizontal and vertical limits.

The proposed construction method to construct the marsh platforms on East Timbalier and the West Belle Headland would first entail the construction of containment dikes to help retain hydraulically dredged sediment within the footprint of the marsh platform.

On East Timbalier Island, the marsh containment dike will be constructed from sand excavated from the Ship Shoal or South Pelto Borrow Areas, transported to the pump-out area, offloaded via the sediment pipeline, and deposited to create the dike. The sediment would be mechanically shaped.

The marsh containment dike for the West Belle Headland Restoration Area will be constructed with in-situ sediments excavated and placed by a barge mounted bucket excavator or track mounted articulated bucket excavators (marsh buggies). Sediment to create the marsh platform would be transported via pipeline, which would be positioned within the marsh fill area with a marsh buggy. The containment dikes help retain hydraulically dredged sediment while the marsh platform undergoes compaction and dewatering, and are expected to degrade naturally over time. If necessary, dikes would be gapped within the first 3 years to allow for tidal exchange with the created marsh and to prevent ponding of water within the containment area. Considerations regarding if and when mechanical gapping will be conducted will be based on site inspections, and determinations will be made in cooperation with natural resource agencies.

Equipment would be transported to the construction site via barges, tugboats, and crew boats. In addition, there may be a quarter's barge on site for housing the crew. Construction access to East Timbalier Island and the West Belle Headland will be limited to the permitted construction access corridors. Personnel transport would be facilitated by use of boats and/or small all-terrain vehicles.

To ensure that all aspects of construction including dredging, placement of sediment, work areas, and corridors are completed as described in this environmental assessment and other permit documents, detailed pre-construction, post-construction, and periodic bathymetric and topographic surveys will be conducted.

2.1.7 Construction Duration

The construction duration for the Project, including any work conducted on West Belle Headland, is 27 months. This includes sand fence installation, which will be installed as dune segments are completed, accepted, and surveyed. Vegetative plantings will be a separate contract and will be installed after construction during fall through early spring pending final completion, out of bird nesting season. While the base bid and primary work is East Timbalier, the contractor could be work at West Belle Headland simultaneously or sequentially within the construction period.

Sailing distances (times) from the borrow area differ for each pump-out area. Probable construction durations, in days, based on the likely pump-out area, or combinations thereof, are summarized in Table 2-1. Production rates were based on an average working time per day of 18 hours. Weather delays are factored into the probable construction duration.

Table 2-1. Estimate Construction Duration (Days)

Restoration Area	Mobili-zation	Pipeline Relocation	Beach and Dune Fill Activities	Marsh Containment Dike	Marsh Fill Activities	Demobili-zation	Construction Duration
East Timbalier	60	50	330	60	80	30	610
West Belle Headland	60	-	80	-	30	30	200

2.2 Alternatives Analysis

The No Action and an array of alternatives were considered in detail during a regional analysis of alternatives for ecosystem restoration on East Timbalier Island, West Belle Headland, Casse Tete Island, and Calumet Island. The alternatives varied in magnitude of beach, dune, and marsh habitat restored in the various areas, including beach and dune width and height; marsh size, width, height and length; and density of sediment placed. Various combinations of template scales and island restoration alternatives were evaluated at 5-year intervals for a 20-year project life. This section briefly describes the alternatives and summarizes factors that were considered in selecting the preferred alternative. The details of the alternatives analysis is provided in Appendix B.

2.2.1 No Action Alternative

This alternative assumes that there will be no barrier island restoration in the future, thus no action to combat ongoing erosion and land loss.

Through analysis of land loss and shoreline erosion it can be determined that, if no action were taken to restore East Timbalier Island and West Belle Headland, the following significant environmental resources that have institutional, public, and technical importance will be lost:

- 173 acres of Essential Fish Habitat (EFH) (TBBSR, 2010);
- critical habitat for piping plover on West Belle Headland;
- 207 acres of supratidal habitat;
- storm surge protection for Timbalier Bay Estuarine System; and
- protection of oil and gas infrastructure.

If no action is taken on East Timbalier, it is predicted to disappear over the next 20 years, and project modeling has shown that the acres above Mean High Water (MHW) would be reduced by 95 percent by 2035 (Stantec, 2017). West Belle Headland will lose approximately 38 percent of its original area if no action is taken.

2.2.2 Array of Alternatives

Various combinations of islands and template scales were evaluated to determine the best combination of features (i.e., alternatives) that would meet the project objective and be consistent with the Louisiana Coastal Master Plan objectives. Through an iterative process of plan development and screening, seven (7) alternatives were defined in the Array of Alternative, including the No Action Alternative. The details on development and screening to determine the

final array of alternatives is presented in the Preliminary Design Report (Stantec, 2017). Several of the alternatives in the final array included beach, dune, and marsh restoration of single islands plan and two (2) plans were a combination of island restoration plans.

2.2.3 Recommended Alternative for Construction

All seven (7) of the selected Array of Alternatives were within the fiscal constraints but the combination of East Timbalier High Sediment and West Belle Low Sediment was ultimately selected due to a number of qualitative benefits provided by its plan. The East Timbalier High Sediment template was designed to maximize the construction footprint for each habitat based on environmental constraints (e.g., wetlands, native vegetation), water depths, and avoiding active oil and gas wells and existing structures, while restoring the GEFF of each barrier feature to the greatest practicable extent. To sustain GEFF of the West Belle Headland, the conceptual plan proposed restoration features for the beach, dune, and marsh habitats as an extension to the northwest of the recently constructed CWPPRA TE-52 West Belle Headland Restoration project (CPE, 2009 and CPE, 2013). Multiple factors were considered in determining the preferred alternative, including habitat acres created and sustained, effectiveness in achieving the Coastal Master Plan objectives, restoring barrier islands in their current footprints, and synergy with completed and planned projects within the system. Socioeconomic factors, which included promoting a viable working coast by protecting existing infrastructure and/or coastal activities, were also considered. Lastly, the Island and Headland provides habitat for threatened species, including the piping plover and red knot, and is a valuable stopover habitat for migratory birds.

It should be noted that the collective benefits of habitat restored over time on both East Timbalier Island and the West Belle Headland are what make this a viable project in meeting the goal to restore the GEFF of the barrier shoreline and the recommended alternative.

2.2.4 Borrow Areas

The search for suitable sediment resources for Louisiana barrier island restoration has been underway for several decades. Multiple target areas within the study area were identified as possible sediment resources composed of sand or mixed sediment or both. The initial screening process applied the criterion of utilizing existing or previously cleared borrow areas. The second screening process applied the additional criteria including available fill volume, adequacy and acceptability of geotechnical and geophysical survey data, and ability to obtain cultural resources clearance. The third and final criterion was a fiscal analysis, which yielded the most cost-effective sources for each specific island in the study area.

<u>Sand Borrow</u>

South Pelto Lease Blocks 13 and 14 were surveyed and analyzed in connection with the Caminada Headland Beach and Dune Restoration projects (BA-45 and BA-143) (CEC, 2012b and 2013). Detailed geophysical and geotechnical investigations and borrow area designs were completed on the eastern end of the South Pelto sand body. Two subareas within the lease blocks were not utilized for the BA-45 and BA-143 projects because BOEM mandated avoidance buffers around several potentially significant archaeological targets in the area.

Since 2011, BOEM investigated these targets and deemed them not to be archaeologically significant and subsequently dismissed the avoidance buffer mandates required during the BA-143 project.

In addition to the remaining areas within South Pelto Lease Blocks 13 and 14, a new target area was identified for this Project within South Pelto Lease Blocks 12, 13, 18, and 19 on the east central portion of the Ship Shoal sand body and designated as the Ship Shoal Borrow Area. As part of the scope of the Project, this area underwent investigations of the extent of sediment resources as well as detailed cultural resources surveys to delineate any petroleum industry infrastructure and cultural resource avoidance areas.

Mixed Sediment Borrow

Numerous historical geophysical and geotechnical investigations performed in this area were reviewed to aid in the delineation of the reconnaissance survey area, including a detailed historical geomorphic study of Little Pass Timbalier and its associated ebb-tidal delta (Miner, 2007). The most recent geophysical and geotechnical investigations performed in the area were by Coastal Planning and Engineering (CPE) in 2009 in support of CPRA project TE-52 (West Belle Pass Barrier Headland Restoration Project). These investigations covered the majority of the marsh sediment reconnaissance survey area. The CPE study estimated approximately 4 MCY of marsh material (silt and clay) in the West Belle Pass Barrier Headland (TE-52) marsh borrow area. The TE-52 Marsh Borrow Area was not completely exhausted in the construction of the project, leaving marsh borrow material available for cost-effective excavation.

2.2.5 Excavation, Transportation, and Conveyance Methods

As part of the Project design phase, the use of both hopper and cutterhead suction dredge alternatives for excavation, transportation, and placement were considered for conveying sediment from the Ship Shoal and South Pelto Borrow areas. The Project design was performed based on minimizing impacts to the Project area while providing flexibility for cost-effective and timely Project implementation.

It is anticipated that the preferred method of mining the sand borrow areas at the Ship Shoal and South Pelto Borrow Areas and conveying it to East Timbalier Island and West Belle Headland will be one of two methods. The first method is by hopper dredge. The excavated sand will be discharged into hoppers within the hull and transported to the designated pump-out areas and hydraulically unloaded. The second method involves use of a conventional cutterhead dredge, which will excavate the sand and transfer it through a spider barge distribution system into scow barges. The scows will be towed to the designated pump-out areas and hydraulically unloaded directly from the scow barges.

For the East Timbalier Island beach, dune, and marsh containment Project features requiring sand, a pump-out area has been delineated with an associated sediment delivery corridor. For the West Belle Headland beach and dune Project features requiring sand, the West Belle Pass TE-52 Marsh Borrow Area has been delineated as a pump-out area with an associated sediment delivery corridor.

Once the sediment has reached the Island it will be handled in the normal manner. The discharge pipeline will be extended the length of the beach and dune template using pipe-handling loaders and bulldozers, and the sand will be graded to conform to the plan dimensions using bulldozers, front-end loaders, and other earth-moving equipment. The marsh fill sediment will be discharged into the cells created by the marsh fill containment dikes and interior training dikes. The marsh fill will not be mechanically graded. Design elevation will be achieved by the construction contractor monitoring dredge discharge locations and dredged material settlement.

2.2.6 Access Channels

Construction access to East Timbalier Island and West Belle Headland shall not impact the existing wetlands or the restored beach, dune, and marsh habitat. The access channel to East Timbalier Island will approach from the northwest within Timbalier Bay. The location and dimensions of the access channel was designed based on the existing water depths identified during the design survey to avoid existing infrastructure, minimize pipeline crossings, and connect to the existing channel directly behind East Timbalier Island. This existing channel is currently utilized and maintained by the local oil and gas operator and by utilizing it to the maximum extent possible; the risk during construction of the Project is minimized.

Two access channels were designed for the West Belle Headland. The first option begins northwest of the Restoration Area and extends southeast to align with the secondary marsh containment dike borrow channel. The second option begins in the Gulf of Mexico south of the Restoration Area, loops around the western end of the restoration template, connects to the first option, and then extends south to connect to the beach and dune fill at the western end of the containment dike. Once access to the island is no longer required via the dredged channels, backfilling operation shall commence and post-construction elevations shall be no higher than 0.5 ft above the pre-construction elevations.

No equipment, fuel, machinery, discharge pipe, or other restoration-associated devices can be moved across or placed in the wetland areas; all such material and devices must remain within the beach and dune fill template. The technical specifications for the Project will include these best management practices and restrictions.

2.2.7 Conveyance Corridors

The utilization of previously approved corridors was maximized while minimizing the length of new corridors needed for Project implementation. Sediment delivery pipeline conveyance corridors have been delineated to connect the marsh borrow areas and pump-out areas to East Timbalier Island and West Belle Headland. Both have been thoroughly surveyed for depth, sonar targets, and magnetic anomalies and sited to avoid as many pipelines, production facilities, and cultural resource targets as possible (RCG, 2017 and TAR, 2010). The corridors do not require any excavation for pipeline installation, as the weighted sediment discharge pipelines will be placed directly on the seafloor.

3.0 - AFFECTED ENVIRONMENT

The Affected Environment section describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section describes only those environmental resources that are relevant to the decision making process. This section, in conjunction with the description of the No Action Alternative, forms the baseline conditions for determining the environmental impacts of the reasonable alternatives.

3.1 Physical Resources

3.1.1 Oceanographic and Coastal Processes

A detailed description of the oceanographic and coastal processes for the Project area is presented in the Preliminary Design Report (Stantec, 2017). A brief summary of the shoreline change analysis, land area change analysis, and sediment budget development are presented herein.

3.1.1.1 Shoreline Change Analysis

For more than a century, East Timbalier Island has experienced significant and persistent degradation and fragmentation. East Timbalier Island shoreline change data were analyzed for the time period between 1887 and 2014 and are presented in Figure 3-1. An average shoreline change rate of -77 ft/yr was calculated for the main portion of East Timbalier Island from 2006-2014.

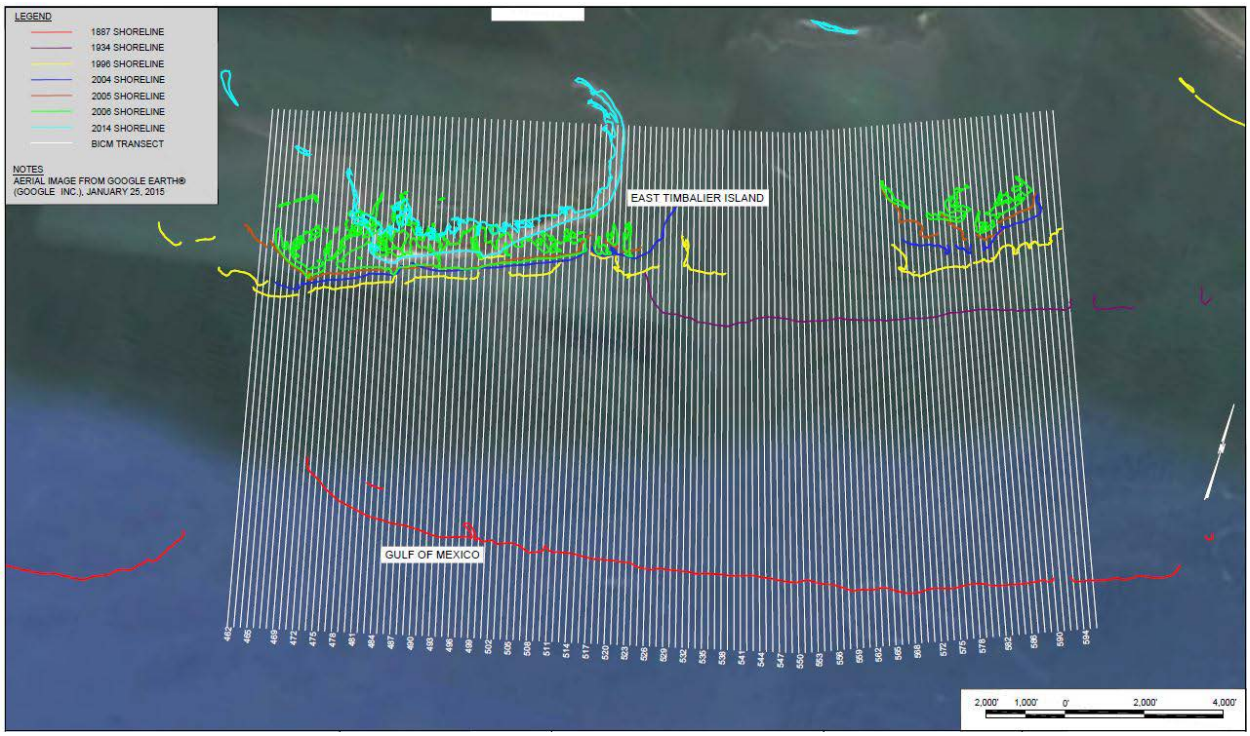

Figure 3-1. East Timbalier Island Historical Shoreline Positions

3.1.1.2 Land Area Change Analysis

Land change rate was analyzed on East Timbalier Island using historic aerial photography and shoreline change locations provided from the BICM Surveys (Martinez, 2009) and the USGS National Assessment of Shoreline Change Dataset (Morton, 2004). The land area change rate on East Timbalier Island has been relatively linear between 2006-2014, as illustrated in Figure 3-2. The trend line equates to an average annual land loss of approximately 25 acres per year. The pre-restoration Year of Disappearance (YOD) is projected to be 2035.

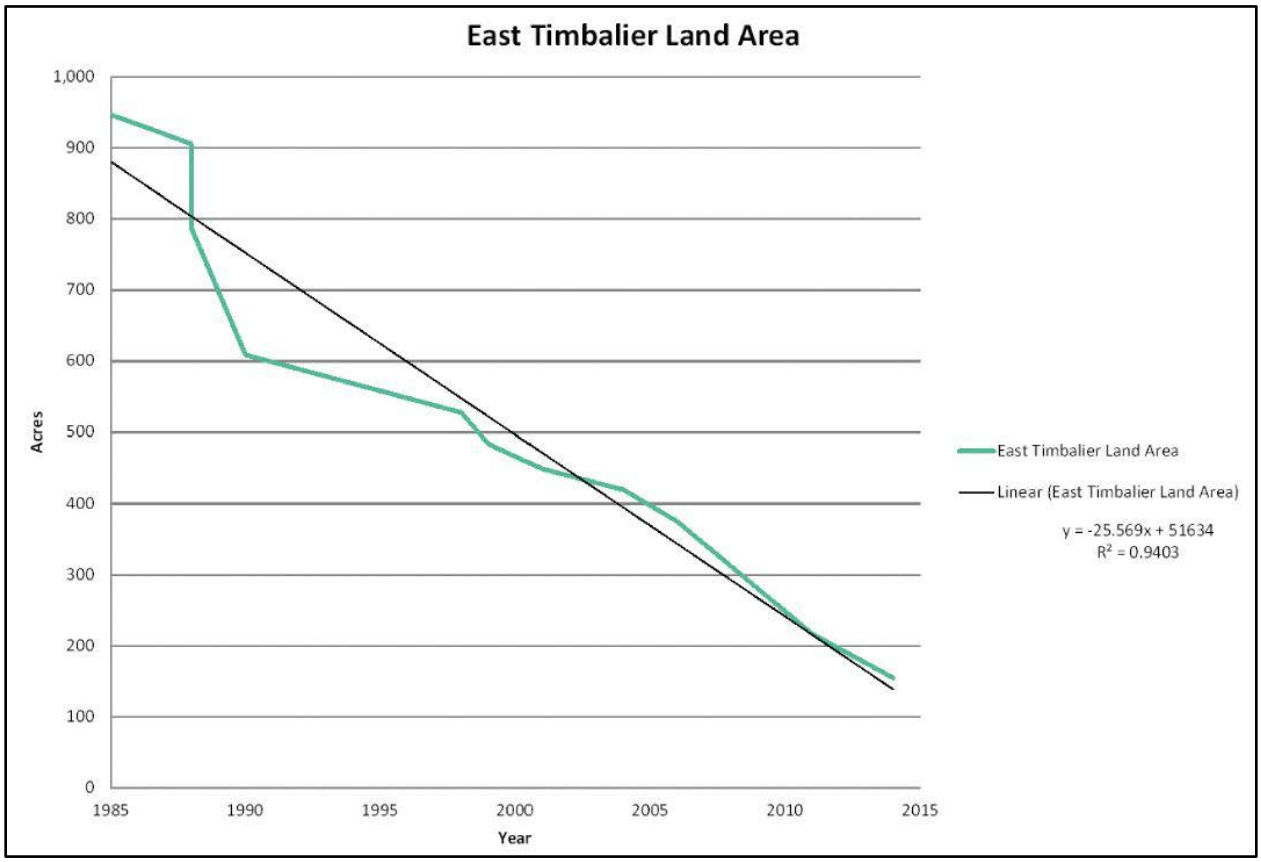

Figure 3-2. East Timbalier Island Land Area Change Rate

3.1.1.3 Sediment Budget

Figure 3-3 presents the sediment budget developed for East Timbalier Island. The sediment budget was completed by selecting the alongshore transport rates. It is noted that the surveys did not extend as far northward as the observed profile changes which could slightly alter the rollover rate affecting the selection of the alongshore transport rates.

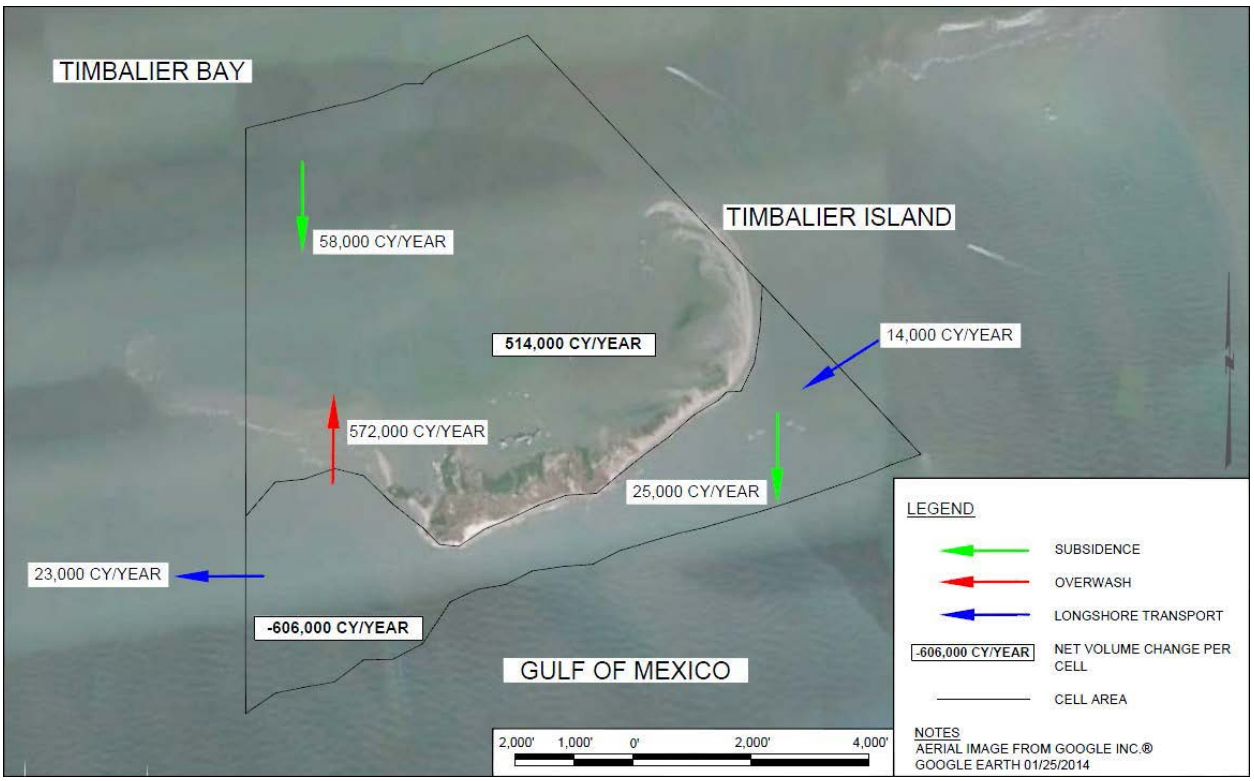

Figure 3-3. East Timbalier Island Sediment Budget

3.1.2 Geology

The geologic setting of the Project Area is dominated by the geomorphology of the Mississippi River Plain. Seven major delta complexes were created and abandoned over the past 9,000 years. The Lafourche Delta was created approximately 3500 to 400 Years Before Present (YBP), which includes East Timbalier Island, West Bell headland along with Timbalier Bay and the inlet systems adjacent to the islands. The sedimentary geology of the Project Area is well described in the literature including the historical geomorphic study of Little Pass Timbalier and its associated ebb-tidal delta (Miner, 2007) and the borrow area investigations for the West Bell project (CPE, 2009).

3.1.3 Air Quality

The proposed Project area lies in the Southern Louisiana-Southeast Texas Interstate Air Quality Control Region. Lafourche Parish meets all national ambient air quality standards, according to the Louisiana Department of Environmental Quality (LDEQ) Office of Environmental Assessment, which monitors air quality at a station south of Thibodeaux (the nearest station to the proposed Project area) (LDEQ, 2017). No significant point sources of air-borne pollutants occur in the vicinity of the proposed Project area, and air quality is generally good. The most prominent source of airborne pollutants in the area is the exhaust from boats. Offshore breezes mix and freshen the air, and frequent precipitation prevents accumulation of particulates.

3.1.4 Water Quality

Waters in the Project area are used for oil and gas production, SCUBA diving, fishing, boating, and other recreation. The LDEQ assesses four categories for water use under the Louisiana Environmental Regulatory Code (LAC Title 33, Chapter 11) that would apply to the Project area:

- *Primary Contact Recreation* includes activities such as swimming, water skiing, tubing, snorkeling, skin diving, and other activities that involve prolonged body contact with water and probable ingestion.
- *Secondary Contact Recreation* includes fishing, wading, recreational boating, and other activities that involve only incidental or accidental body contact and minimal probability of ingesting water.
- *Fish and Wildlife Propagation* includes the use of water by aquatic biota for aquatic habitat, food, resting reproduction, and cover, including indigenous fishes and invertebrates, reptiles, amphibians, and other aquatic biota consumed by humans.
- *Oyster Propagation* includes the use of water to maintain biological systems that support economically important species of oysters, clams, mussels, and other mollusks consumed by humans so that their productivity is preserved and the health of human consumers of these species is protected.

Primary Contact Recreation is impaired in waters in and around East Timbalier Island due to the oil and gas production areas. Over several decades, drilling materials, such as water-based mud and cuttings, has been released in the region. The produced water may have high salinity, organic content and dissolved metals, and lower dissolved oxygen levels than the receiving water. Discharges are periodically tested and must meet National Pollutant Discharge Elimination System (NPDES) limits set by the USEPA.

Fish and Wildlife Propagation is impaired in waters of the area due to elevated levels of mercury (LDEQ, 2006). One of the suspected causes of this impairment is atmospheric deposition. On March 8, 2006, the Louisiana Department of Health and Hospitals, along with the LDEQ and the LDWF, issued a fish consumption advisory for king mackerel, cobia, blackfin tuna, and great amberjack caught off the coast of Louisiana due to elevated levels of mercury (LDEQ, 2006).

3.1.5 Noise

Noise is a localized phenomenon typically associated with human activities and habitations. The Noise Control Act establishes coordination of Federal noise-control activities and provides information to the public regarding noise emissions. Many different noise sources in and near the Project area include commercial and recreational boats, aircraft; and industry-related noise (such as oil and gas facility operation).

Noise levels on the island are typical of commercial oil and gas activities. The Project area does not have any noise-sensitive institutions, structures, or facilities. Noise in this area is

limited to that generated by oil and gas platforms, service vessels, and other vessels passing through the area. Recreational boaters contribute minimally to the noise in the area.

In recent years, concerns have been raised regarding potential impacts of anthropogenic underwater noise on aquatic organisms. Underwater sounds could hypothetically interrupt or impair communication, foraging, migratory, and other behavior of aquatic organisms. Because of this concern, field investigations characterized underwater sounds typical of bucket, hydraulic cutterhead, and hopper dredging operations (Dickerson et al., 2001). Cutterhead dredging operations were relatively quiet compared to other sound sources. Hopper dredges produced more intense sounds similar to those generated by comparable-sized vessels. Bucket dredging created a complex spectrum of sounds, different from cutterhead or hopper dredges. Hopper dredges create two relatively continuous sources of noise: large commercial vessel engine and propeller sounds and draghead sounds when contacting the substrate.

Source levels reported for marine dredging operations ranged from 160 to 180 dB re1uPa @ 1m for 1/3 octave bands with peak intensity between 50 and 500 Hz (Greene and Moore, 1995). Underwater sounds produced by each dredge type are influenced by factors including substrate type, geomorphology of the waterway, site-specific hydrodynamic conditions, equipment maintenance status, and dredge plant operator skill (Dickerson et al., 2001). However, peak source levels from dredging-induced sounds do not exceed Level A Criterion (190 dB re 1uPA rms) for injury/mortality to marine mammals during any aspect of dredging operations (Reine, et al., 2014).

3.1.6 Water Resources

East Timbalier Island is remote and uninhabited, with the exception of the adjacent oil and gas facility which supplies its own water. Water resources, as commonly understood, do not exist.

3.1.7 Climate

The climate of coastal Louisiana is influenced by the Gulf of Mexico waters and winds. These maritime conditions give rise to a humid subtropical climate, with long, hot, humid summers, and mild, abbreviated winters (USACE, 2004). Summer temperatures average approximately 81.0°F. Winters are typically mild, with average temperatures of approximately 52.0°F, however short periods of colder temperatures may be induced by dry continental arctic air. The daily averages for coastal Louisiana are 78.4°F, and 58.8°F for the maximum and minimum temperatures respectively. The climate in the Terrebonne Basin provides an extended frost-free period (264 day per year average), resulting in an average growing season of 317 days per year (USDA, 2005). The maritime tropical air masses typically move inland and mix with continental air masses, producing abundant rainfall, impeding winter air mass passage, and reducing extreme inland temperatures. Wind records indicate that annual average wind speed in coastal Louisiana is approximately 9.8 ft per second (~6.7 miles per hour) from the southeast (USACE, 2004). Localized rain events, which consist of severe summer storms, and sporadic, high-energy winter disturbances, are typically controlled by these offshore unstable air masses and winds. The average rainfall in the coastal zone of Louisiana is approximately 54 inches a year. Though rain events occur frequently (approximately 74 days each year), and are fairly well distributed throughout the year, storm frequencies are slightly elevated during the summer (July

typically contains the highest storm frequency), and are typically least severe, and least frequent in October (USDC, 1998). Compounding the effects of severe wind and rain events is the low topography that is common along the coastal marsh and barrier islands. Coastal Louisiana is a vulnerable target for tropical waves, tropical depressions, tropical storms, and hurricanes generated in the tropical Atlantic, the Caribbean Sea, and the Gulf of Mexico. Historical data from 1899 to 2007 indicate that 30 hurricanes and 41 tropical storms have made landfall along the Louisiana coastline (National Weather Service website and National Hurricane Center website).

East Timbalier Island and the West Belle Headland are generally aligned in an east-west arc and are susceptible to both extratropical and frontal storms and tropical storms. The former are primarily winter events, with winds from the south, while the latter occur in the warmer months and wind directions are quite variable, depending on the storm track. The Louisiana coast feels the impact of a tropical storm on average every 1.2 years, with actual landfall on average every 2.8 years (Stone et al., 1997; Roth, 1998). Regardless, the shallow nature of the sea floor approaching the island and headland facilitates storm surge flooding of coastal areas, which increases beach erosion and island washover. As such storms approach or pass by the coastline, the counterclockwise (cyclonic) wind circulation can drive waves and surges that can impact both the Gulf-facing and back-barrier shorelines. In addition to storm surge flooding, the post-storm retreat can erode tidal inlet shores and exacerbate breach formation.

The Ship Shoal, South Pelto, East Timbalier and West Belle Borrow Areas are completely submerged, however are susceptible to storm-related sediment transport and impacts to oil and gas infrastructure located adjacent to the borrow areas. The shape of Ship Shoal, with a gradual seaward slope and steeper shoreward slope, is indicative of its gradual migration to the north. Profile comparisons have demonstrated migration of approximately 0.6 miles during the last century (Penland et al., 1989). Stone (2000) observed sediment transport events on Ship Shoal associated with storm passage. The direction of transport (onshore vs. offshore) varied during and among the storms. Ship Shoal mitigates the wave field off the adjacent coast during storms (Stone et al., 2004).

3.2 Bio-Physical Environment

3.2.1 Vegetation Resources

Vegetation is an important factor in maintaining both the geomorphology and ecology of barrier islands because it serves to stabilize beach and dune sediment, assists in dune-building by trapping aeolian sand, stabilizing marsh soil against wave action, and building marsh by trapping overwashed sediment. It provided habitat for resident wildlife, shelter and foraging environment for migratory avifauna, and vegetative detritus, an important component of the estuarine food chain, particularly for planktonic fish and invertebrate larval and juvenile stages and for other detritus-feeding organism.

Calculating the vegetation resource acreage within the proposed Project area were estimated by applying ArcGIS to NAIP 2015 imagery provided by the U.S. Department of Agriculture (USDA) Farm Service Agency (FSA). The proposed Project area is predominantly composed of beach and dune, saline marsh and a large majority of open water subtidal habitat.

Other vegetation in the proposed Project area includes marshhay cordgrass, panicum, saltgrass, and black mangrove. The proposed Project area contains the following acreages of beach and dune, marsh and open water areas (Table 3-1).

Table 3-1. Existing Habitat Acres (2015)

	Habitat (acres)			Total
	Beach & Dune	Marsh	Open Water	
East Timbalier Island	62.1	10.0	479.0	551.1
West Belle Headland	289.5	155.5	453.1	898.0

3.2.2 Aquatic Resources

3.2.2.1 Benthic Resources

Benthic animals are directly or indirectly involved in most of the physical and chemical processes that occur in estuaries (Day et al., 1989). Some epibenthic organisms, such as oysters and mussels, provide commercial and recreational fisheries as well as create oyster reef habitats used by many marine and estuarine organisms. The bottom of an estuary regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via the benthic effect. The benthic habitat is a storehouse of organic matter and inorganic nutrients and a site for vital chemical exchanges and physical interactions. Benthos generally includes the entire bottom community and its immediate physical environment, termed the benthic boundary layer (Day et al., 1989). Major benthic consumer groups include bacteria and fungi, microalgae, meiofauna, and microfauna (Mitsch and Gosselink, 1993).

The benthic community structure is not static; it provides a residence for many sessile, burrowing, crawling, and some swimming organisms (Day et al., 1989). The composition and distribution of the macroinfaunal community (relatively large organisms living beneath the sediment surface) in an area is a function of the response of individual species to factors such as sediment characteristics, salinity regime, position in the intertidal zone, and oxygen levels. Benthic fauna include infauna (animals living in the substrate, including burrowing worms, crustaceans, and mollusks) and epifauna (animals living on or attached to the substrate; mainly crustaceans, as well as echinoderms, mollusks, hydroids, sponges, and soft and hard corals) (Michel, 2013). Shrimp and demersal fishes are closely associated with the benthic community. Substrate is the most important factor in the distribution of benthic fauna. Densities of infaunal organisms increase with sediment particle size (Defenbaugh, 1976), although the distribution is also influenced by temperature, salinity, depth, and distance from shore (Defenbaugh, 1976). Less important factors include illumination, food availability, currents, tides, and wave shock. The density of offshore infauna is generally greater during the spring and summer than the winter (Brooks, 1991).

The density of the macrobenthic fauna was low in the lower portions of the Barataria Basin (Connor and Day, 1987). However, there are no clear patterns of benthic abundance in the

Barataria system. Peak seasonal and lowest abundances vary according to different salinity regimes and may be correlated to the salinity pattern of an area, or migratory patterns of estuarine-dependent predators (Connor and Day, 1987).

Strand biota commonly seen on sandy Gulf of Mexico beaches are not residents, but are transient offshore fauna (Britton and Morton, 1989). Three groups of strand biota (bottom dwelling, flotsam dwelling, and Sargassum-associated) are carried onto the upper beach by high tides and storm waves. Bottom-dwelling strand biota can include shells, sea whips, sea pens, sand dollars, and worm tubes. The flotsam-attached biota includes gooseneck barnacles (Lepas anatifera), marine wood boring isopods, Portuguese man-o-war (Physalia physalia), jellyfish, mollusks, and crustaceans. Sargassum-associated strand biota includes Sargassum algae. Sessile biota may remain attached to the algae, whereas motile biota may cling to the algae but can exist independently (Britton and Morton, 1989).

Two natural environmental perturbations that occur over the Louisiana continental shelf and threaten Ship Shoal benthic communities are anoxic to hypoxic bottom conditions and tropical cyclones. Conditions change annually from anoxic to hypoxic with inconsistent intensities and ranges (Rabalais et al., 1993). On average, a tropical cyclone occurs on the Louisiana Continental Shelf once every four years; these cyclones vary in intensity (Stone, 2000). It can take from one to two years for the benthic communities to recover from these events (Baker et al., 1981).

Ship Shoal is a high-relief subaqueous shoal composed of fine sand; the diversity of benthic macrofauna is high and the community structure differs from the surrounding deeper and muddier environments (Stone et al., 2009). Thus, Ship Shoal could be an important biodiversity hot spot and may serve as a stepping-stone for gene flow (Stone et al., 2009). The macrobenthic community on Ship Shoal has high biomass (average of 26.7 g/m2) and high diversity (161 species) (Dubois et al., 2009). Species diversity and total abundance significantly increase with decreasing sediment grain size and increasing bottom water dissolved oxygen. Most species are polychaetes (45 percent; 72 species), dominated by spionids, and crustaceans (28 percent; 46 species), dominated by amphipods. Mole crabs (*Albunea paretti*) and amphioxus (*Branchiostoma floridae*) were present across seasons and contributed most to the biomass. The polychaetes *Neptys simony*, *Neanthes micromma*, *Dispio unicinata*, *Mediomastus californicus*, and *Magelona sp*., the amphipod *Acanthohautorius sp*. and the estuarine longeye shrimp (*Ogyrides alphaerostris*) were seasonally abundant (Dubois et al., 2009).

Ship Shoal is a distinct faunal habitat for macroinvertebrates in a transition zone between inshore and offshore habitats (Stone et al., 2009). Macroinfauna are a unique combination of sandy beach swash zone communities associated with the Mississippi River and the northwest seashore; from shallow enclosed bays of the northern Gulf; and/or from muddy offshore environments. Half of the polychaete species on Ship Shoal were previously reported only from continental shelves of Florida or Texas and Florida. Ship Shoal and other sandy shoals in Louisiana could be important in the dispersal and gene flow of benthic species over the Gulf continental shelf (Stone et al., 2009). Ship Shoal may be a source pool for recruitment of benthic invertebrates to surrounding areas affected by seasonal hypoxia (Stone et al., 2009).

The benthic community of Ship Shoal differed from other Louisiana continental shelf areas in a study by Baker et al. (1981) (Table 3-2). Macroepifauna on Ship Shoal were primarily Osteichthyes (69.3 percent) and decapod crustaceans (30.7 percent) (Table 3-2). Ship Shoal decapods were similar in taxonomic composition, but lower in diversity, than Louisiana continental shelf decapods (Baker et al., 1981).

3.2.2.2 Plankton Resources

The three types of plankton are bacterioplankton, phytoplankton, and zooplankton (Knox, 2001). Bacterioplankton are the bacterial component of plankton and carry out a broad array of essential chemical transformations critical to the ecological function of aquatic systems. Bacteria are the most important decomposers of organic matter. Bacteria can fix nitrogen from dinitrogen gas and are the only organisms capable of converting it to the inert dinitrogen form (i.e., denitrification). Bacteria also transform sulfur, iron, manganese, mercury and many other elements in aquatic systems.

Table 3-2. Percent Taxonomic Composition of Meiofauna, macroinfauna and Macroepifauna for the Baker et al. (1981) study

Category and Taxa	Ship Shoal (Percent)	Louisiana Continental Shelf (Percent)
Meiofauna		
Foraminifera	0.2	55.3
Nematoda	97.0	34.7
Macroinfauna		
Polychaeta	62.6	69.0
Macropifauna		
Osteichthyes	69.3	32.8
Decapoda	30.7	25.7

Phytoplankton are single-cell algae that drift with the motion of water. Diatoms and dinoflagellates are the dominant groups of phytoplankton; other important groups include cryptophytes (unicellular algae), chlorophytes (green algae), and chrysophytes (golden algae). The species composition of a given phytoplankton community is a function of various environmental factors including salinity, turbidity, nutrients, turbulence, and depth (Day et al., 1989).

Phytoplankton provide a major, direct food source for animals in the water column and sediment; are responsible for at least 40 percent of photosynthesis; and have an important role in nutrient cycling (Day et al., 1989). Phytoplankton productivity is a major source of primary food energy for estuarine systems throughout the world and the major source of autochthonous organic matter in most estuarine ecosystems (Day et al., 1989). There is also a public health

concern with blooms of toxin-producing phytoplankton (red and brown tides), large-scale blooms can lead to hypoxia and cause fish kills.

Zooplankton are faunal components of the plankton, and include small crustaceans such as copepods, ostracods, euphausiids, and amphipods; jellyfishes and siphonophores; worms; mollusks such as pteropods and heteropods; and egg and larval stages of most benthic and nektonic animals (Rounsefell, 1975). Zooplankton consist of two broad categories, holoplankton, (planktonic species as adults) and meroplankton (organisms occurring in the plankton during early life stages before becoming benthic or nektonic). Zooplankton are eaten by a variety of estuarine consumers and have an important role in nutrient cycling. In most estuaries, zooplankton feed on phytoplankton and/or ingest detritus (Conner and Day, 1987). Most zooplankton are filter feeders and the suspended detriculate particles in the waters of the Barataria Basin are likely a major food source. Zooplankton provide the trophic link between phytoplankton and intermediate-level consumers such as aquatic invertebrates, larval fishes, and smaller forage fishes (Day et al., 1989). Most fish and other nekton are only part of the planktonic community during early stages of their life cycles (Thompson and Forman, 1987).

In the Barataria Basin, the zooplankton community is dominated by copepods of the genus Acartia (Gillespie 1971, 1978; Bouchard and Turner, 1976; Conner and Day, 1987). The copepod *Acartia tonsa* is the dominant member of the zooplankton community throughout Louisiana (Perret et al., 1971). Zoeae (a larval stage of some crustaceans) can be a large component of the meroplankton. Fish eggs and larvae from Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), inland silverside (*Menidia beryllina*), and striped mullet (*Mugil cephalus*) are found throughout the Barataria Basin (Conner and Day, 1987). In some Louisiana waters, zooplankton are dominated by Harris mud crab (*Rhithropanopeus harrisii*) zoea.

Biological factors affecting zooplankton densities include predation by nekton and ctenophores, meroplankton larval stage duration, and changes in the aquatic environment caused by zooplankton populations (Bouchard and Turner, 1976; Conner and Day, 1987). Physical factors affecting zooplankton populations include tidal flushing, inflow of fresh water carrying organic detritus, river discharge, water depth, tidal changes, turbidity, and dissolved oxygen (Conner and Day, 1987). The distribution of zooplankton is mainly influenced by salinity (Bouchard and Turner, 1976). Some zooplankton are euryhaline, others have distinct salinity preferences. Salinity may primarily control the number of species, whereas temperature, competition, and predation may control the number of individuals (Perret et al., 1971). Spring zooplankton peaks appeared to be related to temperature in at least one study (Gillespie, 1978).

The pelagic offshore plankton contain primary producers (phytoplankton and bacteria; 90 percent of the phytoplankton in the northern Gulf are diatoms) and secondary producers (zooplankton). Offshore zooplankton consists of holoplankton (including protozoans, gelatinous zooplankton, copepods, chaetognaths, polychaetes, and euphausids) and meroplankton (including polychaetes, echinoderms, gastropods, bivalves, and fish larvae and eggs) (DOI-MMS, 2002).

Temperature, salinity, and nutrient availability limit the geographical and vertical ranges of plankton and consumers. The species diversity, standing crop, and primary productivity of

offshore phytoplankton fluctuate less than coastal phytoplankton because salinity, nutrient availability, vertical mixing, and zooplankton predation change less frequently in offshore waters (DOI-MMS, 2002). In general, diversity of pelagic plankton generally decreases with decreased salinity, and biomass decreases with distance from shore. Shelf phytoplankton and zooplankton are more abundant, more productive, and seasonally more variable than deep Gulf plankton. The difference is related to salinity changes, greater nutrient availability, increased vertical mixing, and differences in zooplankton predation in the shelf environment (DOI-MMS, 2002).

The neuston, composed of organisms living at the air-seawater interface is also essential to the offshore environment (DOI-MMS, 2002). Abundant neuston includes copepods, floating Sargassum, and Sargassum-associated organisms. As many as 100 different animal species can be found in the Gulf Sargassum, primarily hydroids and copepods, but also fishes, crabs, gastropods, polychaetes, bryozoans, anemones, and sea spiders. Sargassum rafts are also longterm havens for young sea turtles, which can drift with the algae as they feed, possibly for several years (DOI-MMS, 2002).

The average algal biomass over Ship Shoal varies seasonally. Sediment algal biomass was highest in spring and summer when it exceeded that of the overlying water column over much of Ship Shoal (Stone et al., 2009). Light reaches the seafloor on Ship Shoal to stimulate the growth of benthic algae year round (Stone et al,. 2009). The bottom benthic algae biomass is high and the high proportion of diatoms (compared to settled phytoplankton) suggests that the benthic primary production may comprise most of the primary production on Ship Shoal (Stone et al., 2009).

3.2.3 Fisheries

East Timbalier Island and West Belle Headland:

East Timbalier Island and West Belle Headland has a variety of aquatic habitats, including large expanses of shallow open water. These saline areas typically do not contain submerged aquatic vegetation. The moderate- to high-salinity marine and estuarine waters and shoreline habitat in the Project area provide nursery, spawning, and foraging habitat for many estuarine-dependent commercially and recreationally important finfish and shellfish species. Most of the economically important saltwater fishes and crustaceans harvested in Louisiana spawn offshore and then use estuarine areas for a nursery habitat (Herke, 1971). Populations of most major commercially important fish and invertebrate species have been declining throughout the Project area, only Spanish mackerel (*Scomberomorus maculatus*) populations have increased (LCWCRTF and WCRA, 1999; Saucier and Baltz, 1993; Zimmerman and Minello, 1984; Rozas and Odum, 1987; Hettler, 1989; Kneib, 1991; Rozas, 1992; Rozas and Reed, 1993).

Timbalier Bay's habitats provide unique nursery, foraging, predator refugia, and spawning habitat for many economically important transient marine and estuarine species that prefer, or are dependent on, these transitional habitats during portions of their life history. Barrier headlands and islands provide three primary habitats for shellfish and finfish that can have quite different fish fauna. These habitats include the surf zone beach; back island low-energy zones that are sand and mud flats or marsh; and intra-island ponds, lagoons, and meanders.

The surf zone is temporarily used by larvae and juveniles before they are carried by currents to back-barrier, bay, or mainland habitats (Williams, 1998). Common surf zone species in the area include bay anchovy, Gulf menhaden, inland silverside, striped anchovy (*A. hepsetus*), Florida pompano (*Trachinotus carolinus*), scaled sardine (*Harengula jaguana*), and rough silverside (*Membras martinica*). Barrier headland and island sandflats are typically used by Gulf menhaden, inland silverside, grass shrimp (*Palaemonetes sp.*), white mullet (*Mugil curema*), longnose killifish (*Fundulus similis*), striped mullet, spot (*Leiostomus xanthurus*), and darter goby (*Ctenogobius boleosoma*) (Williams, 1998). The surf zone is also important foraging habitat for larger predators, including red drum (*Sciaenops ocellatus*), Spanish mackerel, spotted seatrout (*Cynoscion nebulosus*), flounder, and coastal sharks.

Marsh edge habitats in the area are used by brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), Atlantic croaker (*Micropogonias undulatus*), spotted seatrout, sheepshead minnow (*Cyprinodon variegatus*), longnose killifish, sand seatrout (*C. arenarius*), bay anchovy, striped mullet, blue crab (*Callinectes sapidus*), white mullet, striped anchovy, grass shrimp, inland silverside, spot, longnose killifish, Gulf menhaden, thin striped hermit crab (*Clibanarius* vittatus), lesser blue crab (*C. similis*), darter goby, skilletfish (*Gobiesox strumosus*), longwristed hermit crab (*Pagurus longicarpus*), xanthid mud crab, oystershell mud crab (*Panopeus simpsoni*), and snapping shrimp (*Alpheus sp.*) (Foreman, 1968; Zimmerman, 1988; Williams, 1998; Roth, 2009).

The headland's coastal wetlands provide nursery and foraging habitats that support economically important marine fishery species, such as Atlantic croaker, red drum, black drum (*Pogonias cromis*), bay anchovy, spotted seatrout, Gulf menhaden, striped mullet, tarpon (*Megalops atlanticus*), and southern flounder (*Paralichthys lethostigma*). Commercial and recreational shellfish species include blue crab, white shrimp, brown shrimp, Eastern oyster (*Crassostrea virginica*), and Gulf stone crab (*Menippe adina*). Many of these species are prey for other Federally managed fishery species such as mackerels, snappers, groupers, billfishes, and sharks.

Other finfish and crustaceans found in the Project area waters include: gafftopsail catfish (*Bagre marinus*), Spanish mackerel, bull shark (*Carcharhinus leucas*), ladyfish (*Elops saurus*), Atlantic needlefish (*Strongylura marina*), Gulf killifish (*Fundulus grandis*), fat sleeper (*Dormitator maculatus*), gobies, speckled worm eel (*Myrophis punctatus*), least puffer (*Sphoeroides parvus*), Gulf pipefish (*Syngnathus scovelli*), Atlantic spadefish (*Chaetodipterus faber*), alligator gar (*Atractosteus spatula*), pink shrimp (*Farfantepenaeus duorarum*), seabob (*Xiphopenaeus kroyeri*), roughneck shrimp (*Rimapenaeus constrictus*), and mysid shrimp. Other invertebrates in the Project area include Rangia clams, jellyfish, and ctenophores (USFWS, 2011).

Ship Shoal:

Fish species in the Gulf of Mexico are generally temperate, with incursions of subtropical Caribbean fauna (DOI-MMS, 2002). Seasonal distribution and abundance fluctuations of Gulf fishes are generally related to oceanographic conditions. Small changes in habitat quality can affect juvenile fish growth and survival and have large impacts on the number of fish produced by a specific habitat (Diaz et al., 2003).

Bottom substrate can affect community structure of fish and macroinvertebrates. Fish usage can be connected with bedform size and density of biogenic structures such as polychaete tubes, megafauna, pits, or fecal mounds (Diaz et al., 2003). Large bedforms with some biogenic structure had the highest occurrence of fishes; reductions in physical relief (from large to small bedforms) resulted in a significant decline in fish occurrence. Shoals with a steeper grade also had greater abundance; however, flat-bottom habitats had greater abundance, species richness, and species diversity than shoal habitats (Slacum et al., 2010). This may have been due to the availability of benthic forage in flat-bottom habitats. In the western Gulf, Brooks et al. (2003) concluded that sand banks, in particular, the interiors of sand banks are important habitats for demersal fish.

Ship Shoal supports estuarine-dependent species such as white and brown shrimp and spotted seatrout fisheries as well as Federally managed species such as mackerels, snappers, groupers, billfishes, and sharks. These species are major components of the Ship Shoal ecosystem. Shrimp and Atlantic croaker on Ship Shoal were typically found in lower numbers than at offshore stations. Ship Shoal is an extremely productive ground for demersal fishes (Baker et al., 1981). The biomass of demersal fishes on Ship Shoal was much higher [151.8 lbs/hr (68.7 kg/hr)] than the biomass on the Louisiana continental shelf, on average [43.3 lbs/hr (19.6 kg/hr)] (Baker et al., 1981).

From at least April through October, Ship Shoal and much of the surrounding area form an important offshore spawing/hatching/ foraging ground for a large segment of the Gulf of Mexico blue crab fishery (Condrey and Gelpi, 2010). Persistent concentrations of spawning, hatching, and foraging female blue crabs have been observed on Ship Shoal (Condrey and Gelpi, 2010). During April-October, mature female crabs may spawn continuously, producing new broods approximately every 21 days while actively foraging. Ship and Trinity Shoals appear to be the most important spawning/hatching/foraging grounds for blue crab, especially in August (Stone et al., 2009).

3.2.4 Wildlife Resources

The populations of the brown pelican, seabirds, and other avifauna have remained steady over the last 10 to 20 years in the Timbalier Islands Shorelines Mapping Unit, while furbearer populations have declined. By 2050, numbers of brown pelican, seabirds, and most other avifauna are expected to remain steady, while furbearer populations are expected to continue to decline (LCWCRTF and WCRA, 1999).

Over the last 10 to 20 years, dabbling ducks, wading birds, shorebirds, seabirds, furbearers, and alligators have experienced decreasing populations in eastern Terrebonne Basin as a result of marsh loss and conversion to saltier marsh types. Across this subprovince, the greatest loss of coastal wetlands has occurred in the fresh and intermediate marshes of the Terrebonne Basin. Fresh and intermediate marshes and swamps in the Terrebonne Basin represent a major fall staging and wintering area for migratory waterfowl (USACE, 2004).

Also over the past 10 to 20 years, duck populations in the Barataria and Terrebonne basins have declined as a result of marsh loss and conversion to saltier marsh types. Louisiana's coastal zone supports 19 percent of the United States' winter population for 14 species of ducks

and geese. The North American Waterfowl Management Plan identified coastal Louisiana as one of the most important regions for the maintenance of continental waterfowl populations in North America (USACE, 2004).

3.2.4.1 Herpetofauana (Amphibians and Reptiles)

There being no permanent fresh water bodies on East Timbalier Island or the West Belle Headland, it is difficult to conceive of any amphibian presence. Two (2) species of toad have been reported from Louisiana salt marsh and beach habitats, but not on the barrier islands (Dundee and Rossman, 1989; USFWS, 2011). The Gulf salt marsh snake, *Nerodia clarkii clarkii*, is known from Timbalier Island (personal observation by the TBBSR PDR), and the diamondback terrapin (*Malaclemys terrapin*) is a salt marsh resident that occurs on Elmer's Island and may occur in the Isle Dernieres.

3.2.4.2 Mammals

No wildlife surveys have been conducted in the proposed Project area. However, some terrestrial mammals which may be present in the vicinity are raccoon (*Procyon lotor*), coyote (*Canis latrans*), and the destructive, exotic nutria (*Myocastor coypus*) an invasive rodent that is common throughout Louisiana's freshwater and estuarine marshes. Neither amphibians, reptiles, nor terrestrial mammals would be present at any of the borrow areas, being completely submerged in the Gulf of Mexico.

3.2.4.3 Marine Mammals

One (1) species of cetacean, the bottlenose dolphin (*Tursiops truncatus*) occurs throughout the estuaries and bays of the Gulf of Mexico and is expected to occur at the Project site and borrow areas. NOAA Fisheries has identified a bottlenose community in the Terrebonne/Timbalier Bay area. A "community" includes resident dolphins that regularly share large portion of their ranges, exhibit similar distinct genetic profiles, and interact with each other to a much greater extent than dolphins in adjacent waters. The degree to which individual dolphins in the Project area are migratory is not known. Throughout the Gulf of Mexico, there is some evidence that dolphins move into more northerly bay systems in summer, and into more southerly systems in winter.

A second species of dolphin, the Atlantic spotted dolphin, *Stenella frontalis*, does not occur in inshore areas, but is known to occur in nearshore shelf waters, thus it may be reported from both Borrow Areas.

3.2.5 Avian Communities

Birds that use the proposed Project area can be divided functionally into swimmers, sea birds, waders, shore birds, birds of prey, and passerine birds. Ducks are part of the swimmer functional group. Although most ducks prefer freshwater marshes and rarely use saline marshes, the marshes near the proposed Project area may provide habitat for the mottled duck (*Anas fulvigula*), the only duck that breeds in large numbers in the coastal marshes of Louisiana (Wicker et al., 1982). The most frequently encountered (and harvested) dabbling ducks are

gadwall (*Anas strepera*), blue-winged teal (*A. discors*), and green-winged teal (*A. crecca*) (Wicker et al., 1982). Open water in brackish marsh is favored by the lesser scaup (*Aythya affinis*), the most commonly harvested diving duck in the area. Except for the mottled duck, all the game birds are migratory winter residents. Other ducks that occur in saline habitats and thus could occur in the proposed Project area include the fulvous whistling-duck (*Dendrocygna bicolor*), American widgeon (*Anas americana*), ring-necked duck (*Aythya collaris*), bufflehead (*Bucephala albeola*), ruddy duck (*Oxyura jamaicensis*), American black duck (*Anas rubripes*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), and northern shoveler (*Anas clypeata*). Other swimming birds that occur in saline habitats include the pied-billed grebe (*Podilymbus podiceps*), eared grebe (*Podiceps nigricollis*), snow goose (*Chen caerulescens*), and Canada goose (*Branta canadensis*) (American Ornithologists' Union 1983, as cited in Gosselink, 1984).

Seabirds are most common along the barrier islands and inland bays of the Barataria-Terrebonne estuaries (Conner and Day, 1987). Three seabird colonies have been identified on the headland east of Belle Pass (GEC, 2001). Seabird colony surveys did not include the proposed Project headland, however. A survey published in 1984 noted that colonies of black skimmers (*Rynchops niger*) and least terns (*Sterna albifrons*) were present (Keller and others 1984, as cited in Gosselink, 1984).

Several wading birds occur in saline habitats and thus could occur in the proposed Project area. The clapper rail (*Rallus longirostris*) is a wading bird common in brackish and salt marsh. The yellow rail (*Coturnicops noveboracensis*), black rail (*Laterallus jamaicensis*), and Virginia rail (*Rallus limicola*) also occur in saline habitats. Other wading species include the least bittern (*Lxobrychus exilis*), great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerules*), tricolored heron (*Egretta tricolor*), reddish egret (Egretta *rufescens*), cattle egret (*Bubulcus ibis*), green-backed heron (*Butorides striatus*), black-crowned night-heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violaceus*), white ibis (*Eudocimus albus*), whitefaced ibis (*Plegadis chihi*), and glossy ibis *(Plegadis falcinellus*) (American Ornithologists' Union 1983, as cited in Gosselink, 1984).

Shore birds are primarily winter visitors and occur on sand beaches and tidal mud flats in large numbers (Conner and Day, 1987). Shore birds likely to occur in the proposed Project area include black-bellied plover (*Pluvialis squatorola*), semipalmated plover (*Charadrius semipalmatus*), black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra americana*), greater yellowlegs (*Tringa* melanoleuca), lesser yellowlegs (*Tringa flavipes*), solitary sandpiper (*Tringa solitaria*), willet (*Catoptrophorus semipalmatus*), spotted sandpiper (*Actitis macularia*), wimbrel (*Numenius phaeopus*), Hudsonian godwit (*Limosa haemastica*), semipalmated sandpiper (*Calidris pusilla*), western sandpiper (*Calidris mauri*), least sandpiper (*Calidris minutilla*), baird's sandpiper (*Calidris bairdii*), dundlin (*Calidris alpina*), stilt sandpiper (*Calidris himantopus*), short-billed dowitcher (*Limnodromus griseus*), long-billed dowitcher (*Limnodromus scolopaceus*), common snipe (*Gallinago gallinago*), and Wilson's phalarope (*Phalaropus tricolor*) (American Ornithologists' Union 1983, as cited in Gosselink, 1984).

Birds of prey that occur in saline habitats and are thus likely to be present in the proposed Project area include the northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), merlin (*Falco columbarius*), peregrine falcon (*Falco peregrinus*) and short-eared owl (*Asio flammeus*) (American Ornithologists' Union 1983, as cited in Gosselink, 1984).

Passerine birds that occur in saline habitats and are thus likely to occur in the proposed Project area include the tree swallow (*Tachycineta bicolor*), bank swallow (*Riparia riparia*), cliff swallow (*Hirundo pyrrhonota*), barn swallow (*Hirundo rustica*), sedge wren (*Cistothorus platensis*), marsh wren (*Cistothorus palustris*), Savannah sparrow (*Passerculus sandwichensis*), sharp-tailed sparrow (*Ammodramus caudacutus*), and seaside sparrow (*Ammodramus maritimus*) (American Ornithologists' Union 1983, as cited in Gosselink, 1984).

The proposed Project area is located at the bottom of the Mississippi Flyway, and birds from central and northern North America start to converge in the fall. Shorebirds begin arriving in mid-July and peak in *September*. Waterfowl migration begins in mid-August, and populations peak in December. Birds of prey and passerine birds also converge in Louisiana. Some stay all winter, but many stay only a few days before they depart southward. The spring return of migrants starts in late February or early March and peaks in late April and early May. Most wading birds do not migrate from Louisiana (Conner and Day, 1987).

3.3 Critical Biological Resources

3.3.1 Essential Fish Habitat

Essential Fish Habitat (EFH) is defined as waters and substrates that are necessary for fish reproduction and growth to reproductive maturity. The proposed East Timbalier Island Restoration (TE-118) Project affects areas designated as EFH.

As stated in the Joint Public Notice (JPN) MVN-2015-0895-CQ dated April 24, 2017, BOEM and NOAA are working collaboratively to ensure effective implementation of the required Magnuson-Stevens Act EFH consultation (Section 305). The excavation and fill tables included in the joint permit application (JPA) outline the maximum excavation/fill volumes and acreages for the borrow areas and fill areas and separate between unvegetated water bottoms, wetlands and supratidal impacts.

EFH designated in and near East Timbalier Island and the West Belle Headland include estuarine emergent wetlands; estuarine water bottoms (e.g., sand, shell and soft bottoms), estuarine water column, marine water column, and marine non-vegetated water bottoms (NOAA Fisheries letter May 23, 2017; Williams, 1998). Wetlands near the Project area are tidally influenced saline marsh and beach berm vegetated primarily with smooth cordgrass, with patches of salt grass and black mangroves (Williams, 1998).

The habitat of East Timbalier Island consists of beach, low dunes, and back-barrier marsh. *Spartina alterniflora* (smooth cordgrass) is the dominant species of the salt marsh communities with *Spartina patens Muhl*. (marshhay cordgrass) and *Distichlis spicata* (seashore saltgrass) also present. *Avicennia germinans* (black mangrove) is distributed across a large area of the island (CPRA 2012a; CPRA, 2009; and Ritchie et al., 1995). The West Belle Headland marsh

vegetation is dominated by *Spartina alterniflora* (smooth cordgrass) and *Avicennia germinans* (black mangrove). Chabreck and Linscombe (1997) classified the Project area as salt marsh habitat.

The proposed fill areas, offshore sand mining sites at Ship Shoal, nearshore marsh borrow areas, pump-out areas, and pipeline conveyance corridors are in areas designated as EFH for federally managed species (letter, May 23, 2017). Table 1 provides a summary of the EFH species listed in the Project area, including species identified by NOAA Fisheries and listed in the NOAA Fisheries Letter Response to the JPN MVN-2015-0895-CQ dated May 23, 2017. These species are from the Shrimp, Red Drum, Reef Fish, Coastal Migratory, and Highly Migratory Fishery Management Plans. Detailed information on federally managed fisheries and their EFH is provided in the 2005 generic amendment of Fishery Management Plans for the Gulf of Mexico Fishery Management Council (GMFMC). The generic amendment was prepared as required by the Magnuson-Stevens Act (Magnuson-Stevens Act, P.L. 104-297) (NOAA Fisheries letter May 23, 2017).

In addition to being designated as EFH for various federally managed fishery species, wetlands and water bottoms of barrier islands, nearshore muddy sea floor, and sandy shoals in the Project area provide unique nursery and foraging habitat for a variety of important marine fishery species such as Atlantic croaker, blue crab, gulf menhaden, spotted seatrout, sand seatrout, southern flounder, and black drum (Table 2; Williams, 1998). Some of these species serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NOAA Fisheries (e.g., billfishes and sharks). Wetlands in the Project area also produce nutrients and detritus, important components of the aquatic food web, which contributes to the overall productivity of the Timbalier and Terrebonne Bay estuaries (NOAA Fisheries letter May 23, 2017; O'Connell et al., 2005; Williams, 1998).

Table 3-3. EFH for the Species and Life Stages Listed in the Project Area
(NOAA Fisheries letter May 23, 2017; GMFMC, 2005; Grimes et al., 1990; Hoese et al., 1998; Larson et al., 1989; McCandles et al., 2002; Muncy, 1984; Starck, 1971; Sutherland and Fable, 1980))

(M – Marine; E-Estuarine)

Species	Life Stage	System	EFH
Brown shrimp *(Farfantepenaeus aztecus)*	eggs	M	<18-110 m; sand/shell/soft bottom
	larvae/postlarvae	M/E	<82 m; planktonic, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
	juveniles	E	<18 m; SAV, sand/shell/soft bottom, emergent marsh, oyster reef
	adults	M	14-110 m; sand/shell/soft substrate
White shrimp *(Litopenaeus setiferus)*	eggs	M	<9-34 m; sand/shell/soft bottom
	larvae/postlarvae	M/E	<82 m; planktonic, soft bottom, emergent marsh
	juveniles	E	<30 m; soft bottom; emergent marsh
	adults	M	9-34 m; soft bottom
Red drum *(Sciaenops ocellatus)*	eggs	M	Gulf of Mexico (GOM) < 46 m
	larvae/postlarvae	E	all estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
	juveniles	M/E	GOM <5 m, all estuaries, SAV, sand/shell/soft/hard bottom, emergent marsh
	adults	M/E	GOM, 1-46 m, all estuaries SAV, pelagic, sand/shell/soft/hard bottom, emergent marsh
Red snapper (*Lutjanus campechanus*)	adults	M	7-146 m; reefs, hard/sand/shell bottom
Lane snapper (*Lutjanus synagris*)	eggs	M	4-132 m: pelagic
	larvae	M/E	4-132 m; reefs, SAV
	juveniles	M/E	<20 m; SAV, mangrove, reefs, sand/shell/soft bottom

Species	Life Stage	System	EFH
Gray or Mangrove snapper (*Lutjanus griseus*)	juvenile	E	SAV, mangrove, mud
	adult	M/E	SAV, mangrove, sand, mud
Vermilion Snapper (*Rhomboplites aurorubens*)	eggs	E	hard bottom, reef
	juveniles	E	hard bottom, reef, emergent marsh
	adult	M/E	hard bottom, reef
Greater amberjack *(Seriola dumerili)*	eggs	M	1-183 m; pelagic
	larvae	M	1-183 m; pelagic
	juveniles	M	1-183 m
Cobia *(Rachycentron canadum)*	eggs	M	pelagic
	larvae	M	11-53 m; pelagic
	juveniles	M	5-183 m; pelagic
King mackerel *(Scomberomorus cavalla)*	larvae	M	9-180 m; pelagic
	juveniles	M	<9 m; pelagic
Bonnethead shark *(Sphyrna tiburo)*	juveniles	E	<25 m; inlets, estuaries, coastal waters
	adults	M	<25 m
Atlantic Sharpnose shark *(Rhizoprionodon terraenovae)*	juveniles	E	<10 m; estuaries, coastal waters
	adults	M	1-280 m
Blacktip Shark *(Carcharhinus limbatus)*	juveniles	M/E	<30 m
	adults	M/E	<30 m
Bull Shark (*Carcharinus leucas)*	juveniles	E	<30 m
	adults	M/E	<30 m
Blacknose Shark (*Carcharhinus acronotus*)	adults	M	25-100 m
Finetooth Shark (*Carcharhinus isodon*)	juveniles	E	<20 m
	adults	M/E	<20 m

Table 3-4. Important Species and Life Stages Listed in the Project Area
(NOAA Fisheries letter May 23, 2017 & Hoese et al., 1998; Leard et al., 1993; Miles, 1950; Odell et al., 2017; Perret et al., 1980; Perry and VanderKooy, 2015; Peters, 1989; Saucier and Baltz, 1993; VanderKooy and Smith, 2015; and VanderKooy, 2000)

Species	Life Stage	System	Habitat Description
Atlantic Croaker	Larval, juvenile, and adult.	M/E	Shallow, estuarine ecosystems characterized by soft substrate (sand and mud)
Blue Crab	Larval, juvenile, and adult	M/E	Estuarine-nearshore marine environment
Gulf Menhaden	Larval, juvenile, and adult	M/E	Shallow, estuarine ecosystems
Spotted Seatrout	Larval, juvenile, and adult	M/E	Shallow, estuarine ecosystems
Sand Seatrout	Larval, juvenile, and adult	M/E	Shallow, estuarine ecosystems
Southern Flounder	Larval, juvenile, and adult	M/E	Shallow, estuarine ecosystems in association with salt marsh, mud and shell bottoms, and shoreline banks
Black Drum	Larval, juvenile, and adult	M/E	Shallow, estuarine ecosystems

3.3.2 Threatened and Endangered Species

There are 23 animal and three (3) plant species under the jurisdiction of the USFWS and/or NOAA Fisheries, presently classified as T&E within the State of Louisiana or GOM waters. Of the list of T&E species that inhabit Louisiana and the Northern Gulf of Mexico, only a few are known to occur in the Project area. Table 3-1 is a list of T&E species (USFWS, 2016) within the Project area.

The following sections provide the Federal status, species descriptions, and habitat information for the T&E species and critical habitat found within the Project boundary. The Project boundary refers to Project features on East Timbalier Island, West Belle Headland, borrow and pump-out areas. Much of this information was adapted from the Biological Assessments (BA) conducted for the Louisiana Coastal Area Terrebonne Basin Barrier Shoreline Restoration Feasibility Study (LCA TBBSR) (USACE, 2010) and Supplemental Biological Assessment for the Louisiana Island Restoration: Caillou Lake Headlands, Chenier-Ronquille and Shell Island (USFWS, 2014).

Table 3-5. Threatened and Endangered Species in Lafourche and Terrebonne Parish

(Last Update: May 4, 2016)

Species	Scientific Name	Federal Status*	State Status
FISH			
Sturgeon, Atlantic (Gulf subspecies)	*Acipenser oxyrinchus desotoi*	T	T
MARINE MAMMAL			
Manatee, West Indian	*Trichechus manatus*	T	E
Whale, fin	*Balaenoptera physalus*	E	E
Whale, humpback	*Megaptera novaeangliae*	E	E
Whale, sei	*Balaenoptera borealis*	E	E
Whale, sperm	*Physeter macrocephalus*	E	E
REPTILE			
Turtle, Green Sea	*Chelonia mydas*	T	T
Turtle, Hawksbill Sea	*Eretmochelys impricate*	E	E
Turtle, Kemp's Ridley Sea	*Lepidochelys kempii*	E	E
Turtle, Leatherback Sea	*Dermochelys coriacea*	E	E
Turtle, Loggerhead Sea	*Caretta caretta*	T	T
BIRD			
Plover, Piping	*Charadrius melodus*	T, CH	T, E
Knot, Rufa Red	*Calidris canutus rufa*	T	

** E=Endangered, T=Threatened, CH=Critical Habitat*

Source: USFWS, last updated May 4, 2016; NOAA Fisheries, accessed January 26, 2017

https://www.fws.gov/lafayette/pdf/LA_T&E_Species_List.pdf

http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/Documents/louisiana.pdf

Of the above-listed species potentially present in the action area, only loggerhead, green, hawksbill, and Kemp's ridley sea turtles are vulnerable to injury and death from the use of hopper dredges for dredging the Ship Shoal borrow area for this Project. In addition, the piping plover and red knot are likely to be affected by the restoration portions of the Project.

Sperm whales occur in the GOM but are rare in inshore waters. Other endangered whales, including North Atlantic right whales and humpback whales, have been observed occasionally in the GOM. The individuals observed have likely been inexperienced juveniles straying from the

normal range of these stocks. Blue, fin, or sei whales would not be adversely affected by hopper dredging operations; the possibility of dredge collisions is remote since these are deepwater species unlikely to be found near hopper dredging sites. There has never been a report of a whale taken by a hopper dredge. Based on the unlikelihood of their presence, feeding habits, and very low likelihood of hopper dredge interaction, the above-mentioned cetaceans are not considered further in this Assessment.

3.4 Cultural Resources

Cultural resources include historic properties, which are defined under the National Historic Preservation Act (NHPA) of 1966, as amended (36 CFR 800), as pre- or post-contact period sites, districts, structures, buildings, objects, or features that are made or modified in the course of human activities. Their discovery, assessment, and management are mandated through Section 106 of the NHPA, which requires Federal agencies to take into account the effect of their undertakings (e.g., projects requiring Federal review and permitting) on properties listed in or eligible for listing in the National Register of Historic Places (NRHP) and to afford the Advisory Council on Historic Preservation (ACHP) as well as other Federal agencies, Tribes, State and local agencies and other interested parties an opportunity to comment on the proposed undertaking. For onshore, nearshore, and offshore components of this proposed Project, the BOEM, the USACE, the State Historic Preservation Offices (SHPO) which in Louisiana operates within the Louisiana Department of Culture, Recreation & Tourism's (CRT) Office of Cultural Development's Division of Archaeology (LADOA) and Division of Historic Preservation (DOHP), as well as the Federally-recognized Chitimacha Tribe, Lafourche Parish, and other interested parties, have been consulted to assist in the determination of NRHP eligibility of cultural resources and provide guidance and recommendations concerning the treatment of any identified historic properties on land and underwater. Other pertinent authorities and guidelines applicable to cultural resources are the Archeological Resources Protection Act, the Native American Graves Protection and Repatriation Act, the Archeological and Historic Preservation Act, the Abandoned Shipwreck Act of 1987.

3.4.1 Terrestrial Cultural Resources

As a component of the TBBSR study, a cultural resource assessment was conducted for six (6) areas of potential effect (APEs) encompassing the Isles Dernieres and the Timbalier Islands, including East Timbalier Island (Nowak et al., 2010). The cultural resource assessment reviewed the geomorphology, prehistory, history and archaeology of the Isle Dernieres and Timbalier Islands to ascertain the probability for the presence of significant cultural resources, i.e., those archaeological sites and other historic properties possessing the qualities of significance and integrity defined by the National Register of Historic Places Criteria for Evaluation (36 CFR 60.4[a-d]).

Research included the review of archaeological site files within ten (10) miles of the barrier island APEs, the results of previous investigations conducted within one (1) mile of the barrier island APEs, and databases (including the National Oceanic and Atmospheric Administration Automated Wreck and Obstruction Information System (AWOIS), BOEM shipwreck database, and Louisiana shipwreck database) reporting locations of shipwrecks and obstructions within 10

miles of the barrier island APEs. The geomorphology of Isles Dernieres and the Timbalier Islands was also reviewed as it related to the potential for the existence of significant cultural resources. Historic maps and charts dating from 1853 to the present were reviewed along with the results of previously conducted geomorphological studies that endeavored to reconstruct the historic shorelines of these island chains. Finally, historic research was conducted in order to ascertain the nature and extent of historic navigation within the general vicinity of the study area. The review and correlation of the geomorphology of the study area with the regional prehistory and archaeological record of this part of south Louisiana indicated a low probability for significant prehistoric archaeological sites or prehistoric watercraft within the barrier island APEs. Additionally, any prehistoric archaeological remains that exist within these areas likely will consist of reworked and/or redeposited accumulations of cultural materials lacking integrity and having little research value (36 CFR 60.4[d]).

Consideration of the geomorphology and history of the study area also suggests that there is a low probability for significant historic archaeological sites or standing structures since no historic occupations were noted on terre firme within the study area. However, various probabilities for the discovery of historic shipwrecks exist within the barrier island APEs.

East Timbalier Island is relatively recent landform. The area it occupies was open water prior to and during the nineteenth and early twentieth centuries. No shipwrecks have been reported within the East Timbalier Island APE. However, ships have sailed through the area now occupied by this island throughout the historic period and could have foundered within the APE. Normally, there would be a moderate probability for historic shipwrecks within such area. However, review of oil and gas field data from the Louisiana Department of Natural Resources, Strategic Online Natural Resources Information System (SONRIS) indicated that extensive disturbance has occurred within the East Timbalier Island APE. As a result, a low-to-moderate probability existing for historic shipwrecks within the East Timbalier Island APE.

No recorded prehistoric properties (i.e., prehistoric archaeological sites), standing structures, or significant traditional cultural properties are within 1.0 mi (1.6 km) of the Project survey areas. Only a single historic archaeological site is located in the Project vicinity. Site 16LF291, East Timbalier, is a historic artifact scatter possibly associated with one or more offshore shipwrecks. The shoreline site, recorded in 2011, consists of secondarily deposited historic artifacts that date from the Louisiana antebellum periods (1803-1860). Investigations determined that the site lacked integrity, had no research value, and subsequently would not be eligible for NRHP listing (RCG, 2017 and HDR, 2015).

Considering the dramatic subsidence, erosion, and migration of the Timbalier islands, a low probability exists for the existence of significant historic properties within any of the Project areas. The vast majority of the areas occupied today by Timbalier and East Timbalier islands comprised open water and marsh prior to the mid-twentieth century. Areas that would have supported earlier historic occupations now are inundated in the Gulf of Mexico (RCG, 2017).

3.4.2 Sediment Pump-Out Areas

The Sediment Pump-Out Area is located within BOEM South Timbalier Lease Block 20 and is approximately 3.3 nm south of East Timbalier Island. In 2001, the United States Geological

Survey (USGS) and UNO performed an exploratory geophysical survey and sampling investigations in Louisiana nearshore waters, which included the area south of East Timbalier Island and the proposed reconnaissance survey area (Calderon et al., 2003). A BOEM charted shipwreck (BOEM, 2013), Trans-Gulf No. 10, plots within 85 ft (25.9 m) of the northern boundary of the Sediment Pump-out Area. No sonar contacts or magnetic anomalies were detected during the reconnaissance or geophysical surveys that indicate a shipwreck at this location (RCG, 2017).

3.4.3 East Timbalier and West Belle Marsh Borrow Conveyance Corridors

Sidescan and magnetometer data analysis identified 9 targets in the East Timbalier Marsh Borrow Area Conveyance Corridor with magnetic anomaly associations suggesting the targets have some ferrous metal component. Based on the archaeological review, avoidance buffers equal to 164 ft (50 meters) were recommended around two (2) of the areas. The subbottom profile data indicated there were no paleo channels and relict subsurface geomorphic features of potential interest (OSI, 2016b and RCG, 2017).

A 2010 cultural resources investigation of the East Timbalier Marsh Borrow Area Conveyance Corridor was conducted in conjunction with a restoration project on West Belle using an adjacent borrow area. Sidescan and magnetic data analysis identified 5 clusters of anomalies in the conveyance corridor which were recommended for avoidance with protective buffers based on their remote-sensing signatures (TAR, 2010).

A 2010 cultural resources investigation of the West Belle Marsh Borrow Area Conveyance Corridor was conducted in conjunction with a restoration project on West Belle using the same marsh borrow area. Sidescan and magnetic data analysis identified 2 clusters of anomalies in the conveyance corridor which were recommended for avoidance with protective buffers based on their remote-sensing signatures (TAR, 2010).

3.4.4 East Timbalier Sediment Conveyance Corridor

Sidescan and magnetometer data analysis identified 14 magnetic anomalies recorded along the breakwater, likely represent debris deposited by waves and tides. Two targets that represent potential cultural resources were identified during analyses. Target 6 comprises one magnetic anomaly: MM417. Magnetic and spatial analyses indicate that anomaly MM417 may represent a buried cultural resource. Target 7 comprises two magnetic anomalies: MM334 and MM330. Magnetic and spatial analyses indicate that these anomalies may represent a buried cultural resource (RCG, 2017).

3.4.5 East Timbalier and West Belle Marsh Sediment Borrow Area

In the proposed East Timbalier Marsh Borrow Area, 32 magnetic anomalies were identified and of these 32 anomalies, 26 exhibited a simple, monopole signature and 6 exhibited dipolar signatures; 3 produced high amplitudes; only 1 was recorded that exhibited a long duration. The magnetometer sensor altitude ranged from 7.0 to 23.0 ft (2.1 to 7.0 m).

Review of subbottom data records acquired in the East Timbalier Marsh Sediment Borrow Area revealed no shallow buried geomorphic features (i.e., in-filled paleochannels, etc.) that could have supported humans. Ten proposed coring locations situated at grid nodes in the Marsh Sediment Borrow Area were reviewed to identify any cultural resources that could be impacted by coring. No cultural resources were identified in the vicinity of any of these locations; therefore no negative impacts to cultural resources were anticipated.

A review of the Louisiana Department of Natural Resources, Office of Conservation (LDNR), Strategic Online Natural Resources Information System (SONRIS) (LDNR, 2014) identified a P&A Dry Hole in State Lease 1022 (29.034932, -90.426887) which is in the western section of the current Marsh Sediment Borrow area. The P&A Dry Hole was not located during the survey. The archaeological analysis of the reconnaissance data returned negative results for the East Timbalier Marsh Sediment Borrow Area; therefore, no negative impacts to cultural resources were anticipated during the vibratory coring activities (RCG, 2017).

A 2009 cultural resources investigation of the West Belle Marsh Borrow Area was conducted in conjunction with a restoration project on West Belle Pass using the same marsh borrow area. Analysis of magnetic and acoustic data generated by the remote-sensing survey identified a total of 30 magnetic and 3 acoustic targets. Four clusters of targets were identified in the West Belle Marsh Borrow Area and were recommended for avoidance with protective buffers based on their remote-sensing signatures (TAR, 2009).

3.4.6 Ship Shoal Sand Borrow Area

OSI conducted geophysical and geotechnical investigations during the period 14 – 21 May and 3 – 8 October 2015 at Ship Shoal in the Gulf of Mexico, approximately 9 nm south of the Isles Dernieres, Louisiana. The proposed borrow area is located within the east central portion of Ship Shoal, at BOEM South Pelto Lease Blocks 12, 13, 18, and 19. The survey investigated an area approximately 2.0 x 1.2 nm, which included the proposed borrow area and a 1,000 ft (304.8 m) buffer around its perimeter. In total, approximately 108 nm of survey tracklines were investigated in the Ship Shoal Borrow Area to support the Project.

An obstruction is plotted in the southern portion of the Ship Shoal Borrow Area within the Borrow Area limits. However, no side scan sonar contacts or magnetic anomalies were recorded that correspond with this obstruction. The wreck, Carl Tide, lost in 1965, plots in the southern portion of the Ship Shoal Borrow area. It is located within the study area limits but outside the borrow area limits (RCG, 2017). No side scan sonar contacts or magnetic anomalies were recorded that correspond with this shipwreck (BOEM, 2015).

3.5 Socioeconomic and Human Resources

3.5.1 Population and Housing

The Project area is located in a remote and uninhabited coastal barrier island and headland in Lafourche Parish and the Ship Shoal area offshore of Terrebonne Parish. No communities or human populations are present in the Project area. However, Port Fourchon is near the Project area and Grand Isle is on a nearby barrier island.

3.5.2 Employment and Income

The Project area is located on a remote and uninhabited coastal headland in Lafourche Parish. There are no communities or human populations in the Project area and therefore no employment or income base. The area supports sources of income related to oil and gas exploration and production and commercial and recreational fishing. Port Fourchon services over 90 percent of the Gulf of Mexico's deepwater oil production (GLPC, 2017) and over 250 companies use Port Fourchon as a base of operation.

3.5.3 Fisheries Resources

Two of Louisiana's commercial fishing ports — Empire-Venice and Intracoastal City — are in the top five landings ports for the United States based on poundage in 2015 (NOAA, 2017b). Empire-Venice, the nearest large commercial fishing port to the proposed Project site, ranked fourth in the nation for quantity of commercial fisheries landings and fifth in the nation for value of landings in 2015 (NOAA, 2017b).

Popular recreational reef fish include groupers, snappers, gray triggerfish and amberjacks, which are fished over rough bottoms in shelf waters 65 to 656 ft (20 to 200 m) deep. Natural outcroppings or manmade reefs are not present on Ship Shoal. Although numerous bottom-anchored oil and gas surface structures on Ship Shoal attract reef fishes, none are located in the proposed borrow area.

Oceanic pelagic fishes live near the edge of the continental shelf. Commercially important oceanic pelagic fisheries include coastal water species, such as Spanish and king mackerel, amberjack, and several species of tuna and billfishes. Oceanic pelagics make seasonal movements along the continental shelf parallel to shore, and between the nearshore and the shelf edge. Few oceanic pelagic fishes are likely to be present in the shallow nearshore area of Ship Shoal.

Bottom-dwelling demersal fishes landed by commercial fishermen in the northeastern Gulf were taken almost exclusively from inland (estuarine) waters. Key species in demersal landings were striped mullet and spotted seatrout.

3.5.4 Aesthetic Resources

Unlike most coasts, Louisiana's barrier islands and headlands are not completely developed for settlement. Principal developments on the coast are associated with the mineral and fishing industry. Scattered petroleum-related industries currently dominate the manmade landscape on the barrier islands and headlands, detracting from the aesthetics of the area.

3.5.5 Recreational Resources

Recreational activity can be undertaken on the surrounding open water, but nothing on the Island or headland itself. Major recreational activities occurring around the headland and adjacent barrier islands include recreational and commercial angling, recreational and

commercial shrimping and crabbing, boating and sailing, wading and swimming, and bird and wildlife viewing. East Timbalier Island and West Belle Headland are owned by the state of Louisiana.

3.5.6 Waterborne Commerce, Navigation, and Public Safety

Port Fourchon supports considerable internal waterborne commerce (Hughes et al., 2001). Bayou Lafourche is navigable from upstream of the northern end of the Federal navigation project in Lockport, Louisiana, to the Gulf of Mexico. This waterway links the Louisiana communities of Raceland, Lockport, Larose, Golden Meadow, and Leeville to the Gulf Intracoastal Waterway (GIWW). The GIWW intersects Bayou Lafourche at Larose (GIWW mile 35). Waterborne commerce on Bayou Lafourche averaged approximately 1.15 million tons annually from1987 to 1990 (Hughes et al., 2001). Approximately, 270 large supply boats travel in the port's channels daily (Greater Lafourche Port Commission, 2017).

The landward side of East Timbalier Island has a considerable amount of waterborne commerce to shuttle supplies and personnel servicing the KREWE production facility.

Authorized navigation channels near West Belle Headland area include Bayou Lafourche and the Port Fourchon Navigation Channel. The 3,600-acre Port Fourchon services domestic deepwater oil and gas producers operating in the Gulf of Mexico. Over 95 percent of the port's cargo is oil and gas industry related. Approximately 30 percent of the cargo is moved by barge to and from more inland areas; and 70 percent is moved by vehicle. The importance of the port was underscored by the aftermath of Hurricanes Katrina and Rita, when oil and gas valued at about $10 billion dollars was unavailable to the nation for a two-month period (GLPC, 2005), raising gasoline prices nationwide. The port's facilities also include the South Lafourche Leonard Miller Jr. Airport in Galliano, Louisiana.

Recreational and commercial fishing is common in the area marinas and boat launches are located in Port Fourchon and on the bay side of the adjacent Grand Isle. Many commercial and recreational fishing boats are also docked along Bayou Lafourche in various communities.

3.5.7 Infrastructure, Oil, Gas, and Other Minerals

The Gulf of Mexico OCS has one of the highest concentrations of oil and gas activity in the world. Onshore infrastructure includes gas processing plants, navigation channels, oil refineries, pipelines and pipeline landfalls, pipecoating and storage yards, platform fabrication yards, separation facilities, service bases, terminals, and industry-related installations such as landfills and disposal sites for drilling and production waste. In addition to onshore service and support facilities, offshore oil and gas facilities have an extensive development of bottom-founded pipelines, surface platforms, caissons, well protectors, and casing stubs (wellhead structures from temporarily plugged and abandoned wells) (DOI-MMS, 2002).

East Timbalier Island and West Belle Headland is owned by the Louisiana State Land Office. Krewe Energy (KREWE) leases water bottoms in the vicinity of East Timbalier Island from the State. There are no residential, commercial, or industrial uses on East Timbalier Island except for the elevated oil and gas production facilities owned by KREWE and located at the eastern

and western ends of the island. Oil and/or gas wells and pipelines are located on and adjacent to the property.

According to the KREWE well head plan, there are three active, seven inactive, and 22 plugged and abandoned oil and/or gas wells located within the proposed restoration Project boundaries. These were previously owned by oil and gas companies including Gulf, Chevron, Pioneer, Maritech, and Greenhill which are predecessors to KREWE. An additional 15 wells that are not part of the KREWE well head plan are located within the boundaries of the proposed restoration Project. Nine of these oil and/or gas wells are plugged and abandoned, two are active, and four are inactive.

Port Fourchon is the closest major Louisiana port to the Gulf of Mexico. The port covers 3.6 thousand acres and extends approximately three miles along the east side of Bayou Lafourche from its junction with Belle Pass and Pass Fourchon to the Flotation Canal (USACE and GLPC, 1994). Port Fourchon services 90 percent of all deepwater platforms in the Gulf of Mexico and roughly 45 percent of all shallow water platforms in the Gulf. The Louisiana Offshore Oil Port (LOOP) is the second component of Port Fourchon's economic contribution. LOOP's onshore facilities, the Fourchon Booster Station and Clovelly Dome Storage Terminal, are located just onshore in Fourchon and 25 miles (40.2 km) inland near Galliano. The Fourchon Booster Station has four 6,000-hp (4.5 MW) pumps, which increase the pressure and crude oil flow en route to the Clovelly Dome Storage Terminal.

3.5.7.1 Pipelines:

Pipelines are the primary means of transporting produced hydrocarbons from offshore oil and gas fields to distribution centers or onshore processing points. Currently, there is over 34,600 mi (54,718 km) of pipeline on the Gulf OCS. The Project area is crossed by numerous oil and gas pipelines of various sizes; some pipelines are near or cross the templates and corridors.

Pipelines are anchored and installed by dynamically-positioned lay barges. Pipeline sections are typically welded at fabrication sites onshore and spooled onto a large mounted roller (stinger) on the lay barge. The stinger unrolls a continuous length of pipeline into position on the sea bottom. The pipeline is laid into a depression created by a plow or water jet sled towed by the lay barge. The pipeline is buried as it settles into the bottom sediment. All pipelines near the borrow area are buried (DOI-MMS, 2002). BSEE regulation at 30 CFR 250.1003(a)(1) requires that OCS pipelines in water depth less than 200 ft (60 m) be placed at least 3 ft (1 m) below the mudline.

The pipeline infrastructure near East Timbalier and Ship Shoal borrow area ranges from small-diameter gathering lines linking individual production facilities to larger trunklines that transport to shore. Pipelines can range in diameter from 4 to 36 inches (10 to 91 cm). Pipelines can be coated in concrete for weight and can include cathodic protection to enhance corrosion resistance. The pump-out areas and conveyance corridors were sighted to avoid pipelines (Figures 2-12 and 2-13). No pipelines are within the borrow area, although several are adjacent (Figures 2-8 thru 2-14).

3.5.8 Environmental Justice

Executive Order (EO) 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995 direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population is defined when the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than the general population. The poverty line was defined in 2015 as $ 24,563 in annual income for a family of four. In 2015, 14.1 percent of Lafourche Parish residents lived below the poverty level (U.S. Census Bureau, 2016).

The East Timbalier Island and West Belle Headland Project area does not have a minority and/or low-income population. The Project area is located in a remote and uninhabited island in Lafourche Parish and the Ship Shoal area offshore of Terrebonne Parish. No communities or human populations are present in the Project area. However, Port Fourchon is near the Project area. The nearest populated areas to the Project are Port Fourchon and Grand Isle, a nearby barrier island.

3.6 Hazardous, Toxic, and Radioactive Waste (HTRW)

Coastal Tech (CTC) – G.E.C. Inc. (GEC) (CTC-GEC) performed a Phase I ESA of East Timbalier Island on 13 October 2016, in accordance with the scope and limitations of ASTM E 1527-13 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.

Based on the review of federal, state, and local environmental databases, historical research, interviews, and site investigations, the assessment revealed one recognized environmental condition (REC) on the property. The REC, a waste pit, located within the proposed restoration Project property boundary is related to oil/gas drilling activities. No records were found to indicate that the site has been closed. The waste pit also had been breached.

Based on the findings of the ESA, CTC-GEC recommended further investigation of the waste pit on the property to determine if contamination is present on the property. It was recommended that three sediment samples be taken within the waste pit and one sample outside of the waste pit in accordance with Office of Conservation Rules and Regulations within Title 43 of the Louisiana Administrative Code (LAC) (43:XIX.311 and 313, Subpart 1. Statewide Order No. 29-B).

CTC-GEC performed sediment sampling on February 20, 2017 and provided the samples to TestAmerica-Pensacola (National Environmental Laboratory Accreditation Program Cert. #30976) for lab analysis. The specific analysis chosen was oil field legacy 29-B, passive pit closure. Results of samples analyzed found the Oil Field Passive Pit Closure Parameters were all below regulatory levels. The results tested for total metals, radionuclides, and NORM materials. The material appeared innocuous (CTC-GEC, 2017).

4.0 - ENVIRONMENTAL CONSEQUENCES

This section of the EA evaluates the anticipated environmental impacts to the human environment that would result from implementation of the proposed Project. It includes an analysis of the direct, indirect, and cumulative impacts of Project alternatives, including the preferred alternative and the no-action alternative. The elevations, widths, and configurations of the landforms created for the conceptual plans are informed by previous work performed on the TBBSR (USACE, 2010a), Barataria Basin Barrier Shoreline Feasibility Study (USACE, 2012), and recent barrier island modeling and planning work done to support the development of the 2017 Coastal Master Plan (CEC, 2015). Subsequent plan iterations were developed by reducing the planforms and / or eliminating habitat features.

A qualitative assessment was conducted for direct and indirect short-term (occurring during construction) and long-term (occurring during Project life) impacts. The actual construction duration cannot be known in advance, as duration is affected by final design, weather, mechanical performance, and other factors that cannot be completely controlled. The range of estimates provided in the Preliminary Design Report (Stantec CEC, 2017) provided the basis for designations of short- and long-term impacts. In the following sections, impacts that occur only during the construction phase are considered short term, temporary, and reversible. An example of a short-term impact is increased turbidity during dredging. Long-term impacts are those that persist well-beyond the construction phase, and are considered semi-permanent and irreversible within the 20-year lifespan of the Project. An example of a long-term impact is the increase in dune elevation to +6.0 ft NAVD. The estimated duration of each component of construction is given in the appropriate sections below.

In addition to the temporal component of each impact, the magnitude or severity of the impact is described in qualitative terms. Alternatives were designated as having no impact, no significant impact, or significant impact. The impacts that were found not significant were further defined by the terms minor and moderate. Minor impacts are those that may be measurable, but not result in adverse effects.

An example of a minor impact is construction causing birds to temporarily avoid a local area. If the birds have access to similar areas, and are not prevented from foraging altogether in the area, it is not significant that they were dislocated a few meters down the beach. In human terms, “minor” is equivalent to “inconvenient but not harmful.” Moderate impacts may have a population-level effect, and thus warrant some mitigation or revision of the Project component causing the impact. An example of a moderate impact is the loss of beach habitat during the construction phase. Although the loss is spatially extensive, it is temporary, and the restoration will more than compensate for the temporary disruption of beach habitat to all of the affected fish and wildlife species.

In contrast, significant impacts warrant preparation of a full environmental impact statement (EIS). Significant impacts may result from “taking”, which is actions resulting in the death of an endangered species, or interfering with reproduction of a local population of fish or wildlife if, for example, it causes an irreversible negative effect. In that case, the alternative would either be

rejected, amended to include mitigation actions that reduce the impacts to acceptable levels, or evaluated in an EIS.

The qualitative assessment of an impact's context and intensity is based on a review of the available and relevant reference material and on professional judgment, which includes consideration of the permanence of an impact or the potential for natural attenuation of an impact, the uniqueness of the resource, the abundance or scarcity of the resource, and the potential that mitigation measures can offset the anticipated impact. A quantitative assessment is included when sufficient data are available to conduct such an analysis.

Adverse environmental consequences of the no-action alternative contrast with the benefits of the preferred alternative. With no action, continued loss of headland, supratidal, and intertidal habitats likely would occur, along with associated declines in fish and wildlife resources. However, the preferred alternative can offset adverse impacts to these habitats.

A detail description of modeling analysis and habitats created for the alternatives is provided in Appendix B. Table 4-1 summarizes general construction plan features for the alternatives. Table 4-2 presents a comparison of environmental impacts associated with the no-action, preferred, and other alternatives. The alternative analysis in Appendix B provides more detail of all the alternatives considered, whereas Table 4-2 will only focus on a couple of the alternatives. Table 4-3 presents the mitigation measures of the preferred alternative.

Table 4-1. Overview of Construction Plans for Alternatives

Project Alternative		Fill Added (MCY)	Beach-Dune/Marsh Target Elevation (ft NAVD)	Beach-Dune/Marsh Width (ft)	Beach-Dune/Marsh Length (lf)	Habitat Created (acres)
No-Action		0	No Change	No Change	No Change	0
Preferred Alternative ETI	ETI Beach/Dune	6.6	+7.5 (Dune) +5.0 (Beach)	100 (Dune) ~170-400 (Beach)	13,600	
	ETI Marsh	1.75	+3.0 (Marsh)	~800-1,073	~6,800	516
	WB Beach /Dune	2.2	+7.5 (Dune) +5.0 (Beach)	100 (Dune) ~392 (Beach)	~10,000	
	WB Marsh	1.3	+3.0 (Marsh)	~1,120	~10,000	819
Other Alternatives Analyzed	CTC High Beach-Dune	5.2	+7.0 (Dune) +4.8 (Beach)	100 (Dune) 350 (Beach)	~7,500 (Dune) ~15,000 (Beach)	
	CTC High Marsh	10.3	2.6	~3,850	~7,500	839
	CTC Low Beach-Dune	4.6	+7.0 (Dune) +4.8 (Beach	100 (Dune) 550 (Beach)	~6,500 (Dune) ~7,200 (Beach)	
	CTC Low Marsh	6.2	2.6	~1,000	~7,000	546

Table 4-2. Comparison of Environmental Impacts of Preferred Action and Alternatives

Resource	No Action	Alternative 4	Alternative 5	Alternative 6 Preferred Alternative	Alternative 7
		Casse Tete/Calumet – Low Sediment	East Timbalier – High Sediment (with Shoal)	East Timbalier – High Sediment (w/o Shoal) & West Belle – Low Sediment	Casse Tete/Calumet & West Belle – Low Sediment
Geology, Topography, and Physical Oceanographic Processes	Without action, the remaining supratidal acreage will disappear by TY 20. The existing breach at East Timbalier is expected to widen. Under the no-action alternative, material from the borrow areas is likely to be used for other restoration projects in the area.	Beneficial impacts are the same as for Alternative 6, but East Timbalier and West Belle Headland would continue to erode. Temporary impacts to existing beach and marsh are the same as for Alternative 6. Borrow area impacts are the same as for Alternative 6.	Beneficial impacts are the same as for Alternative 6. Temporary impacts to existing beach and marsh are the same as for Alternative 6. Borrow area impacts are the same as for Alternative 6.	Emplaced materials would result in long-term, direct, beneficial impacts in the proposed Project area by protecting marshes from storm surge, reducing erosion rates, and increasing seaward position at the 20-year mark. Island construction would result in coverage of existing marsh and shallow water habitat. Short-term, direct, moderate, adverse effects would occur in the proposed borrow areas associated with suspension of sediment and disturbance to natural sediment sorting and layering within the borrow areas.	Beneficial impacts are the same as for Alternative 6, but East Timbalier continue to erode and disappear. Temporary impacts to existing beach and marsh are the same as for Alternative 6. Borrow area impacts are the same as for Alternative 6.
Air Quality	No impacts	Same as Preferred Alternative	Same as Preferred Alternative	Construction and dredging would result in adverse, direct, short-term, minor impacts from exhaust diesel fumes and fugitive dust generated by dredging equipment, earthmoving equipment,	Same as Preferred Alternative

				tugs, and barges.	
Surface Water and Water Column Resources	No direct impact. The cumulative impact of loss of the barrier headland would be to allow increased exchange of gulf waters with Timbalier Bay, leading to increased salinity, loss of intermediate marsh vegetation, and increased vulnerability to storm surge.	Adverse impacts would be generally the same as for Alternative 6, but less material would be dredged. Beneficial impacts would be similar to Alternative 6, but to a lesser degree.	Adverse impacts would be generally the same as for Alternative 6, but less material would be dredged. Beneficial impacts would be similar to Alternative 6, but to a lesser degree.	Dredging and emplacement would result in adverse, direct, short-term, minor impacts to surface water quality associated with (1) increased turbidity in the water column at the dredge site (dredge plume) and at the construction location; (2) exhumation of buried trash and debris; and (3) discharges from the dredge vessel. Long-term beneficial impact to surface water quality would result from increased wetland acreage.	Adverse impacts would be the same as Alternative 6. Beneficial impacts would be similar to Alternative 6, but to a lesser degree.
Wetlands	Continued erosion and overwash are expected to occur, resulting in losses to wetland resources. All supratidal habitats are expected to be lost by TY 20. About 40% of the existing intertidal habitat (207 acres) will be lost within 20 years.	Adverse impacts would be the same as Alternative 6. Beneficial impacts would be similar to Alternative 6.	Adverse impacts would be the same as Alternative 6. Beneficial impacts would be similar to Alternative 6.	Emplacement would result in temporary adverse, direct, short-term, minor impacts to intertidal marsh and dune vegetation thru covering or crossing over wetlands during construction. The alternative would restore and rehabilitate supratidal and intertidal vegetated coastal barrier habitats; reduce conversion of these habitats to open water habitat; and provide nursery habitat for several species, including brown and white shrimp, and blue crab.	Adverse impacts would be the same as Alternative 6. Beneficial impacts would be similar to Alternative 6.
Vegetation	All supratidal habitats	Adverse impacts would	Adverse impacts would	The proposed action	Adverse impacts would

	are expected to be lost by TY 20. Intertidal habitat will be reduced by 40% within the next 20 years.	be the same as Alternative 6. Long-term beneficial impacts would be similar to Alternative 6 but to a lesser degree.	be the same as Alternative 6. Long-term beneficial impacts would be similar to Alternative 6 but to a lesser degree.	would result in short-term, adverse, direct, minor impacts by covering existing vegetation or crossing over vegetation with heavy equipment during construction. The long-term direct benefits of implementing the project would create 1,335 of beach, dune and intertidal marsh, providing for essential vegetated habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; and increased vegetation growth and productivity.	be the same as Alternative 6. Long-term beneficial impacts would be slightly greater than Alternative 6.
Aquatic Biota, Fisheries, and Essential Fish Habitat	Intertidal habitat will be lost, and open water habitat will increase. Animals that rely on marsh vegetation and marsh edge habitat will decline.	Adverse impacts would be the same as Alternative 6. Positive impacts would be similar to, but less lasting than, Alternative 6, because less overall marsh habitat.	Adverse impacts would be the same as Alternative 6. Positive impacts would be similar to, but less lasting than, Alternative 6, because less overall marsh habitat.	Slow-moving or sessile organisms in the borrow areas may be killed during dredging. Sessile organisms in the emplacement areas may be buried or injured. Short-term increases in turbidity may temporarily reduce habitat quality in the borrow areas and the emplacement areas. The proposed Project would have long-term, moderate, direct and indirect beneficial impacts to EFH for the immediate Project area through protection, restoration, and creation of marsh. The proposed Project would provide long-term	Adverse impacts would be the same as Alternative 6. Positive impacts would be similar to but greater than Alternative 6, because greater overall marsh habitat.

				benefits, such as enhanced habitat, surf zone stability, increased food and shelter resources, improved water quality; and greater access to interior island locations during storm or high-water events.	
Terrestrial Wildlife	All dune and supratidal habitats are expected to be lost by TY 20.	The adverse impacts would be the same as Alternative 6. Positive impacts would be less than Alternative 6 because less overall beach and dune habitat restored.	The adverse impacts would be the same as Alternative 6. Positive impacts would be less than Alternative 6 because less overall beach and dune habitat restored.	Construction and dredging would result in localized, adverse, direct, short-term, minor impacts to beach habitat through covering of existing beach. The preferred alternative would increase the longevity of supratidal habitat, resulting in a net benefit to terrestrial wildlife..	The adverse impacts would be the same as Alternative 6. Positive impacts would be similar to Alternative 6.
Threatened, Endangered, and Sensitive Species	Loss of beach and dune habitat will likely adversely affect the piping plover and red knot. Critical habitat for the piping plover is expected to diminish during the next 20 years.	Adverse impacts would be the same as Alternative 6. Beneficial impacts would be less than Alternative 6, and offer less supratidal habitat over time.	Adverse impacts would be the same as Alternative 6. Beneficial impacts would be less than Alternative 6, and offer less supratidal habitat over time.	Construction would temporarily affect critical habitat for the piping plover by depositing new material in intertidal and supratidal areas, which would render those areas unsuitable for foraging until benthic prey species recolonize the Project area. Excavation could result in localized, adverse, direct, short-term, minor impacts to sea turtles in the borrow areas, which could be disturbed by the dredge. On-shore construction will take place during the fall and spring, when sea turtles are off shore.	Adverse impacts would be the same as Alternative 6. Beneficial impacts would be greater than Alternative 6.

				The proposed action would result in positive, indirect, long-term, moderate impacts to T&E species by maintaining the barrier headland system.	
Cultural and Historic Resources	No impact	Same as Alternative 6	Same as Alternative 6	No impact. Dredging will not occur within a protective buffer zone around underwater cultural resources.	Same as Alternative 6
Land Use/Recreation	Fisheries-related activities would decline, as marsh-dependent fish and shellfish species relocate.	Adverse impacts would be the same as for Alternative 6. Beneficial impacts would be less than Alternative 6, but for a shorter duration.	Adverse impacts would be the same as for Alternative 6. Beneficial impacts would be less than Alternative 6, but for a shorter duration.	Construction would result in adverse, direct, short-term, minor impacts to land use, including minor, localized disruption of fishing. Long-term, direct, moderate beneficial impacts to recreation, including improved fisheries nursery habitat.	Adverse impacts would be the same as for Alternative 6. Beneficial impacts would be less than Alternative 6, but for a longer duration.
Infrastructure	Infrastructure would become more vulnerable to storm damage.	Same as the No Action Alternative	Similar to Alternative 6, but less protection to Port Fourchon.	Long-term, beneficial impacts would be expected for oil and gas leases and infrastructure, as pipelines would be better protected from problems associated with erosion. Short-term, substantial, adverse impacts are possible in the event that a pipeline is damaged during dredging.	Similar to the No Action Alternative.
Socioeconomics	Loss of habitat that supports fisheries may lead to reduced income. Increased damage to the build environment from storms has an economic impact.	No adverse impacts would occur. Positive impacts would be similar to Alternative 6, but of shorter duration.	No adverse impacts would occur. Positive impacts would be similar to Alternative 6, but of shorter duration.	No adverse impacts to socioeconomics are expected. The preferred Project will result in long-term, moderate, beneficial impacts to	No adverse impacts would occur. Positive impacts would be similar to Alternative 6, but of longer duration.

				socioeconomics by improving fisheries, recreational opportunities, commercial fishing outfits, and pipelines.	

Table 4-3. Summary of Avoidance, Minimization and Mitigation Measures of Preferred Action

Resource	Potential Avoidance, Minimization and Mitigation Measures
Geology, Topography, and Physical Oceanographic Processes	• Construction of marshes would replace marsh covered during island construction. • Containment dikes would contain emplaced materials to allow for consolidation and stabilization. • Sand fencing and vegetative plantings of disturbed areas would stabilize soil, reduce resuspension of recently deposited sediment, and enhance sedimentation. • Borrow areas would be far enough off shore that no impacts to shorelines are anticipated.
Air Quality	• Best management practices, including sand fencing and revegetation, would minimize exhaust fumes and fugitive dust.
Surface Water and Water Column Resources	• Best management practices would prevent or minimize soil erosion. • Compliance with the Clean Water Act and other regulations would protect water resources.
Wetlands	• Best management practices would minimize disturbance of intact wetlands. • Compliance with the Clean Water Act, Section 404 and Section 301, would protect wetlands from unnecessary disturbance.
Vegetation	• Project-specific evaluations and coordination with appropriate federal, state, and local agencies would focus on effective vegetation management. • Best management practices would reduce scour, erosion, and sedimentation. • Habitat restoration would focus on replanting native species.
Aquatic Biota, Fisheries, and Essential Fish Habitat	• Dredging would be scheduled so as to avoid peak infaunal periods (spring and summer). • Undredged areas adjacent to borrow areas would provide source organisms for recolonization. • Best management practices would minimize turbidity in borrow areas. • Project-specific evaluations and consultation with appropriate federal, state, and local agencies would focus on protecting sensitive species. • Tidal features would be constructed in the marsh to increase habitat complexity for estuarine species. • Retention dikes would be gapped after construction to provide tidal connection.
Terrestrial Wildlife	• Project-specific evaluations and coordination with appropriate federal, state, and local agencies will focus on protecting sensitive wildlife species.
Threatened, Endangered, and Sensitive Species	• The project would be scheduled to minimize impacts on the piping plover. • Use of a cutterhead dredge would not likely impact sea turtles. • Coordination with the U.S. Fish and Wildlife Service, NOAA Protected Resources, and state agencies on state and federally listed species would focus on protecting threatened and endangered species.

Resource	Potential Avoidance, Minimization and Mitigation Measures
Cultural and Historic Resources	• Magnetic and acoustic anomalies identified during the offshore cultural resources survey would be protected by buffers to protect sensitive submerged cultural resources in the borrow areas. • If artifacts of potential cultural or historical significance are unearthed, construction or excavation activities would be immediately halted and the Louisiana State Historic Preservation Office (SHPO) consulted. • Appropriate Section 106 Consultation with the Louisiana SHPO would be completed if necessary.
Land Use/Recreation	• Coordination with appropriate federal, state, and local agencies would focus on maintaining the quality of public recreation. • All staging areas used for construction materials or debris would be restored to preconstruction conditions (or better).
Infrastructure	• Construction would avoid pipelines and other oil and gas equipment, which have already been identified by magnetometer surveys and on-going coordination with the pipeline owners.
Socioeconomics	• Coordination with appropriate federal, state, and local agencies would ensure that public concerns are addressed.

4.1 Impact-Producing Factors

4.1.1 Dredging Operation Characteristics

Dredging at both borrow areas will be carried out by either hopper dredge(s) or hydraulic cutterhead dredge(s). The first method is by hopper dredge. The excavated sand will be discharged into hoppers within the hull and transported to the designated pump-out areas and hydraulically unloaded. The second method involves use of a conventional cutterhead dredge, which will excavate the sand and transfer it through a spider barge distribution system into scow barges. The scows will be towed to the designated pump-out areas and hydraulically unloaded directly from the scow barges.

For the East Timbalier Island beach, dune, and marsh containment Project features requiring sand, a pump-out area has been delineated with an associated sediment delivery corridor. For the West Belle Headland beach and dune Project features requiring sand, the West Belle Marsh Borrow Area has been delineated as a pump-out area with an associated sediment delivery corridor.

The total estimated construction time is 810 days. Project scheduling assumes dredging will be continuous, eighteen (18) hours per day, seven (7) days per week. Dredge down time is assumed to be twenty (20) percent: fifteen (15) percent for maintenance and five (5) percent for weather contingencies. The combination of sailing distances and discharge pipeline lengths from the Ship Shoal and South Pelto Borrow Areas to the Restoration Area are approximately 23 NM and 20 NM, respectively.

4.1.2 Effluent Discharge at Sea

Effluent discharges are not expected at either borrow area. Temporarily elevated turbidity is limited to the immediate vicinity of the cutterhead and the majority of it is entrained in the slurry that is pumped ashore.

4.1.3 Total Depth of Cut Within the Borrow Areas

The dredge cut at the South Pelto Borrow Area will be stepped downward progressively towards the center of the borrow area to follow the thickness of the beach-compatible sediment. The design depth ranges from -40 ft NAVD88 to -44 ft NAVD88 with a 3.0 ft allowable overdredge ranging from -43 ft NAVD88 to -47 ft NAVD88. Because the bottom topography of South Pelto is sloping, the actual cut thickness varies from 6 to 12 ft.

The dredge cut at the Ship Shoal Borrow Area will also be stepped downward progressively toward the center of the cut template to follow the thickness of the beach-compatible sediment. The design depth ranges from -35 ft NAVD88 to -38 ft NAVD88 with a 3.0 ft allowable overdredge ranging from -38 ft NAVD88 to -41 ft NAVD88. Because the bottom topography at Ship Shoal is also uneven, the actual cut thickness varies from four (4) to ten (10) ft. The side slopes at both cuts shall be one (1) ft vertical for every ten (10) ft horizontal.

Several studies have addressed questions on the effects of sand mining at Ship Shoal on wave dynamics both over the shoal and on the adjacent nearshore areas. Stone and Xu (1996) used the STWAVE model to assess wave height variations associated with normal and storm conditions following removal of the shoal. The model results indicated that removal of the shoal would not have significant impact on the adjacent shorelines (Stone, 2004). Stone et al. (2009) subsequently modeled several different mining scenarios, using the projected volume calculations for different restoration "targets," (Caminada Headland, Isles Dernieres, Whiskey & Trinity Islands, etc.). They concluded that mining Ship Shoal on these scales would not have adverse impacts on hydrodynamics or sediment transport. They did recommend against complete removal of the shoal, which would be impossible because of the extensive petroleum extraction and distribution infrastructure on much of it.

4.1.4 Emplacement on Beach, Dune, and Marsh Habitats

The East Timbalier High Sediment template was designed to maximize the construction footprint for each habitat based on environmental constraints (e.g., wetlands, native vegetation), water depths, and avoiding active oil and gas wells and existing structures, while restoring the GEFF of each barrier feature to the greatest practicable extent. The only habitats that will be impacted are the open sandy beach and the nearshore inter- and sub-tidal sandy areas. Project involves restoring approximately 516 acres of beach, dune, and intertidal marsh habitat on East Timbalier Island and approximately 819 acres of beach, dune, and intertidal marsh on the West Belle Headland, for a combined total of 1,335 acres

Sediment placement affects the terrestrial and benthic fauna in both the beach and intertidal zones by covering them with a layer of sediment. The most obvious organisms on or in the beach are the burrowing ghost crabs (Ocypode quadrata) and the amphipods, spiders, and insects that inhabit the wrack line. Some terrestrial and benthic species can burrow through a modest layer (from fifteen (15) to thirty-five (35) inches for different species) of added sediment since they are adapted to the rapidly shifting environment of the beach and intertidal zone; however, thicker layers (greater than forty (40) inches) of sediment are likely to smother the benthic fauna (Greene, 2002). After sediment placement, benthic fauna can take anywhere from six (6) months to two (2) years to recover (Peterson et al., 2000; 2006).

The marsh fill template covers both unvegetated beach and nearshore intertidal bay bottom. Sediment placement impact will be comparable to the impact on the beach. The marsh fill sediment will be allowed to settle and dewater. Marsh vegetation planting will occur during the next few growing seasons following completion of marsh construction. Marsh fauna will recolonize the area as tidal inundation is naturally reestablished. This may take several years, however it is understood that for a restored marsh to persist successfully over time, its initial elevation cannot start so low that it is intertidal at every tidal cycle. Rather, it is built higher to account for the compaction and settlement over time, with the goal of having the marsh platform elevation enter the tidal range between Mean Higher High Water and Mean Lower Low Water in approximately three (3) years.

Additional impacts in the Conveyance Corridors can result from laying sediment pipeline from the Pump-Out Areas to the Restoration Area. These effects would be minor and short-term; these benthic resources would reestablish from adjacent undisturbed areas. The benefits of additional acreage of beach, dune, and marsh as new habitat and protection of the adjacent estuary were weighed in the TBBSR study and considered to outweigh the unavoidable loss of habitat that accompanies fill placement (USACE, 2010).

4.2 Physical Resources

This section describes potential impacts to geology, topography, and physical oceanographic processes; air quality; and surface water and water column resources for all alternatives, including no action and the preferred action.

4.2.1 Oceanographic and Coastal Processes

No-Action Alternative - East Timbalier and West Belle Headland

Direct

Existing conditions include continued barrier island deterioration, fragmentation, and degradation of the barrier islands. Existing dune, supratidal, and intertidal habitats will convert to subtidal habitats.

Indirect

Without any action, the Terrebonne Basin Barrier Island system would continue to deteriorate, degrade, fragment and eventually convert into shallow open water. The barrier system would continue to experience higher wave energy levels and associated shoreline erosion. The interior estuarine bays and beach ridges would continue to be transformed into marine open water habitat. Penetration of salt water into areas previously isolated from direct exchange and increased tidal flows could enhance erosion of some marsh types.

The indirect impacts of not implementing the Project are associated with changes in coastal processes. Natural and human-induced changes to coastal processes of water flows and levels would continue. Natural subsidence, barrier shoreline erosion due to waves and storms, construction of oil and gas exploration canals, construction and maintenance of navigation

channels, as well as mineral extraction would continue to contribute to alteration of the natural coastal processes and flow and water levels.

No-Action Alternative - Ship Shoal / South Pelto Borrow Area

The No-action Alternative would not have any direct or indirect impacts on the physical oceanographic and coastal processes at the borrow areas of Ship Shoal and South Palto.

Preferred Alternative - East Timbalier

Direct

The Project would restore the geomorphic form of the beach and dune, enabling the barrier shoreline to absorb wave energy during storms and fair-weather conditions and provide some storm surge protection, reducing storm damage to upland areas landward of the beach and dune; and decreasing land loss rates.

Placement of borrow area sediment would unavoidably bury existing dune, supratidal, gulf intertidal and gulf subtidal habitats, altering the topography and bathymetry within the Fill Template.

Use of the East Timbalier Offshore Pump-out Areas for temporary mooring of the hopper dredge or barge offloading equipment via anchoring systems will not have measurable direct impacts on the physical oceanographic and coastal processes. Temporary disturbance of the Gulf bottom will be negligible during anchor and sediment pipeline installation and removal. Anchor lines will not alter the wave field or sediment transport patterns. Dredging of the East Timbalier Island Marsh Borrow Area and associated pipeline corridor is not expected to change the beach erosion patterns near the proposed Project or anywhere along the Timbalier Barrier Island shoreline. Access dredging for equipment is limited to the existing access corridor utilized by the Krewe Energy facility. This sediment would be placed along the access channel and may alter the bathymetry but will not affect the wave field or sediment transport. These effects are minor and short-term.

Indirect

Indirect impacts would include geomorphological benefits associated with the deposition and natural redistribution along the sediment-deprived barrier system. The borrow area sediment will be subjected to physical and coastal processes that would, over time, begin to more closely resemble the sediment they are covering on the island. The restoration would reduce potential adverse impacts associated with increased storm surge and wave potential to the interior estuarine wetlands and beach ridges. This Project would reduce the potential for storm damage to the existing and expected infrastructure.

Other indirect impacts would include marine organisms (especially benthos) that presently utilize the Gulf bottom substrates would have to adapt to changes in Gulf bottom topography; restoration construction activities could cause short-term disruption of commercial and recreational fishing; and alteration of Gulf water bottoms may change littoral drift dynamics;

and creation of depressions, furrows, and pits could impact recolonization by the benthic community (Nairn et al. 2004).

Preferred Alternative - West Belle Headland

Direct

The beneficial impacts are the same as for East Timbalier Island. Impacts of placing dredged materials onto existing marsh habitat would be similar to East Timbalier, but the new marsh would be constructed at an elevation of +2.5 ft NAVD, 0.5 ft lower than East Timbalier. The West Belle Marsh Borrow area was previously analyzed for the West Belle Pass Barrier Headland Project (TE-52). The TE-52 Marsh Borrow Area was permitted and partially used to construction the TE-52 project but, was not completely exhausted in the construction of the Project. Dredging the West Belle Marsh Borrow Area will result in suspension of sediment and disturbance to natural sediment sorting and layering within the borrow area. Over the long term, dredged materials removed from the borrow areas would be expected to rearrange by natural processes, and predredging bathymetric contours would return to the dredged areas. Temporary disturbance of the Gulf bottom will be negligible during anchor and sediment pipeline installation and removal.

Indirect

The indirect impacts are the same as for East Timbalier Island.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area

Direct

The dredged material used in both island and marsh construction would consist of naturally occurring material deposited in the gulf over time by riverine processes. Dredging would result in suspension of sediment and disturbance to natural sediment sorting and layering within the borrow area. Water depth would increase in the area as sediment were removed. Over the long term, dredged materials removed from the borrow areas would be expected to rearrange by natural processes, and pre-dredging bathymetric contours would return to the dredged areas.

Indirect

Previous Delft3D numerical modeling studies have shown that dredging the OCS borrow areas does not change the beach erosion patterns anywhere along the Timbalier Barrier Island shoreline (CPE 2009). Noticeable changes to the wave patterns near the borrow areas during storms may occur after excavation. However, based on the large distances between the borrow areas and the shoreline, changes to the nearshore waves and sediment transport patterns would be negligible during storms and average conditions. Accordingly, sand mining in the borrow areas would not result in any noticeable changes to the long-term storm erosion patterns along the nearby shorelines. The model results for the 20-year storm event show infilling of the borrow area from the immediate surroundings but no bathymetric changes that

would extend to the shoreline. Dredging the borrow areas as described in the preferred alternative will not affect adjacent shorelines.

4.2.2 Geology

No-Action Alternative - East Timbalier and West Belle Headland

Direct

Under the No-action Alternative, the historic land loss and erosion rates will continue and the barrier shoreline will eventually convert to shallow open water bottoms. Sand resources within the beach and dune system will be overwashed into the back-barrier system or lost offshore during significant storm events. The island and headland will lose its geomorphic form and function.

Indirect

Under the No-action Alternative, the island will continue to erode and migrate landward. Sedimentary modifications produced by Headland migration would include textural changes, steepening, and reorientation of stratification. The reworking of sediment, which accompany Headland migration, could potentially alter the texture of sediment, depending on the material available for deposition and the composition of the sediment being reworked. In absence of restoration, the interior bay and beach ridge system along with their sediment resources will continue to be transformed into marine open water habitat.

No-Action Alternative - Ship Shoal / South Pelto Borrow Area

Direct/Indirect

The No-action Alternative would not have any direct or indirect impacts on the geology and sand resources of the borrow area on Ship Shoal.

Preferred Alternative - East Timbalier

Direct

Restoration of the island by placement of over 2.2 MCY of beach and dune compatible sand will improve the ability of the island to resist shoreline erosion, wave overtopping, and breach formation. Installation of sand fencing and dune vegetation would provide a mechanism for future aeolian sand transport and dune enhancement for additional shoreline protection. The addition of sand from Ship Shoal would introduce sand to the sand-starved system from outside the system, which is congruent with the principles of the Coastal Master Plan (CPRA, 2017).

Following placement, consolidation of borrow area sediment would occur; consolidation is predicted to take about one year. Adverse direct impacts of placing borrow area sediment into

the dynamic high-energy barrier system would generally be minimized by placement of compatible sediment in this sediment-starved barrier system.

Indirect

Indirect impacts on the geology of the Project area would include the geomorphological benefits associated with the deposition and natural redistribution along the headland and to the adjacent sediment-deprived barrier systems.

Preferred Alternative - West Belle Headland

Direct

Restoration of the headland by placement of over 2.2 MCY of beach and dune compatible sand will improve the ability of the headland to resist shoreline erosion, wave overtopping, and breach formation. Installation of sand fencing and dune vegetation would provide a mechanism for future aeolian sand transport and dune enhancement for additional shoreline protection. The addition of sand from Ship Shoal would introduce sand to the sand-starved system from outside the system, which is congruent with the principles of the Coastal Master Plan (CPRA, 2017).

Following placement, consolidation of borrow area sediment would occur; consolidation is predicted to take about one year. Adverse direct impacts of placing borrow area sediment into the dynamic high-energy barrier system would generally be minimized by placement of compatible sediment in this sediment-starved barrier system.

An access channel to the West Belle Headland project requires dredging of approximately 360,000 CY. This sediment would be placed within the Fill Template; the direct impacts on geology and sand resources are described above. Dredge depths were set equal to or shallower than the existing navigation channel depths. Infilling of these areas is expected from natural tidal flow carrying suspended sediment, thus the impacts will be minor and temporary.

Indirect

Indirect impacts on the geology of the Project area would include the geomorphological benefits associated with the deposition and natural redistribution along the headland and to the adjacent sediment-deprived barrier systems.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area

Direct

Removal of up to 4.7 MCY of sand from 253 acres of South Pelto and 6.5 MCY of sand form 584 acres of Ship Shoal for restoration of the East Timbalier and West Belle Headland is considered small-scale mining in the context of the various Ship Shoal modeling studies (Stone 2000; Stone et al. 2004, 2009). Ship Shoal contains an estimated 1.57 billion cy of very

fine- to medium-grained sand (DOI-MMS 2004; USACE 2012). The Project represents 0.7 percent of the total volume. The sand body encompasses approximately 76,600 acres. The Project represents 1.1 percent of the total surface area of the sand body.

Indirect

The Project would not contribute to any indirect impacts to the geology and sand resources at the borrow areas.

4.2.3 Air Quality

No-Action Alternative - East Timbalier/West Belle Headland and Borrow Areas

Direct/Indirect

The No-action Alternative would not have any direct impacts, and would not contribute to any indirect impacts, on air quality. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland and Borrow Areas

Direct/Indirect

Although Ship Shoal is approximately 23 nm from the East Timbalier Pump-out area, movement of vessels between these areas would occur during the proposed Project, and the same direct and indirect impacts would be imposed on air quality across the entire Project area.

Air emissions associated with the proposed East Timbalier Project would result from diesel engines powering the dredging activities, propulsion between the dredge site and pump-out operations. Additional emissions would result from equipment used in the placement and relocation of the mooring buoys. Air emissions on the beach would result from bulldozers, graders, and other equipment. The majority of emissions would occur during dredging activities which are estimated at 520 days of the estimated total construction period of about 810 days. The majority of emissions would occur at the dredge site and pump-out areas. The principal emissions would consist of nitrogen oxides (NOx), with smaller volumes of carbon monoxide (CO), sulfur dioxide (SO2), particulate matter (PM), and volatile organic compounds (VOC). Emissions of NOx and VOC are potential precursors to ozone, primarily during June through September.

The quantity of emissions are difficult to project, but would be larger than quantities associated with the other barrier island projects with shorter distances from the dredge site to the onshore construction sites. Most emissions would occur over OCS waters, with smaller volumes in Lafourche Parish.

Therefore, if restoration is undertaken, air quality on East Timbalier Island, West Belle Headland, and the borrow areas will be temporarily negatively affected. This level of activity will persist throughout the duration of the Project and return to pre-construction conditions shortly after the completion of construction activities.

4.2.4 Water Quality

No-Action Alternative - East Timbalier/West Belle Headland and Borrow Areas

Direct/Indirect

The No-action Alternative would not have any direct impacts on water quality. However, the cumulative impact of loss of East Timbalier Island and West Belle Headland would allow increased exchange of gulf waters with the Timbalier Bay estuary system. The increased salinity would lead to loss of brackish and intermediate marsh vegetation, rendering the mainland shoreline more vulnerable to storm surge.

Preferred Alternative - East Timbalier and West Belle Headland

Direct

Pump-out operations would produce temporary minor changes in water quality at the pump-out locations. Turbidity levels in the pump-out areas would be elevated above normal during dredging within the mixing zone. Visible plumes at the water surface are expected in the immediate vicinity of the operation. Similar water quality effects are expected at the beach nourishment location. During placement, sand slurry will be pumped onto the beach through a temporary pipeline. Fine-grained sand will settle out rapidly and water will separate from the slurry and drain off the beach into the surf zone or percolate into the sand. If silt- or clay-sized sediment are part of the slurry, the settling velocity of these suspended solids will control the amount of silt and clay that is deposited on the beach or remains in suspension to drain into the surf zone. Elevated turbidity levels are expected to dissipate rapidly, returning to background levels in a short period. The Contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material for the borrow area.

Indirect

Exhumed contaminants, or trash and debris present in the dredged sand could also be deposited on the beach. The placement area for dredged sand is expected to total hundreds of acres, but only an area of 5-10 ac would be active at any one time as the sand slurry is discharged and new beach and dune platform area is created and graded with bulldozers. Although suspended particulate matter levels in the receiving water could temporarily increase, it would take place in a limited emplacement area and is expected to have minimal effects on water quality.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area

Direct

During dredging, sand would be collected from the dredge site with a hopper dredge or cutter head dredge. Silt or clay that may be present in the sandy substrate may become suspended in the water column near the dredge site. The suspended sediment would settle in a matter of

hours to days (depending on current). If the disturbed sediment were anoxic, the biological oxygen demand in the water column would increase.

Turbidity and suspended particulate levels in the water column above the preferred borrow areas normally fluctuate as a result of seasonal riverine inputs and discharge rate. The increased turbidity is expected to affect water quality only in the immediate area of dredging (DOI MMS 2002).

Indirect

Indirect impact-producing factors of dredging include uncovering buried trash and debris, and dredge vessel discharges. Materials buried in the sediment, such as drilling mud and trace contaminants, could be resuspended, or trash and debris could be exhumed and exposed through the dredging operation.

Sanitary and domestic wastewater discharges from the dredge vessel will contribute nutrients, suspended matter, and chlorine into the receiving water. Wastewater consists of sewage and gray water generated from shipboard sinks, showers, laundries, and galleys. USEPA and USCG regulations require that sanitary waste be treated prior to discharge and prohibit the disposal of trash or debris into the marine environment. The discharge of food waste is prohibited within 12 nm (22 km) from the nearest land. Other discharges include drainage from the deck surface that may hold small quantities of oil or grease and uncontaminated seawater from cooling, both of which are benign.

The relatively infrequent trips by the support vessels to the dredging vessel may also contribute discharges into waters crossed in transit and at the dredge site. During a trip (trip duration was estimated at four days for a round trip twice a month), a crew (crew size estimated at 30 for a service vessel) would contribute an estimated total discharge of 237,600 gallons of combined domestic and sanitary wastes over 16.5 months of continuous dredging operation. Overboard discharges permitted by regulation occur over time and space that diminishes potential impacts and renders them benign.

4.2.5 Noise

No-Action Alternative - East Timbalier and West Belle Headland

Direct/Indirect

The No-action Alternative would not have any direct impacts, or contribute to any indirect effects, on noise. Existing conditions would persist.

Preferred Alternative - East Timbalier and West Belle Headland

Direct/Indirect

Pump, transport, deposition, and ship/machinery noise would be present during operations at East Timbalier and West Belle Headland and pump-out areas. Noise associated with the Fill Template would result from barge transport, and unloading and transfer operations. These

operations would involve a variety of equipment including a dredge vessel, barges, bucket cranes, and bulldozers. Sand would be transported to onshore construction sites. Bulldozers and graders would be used for beach and dune construction. The dredging would take place over 520 days.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area

Direct/Indirect

Dredging noise can result in the localized, minor, and short-term effect of displacing bird populations. Dredging noise can affect marine mammals, sea turtles, and fishery organisms. Possible effects vary depending on a variety of internal and external factors, and can be divided into masking (obscuring of sounds of interest by interfering sounds, generally at similar frequencies), response, and discomfort, hearing loss and injury (Thomsen et al. 2009). Direct effects would be discomfort, hearing loss, and injury. Deeper water operations can propagate sound over greater distances than activities in confined nearshore areas (Hildebrandt 2004).

Noise associated with dredging is predominately low frequency (below 1 kHz); estimated source sound pressure levels range between 168 and 186 dB re one upa at 1 m. The noise is generally continuous. The limited available data indicates that dredging is not as noisy as seismic surveys, pile driving, and sonar; but it is louder than most shipping, operating, offshore wind turbines, and drilling. Studies to date have been limited, undertaken on a few dredges and at a limited number of sites. Dredging to create new waterways or channels or to extract marine aggregates produces broadband and continuous sound, mainly at lower frequencies (Thomsen et al. 2009).

Noise associated with dredging activities can be placed in five categories (Thomsen et al. 2009). Collection noise arises from the collection of material from the sea floor and is dependent on the structure of the sea floor and the type of dredge used. Pump noise arises from the pump driving the suction through the pipe. Transport noise arises from the material being lifted from the sea floor to the dredge. This is the noise of the material as it passes up the suction pipe for trailing suction hopper dredges and cutter suction dredges. Deposition noise is associated with the placement of the material in the barge or hopper. Ship/machinery noise is associated with the dredging ship itself. For stationary dredges, the primary source will be the onboard machinery; most of this energy will appear in discrete spectral lines. Mobile dredges will also have propeller and thruster noise. The proposed Project would create collection, transport, and ship/machinery noise at Ship Shoal and possibly cause masking (obscuring of sounds of interest by interfering sounds, generally at similar frequencies), response, and discomfort, hearing loss and injury in wildlife (Thomsen et al. 2009).

4.2.6 Water Resources

Neither East Timbalier Island, West Belle Headland nor the two (2) borrow areas provide water resources. The former because it is remote and the groundwater beneath it is salty; the latter because they are submerged in the Gulf of Mexico.

4.2.7 Climate

Neither the No-Action Alternative nor the Preferred Alternative would impact the local climate at East Timbalier Island, West Belle Headland or the two (2) borrow areas.

4.3 Bio-Physical Environment

4.3.1 Vegetation Resources

No-Action Alternative - East Timbalier and West Belle Headland:

Direct

The No-action Alternative would not have any direct effect on vegetation resources on the East Timbalier and West Belle Headland.

Indirect

Existing conditions, including habitat degradation and loss, would persist. Without implementation of the proposed Project, vegetation resources, including beach, dune, barrier grassland, salt marsh, mangrove, intertidal mud flats, would be expected to decrease in the Project area.

Indirect impacts would include a decline in wetland vegetation as well as net primary productivity within the Project area. The ongoing conversion of existing fragmented emergent wetlands to shallow open water would continue with associated indirect impacts on coastal vegetation, fish and wildlife resources, EFH, recreation, aesthetic, and socioeconomic resources. Other indirect adverse impacts that would result from the loss of important and essential vegetated habitats used by fish and wildlife are the loss of shelter, nesting, feeding, roosting, cover, nursery, and other life requirements for fish and wildlife; loss of productivity; loss of transitional habitat between estuarine and marine environments; and increased inter- and intraspecific competition between resident and migratory fish and wildlife species for decreasing wetland resources. This would also reduce the availability of important stopover habitats used by migrating Neotropical birds.

No-Action Alternative - Ship Shoal / South Pelto Borrow Area

Direct/Indirect

There are no submerged aquatic vegetation resources on Ship Shoal.

Preferred Alternative - East Timbalier and West Belle Headland

Direct

The direct effects of implementing the Project would create approximately 1,335 acres of beach, dune and intertidal marsh habitat. The newly created dune and marsh platforms will be planted with native vegetation, providing for essential vegetated habitats used by wildlife for

shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; increased vegetation growth and productivity; and reduced inter- and intra-specific species competition between resident and non-resident fish and wildlife species for limited coastal vegetation. The Project would restore and rehabilitate dune, supratidal and intertidal vegetated coastal barrier habitats; reduce conversion of these habitats to open water habitat; and provide nursery habitat for several species, including brown and white shrimp, and blue crab.

Indirect

An indirect impact is the minor benefit that restoration of East Timbalier Island and the West Belle Headland would provide through its more robust marine-estuarine geomorphologic boundary contributing to protecting the interior vegetated resource areas north of the Project area.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area

Direct/Indirect

There are no submerged aquatic vegetation resources on Ship Shoal.

4.3.2 Aquatic Resources - Benthic

No-Action Alternative - East Timbalier and West Belle Headland

Direct/Indirect

The no-action alternative would have no immediate impact on benthic resources. Eventual loss of East Timbalier Island and the West Belle Headland and their wetland habitats would reduce and ultimately eliminate the ecological benefits it provided to the estuarine faunal community, which includes available nutrients and detritus. The same holds true for the adjacent wetlands to the north of the islands which will also eventually suffer a reduction in the ecological benefits they provide to the resources of Terrebonne Basin. This loss of the barrier habitats and estuarine habitats could lead to the conversion of primarily estuarine-dependent benthic species assemblages to more marine-dominated (in the case of the barrier island) and open water benthic species assemblages.

No-Action Alternative - Ship Shoal / South Pelto Borrow Area

Direct/Indirect

The no-action alternative would not have direct impacts on benthic resources. Existing conditions would persist.

Preferred Alternative - East Timbalier and West Belle Headland

Direct

Sediment placement temporarily affects the benthic fauna in intertidal systems by covering them with a layer of sediment. Some benthic species can burrow through a thin layer (from 15 to 35 inches for different species) of additional sediment since they are adapted to the turbulent environment of the intertidal zone; however, thicker layers (greater than 40 inches) of sediment are likely to smother the benthic fauna (Greene 2002). After beach renourishment or sediment placement, benthic fauna can take anywhere from six months to two years to recover (Rakocinski et al. 1996; Peterson et al. 2000, 2006). Such delayed recovery of benthic prey species temporarily affects the quality of piping plover foraging habitat. Additional impacts can result from laying sand transport pipeline from pump-out areas to the Fill Template. As described in Section 4.2.2, placement of borrow area sediment could destroy any slow-moving or sessile benthic organisms within the Fill Template. These effects would be minor and short term; these benthic resources would reestablish from adjacent undisturbed areas.

As the vegetation in the marshes expands in the Project areas, on the East Timbalier Island and the West Belle Headland, and continues to grow it produces more leaf litter, which in turn produces more detritus, which is a major energy source for both planktonic and benthic communities of the estuarine and nearshore habitats.

Indirect

The proposed Project would include the deposition of dredged material and could create physical disturbances and indirect impacts such as those described below for Ship Shoal.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area

Direct

The primary impact-producing factor affecting benthic resources would be from mechanical disturbance of the sea bottom. Direct impacts would be mid-term; it would take two to three years for the dredged area to recover to existing conditions. Physical disturbances at Ship Shoal include disruption of the sea bottom by sand removal, suspension of fine-grained sediment at the bottom and in a surface dredge plume, and dispersion and persistence of turbidity.

Removal of sand resources can expose underlying sediment and change the sediment structure and composition of a borrow area, consequently altering its suitability for burrowing, feeding, or larval settlement for some benthic organisms. Decreases in mean grain size, and in some cases, increases in silt and clay in borrow sites can follow dredging (NRC, 1995). Changes in sediment composition could potentially prevent recovery to an assemblage similar to that which occurred in the borrow area prior to dredging and could affect the nature and abundance of food organisms for commercial and recreational fishery stocks (Coastline Surveys Limited 1998; Newell et al. 1998). Thickness of the sand resource varies from zero on the edges to more than 5 m (16 ft) on the shoal crest (Kulp et al. 2001). Portions of the borrow areas dredged to depths greater than 4 m may expose underlying sediment of a different character with a greater quantity of silt and clay.

The influence of sediment composition on benthic community composition has long been recognized (Peterson 1913; Thorson 1957; and Sanders 1958). However, more recent studies suggest that precise relationships between benthic assemblages and specific sediment characteristics are poorly understood (Snelgrove and Butman 1994; Newell et al. 1998). Sediment grain size, chemistry, and organic content can influence recolonization of benthic organisms (McNulty et al. 1962; Snelgrove and Butman 1994), although the effects of sediment composition on recolonization patterns of various species are not always significant (Zajac and Whitlatch 1982). The composition of benthic assemblages are likely controlled by a wide array of physical, chemical, and biological variables that interact in complex ways that vary with time.

Ship Shoal is about 3 m (9 ft) deep in the shallowest areas and is surrounded by deeper waters and may serve as a fish refuge from hypoxic conditions. Dredge activities could slightly reduce the value of Ship Shoal as a refuge for benthic fauna from hypoxia. Reduction of shoal elevation or creation of depressions could increase the possibility of hypoxic conditions at dredged sites. Dredged areas will be relatively small compared to the surface area of the entire shoal; furthermore, the duration of stagnant or poorly oxygenated water in dredged depressions or swales on the shoal would be temporary.

Removal of sediment from borrow areas can alter seabed topography, creating pits, trenches, or craters that may refill rapidly or remain persistent to cause detrimental impacts for extended periods. Borrow areas can remain well defined 8 years after dredging (Marsh and Turbeville 1981; Turbeville and Marsh 1982). In general, shallow dredging over large areas causes less harm than small but deep pits, particularly pits opening into sediment layers of different characteristics (Thompson 1973; Applied Biology Inc. 1979).

Deep pits, greater than 3 m (10 ft), can harm bottom communities (Thompson 1973). Deep borrow can reduce bottom current velocities, resulting in deposition of fine particulate matter; this can change the biological assemblage. The reduced bottom circulation in deep dredge pits can decrease dissolved oxygen to hypoxic or anoxic levels and increase hydrogen sulfide levels (Murawski 1969; Saloman 1974; NRC 1995). Summer hypoxic zones in the Ship Shoal area can worsen this potential problem. Bottom areas projected to be disturbed in the proposed borrow area are on the order of hundreds of acres, and dredge areas are expected to be broad enough to allow current flow to follow bottom contours and prevent hypoxic water from being trapped in a borrow site.

Dredging causes suspension of silt and clay in bottom sediment at the draghead and forms a dredge plume on the surface when the excess water is decanted from the dredge vessel. This fine-grained sediment increases turbidity at the bottom and in the water column while it disperses and drifts with the current. The extent of suspension/dispersion depends primarily on sediment composition, currents and sediment transport processes, the type of dredging equipment and operating techniques, amount of dredging, and thickness of the dredge cut. Suspended sediment concentrations in near bottom waters can be elevated up to several hundred meters laterally from the draghead (LaSalle et al. 1991). A dredge plume affecting the surface and water column is estimated to be 5 to 10 ac in size, depending on currents and

local circumstances. A turbidity plume could cover twice as much bottom area or more in poorly circulated bottom waters.

Increased turbidity interferes with the food gathering process of filter feeders and organisms that feed by sight while inundated with nonnutritive particles. Bottom sediment put into suspension decreases light penetration and changes the proportion of wavelengths of light reaching the bottom, leading to decreases in photosynthetic activity. Suspension and dispersion of sediment may cause changes in sediment and water chemistry, as nutrients and other substances are released from the substrate and dissolved during the dredging process.

Sediment on the crest areas of Ship Shoal and in the proposed borrow area is composed of homogenous, clean sand (Kulp et al. 2001). Release of nutrients would be of little concern. The turbidity plume from dredging in this sandy substrate is expected to be relatively low. Dispersion should be localized with significant sedimentation only in the immediate vicinity of the borrow area. The area normally experiences very high turbidity levels due to the proximity of the Atchafalaya and Mississippi Rivers and their normally turbid discharge, and deposition from dredging activity would likely be similar to conditions normally experienced by the benthos. Impacts should be evaluated in terms of average background conditions as well as occasional high-level disturbances associated with storms, floods, hypoxia, or trawling (Herbich 1992). Physical disturbance of the bottom and resulting biological impacts from dredging are similar to effects caused by storms, but at a much smaller spatial scale.

In benthic areas that undergo frequent perturbations, benthic invertebrates tend to be small bodied, short-lived, highly fecund, and adapted for maximum rates of population increase. They also tend to have efficient dispersal mechanisms, dense settlement patterns, and rapid growth rates (MacArthur 1960; MacArthur and Wilson 1967; Odum 1969; Pianka 1970; Grassle and Grassle 1974). The rate of recolonization depends on numerous physical and biological factors. Physical factors include the time of year, depth of borrow cuts, water currents, sediment composition, bedload transport, temperature and salinity, natural energy levels in the area, and frequency of disturbance.

Borrow areas can be recolonized by transport of larvae from neighboring populations by currents and subsequent growth to adults, immigration of motile species from adjacent areas, organisms in bypassed areas or that slump from the sides of borrow pits, or return of undamaged organisms from the dredge plume. The rate of recolonization depends on the size of the pool of available colonists (Bonsdorff 1983; Hall 1994). Other biological factors such as competition and predation determine the rate of recolonization and the composition of resulting benthic communities. Many benthic species have distinct peak periods of reproduction and recruitment. Because larval recruitment and adult migration are the primary recolonization mechanisms, biological recovery from physical impacts generally should be most rapid if dredging is completed before seasonal increases in larval abundance and adult activity (Herbich 1992). Recovery of a community disturbed after peak recruitment will be slower than one disturbed prior to peak recruitment (LaSalle et al. 1991). Seasonality and recruitment patterns indicate that removal of sand between late fall and early spring would stress benthic populations less.

The general pattern of succession of marine benthic species following cessation of dredging or other environmental disturbance begins with initial recolonization. Initial recolonization occurs relatively rapidly by small opportunistic species that reach peak population densities within months of the availability of a new habitat after catastrophic mortality of the previous assemblage. The population density of the initial colonizers declines as adult species migrate into the disturbed area from adjacent undisturbed areas. This transitional period and assemblage with higher species diversity and a wide range of functional types may last for years, depending on numerous environmental factors. If environmental conditions remain stable, some members of the transitional assemblage would be eliminated by competition, and the species assemblage would form a recovered community of larger, long-lived, and slow-growing species with complex biological interactions with one another.

Benthic recolonization and succession have been reviewed for a wide variety of habitats throughout the world (Thistle 1981; Thayer 1983; Hall 1994; Coastline Surveys Limited 1998; Newell et al. 1998). Recolonization is highly variable, ranging from months (Saloman et al. 1982) to more than 12 years (Wright 1977), depending on the habitat type and other physical and biological factors. In general, recovery times from dredging of six to eight months are characteristic for many estuarine muds, two to three years for sand and gravel, and five to ten years as the deposits become coarser (Coastline Surveys Limited 1998; Newell et al. 1998).

Recovery of dredged areas can occur in one year (total taxa, total number of individuals, species diversity, evenness, and richness). These parameters, however, do not necessarily reflect the complex changes in community structure and composition that occur during the recovery process. Major changes in species assemblages and community composition usually occur shortly after dredging, resulting in a different type of community. Although the number of individuals, species, and biomass of benthic infauna may approach pre-dredging levels within one to three years after dredging in fine-grained sand, recovery of community composition and trophic structure may take longer.

When long-term changes in sediment structure and composition occur from dredging, long-term differences in the composition of benthic assemblages inhabiting those sites may occur as well. The recovery time for benthic assemblages after dredging depends largely on the degree and duration of the sediment alteration (Van Dolah 1996). Recolonization success and recovery are also controlled by compaction and stabilization processes involving complex interactions between particle size, water currents, waves, and biological activities of the benthos following sediment deposition (Oakwood Environmental Ltd. 1999). Although the abundance and diversity of infaunal assemblages in dredged areas can recover relatively rapidly, it can take years to recover in terms of sediment composition of the original substrate and the original species composition of the benthic community. Perturbations to infaunal communities in dredged areas are generally considered negligible because burrowing organisms recolonize rapidly (Wilber and Stern 1992). This conclusion is often based on densities, species diversity/evenness indices, relative distribution of classes or phyla, and species-level dendrograms. For example, borrow and reference area infaunal communities can differ considerably at the species level, although these differences are usually considered insignificant because species diversity is high. Reliance on these studies may lead to a premature conclusion that impacts to dredged area infauna are minimal because these

measures are relatively superficial and because the characteristics of infaunal communities are ambiguous. Infaunal communities that recolonize dredged areas can remain in an early successional stage for two to three years or longer as opposed to being completely recovered in shorter timeframes (Wilber and Stern 1992) The borrow area is bordered by oil and gas pipelines that will restrict dredging activity in buffer areas around pipelines. Tracts of undisturbed sand would be bypassed in areas set back from pipelines. These undisturbed areas of seed sand harbor native organisms that would furnish larvae for recolonization and/or may immigrate to the unpopulated dredged sites. Adjacent areas of seabed outside the borrow area have very similar grain-size characteristics and would provide a source of larvae and juveniles for initial benthic infauna recolonizers and transitional assemblages that follow.

Indirect

Dredging would have some indirect effects in nearby areas; these effects would be short-term and minor. Far-field impacts from suspension and deposition of sediment can be detrimental or beneficial. Deposition of sediment can smother and bury benthic fauna, although some organisms are able to migrate vertically to the new surface (Maurer et al. 1986). Dredging effects can extend to nearby areas (McCaully et al. 1977; Johnson and Nelson 1985). Conversely, biodiversity of benthos can increase downstream of the dredge site (C-CORE 1995). In some areas, population density and species composition of benthic invertebrates increased rapidly outside dredging sites; the level of enhancement decreased with increasing distance from the dredged area up to a distance of 1.2 mi (2 km) (Stephenson et al. 1978; Jones and Candy 1981; Poiner and Kennedy 1984). The enhancement was attributed to the release of organic nutrients from the dredge plume (Ingle 1952; Biggs 1968; Sherk 1972; Oviatt et al. 1982; Coastline Surveys Limited 1998; Newell et al. 1998).

4.3.3 Aquatic Resources – Plankton

No-Action Alternative - East Timbalier and West Belle Headland

Direct/Indirect

Not implementing the restoration Project would have no immediate impact on planktonic resources. Eventual loss of the Island and Headland and their wetland habitat would reduce and ultimately eliminate the ecological benefits they provide to the estuarine faunal community, which includes organic detritus and dissolved organic compounds that are nutrient sources for both estuarine and oceanic phyto- and zooplankton. The same holds true for the adjacent wetlands to the north, which will also eventually suffer a reduction in the ecological benefits they provide to the resources of the Terrebonne Basin. This loss of the barrier habitats and estuarine habitats could lead to the conversion of primarily estuarine-dependent plankton species assemblages to more marine-dominant and open water plankton species assemblages. This conversion may alter the predator-prey balance by changing the makeup of the community of planktivorous fishes in coastal waters.

Preferred Alternative - East Timbalier and West Belle Headland

Direct

Localized and short-term adverse impacts could occur, including mortality of some plankton populations due to construction activities associated with placement of borrow. During construction, there would be a localized and short-term decrease in available dissolved oxygen and an increase in turbidity, temperature, and biological oxygen demand. Following construction and dredging operations, the area would return to ambient conditions and be recolonized by plankton populations.

Indirect

Existing shallow open water and fragmented barrier habitats would be converted to beach, dune, supratidal, and intertidal habitats. Protection, creation, and nourishment of transitional barrier habitats would enhance and increase, to some undetermined level, aquatic productivity and nutrient transformation functions.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area:

Direct/Indirect

Dredging would cause localized and short-term adverse impacts, including mortality of some plankton populations. As with placement of borrow, available dissolved oxygen would temporarily decrease and turbidity, temperature and biological oxygen demand would temporarily increase.

4.3.4 Wildlife Resources – Amphibians, Reptiles, Terrestrial Mammals, and Invasive Wildlife Species

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow Area

Direct/Indirect

The No-action Alternative would not have any direct or indirect impacts on amphibians, reptiles, terrestrial mammals, and invasive wildlife species. Existing conditions would persist. Continued erosion of East Timbalier and West Belle Headland would decrease available habitat. The continued loss of barrier and wetland habitats would likely become a general limiting factor for amphibians and reptiles, terrestrial mammals, and invasive wildlife that utilize the Project area. This would likely result in increased inter- and intra-specific competition for decreasing barrier and wetland habitats and associated resources.

Preferred Alternative - East Timbalier and West Belle Headland:

Direct

Generally, there are low populations of amphibians, reptiles, terrestrial mammals, and invasive species in the entire Project area. No direct impacts would be expected for these populations.

Indirect

The preservation of barrier and wetland habitats would likely improve the habitat for amphibians and reptiles, terrestrial mammals, and invasive wildlife that may utilize the Project area.

4.3.5 Wildlife Resources – Marine Mammals

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow Area

Direct/Indirect

The No-action Alternative would not have any effects on marine mammals. Existing conditions would persist.

Preferred Alternative - East Timbalier and West Belle Headland

Direct

One of the primary impact-producing factors affecting marine mammals is collision by vessels. Collisions between a marine mammal and a service or dredge vessel can be lethal or result in crippling injuries. Marine mammals are unlikely to be physically injured by dredging because they generally do not rest on the bottom and most can avoid contact with dredge or service vessels. Blue, fin, or sei whales would not be adversely affected by hopper dredging operations because these are deepwater species unlikely to be found near hopper dredging sites. There has never been a report of a whale taken by a hopper dredge.

The marine mammals most likely to be found in the nearshore waters off Louisiana, such as bottlenose dolphins and Atlantic Spotted dolphin, are agile swimmers and are presumed capable of avoiding physically injury during dredging. The Florida manatee is extralimital in Louisiana coastal waters. Sightings off the Louisiana coast or strandings on Louisiana shorelines are rare. The manatee is not expected to be impacted by dredging operations. Sand mining poses no foreseeable threat to migratory and highly mobile marine mammals (Virginia Institute of Marine Science 2000).

Indirect

Dredging can indirectly affect marine mammals due to noise and turbidity plumes. Some concerns about the effects of dredging noise on marine mammals include animals avoiding intense sounds, some mammals could be attracted to sounds, mammals could change their behavior in response to sound, and habituation can occur where the response of mammals wanes when exposed repeatedly to sounds (Ocean Studies Board 2005). Proper maintenance of dredge equipment could help reduce effects of noise (Byrnes 2004). Suspended sediment generated by the dredging could temporarily interfere with marine mammal feeding or other activities; however, marine mammals could leave the area and turbidity is unlikely to have a significant effect.

Visual and acoustic disturbance from construction could result in the temporary modification in the behavior of bottlenose dolphins. Although dolphins and other marine mammals could temporarily vacate the area, dredging is expected to have a negligible impact on the animals. No take by injury and/or death or incidental harassment of dolphins is anticipated. Impacts would be short-term and temporary and should have no lasting effects on marine mammal populations in the area.

4.3.6 Avian Communities

No-Action Alternative - East Timbalier/West Belle Headland

Direct

The No-Action Alternative would not have any effect on coastal, marine, and colonial nesting birds on East Timbalier or West Belle Headland. Deteriorating existing conditions would persist.

Indirect

Without implementation of proposed coastal barrier system restoration, the fragmentation and loss of the barrier systems and back-barrier marsh would continue to adversely impact foraging, nesting, wintering, resting, refugia, and other important habitats for all resident and migratory birds. The eventual disappearance of East Timbalier Island would eliminate it as habitat for most avian fauna, with the exception of wading birds, since emergent marsh may persist briefly without the protection afforded by any adjacent upland.

No-Action Alternative - Ship Shoal / South Pelto Borrow Area:

Direct/Indirect

The No-Action Alternative would not have any effect on coastal, marine, and colonial nesting birds over Ship Shoal.

Preferred Alternative - East Timbalier and West Belle Headland

Direct

Implementing the restoration for East Timbalier and West Belle Headland would create approximately 906 acres of sandy beach and dune and approximately 429 acres of marsh. The beach/dune restoration template requires covering approximately 229 acres of existing beach. The marsh creation template requires covering 60 acres of back-barrier beach and 964 acres of unvegetated intertidal and subtidal water bottoms. A migratory bird abatement program, developed cooperatively by the CPRA and USFWS, will be established to avoid or minimize impacts to the avifauna that uses East Timbalier Island and West Belle Headland. This effort will be in place prior to start of any construction activity on the Island and it will be in effect throughout construction. The construction activities and associated noise will result in disturbance to the avifauna that utilizes the Project footprint areas for nesting, roosting, and foraging, until the work is completed. Depending on the pace of construction, some species

may be displaced to the remaining undisturbed marsh, but it is likely that some of the species that inhabit the undisturbed marsh areas will also be displaced to one of the neighboring islands during the construction process. As observed on similar dredging projects, an increase in avian presence by certain species could be expected during the discharge of the slurry. After Project completion, as the vegetation efforts take root, the new shoreline adjusts to the natural wave and tide regime, and their infaunal assemblages are reestablished, the avifauna will gradually become reestablished and its population numbers will increase because of the increase in available habitat. Reestablishing the forage base of beach, intertidal, and subtidal invertebrates that support many of the shorebirds may take several years. Reestablishing the population of forage fishes associated with the beach and marsh environment is often dependent on reduction in nearshore turbidity and associated increases in zooplankton population.

Indirect

There could be a temporary loss of prey items and foraging habitat for some bird species in the subtidal zone, however effects would be short-term and localized. Additional Project factors that could affect coastal and marine birds include air emissions; water quality degradation from the dredge plume at the dredging site and slurry discharge at the beach nourishment site; dredge or vessel noise; light attraction; and discarded trash and debris from dredge or service vessels.

Emissions of pollutants into the atmosphere from dredge and service vessel activities are expected to have minimal effects on air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Emissions from dredging and pump-out operations and bulldozers and other equipment onshore are below the exemption criteria. Therefore, no impacts on birds on or behind the shoreline from emissions related to the proposed action are expected.

Seabirds (e.g., laughing gulls) could be attracted by lights on the dredge vessel or to the vessel itself. Coastal and marine birds can ingest or become entangled in discarded trash and debris; such interactions can lead to serious injury and death. The USCG prohibits the disposal of trash and debris into the marine environment. The BSEE prohibits disposal of OCS equipment, containers, and other material into offshore waters by lessees (30 CFR 250.300). MARPOL (Annex V, Public Law 100-220; 101 Statute 1458; effective January 1989) prohibits the disposal of any plastics at sea or in coastal waters.

Preferred Alternative - Ship Shoal / South Pelto Borrow Area

Direct/Indirect

The Future With-Project Alternative would not have any effect on coastal, marine, and colonial nesting birds over Ship Shoal.

4.4 Critical Biological Resources

4.4.1 Essential Fish Habitat

No-Action Alternative - East Timbalier and West Belle Headland

Barrier islands directly provide essential habitat for many fish species, and East Timbalier Island in particular has been documented to rank among the highest in total nekton species numbers from those reported from other Gulf of Mexico barrier islands (Williams, 1998). The indirect benefits of barrier islands are equally important because they: 1) provide a buffer to estuaries and attendant wetlands by attenuating energy of ocean waves (List et al., 1994; Walmsley et al., 2009); 2) constrict tidal flow at inlets facilitating estuarine circulation and attenuating tidal prism that influences estuarine gradients and marsh flooding hydroperiod (List and Hansen, 1992; and 3) attenuate storm surge levels for the mainland (Stone et al., 2005). The tidal inlets that exist because of the barrier islands play an important role in the life cycle of many estuarine dependent species (e.g., O'Connell et al, 2005; Christmas et al., 1982).

In coastal Louisiana, rapid subsidence, reduced sediment supply, and frequent storm events are causing disintegration of barrier islands and headlands. Over time, they are unable to maintain subaerial exposure and become submerged sand shoals (Penland et al., 1988). Once barriers become submerged, they no longer function to regulate estuarine conditions (physical, chemical, and biological). An example is the East Timbalier Shoal, which separated from the main island in the late 1990's and is now a submerged sand body slowly migrating landward. As barriers deteriorate, break-up and become submerged, substantial changes occur in the durations of salinity levels and hydroperiod along the estuarine gradient. Modeling illustrates that negative impacts are substantial under the absence of the barrier system (Reyes et al, 2005).

Grzegorzewski et al. (2011) employed numerical models to demonstrate and quantify the significant storm damage risk reduction benefits of the geomorphic form and function of restored barrier islands and associated tidal inlets in Louisiana. Functional restoration of barrier islands is defined as an engineering and ecological design such that a barrier island can perform as a wave attenuator, storm surge buffer, and ocean boundary for an estuary, bay and mainland over the designed lifetime (Rosati, 2009).

Not implementing the TE-118 restoration Project would result in EFH impacts as the gradual disappearance of East Timbalier Island and the West Belle Headland would reduce the productivity of its marshes and the service they provide as shelter and forage areas for numerous species of estuary-dependent fishes. The same holds true for those species that forage in the shallow foreshore, back shore, and adjacent passes. The ultimate value of East Timbalier Island and the West Belle Headland would be reduced to the background value of open water, which is not in short supply. The adjacent wetlands that are presently protected by East Timbalier Island and the West Belle Headland would lose their protection, and their shoreline would degrade in similar fashion, thus magnifying the impact on the ecology of the Terrebonne Basin.

Preferred Alternative – East Timbalier and West Belle Headland

In the long term, construction of the proposed Project features on East Timbalier Island and the West Belle Headland would improve marine/estuarine-related EFH by re-establishing marsh and protecting marsh habitat from erosion as well as re-establishing barrier island surf zone, tidal inlet, and lagoon habitats. Results of numerical modeling of Project alternatives indicate that the Project would restore habitat critical to the geomorphic and ecological form and function of the barrier islands (Stantec, 2017).

The table below presents the land area summary modeling results for East Timbalier and West Belle Headland for with and without Project conditions. It should be noted that the model results presented are based on acreages within the model domain and vary from the final calculated acres restored by the Project presented in the Project Description. Overall, modelling results show that after 20 years, there would be 68.9 percent of total land area remaining. All individual areas performed equally well, approximately 69 percent remained on East Timbalier Island and 69 percent remained on West Belle Headland.

Table 4-4**.** Land Area Summary (Stantec and CEC, 2017)

Year	East Timbalier Island acres at MHW (MHW = Mean High Water)		West Belle Headland acres at MHW (MHW = Mean High Water)		Total acres	
	Without Project	With Project	Without Project	With Project	Without Project	With Project
0	105.7	472.2	555.1	932.6	660.8	1,404.8
5	31.3	408.6	343.6	678.5	374.9	1,087.1
10	24.5	351.2	377.8	696.5	402.3	1,047.7
15	35.0	341.4	392.6	697.6	427.6	1,039.0
20	5.5	325.3	343.1	642.3	348.6	967.6
Percent Acres Remaining after 20 Years						
20	5.2%	68.9%	61.8%	68.9%	52.7%	68.9%

Construction of the Project features would result in localized, adverse, direct, short-term minor impacts to EFH. Short-term increases in turbidity may temporarily reduce quality in the emplacement areas. Approximately 10 acres of marsh at East Timbalier Island and 155.5 acres of marsh at West Belle Headland would be covered by fill and turbidity would increase. However, post-construction, increases in the quality and quantity of intertidal marsh would offset these impacts. Compared with pre-construction acreage, a net increase of 425 acres of intertidal habitat would be created at TY 1 and 413 acres of intertidal habitat would remain at TY 20. When comparing the with Project acreages against the without Project acreage at TY 20, approximately 619 more acres of habitat will remain (including intertidal, supratidal and dune habitat). Following construction, turbidity would return to ambient conditions. Short-term, unavoidable, adverse impacts to habitats supportive of various life stages of brown shrimp, white shrimp, and juvenile cobia, lane snapper, and bonnethead shark would occur during the construction phase of the proposed Project as beach, dune, and marsh habitat are created.

The proposed Project would have long-term, moderate, direct and indirect beneficial impacts to EFH for the immediate Project area through protection, restoration and creation of marsh. The proposed Project features would provide long-term benefits, such as enhanced habitat, surf zone stability, increased food and shelter resources, improved water quality, and greater access to interior island locations during storm or high-water events.

Marsh, inner marsh, and marsh edge habitat would increase with the vegetative plantings. Detrital material, formed by the decomposition of emergent vegetation, would contribute to the aquatic food web of East Timbalier Island and near-shore Gulf of Mexico ecosystems. Decreases in erosion rates and tidal scour also would protect estuarine mud bottoms and marsh ponds. A continuous shoreline and introduction of new sand to the sand-starved system will help to reduce tidal prism locally as spits will build away from the fill area into inlets. Thus, construction of the proposed Project would greatly benefit brown shrimp, white shrimp, and red drum. King mackerel, cobia, bonnethead shark, and lane snapper also likely would benefit since these species depend on various types of estuarine features during their life cycles and on prey species that rear in the marsh.

Preferred Alternative – Ship Shoal and South Pelto Borrow Areas (Offshore):

The primary impact-producing factor affecting EFH for the proposed OCS borrow areas on Ship Shoal would be temporary impacts from mechanical disturbance of the sea bottom locally at the borrow areas. Short-term adverse minor impacts to EFH could result from dredging the proposed borrow areas. Impacts on the shrimp fishery are expected to be negligible because brown and white shrimp prefer mud bottoms (Defenbaugh, 1976; Williams, 1965). Turbidity of the water column would increase during dredging, affecting pelagic and shallow EFH of brown shrimp, white shrimp, red drum, king mackerel, cobia, bonnethead shark, and lane snapper however, turbidity at Ship Shoal is minimized due to the high sand content. Turbidity would be expected to return to ambient conditions once dredging is complete (DOI MMS, 2004).

While the OCS borrow areas on Ship Shoal are identified as EFH for adult brown and white shrimp, investigations of the potential long-term impacts of mining on Ship Shoal on shrimp populations concluded that given that small quantities of shrimp were collected during multiple sampling events that “direct mortality to these nekton resulting from sand mining is likely to be minimal” (Stone et al., 2009). Further, this study found little evidence that spotted seatrout whose diet includes white and brown shrimp, were in abundance on the surface of Ship, Trinity, or Tiger Shoals (Stone et al., 2009).

Similar to other sandy substrates in the north-central Gulf of Mexico, Blue Crab spawning, reproducing, and foraging on the shoal from April through October has been documented at Ship Shoal (Stone et al., 2009). Female crabs apparently go through a continuous cycle of reproduction, producing a new egg mass (sponge) approximately every twenty-one (21) days. Fecundity appears to be correlated with infaunal prey density, which declines somewhat over the course of the crab reproductive season (Stone et al., 2009). While blue crabs are a significant inshore fishery resource in Louisiana, there is no fishery for them on Ship Shoal. As stated below, less than 1 percent of the area of Ship Shoal would potentially be mined through this proposed Project and when combined with previous and currently proposed Projects, approximately 2 percent of the area of Ship Shoal would be impacted cumulatively. However,

it is important to note that these impacts from each dredging event are temporary due to high rates of sand transport associated with substantial current velocities over the shoal that facilitate rapid recovery of the borrow area (Nairn et al., 2004; 2005).

Noise levels during dredging operation typically do not exceed NOAA Fisheries Level A Criterion (180 dB re 1µPa rms) for injury/mortality to marine mammals during any aspect of the dredging operations and noise generally decreases to 120 dB within 1.2 km from the source (Reine, 2014). A limited number of studies have indicated that dredge noise occurs in the low frequency range (< 1200 Hz), which is within the audible range of many species of fish. Exposure to underwater sound may potentially affect communication, foraging, predator evasion, and navigation of marine organisms, which to various degrees rely on sound to communicate and to derive information about their environment. Sound generated by hopper dredging is continuous rather than punctuated and is primarily within the low frequency range. With regard to fish, it has been hypothesized that dredging-induced sound could block or delay the migration of anadromous fishes, interrupt or impair communication, or impact foraging behavior. The majority of fish species detect sounds from below 50 Hz up to 1500 Hz.

Potential short-term impacts to EFH include movement of prey species away from the construction area, interruption of feeding or spawning by some species, and other effects on behavioral patterns. Because tens of thousands of acres (see Table 4-5) located on Ship Shoal of similar substrate to the proposed borrow areas are available to organisms outside of the areas to be dredged, impacts are expected to be negligible and temporary. It should also be noted that significant areas of similar habitat exist on Tiger and Trinity Shoals, Sabine Bank and along subaqueous portions of the Chandeleur Islands/Shoals chain in coastal Louisiana.

Table 4-5. Ship Shoal Borrow Usage

Project	Area (Acres)	Volume (Cubic Yards)
Ship Shoal	101,091 (BOEM, 2012)	1,200,000,000 (Kulp et al, 2001 and Penland et al, 1991)
BA-45 Caminada Headland Restoration Increment 1	182.8 (CEC, 2012)	3,650,000 (CEC,2012)
BA-143 Caminada Headland – Increment 2	280.7 (CEC, 2013a)	5,470,000 (CEC, 2013a)
TE-100 Caillou Lake Headlands Restoration	800.7 (CEC, 2013b)	10,000,000 (CEC, 2013b)
TE-118 East Timbalier Island/West Belle Headland	816.3 (Stantec and CEC, 2017)	13,430,000 (Stantec and CEC, 2017)
Totals	**2,080.5 (2.06% of total)**	**34,550,000 (2.8% of total)**

The OCS Study MMS 2009-024 (Stone et al., 2009) highlights the fact that although there may be large sediment volumes in Ship Shoal, the presence of oil infrastructure and obstructions (pipelines, flow lines, rigs, abandoned pipes, wrecks) may preclude exploration and development of sand in many areas (Stone et al., 2009). Avoidance buffers of 1,000 ft were established during borrow area design around oil and gas infrastructure and other magnetic anomalies occurring in and around the proposed borrow areas to ensure quality of the borrow sediment, to enhance the safety of dredging operations, and to ensure that sediment cover over buried pipelines is not compromised as the seafloor equilibrates post dredging. A 2010 paper from Khalil et al concluded that recent surveys indicate that dredgeable sand in the shoal are restricted to Ship Shoal Blocks 88 and 89, South Pelto Blocks 12 and 13, and western Ship Shoal Blocks 84, 85, 98, and 99 and represent less than 10 percent of the total volume of sand in the Shoal (Khalil et al., 2010). Further investigations would be required to identify sand, potential cultural resources or hazards, and delineate borrow areas in order to have a definitive volume estimate of dredgeable sand. Finally, it is important to acknowledge that Ship Shoal is an active sand body subject to coastal processes which can modify its configuration (Cuomo, 1984).

An evaluation by the BOEM of dredging activities on Ship Shoal noted that mobile fish and invertebrates would be able to swim clear of dredge operations and that only the less mobile species of fish, or those that feed exclusively on nonmobile prey, would be expected to experience affects from dredging (Van Dolah, 1998; DOI MMS, 2004). During the approximately 3-8 years while the excavation persists as a bathymetric depression, the duration of stagnant or poorly oxygenated water in dredged depressions or swales on the shoal would be temporary or non-existent because of water-column mixing above fair-weather wave base. The Project would impact less than 1 percent of the surface area of Ship Shoal and less than 1.5 percent of the total volume of sand resources present on the shoal. Previous projects have dredged sand resources from Ship Shoal and the quantity of sediment removed and area acreage is presented in Table 3 documenting Ship Shoal sediment mined and acreage for the Caminada Headland – Increments 1 and 2 projects, Caillou Lake Headlands Project, and the proposed East Timbalier restoration project. As a result of previously used and proposed use of Ship Shoal sediment, approximately less than 3 percent of the total Ship Shoal volume will be used and approximately 2 percent of the area will be impacted by dredging. Note that these calculations only consider the shoal bathymetric high, and do not account for large areas of sandy seafloor substrate that have been mapped adjacent to the shoal and along its retreat path (Penland et al., 1988). A 2004 Biological Assessment of Ship Shoal to evaluate the potential environmental impacts associated with the removal of sand resources noted that the plethora of structures (pipelines, platforms, wellheads, etc.) precludes the use of a significant portion of Ship Shoal as borrow sites (DOI MMS, 2004)

Ship Shoal's gross transport rate is relatively high and morphological response (i.e., borrow area infilling) should be rapid (Nairn et al., 2005). Based on field surveys and sediment sample analysis it is suggested that an occasional sediment plume shift from the Atchafalaya River/Bay to the southeast may result in accumulation of a thin fluid mud layer on patchy portions of the shoal, with a maximal thickness of approximately 2 – 4 cm (Stone et al., 2009). Furthermore the accumulation of fluid mud may be ephemeral and non-uniform on the shoal given the frequencies of the dispersal shifts (once every 19 days) and more frequent re-

suspension events associate with winter storms (once every 6.0 days). In-situ measurements supported that the deeper eastern flank of the shoal is in favor of fluid mud accumulation (Stone et al., 2009).

Given the relatively shallow borrow area design and high sand transport rates on Ship Shoal (Kulp et al., 2001; Stone et al., 2009; Nairn et al., 2005; Penland et al., 1988; List et al., 1994) it is anticipated that infilling and recovery of the pit should take approximately 3 to 5 years (Nairn et al., 2005). Similarly, Newell et al (1998) estimated the recovery for sandy environments after dredging or mining activities between 2-3 years (Stone et al., 2009). For example, monitoring of an offshore borrow area for the Holly Beach Project CS-30 in Cameron Parish, Louisiana, confirmed that the borrow area which was mined in 2003 had infilled completely by 2016 (Robichaux et al., 2017).

Surveys conducted by BOEM and LSU in July 2017 over the Caminada Headland borrow area on Ship Shoal demonstrated rapid early infilling dominated by sand with small mud drapes in deeper swales. Sufficient biological communities would remain undisturbed to support recolonization and substrate texture would be reestablish rapidly. The borrow areas would be recolonized by migration of adult organisms or by larval and juvenile organisms recruited from adjacent undisturbed sand habitats. Furthermore, impacts to EFH due to the temporary loss of benthic communities is relatively small when considering the harvest levels of many of the commercially important species in the area (Nairn et al., 2007). BOEM and LSU have developed a program that will continue to monitor borrow area physical, chemical (water quality) and biological evolution of borrow areas on Ship Shoal to improve predictive models developed by Nairn et al. (2005; 2007), better understand short term and cumulative impacts to EFH of sand mining at the shoal and elsewhere on the OCS, and potentially enhance or refine mitigations to minimize impacts to EFH.

Another potential impact is the temporary loss of a hypoxia refuge for benthic invertebrate sensitive to low Dissolved Oxygen (DO) concentration. While Ship Shoal is situated in an area prone to hypoxia, the estimates of bottom DO concentrations over the entire shoal were fairly high and constant in spring, summer and autumn. Shallow depths, wave action and biogenic activity all probably contribute to Ship Shoals higher DO concentrations (Stone et al., 2009). As the borrow areas fill back to shallower depths, and only a fraction of the shoal is currently utilized for borrow, the refuge status should remain in undisturbed areas and be restored in areas subject to borrow.

<u>Preferred Alternative – East Timbalier and West Belle Headland Marsh Borrow Areas (Nearshore)</u>

There have not been specific studies of the fish assemblage on the East Timbalier and West Belle Headland Marsh Borrow Areas. Since they are on the inner shelf and under the strong influence of the adjacent Timbalier and Terrebonne Bay estuaries, the conditions should be similar to those described above and in Williams (1998) for the ichtyofauna at East Timbalier Island and the West Belle Headland, with a preponderance of demersal or benthic species (drums, croakers, and flatfishes). The primary impact-producing factor affecting EFH for the proposed East Timbalier and West Belle Headland Marsh Borrow Areas would be temporary impacts from mechanical disturbance of the sea bottom locally at the borrow areas. Short-term

adverse minor impacts to EFH could result from dredging the proposed marsh borrow areas. Turbidity would be expected to return to ambient conditions once dredging is complete (DOI MMS, 2003). EFH for adult brown shrimp, adult white shrimp, adult red drum, and adult lane snapper include either sand or mud substrates located in marine waters; therefore, dredging of the borrow areas could negatively affect these species for a short time locally.

Due to natural sedimentation rates and high rates of shoreface erosion, the East Timbalier and West Belle Headland Marsh Borrow Areas are expected to equilibrate to adjacent seafloor contours in the near-term. The West Belle Headland Marsh Borrow Area had previously been dredged in 2012 for the NMFS TE-52 project (Coastal Wetland Planning, Protection and Restoration Act (CWPPRA)). A monitoring survey of the borrow area conducted in 2013, six months after the as-built survey noted that 104,000 cubic yards of sediment had filled the borrow area after dredging. At an infilling rate of approximately 208,600 cubic yards per year, this borrow area is infilling at a rate of 2.8 ft annually (CB&I, 2015). We are not aware of reports of any negative impacts to EFH resulting from the construction of the NMFS-sponsored TE-52 Project, which dredged borrow areas immediately adjacent to the East Timbalier and West Belle Headland Marsh Borrow Areas proposed for this Project (NMFS, 2010). The Environmental Assessment for the NMFS-sponsored TE-52 Project concluded that the proposed Project was not likely to adversely affect EFH and this opinion was concurred to and documented in correspondence by the National Marine Fisheries Service in a letter from Miles Croom (NMFS Southeast Regional Office) to Cheryl Brodnax (NMFS Restoration Center) dated September 16, 2009 (NMFS, 2010).

4.4.2 Threatened and Endangered Species

Table 4-6. Summary of Threatened and Endangered Species Impacts

	No Action Alternative	Preferred Alternative
Gulf Sturgeon	No impact	Not likely to affect
Sea Turtles	No impact	Potential for incidental takings
Piping Plover and Red Knot	Loss of habitat	Temporary disturbance of habitat
West Indian Manatee	No impact	Not likely to affect
Whales	No impact	Not likely to affect

Gulf Sturgeon

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The No-action Alternative would not have any effects on Gulf sturgeon. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland/ship Shoal Borrow:

Direct/Indirect

Gulf sturgeon, the only threatened fish species in the Gulf, inhabit riverine and estuarine environments in the spring during breeding, and either move offshore or parallel to shore between adjacent estuary systems during winter months. The Gulf sturgeon is unlikely to be present in the project area and is not likely to be adversely affected by this Project.

4.4.2.1 Sea Turtles

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The No-action Alternative would not have any direct impacts on sea turtles. Existing conditions would persist, the potential sea turtle nesting habitat would continue to erode, and eventually all potential nesting habitat in the area would be lost.

Preferred Alternative - East Timbalier and West Belle Headland

Direct

There would also be a potential for incidental takings of sea turtles during dredging operations, despite all possible precautions being taken (e.g., use of turtle exclusion devices, observers, etc.) to avoid, minimize and reduce any such impacts. Collisions with service vessels may pose a threat to sea turtles at the headland; however, the species of sea turtles in the Project area that might be affected by the proposed actions are highly migratory. No individual turtles of any species are likely to be year-round residents in the Project area, although some individuals may be present at any given time. The period of greatest sea turtle activity in the Project area is spring and summer. The CPRA will continue to coordinate with the NOAA Fisheries to implement specific actions to avoid and minimize potential impacts to sea turtles.

Indirect

The indirect impact-producing factors affecting sea turtles at the headland include degradation of benthic feeding areas, and discarded trash and debris from dredge or service vessels. Sediment plumes created by dredge operations would be minor and short-term; consequently, effects to sea turtles should be minor and short-term as well.

Activities including beach renourishment can result in sand compaction. Compaction negatively affects site selection, and may discourage nesting along the affected area. Sand placed on the beach that differ in characteristics such as grain size, sorting, and moisture content can alter incubation temperatures, reduce egg hatching, reduce survivorship, and affect sex ratios of hatchlings. Once sand is placed on the beach, physical reworking of the material will occur that can initially cause the creation of escarpments. These escarpments may initially impair the ability of adult turtles to reach the upper beach and cause the nesting

turtles to abandon nesting attempts (DOI-MMS, 1997). However, in the long term, beach nourishment can improve habitat for nesting turtles.

Sea turtles have been known to consume plastic bags, tar balls, and other discarded trash or litter. Regulations reduce the accumulation of plastic and other debris in the marine environment, thereby reducing the likelihood of causing adverse impacts on sea turtles.

Preferred Alternative - Ship Shoal Borrow Area

Direct

Collisions with vessels are a particular concern for marine turtles because they mate, bask, and forage on the surface. Approximately 400 sea turtles per year are estimated to be killed by boat collisions off coastal beaches (NRC, 1990). Most collisions involve propeller and boat strikes by commercial transport and recreational boat traffic.

The proposed Project could impact sea turtles at Ship Shoal through entrainment and dismemberment in dredge suction draglines, or collisions with dredge or service vessels. Hopper dredge dragheads can catch and kill turtles. Historically, sea turtle takes associated with sand mining activities for beach restoration have been few compared to channel dredging, especially for projects in OCS Waters. Dredging with hopper dredges for Gulf beach nourishment projects could occasionally kill sea turtles, particularly loggerheads and Kemp's ridleys. The chances of the proposed Project affecting hawksbills are discountable (NMFS, 2005). Leatherbacks are unlikely to be found associated with relatively nearshore, shallow borrow areas such as Ship Shoal and thus are unlikely to be impacted by hopper dredging activity or relocation trawling associated with the proposed action (NMFS, 2005). Mitigation measures such as turtle observers and relocation trawling will minimize the potential for collisions with sea turtles and incidental turtle takes. All terms and conditions and conservation recommendations of the NMFS biological opinion (BO) (NMFS, 2005) will be adhered to for this Project.

Indirect

The indirect impact-producing factors affecting sea turtles at Ship Shoal are the same as those described above for the barrier system, degradation of benthic feeding areas, and discarded trash and debris from dredge or service vessels. Sea turtles are highly mobile and can move to better forage areas until the affected area becomes recolonized by benthic organisms. Because of the relatively small area to be disturbed, compared to the surrounding area and the expected recolonization (3 to 24 months) of the proposed Project area, impacts to sea turtles are expected to be temporary. Possible indirect impacts include interference with underwater resting habitats, disturbance to benthic foraging habitats, and disruption of the prey base. Sea turtles feed on benthic invertebrates, fish, crabs, jellyfish, sponges, and sea grasses. Dredging in shallow areas can destroy sea turtle foraging habitat.

4.4.2.2 Piping Plover and Red Knot

No-Action - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The only T&E species that may occur on East Timbalier Island or the West Belle Headland are the piping plover and red knot, as West Belle Headland is designed critical habitat. As East Timbalier Island and the West Belle Headland degrades, the preferred piping plover and red knot habitat, sparsely vegetated sand (supratidal beach and dune and overwash fans, and their foraging ares, intertidal beach, sand- and mud-flats) will gradually disappear, and plover and knot habitat along with it.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow:

Direct

The proposed Project would not have any direct impacts on piping plover and red knot within or around the Project area. Implementation of the proposed action is not likely to kill any piping plovers and red knot since the birds are highly mobile and can quickly move out of harm's way. The Project is not likely to jeopardize the continued existence of non-breeding piping plover and red knot.

Indirect

The Endangered Species Act prohibits unauthorized taking of endangered or threatened species. Section 7 of the ESA requires Federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

The construction activities may lead to temporarily diminished quantity and quality of intertidal foraging and roosting habitats within the Project area, resulting in decreased survivorship of migrating and wintering plovers and temporary adversely affects critical habitat. Ultimately, the Project goal is to restore the diversity of coastal barrier island and headland habitats, but the temporary effects of construction will require time for natural recovery and would extend beyond one wintering season.

Without the Project, there would be little or no habitat remaining on East Timbalier. The prolonged existence and restoration/creation of foraging and roosting habitat for piping plovers and red knot along the island and headland would be the overall result of the Project. Much of the existing system is sediment-starved, and the proposed action would introduce sediment into that system that would be reworked and redistributed through natural processes, thus maintaining and/or enhancing the features of critical habitat. The additional sediment (within the sediment starved Timbalier Basin barrier system) would be re-worked by wind and wave action and storm events to allow for natural shoreline nourishment and repair along the headland; this should result in the natural reformation of optimal habitat in the form of over-wash areas, sand flats, mud flats, and sand spits. The restoration and maintenance of intertidal habitat is important for the restoration of the piping plover and red knot population to healthy levels.

The temporary impacts to the red knot, the piping plover and its critical habitat is likely to adversely affect the species throughout the Project area from increased human activity during construction. The nearest suitable habitats to East Timbalier and West Belle Headland into which piping plovers can disperse are located on Timbalier Island (located west of East Timbalier) and Caminada Headland (located east of West Belle Headland).

4.4.2.3 West Indian Manatee

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The No-action Alternative, not implementing the Project, would not have any direct impacts on the West Indian manatee. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

Florida manatees are unlikely to be present in the Project area. Standard manatee protection procedures would be followed to decrease the chances of injury. The Project is not likely to adversely affect the Florida manatee.

4.4.2.4 Whales

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The no-action alternative would not have any direct and negligible or indirect impacts on whales. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct

Whales are unlikely to be in the Project area. The proposed Project would be expected to have negligible effects on whales. No collision fatalities are expected. The most likely impacts on whales would be restricted to behavior modifications, possibly the avoidance or temporary displacements from preferred feeding or resting areas caused by the temporary disturbances associated with dredging. There has never been a report of a whale taken by a hopper dredge. Based on the unlikelihood of their presence, feeding habits, and very low likelihood of hopper dredge interaction, whales are unlikely to be affected by the Project.

Indirect

Dredging can be a significant source of continuous underwater noise in nearshore areas, particularly in low frequencies (1,000 Hz) (Richardson et al., 1995). This noise is typically

diminished to background levels within about 20-25 km of the source. These noise levels are not sufficient to cause hearing loss or other auditory damage to marine mammals (Richardson et al., 1995). However, some observations near dredging operations and other industrial activities have documented avoidance behavior, while in other cases; animals seem to develop a tolerance for the industrial noise (Malme et al., 1983; Richardson et al., 1995). Due to the frequency range of their hearing, whales are more likely to be affected by low-frequency noise than odontocetes (dolphins).

4.5 Cultural Resources

No-Action Alternative East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

Based on the Phase I and Phase II investigations described herein, there are no identified cultural resources on East Timbalier Island or the West Belle Headland, thus the No-Action Alternative will not have any effect on cultural resources on East Timbalier Island, West Belle Headland or the borrow areas.

Preferred Alternative - East Timbalier/West Belle Headland

Direct/Indirect

Since there are no known sites within the proposed restoration areas, no effects on cultural resources are anticipated.

Preferred Alternative - Ship Shoal Borrow Area, Timbalier Marsh Borrow Area, West Belle Marsh Borrow Area and Conveyance Corridors

Direct/Indirect

The borrow areas and conveyance corridors have been designed to provide the recommended avoidance buffers developed from Phase I surveys during the design process for this Project and previous projects (RCG, 2017; HDR, 2015; TAR, 2010; and TAR, 2009), thus no historic properties will be affected within the borrow areas or within the conveyance corridors, as proposed.

4.6 Socioeconomics and Human Resources

4.6.1 Population and Housing

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The No-action Alternative would not have any direct or indirect impacts on population and housing. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The proposed Project would create temporary jobs and the need for short-term housing in adjacent areas. However, the fluctuations in jobs and housing are common in this area due to market vagaries of the oil and gas industry.

4.6.2 Employment and Income

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The no-action alternative would not have any direct impacts on demographic patterns and employment. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The proposed action is expected to have a negligible economic impact in Lafourche and Terrebonne parishes and throughout all of the coastal Louisiana parishes. The Project would restore a portion of the natural services (e.g., recreation and aesthetics) and productivity (e.g., fish and shellfish) thereby reducing, to some unknown extent, the annual economic loss to Louisiana and the nation. Minimal effects on population are projected from activities associated with the proposed Projects. While some of the labor force is expected to be local to the onshore service base in Houma, crewmembers are not expected to require new permanent local housing, although a small number of month-to-month or apartment rental units may be leased. The proposed Project would be expected to have negligible economic effects on Lafourche and Terrebonne parishes.

4.6.3 Fisheries Resources

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow:

Direct/Indirect

The no-action alternative would not have any direct effects on commercial fisheries. However, as the island continues to erode and degrade, important habitat, including marsh and marsh edge, shallow sand and mud flats, and mangrove stands will be lost, thus removing nursery and forage resources for a wide range of fish and wildlife.

Preferred Alternative - East Timbalier/West Belle Headland:

Direct

The proposed East Timbalier Project would not be expected to have adverse effects on commercial fisheries. Temporary and minimal disturbances to commercial fishing could occur, particularly within Little Timbalier Pass and Raccoon Pass from use of the pump-out areas during construction. A pipeline would remain in place on the bottom between the hopper or cutter dredge offloading location and the shore during each proposed Project period. The presence of this pipeline on the sea bottom will preclude trawling activities in the area occupied by it. The pipeline obstruction could be in place for an extended period. Damage to fishing gear could also occur without proper marking or avoidance of the sand transport pipeline and mooring buoy. Adverse impact would be caused more by obstruction and competing space usage than by alteration of habitat. Adult shrimp would be expected to move away from the operating draghead and the sea-bottom disturbance it causes.

Indirect

Indirect effects would be minor and short term. Dredging the bottom substrate to the projected depth is not expected to alter the bottom texture from the original fine-grained sand; however, new bottom topography would be created and an increased silt and clay-sized grain fraction is possible in areas subjected to deep dredging. Topographic lows, trenches, or pits may restrict circulation, pond hypoxic water, or create a deleterious habitat for bottom-dwelling commercial species. Benthic invertebrates used as food sources by bottom-dwelling commercial species would be absent for some months until recolonization begins and a semblance of the original benthic community structure is re-established. Very few longline sets are known to occur this close to shore, although a few have been reported in the vicinity during the 1990s (CSA, 2002). The presence of the hopper dredge and scows will preclude any longline sets in the vicinity for the duration of dredging and sand transport to shore. Commercially valuable fish populations are not expected to be adversely affected by dredging activities due to the ability of adult fish to avoid the dredging operations and the abundance of equivalent and undisturbed habitat in the vicinity.

Preferred Alternative - Ship Shoal Borrow Area

Direct

The Project would not likely have any adverse effects on commercial fisheries. No managed fish species specifically requires Ship Shoal or a sandy bottom substrate to sustain its life cycle. Although estuarine-dependent fish and invertebrates can be found on Ship Shoal, most do not exhibit preferences for the habitat type found in the borrow area as opposed to extensive adjacent shoal areas with equivalent habitat. Shrimp and demersal fisheries may be slightly affected by a combination of removed or degraded bottom substrates, creation of bottom topography that restricts circulation or ponds hypoxic bottom water, and temporary removal of invertebrate food sources that inhabit the borrow area. The primary impact-producing factor affecting commercial fisheries would be impacts from mechanical disturbance of the sea bottom on those fish or shellfish species with benthic lifestyles inhabiting the featureless sandy bottoms on Ship Shoal. Impacts to the shrimp fishery are expected to be negligible because brown and white shrimp appear to prefer mud bottoms (Defenbaugh, 1976; Williams, 1965). Although pink shrimp are frequently found on sand bottoms, they appear to select for calcareous sediment and are only present in the Ship Shoal area in low densities.

Due to the small area, commercial fishing is unlikely to be adversely affected with respect to fisheries dependent on the bottom habitat of the borrow area, primarily shrimp trawling. Ship Shoal is an important offshore habitat for blue crab, providing spawning/hatching, foraging habitat from April to October; however, only a small portion of Ship Shoal would be dredged.

Indirect

Indirect effects are minor and short-term. These effects include the possible relocation of some fishing vessels during the dredging. It may take two to three years for the benthos to return to the area; however, forage for commercial fishery species would be available in adjacent areas.

4.6.4 Aesthetic Resources

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The no-action alternative would not have any direct impacts on aesthetic (visual) resources. Existing conditions would persist. Without implementation of wetland creation and shoreline protection measures, continued bank line erosion and sloughing of the shoreline and conversion of existing fragmented wetlands to open water habitats would persist. Degradation of the land would convert existing viewsheds of marsh, wetland, dune, and beach to more open water views.

The linear viewpoint that delineates the northern portion of the study is located along State Route 1. It is the only road that allows access to (and storm evacuation from) the historical recreational setting that encompasses Grand Isle; thereby it is maintained accordingly. Land loss would also affect this scenic byway and views into the Project area. Panoramic views to the south, southeast, and northwest would most likely be lost. Viewsheds typical of a beachfront recreational area, foreground views of near-shore breakwaters, back-beach dunes, and the occasional shrub line and wetland grasses may also be lost. Middle ground views of wetland areas broken up by Bay Champagne and small ponds, woody vegetation, and the Gulf of Mexico's marine environment may also be lost.

No-Action Alternative - Ship Shoal Borrow Area

Direct/Indirect

The no-action alternative would not have any direct impacts on aesthetic resources at Ship Shoal. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland

Direct/Indirect

East Timbalier Island is inaccessible to the general public, therefore the restoration on East Timbalier wound not have any direct impact to the aesthetic resource. However, since West

Belle Headland is assessable to the general public, implementation of the West Belle Headland restoration component of the Project would greatly increase the visual interests in the area by improving beach, dune and marsh habitat. This mixture of physical environmental elements creates borders and frames for potential views to the Gulf of Mexico and other inland water features, which act as the focal point to any given scene. During dredging, equipment used for dredging would be visible, resulting in a temporary reduction in the aesthetic value offshore. During construction, bulldozers and other equipment would be visible.

Preferred Alternative - Ship Shoal Borrow Area

Direct/Indirect

During dredging, equipment used for dredging would be visible, resulting in a temporary reduction in the aesthetic value offshore.

4.6.5 Recreational Resources

No-Action Alternative East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The no-action alternative would not have any direct impacts on recreational resources. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland

Direct/Indirect

The preservation of West Belle Headland would provide recreational opportunities for many outdoor activities, such as fishing, boating, and camping. There would be some negative impact producing factors associated with transport, and beach nourishment that could have minor and short-term effects on recreational resources on the headland. These include: (1) increased turbidity and water quality degradation from resuspended organic matter in the dredge plume, (2) material spills from vessels, (3) visual impacts from shore, and (4) temporary unavailability of preferred recreational fishing space due to presence of the dredge vessel or dredge plume.

Visitors attracted to the northern Gulf coast are responsible for thousands of local jobs and billions of dollars in regional economic activity. Most recreational activity occurs along shorelines and includes such activities as beach use, boating, camping, water sports, recreational fishing, and bird watching. The location of the offshore dredge operations limits the affects that the dredge plume (i.e., increased turbidity and water quality degradation from resuspended organic matter) or diesel spills can have on recreational resources. Because dredging will be taking place in relatively clean offshore environments, no chemical contaminants would be expected in the dredge plume.

Only waterborne recreational activities such as boating, fishing, or diving would potentially be affected by the offshore presence of the dredge vessel, dredge plume, or service vessel.

Pleasure craft may encounter the dredge vessel while in operation, but motorboats are highly mobile and can relocate to equivalent, unoccupied areas. The dredge vessel or surface plume may disturb surface waters and occupy space sought by recreational fishermen in private boats or charters; however, the footprint of these temporary impacts is so small and the undisturbed equivalent area that is available is so vast that the impact is negligible. There are no artificial reef sites near the proposed borrow area; therefore, this potential diving attraction does not exist. The consequences of boaters encountering the dredge vessel in operation are insignificant and may consist of nothing more than experiencing unpleasant odors.

Preferred Alternative - Ship Shoal Borrow Area

Direct/Indirect

The impact-producing factors associated with sand dredging at Ship Shoal include all of those stated above for the barrier restoration as well as degradation of dredged areas that may be habitat for fish desired by recreational fishermen. Recreational fishermen may be impacted by degraded sea-bottom areas subject to dredging. Game fish dependent on vital and healthy sea bottom may be temporarily displaced until bottom conditions and food source trophic structure is reestablished in two to three years (Coastline Surveys Limited, 1998; Newell et al., 1998).

4.6.6 Waterborne Commerce, Navigation and Public Safety

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The no-action Alternative would not have any direct impacts on waterborne commerce. Existing conditions would persist.

The no-action alternative would not have any direct impacts on navigation and public safety. Existing conditions would persist. Continued erosion may increase the need for dredging of navigation channels in the area.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

Temporary and minimal disturbances to navigation in Raccoon Pass and Little Timbalier Pass from use of the pump-out areas during construction. The Ports of Terrebonne and Fourchon are capable of providing the relatively low level of support services necessary for the Project. No onshore expansion would be expected from the proposed Project. Port Fourchon is heavily used for oil and gas activities, commercial fishing and recreational activities, and the increase in waterborne commerce would be negligible. Minimal and temporary impacts to the East Timbalier Island facility is expected. The construction contractor will be required to coordinate with the operator since access to the island is the same as access to the facility.

During dredging operations, it may be necessary to restrict watercraft access to the construction area in the interests of public safety. These restrictions would be of short duration and are expected to be minor to boat operators. During dredging and placement, the use of the area immediately surrounding the borrow area, East Timbalier and West Belle Headland in the vicinity of the shore restoration would be temporarily restricted due to public safety. All U.S. Coast Guard regulations will be adhered to during construction.

4.6.7 Infrastructure, Oil, Gas, and Other Minerals

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The no-action alternative would not have any direct impacts on onshore infrastructure. Existing conditions would persist. Erosion of East Timbalier Island, if it continues, could adversely affect the existing infrastructure directly behind East Timbalier by exposing the well heads, service facilities and pipelines to potential tropical storm affects.

The no-action alternative would not have any direct impacts on oil, gas, and mineral resources. Existing conditions would persist. Indirect impacts of not implementing the barrier restoration would result in the continued deterioration of existing conditions for oil and gas infrastructure.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The Project will increase protection of the oil and gas infrastructure on the island, including pipelines, wells, storage tanks and processing infrastructure from those same tropical storm events. To avoid adverse impacts to oil and gas infrastructure on the island, design of the Project specifically considered actions that reduce the risk of damage and ensure that the island is more secure at the conclusion of the Project than it is now. The CPRA is coordinating with the facility operator (Krewe Energy) and has contracted with a landrights firm to work with all the operators to verify the location and identify the status (active, inactive, abandoned or to be abandoned) of pipelines in the footprint of the East Timbalier Project features. Once the location and status of active lines are identified, the Project team will establish reasonable and prudent measures around active lines to mitigate potential impact of construction equipment. Specifications will include best management practices for establishing “No Work Zones” over active pipelines that do not have a minimum of 3 ft of cover, and will establish sediment pipeline corridors and equipment corridors to avoid crossing active oil and gas infrastructure. CPRA will require the operators to have them remove inactive and abandoned pipelines within the restoration footprint prior to construction.

Implementing these alternatives would have no direct impact on oil, gas and mineral reserves. Indirect effects would include the additional protection against erosion of existing pipelines in the Project area. Despite extensive surveys of the borrow area, there remains a potential for disturbing oil and gas infrastructure (pipelines, platforms, and other structures). The proposed

fill templates and onshore sediment pipelines would cross oil and gas pipelines; however, these pipelines and cables are buried and no damage is expected.

No pipelines are in the borrow area; pump-out areas and conveyance corridors were sited to avoid offshore pipelines.

4.6.8 Environmental Justice

No-Action Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

The no-action Alternative would not have any direct impacts on environmental justice. Existing conditions would persist.

Preferred Alternative - East Timbalier/West Belle Headland/Ship Shoal Borrow

Direct/Indirect

Federal agencies are directed by Executive Order 12898 to assess whether their actions would have a disproportionate and negative effect on the environment and health of people of ethnic or racial minorities or those with low income. No disproportionate impacts on ethnic or racial minorities or poor people would result from the Project.

4.7 Hazardous, Toxic and Radioactive Waste (HTRW) Impacts

Oil and gas exploration has been ongoing in Timbalier Bay near East Timbalier island since the 1930s (Gotech, 1998). There are numerous oil well platforms and storage tanks on and near East Timbalier Island, along with numerous pipelines, wellheads and abandoned waste pits. Given the nature of the activity near the island, a Phase I ESA was conducted to identify any potential RECs located on or in the vicinity of East Timbalier Island that have, or may have in the past, adversely impacted environmental conditions at the site. CTC-GEC performed sediment sampling on a waste pit and results of samples analyzed found the Oil Field Passive Pit Closure Parameters were all below regulatory levels. The results tested for total metals, radionuclides, and NORM materials. The material appeared innocuous (CTC-GEC, 2017). Therefore, based on an appropriate inquiry level and professional judgment, the presence of HTRW within the Project limits is very low to nonexistent.

No evidence of contamination by hazardous or toxic wastes at Ship Shoal was noted during prior surveys or site investigations; therefore, it would not contribute these materials to the beach nourishment location.

Accidental spills and releases of waste/fuel, although remote, are possible. The Contractor will prevent oil, fuel, or other hazardous substances from entering the air or water. This will be accomplished by design and procedural controls. All wastes and refuse generated by Project construction would be removed and properly disposed. The Contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material for the borrow area. Compliance

with U.S. EPA Vessel General Permits would be ensured, as applicable. The use of Ship Shoal would not adversely affect HTRW within the Project area.

4.8 Cumulative Impacts

4.8.1 Future Projects in the Project Area

Louisiana has invested hundreds of millions of dollars over the past two decades restoring its barrier islands and shorelines and plans to continue to invest in rebuilding these features (CPRA, 2017). CPRA intends to monitor and assess the Terrebonne, Timbalier, and Barataria barrier islands and shorelines as part of a regular rebuilding program. The barrier island program will allow CPRA to respond when catastrophic events like future hurricanes impact these areas. One and a half billion dollars of the $25 billion restoration budget has been identified to fund the Barrier Island Program (CPRA, 2017).

4.8.2 Cumulative Effects

Direct and indirect impacts of past, present, and reasonably foreseeable future events were considered in the analysis of the proposed Project consequences. These impacts include historical and predicted future land loss rates for the area and other restoration projects in the vicinity. The preferred alternative would have temporary adverse impacts to some environmental resources but cumulative benefits to the environmental resources.

Implementing the Project will restore East Timbalier and West Belle Headland's GEFF. The cumulative benefit will be seen as the Island retains its form and all of the ecological benefits (pelagic and benthic estuarine productivity, wildlife habitat, EFH, habitat for migratory birds, habitat for T&E species and protection of adjacent wetland shores, etc.) into the future. The proposed restoration of the barrier shoreline and creation of new marsh will bolster the Island and headland's ability to resist beach erosion, storm surge overwash, and breach formation. In addition, the feeder beach will provide sediment to nourish the headland shoreline, as well a re-nourishment component at the site of the previously competed West Bell Headland Project TE-52.

Cumulative effects on the Ship Shoal sand resources would be minor, even in combination with other planned Federal and State utilization of Ship Shoal for restoration efforts. Ship Shoal encompasses approximately 76,600 acres and contains an estimated 1.57 billion cubic yards of very fine- to medium-grained sand (DOI-MMS 2004; USACE 2012). Removal of up to 4.7 MCY of sand from 253 acres of South Pelto and 6.5 MCY of sand form 584 acres of Ship Shoal for restoration of the East Timbalier and West Belle Headland is considered small-scale mining in the context of the various Ship Shoal modeling studies (Stone, 2000; Stone et al., 2004, 2009). The Project would impact less than 1 percent of the surface area of Ship Shoal and less than 1.5 percent of the total volume of sand resources present on the shoal. It is noted that previous projects have dredged sand resources from Ship Shoal and the quantity of sediment removed is less than 4 percent and area impacted by dredging is approximately 2 percent.

Some minor effects on the benthic community would occur, including turbidity, burial, changes in sediment parameters and suitability, and sediment resuspension. These effects are minor and short-term, and there would be little to no cumulative effects.

4.8.3 Irreversible and Irretrievable Commitment of Resources

Ship Shoal is the largest of a series of inner shelf sand shoals off the Louisiana coast. The use of the sand from South Pelto Blocks 13 and 14 is unlikely to deplete the supply of sand suitable for future restoration projects. There would be sufficient sand remaining in the dredged areas for re-colonization of benthic organisms. Use of the sand from this area is not an irreversible irretrievable commitment of resources.

4.8.4 Unavoidable Adverse Environmental Effects

The Alternatives and the No-action Alternative have minor, short-term, unavoidable, adverse, direct and indirect environmental effects that are discussed in this document. However, many of these effects are temporary and minor.

4.8.5 Compatibility with Federal, State, and Local Objectives

The Project is compatible with Federal, state, and local objectives of restoring the Timbalier Barrier Island System.

5.0 - CONSULTATION AND COORDINATION

5.1 USACE Environmental Assessment, Section 10/Section 404 Permit, and Coastal Use Permit

5.2 Landowner Involvement

5.3 Non-Governmental Organization Involvement

Restore or Retreat (ROR) is a non-profit coastal advocacy group

5.4 Governmental Organization Involvement

Lafourche Parish Government Office of Coastal Zone Management staff and Terrebonne Parish Consolidated Government Coastal Zone Management staff were formally notified by the Louisiana Department of Natural Resources Office of Coastal Management of the Public Notice for the permit via email on January 27, 2017. Terrebonne Parish provided a comment to the Louisiana Department of Natural Resources Office of Coastal Management on January 25, 2017 that the proposed activity will not impact emergent wetlands in Terrebonne Parish. The Lafourche Parish Office of Coastal Zone Management submitted a letter on February 23, 2017 with no objection to the project. Comments received from reviewers are provided in Appendix A.

In September 2016 a permit pre-application meeting was held at CPRA to disseminate information and solicit comments on the preliminary designs of the island beach, dune, and marsh fill templates as well as the sediment borrow areas and their conveyance corridors. The meeting was attended by representatives of CPRA and their consultants, USACE, LADNR-OCM, NOAA, BOEM, and USFWS. In addition to updating all of the agencies on Project progress the meeting ensured team coordination regarding the information needed to complete the CUP and Section 10/Section 404 Permit applications and other relevant permits and documents (i.e., BA/BO).

On April 6, 2015, a Notice on Proposed Rulemaking was published in the Federal Register by the United States Coast Guard (USCG) that would provide for the establishment of anchorage grounds: South Timbalier, Port Fourchon, Louisiana, Gulf of Mexico which would be located Area offshore of East Timbalier Island. The Anchorage Area would partially overlap with the proposed East Timbalier Pump Our Area. The goal of the proposed rule is to reduce congestion and improve safety for the users of Port Fourchon. Following the public notice, the project Team for the East Timbalier Island Project and representatives of Port Fourchon discussed the matter and anticipate a mutually satisfactory arrangement. Letters documenting the coordination were submitted to the USCG from BOEM (dated July 31, 2017); CPRA (dated July 19, 2017); and the Louisiana Department of Natural Resources Office of Coastal Management (dated July 25, 2017) are provided in Appendix A.

6.0 - PERMITS AND COMMITMENTS

6.1 Permits

The following is a list of permits that are required to implement the proposed Project:

- LDNR Office of Coastal Management - Coastal Use Permit
- USACE Section 10/404 Permit including an independent Environmental Assessment
- LDEQ 401 Water Quality Certification
- LDWF Special Use Permit

All of the requisite permits were obtained in conjunction with the submission of the Joint Coastal Use and Section 10/Section 404 Permit Application that was filed in January 2017. The USACE completed an independent Project-specific EA prior to issuance of the 10/404 permit (MVN-2015-0895-CQ) on November 7, 2018. As part of the review process USACE received comments from LDWF, USFWS, and NOAA Fisheries. The permits and associated documents are included in Appendix A.

6.2 Environmental Impact Statement Documentation

As part of the development of the TBBSR EIS, the USACE and CPRA coordinated with state and federal agencies and received a variety of regulatory consultation documents associated with the NER Plan (USACE, 2010). Similarly, development of the NOAA EA for the West Belle Headlands project resulted in receipt of comments and formal consultation documents from the agencies listed in §6.1, above.

6.2.1 Protection of Fish and Wildlife Resources

The CPRA, BOEM and USACE prepared a Biological Assessment, which was provided to USFWS and NOAA Fisheries. The USFWS issued a concurrence letter response for the TE-118 Project on November 6, 2017. The USFWS correspondence responding to the USACE Section 10/404 permit public notice is included in Appendix A.

It should be noted that the initial USACE 10/404 permit that was proffered in May 2017 was objected to by the CPRA in order to clarify the bird monitoring. The CPRA coordinated closely with the USFWS and both agreed upon an approach to bird monitoring that was included in the USACE 10/404 permit dated November 7, 2018.

On May 23, 2017, the National Marine Fisheries Service sent correspondence requesting project information relative to Essential Fish Habitat. The CPRA provided a response on August 28, 2018. The NMFS correspondence responding to the USACE Section 10/404 permit public notice is included in Appendix A.

6.2.2 Water Quality

CPRA submitted an application for a Water Quality Certification (WQC) to the LDEQ for the implementation of the TE-118 Project. A WQC letter from LDEQ dated August 25, 2017 stated that the requirements for a Water Quality Certification (WQC170410-04) for permit MVN-2015-0895-CQ had been met and that the placement of fill material would not violate water quality standards in Louisiana in accordance with Section 404(b)(1) of the Clean Water Act. The Water Quality Certification is included in Appendix A.

6.2.3 Coastal Use Permit and Coastal Zone Consistency Determination

In accordance with Section 307 of the Coastal Zone Management Act the Louisiana Department on Natural Resources (LDNR), Office of Coastal Management (OCM) reviewed the Project for consistency with the approved Louisiana Coastal Resources Program (LCRP). The LDNR OCM issued a letter of consistency (C20170012) dated February 15th, 2017. Following receipt of the Coastal Use Permit (CUP) application for the TE-118 Project, OCM issued the Coastal Use Permit/Consistency Determination (P20170043) on August 4th, 2017, included in Appendix A.

6.2.4 Cultural Resources

Archival research, surveys, and consultation with the Louisiana State Historic Preservation Officer (SHPO) was conducted for the Project. All activities have been conducted in accordance with the National Historic Preservation Act, as amended; the Archeological and Historic Preservation Act (AHPA), as amended; and Executive Order 11593. The Project is in full compliance with the NHPA as well as the AHPA and EO 11593. Coordination with SHPO and the Sovereign Nation of the Chitimacha for the USACE, LDNR, and LDEQ permit actions is complete. SHPO concurrence was received on November 29, 2017 for the Phase 1 Cultural Resources Investigation for the East Timbalier and West Belle Borrow Areas (Appendix A). Marine Archaeological surveys were completed for the OCS portion of the Project. The OSI marine survey reports were reviewed and approved by BOEM archaeologists. SHPO concurrence was previously received on July 27, 2009 for the West Belle Marsh Borrow Area (Appendix A). Buffer zones were created around potentially significant resources to avoid accidental disturbance from dredging activities. Buffer zone requirements will be specifically detailed in the BOEM Non-Competitive Negotiated Agreement. In summary, no significant cultural resources are located within the APE for the fill template and no significant cultural resources will be affected in the OCS portion of the Project. Therefore, the planned undertaking will have no effect on prehistoric and/or historic properties (36 CFR Part 800.4(d)(1).

6.2.5 Commitments

The CPRA commits to avoiding, minimizing, or mitigating for adverse effects during construction activities for the Project. The CPRA will comply with the Endangered Species Act requirements elaborated in the consultation documents and permits associated with this Project provided by BOEM, USACE, USFWS, NOAA Fisheries, LDNR, LDEQ, and LDWF. Specific attention will be directed to the requirements of the Section 10/Section 404 and

Coastal Use permits and BOEM's OCS Lease. General Provisions 36, 37, and 38 in the Project Contract Specifications address contractor compliance with the maritime Rules of the Road and the U.S. Coast Guard regulations regarding vessel operation and obstruction to navigation.

The CPRA will ensure that all construction activities will be kept under surveillance, management, and control to minimize interference with, disturbance to, and damage to fish and wildlife. The CPRA commits to having a Bird Monitoring and Abatement Plan implemented by the construction contractor during the Project, the contents of which will be developed in consultation with the USFWS and LDWF. The CPRA also commits to surveys and monitoring for the piping plover and red knot including a benthic survey; details of which will be developed in consultation with the USFWS and LDWF.

The CPRA commits to construction monitoring which will begin with a pre-construction meeting and continue with bi-weekly meetings through the duration of construction. Pre-construction hazard surveys will be conducted to verify and mark the location of hazards prior to construction. Pre- and post-construction and dredging progress bathymetric and topographic surveys will be conducted to monitor the Borrow Areas, Conveyance Corridors, and fill areas. Construction activities will be monitored to ensure that the activities stay within the Project footprint and all activities are completed in accordance with all permit conditions and stipulations. Emphasis will be placed on the several cultural resource avoidance buffers along the corridors, including pipeline crossings, and in the borrow areas. Upon completion of construction, the CPRA will document construction activities in a construction completion report.

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9.0 - APPENDICES

A Correspondence and Permitting Documents

B Alternatives Analysis Report