Deepwater Port License Application
Blue Marlin Offshore Port (BMOP) Project

Volume IIb – Onshore Project Components Environmental Evaluation (Public)
Topic Report 4: Aquatic Resources

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Deepwater Port License Application
Blue Marlin Offshore Port (BMOP) Project

Volume I: General (Public), including Deepwater Port License Application and Appendices
(*under separate cover*)

Volume IIa: Offshore Project Components Environmental Evaluation (Public)
(*under separate cover*)

Volume IIb: Onshore Project Components, Environmental Evaluation (Public)
(*herein*)

Volume III: Technical Information
[***Confidential***]
(*under separate cover*)

Volume IV: Company and Financial Information
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ABBREVIATIONS AND ACRONYMS

Applicant	Blue Marlin Offshore Port LLC
BMOP	Blue Marlin Offshore Port
BMP	Best Management Practice
bph	barrels per hour
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CUP	Louisiana Coastal Use Permit
DWP	Deepwater Port
DWPA	Deepwater Port Act
EFH	Essential Fish Habitat
GOM	Gulf of Mexico
HDD	Horizontal directional drill
ICWW	Intracoastal Waterway
LDEQ	Louisiana Department of Environmental Quality
LDWF	Louisiana Department of Wildlife and Fisheries
LQ	living quarters
MARAD	United States Maritime Administration
MLV	Mainline valve
MMPA	Marine Mammal Protection Act
MP	Milepost
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries Service
OD	Outside diameter
PCB	Polychlorinated biphenyl
ppt	parts per thousand
Project	Blue Marlin Offshore Port Project
PSD	Prevention of Significant Deterioration
ROW	Right-of-way
SAV	Submerged aquatic vegetation
SPAR	Spill Prevention and Response
TAC	Texas Administrative Code
TC	TransCanada
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Parks and Wildlife Department
TSS	total suspended solids
TWC	Texas Water Code
U.S.	United States
USACE	United States Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	United States Fish and Wildlife Service

USGS	United States Geological Survey
VBT	Vent Boom Tripods
VLCC	Very Large Crude Oil Carrier

PROJECT FAST FACTS

General Project Terminology	
Applicant	Blue Marlin Offshore Port LLC
Project Name	Blue Marlin Offshore Port (BMOP)

BMOP Location and General Information	
Nederland Terminal (NT)	The location where the oil for BMOP originates. This is the existing Sunoco Partners Marketing & Terminals L.P. facility located in Nederland, Jefferson County, Texas
New 42-inch Pipeline	37.02 miles of 42-inch pipeline from NT to Station 501
Existing Mainline from Cameron parish Louisiana to WC 509	Cameron Parish, Louisiana Louisiana State Blocks: WC 11, 20, 21 OCS Blocks: WC 21, 44, 43, 58, 79, 78, 95, 114, 113, 132, 133, 148, 169, 170, 183, 196, 205, 212, 213, 224, 230, 241, 245, 246, 255, 258, 259, 266, 269, 276, 275, 277, 282, 408, 431, 432, 433, 456, 459, 482, 483, 484, 508, 509
Deepwater Port Location (Platform – CALM Buoys)	West Cameron Block 509 (WC 509) West Cameron 508 (WC 508) East Cameron 263 (EC 263)
Deepwater Port Water Depth	156 to 162 feet water depth
Loading Capacity	80,000 barrels per hour (bph)

BMOP Deepwater Port Components	
Existing Stingray Pipeline (Mainline)	One existing 36-inch Outer Diameter (OD) pipeline, approximately 104 miles long from Station 501 in Cameron Parish, Louisiana to WC 509. This line consists of the existing 36-inch OD subsea line from WC 509 to Station 701 and the existing 36-inch OD onshore line from Station 501 to Station 701.
Deep Water Port (DWP)	The offshore loading facility site located in WC 509, WC 508, and EC 263. The facilities consist of the existing WC 509 Platform Complex; two new PLEMs and CALM Buoys in WC 508 and EC 263; two new Crude Oil Loading Pipelines from the WC 509 Platform Complex to the PLEMs and the flexible hoses attached to the CALM Buoys. The WC 509 Platform Complex will be converted from gas service to oil and gas service. The converted platforms will support oil export and natural gas transportation.
WC 509 Platform Complex (509 Complex)	The existing WC 509 Platform Complex consists of three platforms and two Vent Boom Tripods (VBT). The WC 509A Platform is the natural gas gathering platform. This will also house the 36-inch riser and pig barrel of the crude oil Mainline. The WC 509B Platform currently is the natural gas compression and control platform. It houses natural gas compressors, separators, the Control Room and Platform Complex's utilities. The WC 509B Platform will continue to house the natural gas separation facilities and the Platform Complex's utilities. It will also house the crude oil Control Room, metering facilities, and pig barrels for the two Crude Oil Loading Lines. The WC 509C Platform is the Living Quarters (LQ) platform and will continue in that role. The WC 509 VBTs are utilized to bridge the natural gas vent piping to a point approximately 660 feet from the 509B Platform and will continue in this role for any planned and emergency natural gas blowdowns.

BMOP Deepwater Port Components	
WC 148 Platform	The existing WC 148 Platform will be converted from natural gas transportation service to oil transportation service. All gas piping facilities on the deck will be removed and replaced with new pipe and a new Mainline Valve (MLV). This valve will be able to be remotely operated.
Catenary Anchor Leg Mooring (CALM) System	There will be two floating Calm Buoys installed approximately 4,710 feet and 6,085 feet from the WC 509B Platform. The CALM Buoys will be installed with a minimum of 5,000 feet separation. Each Buoy will be moored in place with 6 or more anchor chains connected to engineered anchors installed at locations around the Buoy. Flexible hoses will be connected from the PLEMs to the Calm Buoys. Floating flexible hoses will also be connected to the CALM Buoy and, during loading, the opposite end will be connected to the ship. CALM Buoy No. 1 will be installed in WC 508 and CALM Buoy No. 2 will be installed in EC 263.
Crude Oil Loading Pipelines	Two 36-inch diameter pipelines from the existing WC 509B Platform to the PLEMs.
Pipeline End Manifold (PLEM)	One PLEM will be installed on the seafloor at each CALM Buoy. Each PLEM will be connected to a 36-inch Crude Oil Loading Pipeline from the WC 509B Platform and a CALM Buoy floating above the PLEM. The two PLEMs will be in WC 508 and EC 263.
VLCC or other Crude Carrier	Very Large Crude Carriers (VLCCs), Suezmax, Aframax or other large capacity seafaring vessels.
Meter for Measuring Departing Crude Oil	The DWP will have two-meter stations with associated prover and lab facilities. One of the meter stations will be located at the new BMOP Pump Station adjacent to the NT and one will be located on the offshore crude export platform (WC 509B Platform).
Pre-fabrication Yards	Existing yards will be used along the northern Gulf of Mexico (GOM) coast.
Support Facility	An onshore support base will be established at an existing port facility to provide the necessary security to support the DWP operations.

BMOP Onshore Pipeline Components	
BMOP Pump Station	The onshore metering, pumping, and pig launcher station will be located in Nederland, Texas, adjacent to the existing NT.
Onshore Crude Oil Pipeline	A new, approximate 37.02-mile, 42-inch OD pipeline connecting the existing NT in Jefferson County, extending across Orange County, Texas to the existing 36-inch OD Mainline at Station 501 in Cameron Parish, Louisiana.
Station 501	The existing NGPL/Stingray interconnect facility (Station 501) will be abandoned and demolished. A new pig receiver and launcher will be installed to connect the new 42-inch OD onshore pipeline with the existing 36-inch OD onshore Stingray Mainline.
Station 701	The existing compressor Station 701 in Cameron Parish, Louisiana will be demolished. All existing natural gas equipment will be removed from the Station except for several large 10,000-barrel storage tanks. Approximately 1,000 feet of new 36-inch pipe, surge tanks, surge valves, and a new MLV will be installed. The existing 10,000-barrel tanks located at Station 701 will be converted to surge relief tanks.
Stingray ANR Tap Removal Site	BMOP will remove the tap and install 36-inch pipe in its place.

BMOP Onshore Pipeline Components	
Mainline Valves (MLV)	Six new MLVs will be installed within the permanent pipeline right-of-way (ROW) of the new build pipeline. MLVs will also be installed at the BMOP Pump Station, Station 501, and Station 701. These valves will be used for isolation and spill control purposes.
Pipeline Pig Launchers and Receivers	Pig Launchers/Receivers will be located at the BMOP Pump Station, Station 501, and the DWP. These are utilized for cleaning the pipelines and running intelligent devices to assess pipeline integrity.
Access Roads and Canals	The Project will utilize existing access roads and canals. One new temporary access road and four new permanent access roads will be required.
Pipe and Contractor Yards	BMOP will utilize existing facilities along the northern GOM coast, U.S. or international locations for manufacturing pipe and for fabricating the PLEMs, CALM Buoys, and end connectors. Pipe coating activities will be performed at existing facilities along the northern GOM coast. Selection of the marine contractor will be completed after the MARAD filing; however, the successful contractor(s) will utilize existing fabrication and logistical facilities located along the northern GOM coast.

PROJECT ENVIRONMENTAL EVALUATION ASSESSMENT CRITERIA

Environmental Evaluation Assessment Criteria		
Criteria	**Values**	**Definition**
Outcome	**Direct**	***Direct effects*** are "caused by the action and occur at the same time and place" of the Project (40 CFR § 1508.8).
	Indirect	***Indirect*** impacts are "caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR § 1508.8). Indirect impacts are caused by the Project, but do not occur at the same time or place as the direct impacts.
	Cumulative	***Cumulative impact*** is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR § 1508.7).
Type	**Adverse (Negative)**	***Adverse*** would cause unfavorable or undesirable outcomes for the natural or social environment. Negative impacts result in a net loss to the resource.
	Beneficial (Positive)	***Beneficial*** impact would cause positive or desirable outcomes for the natural or social environment. Beneficial impacts result in a net benefit to the resource.
Duration	**Short-term (Temporary)**	***Short-term (or temporary)*** impacts are those that would occur only during a specific phase of the proposed Project, such as noise during construction or certain installation activities. Short-term impacts would end at the time, or shortly after, construction activities ceased. The duration of most short-term impacts would be a few hours to a few days.
	Long-term	***Long-term*** impacts would occur either continually or periodically throughout the life of the Project (e.g., operational air emissions, stormwater discharge), or would last for years after an impact-producing activity occurred (e.g., removal of wildlife habitat).
Magnitude	**Negligible**	***Negligible*** impacts are generally those that might be perceptible, but in certain cases may be undetectable.
	Minor	***Minor*** effects are those that could be perceptible but are of very low intensity and may be too small to measure.
	Moderate	***Moderate*** impacts are more perceptible, can often be quantified, and may approach the thresholds for major impacts.
	Major	***Major*** impacts, based on their context and intensity (or severity), have the potential to meet the thresholds for significance set forth in Council in Environmental Quality (CEQ) regulations (40 CFR §1508.27). Major impacts warrant additional attention in a National Environmental Policy Act (NEPA) analysis and a review of potential mitigation measures that would fulfill the policies set forth in NEPA, which include avoiding, minimizing, or mitigating major impacts.
Likelihood	**Unlikely**	Low probability.
	Potential	Possible or probable.

Environmental Evaluation Assessment Criteria		
Criteria	**Values**	**Definition**
	Likely	Certain.

4.0 AQUATIC RESOURCES

4.1 PROJECT OVERVIEW

Blue Marlin Offshore Port LLC (the Applicant) is proposing to develop the Blue Marlin Offshore Port (BMOP) Project (Project) in the Gulf of Mexico (GOM) to provide crude oil transportation and loading services for crude oil produced in the continental United States (U.S.). A Project overview map is provided in **Figure 4-1**. The Deepwater Port (DWP) will be utilized to load the transported crude oil onto very large crude carriers (VLCCs) (and other crude oil carriers) for export to the global market. The Applicant is filing this application for a license to construct, own, and operate the Deepwater Port (DWP) pursuant to the Deepwater Port Act (DWPA) of 1974, as amended, and in accordance with U.S. Coast Guard (USCG) and U.S. Maritime Administration (MARAD) implementing regulations.

The primary purpose of the Project will be to provide for safe and reliable long-term supply of crude oil for export to the global market. Oil for export will be transported out of the existing Sunoco Partners Marketing and Terminals, L.P., a terminal and storage facility in Jefferson County, Texas (Nederland Terminal or NT). This terminal is connected to multiple crude oil pipelines connecting to production from across the U.S. In addition, an affiliate of the Applicant owns the Stingray Pipeline System and has confirmed that its subsea pipeline and offshore platforms are suitable for converting to facilitate crude oil export from a DWP in the northern GOM. The Applicant has the exclusive right to lease or purchase the Stingray Pipeline System for use in the Project.

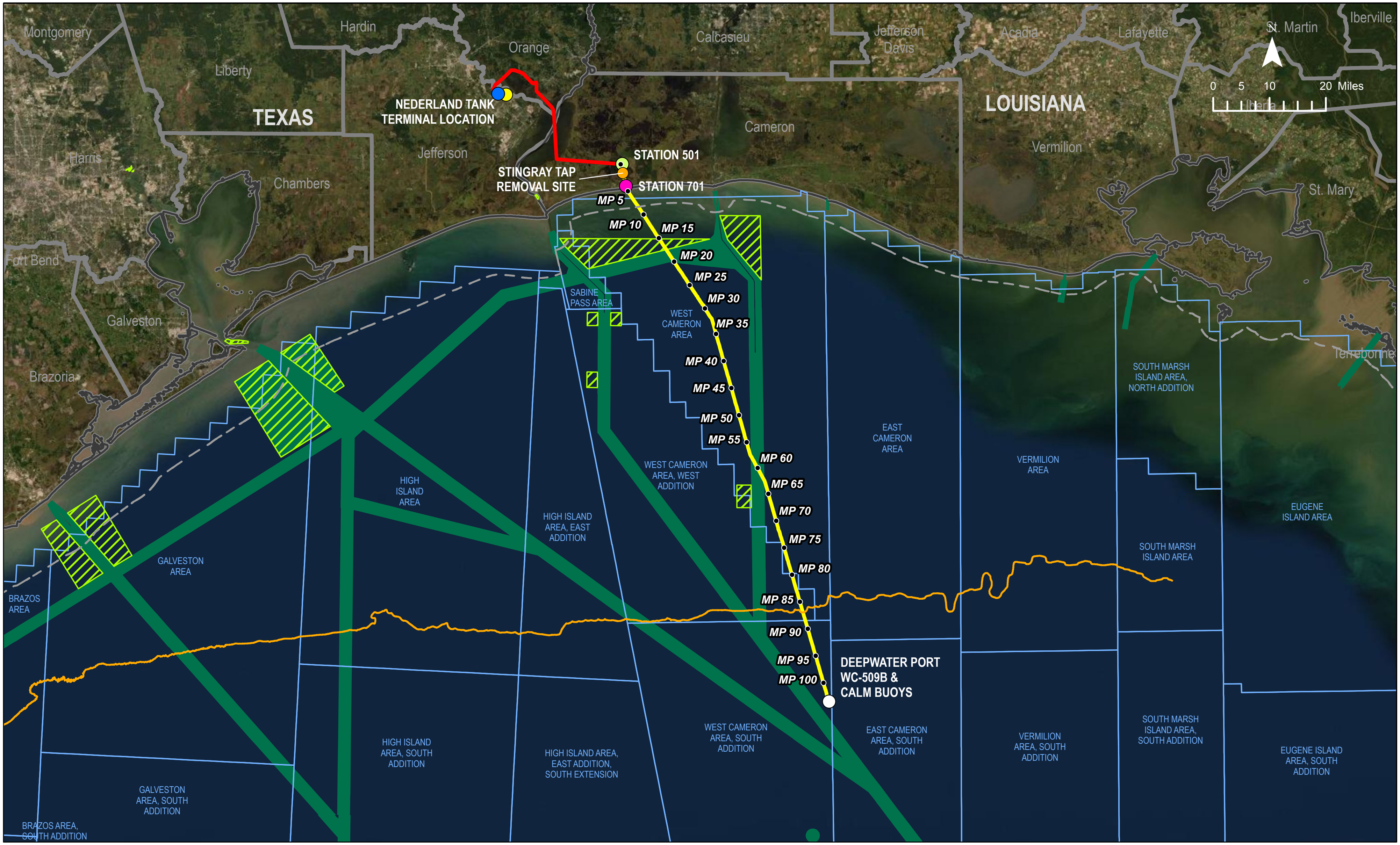
The DWP will be located in federal waters within and adjacent to the Outer Continental Shelf (OCS) in West Cameron Lease Blocks (WC) 509 and 508 and East Cameron Block 263. The DWP will be approximately 99 statute miles off the coast of Cameron Parish, Louisiana, with an approximate water depth of 162 feet. Crude oil will be routed from pumps at Nederland, through a new 42-inch outer diameter (OD) onshore pipeline to the existing Stingray Mainline at Station 501 (see Section 4.1.1), and from there through the existing Stingray Mainline to the DWP.

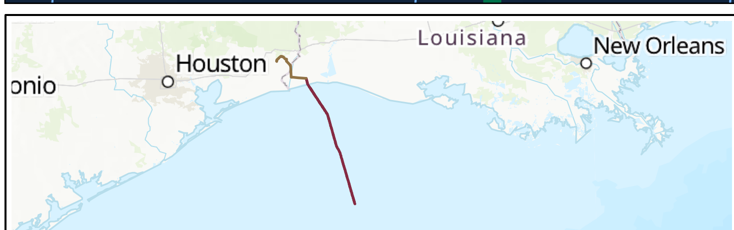
As depicted in **Figure 4-1**, the BMOP facilities consist of the pumps and meters at NT; a new approximate 37-mile, 42-inch OD pipeline; the existing 36-inch OD Mainline; an existing fixed, manned platform complex at WC 509; an existing platform at WC 148; two new Crude Oil Loading Pipelines; and two new PLEM and CALM Buoys located in WC 508 and EC 263. A Project overview map of the onshore Project components is provided in **Figure 4-2.** Details of the Project's offshore facilities are provided in Topic Report 1, "Project Description, Purpose, and Need" (Volume IIa). This Topic Report includes details of the onshore Project facilities.

This report identifies and discusses aquatic resources including invertebrates and fish species with the potential to occur in the Project area, the potential impacts of construction and operation on these resources, and measures that will be implemented to reduce and mitigate potential Project-related impacts. Characterization of aquatic resources potentially impacted by construction and operation of the onshore components of the Project is based on field surveys, publicly available data, and consultation with various federal and state natural resource agencies.

To avoid and minimize potential impacts to aquatic resources during construction and operation of the Project, the Applicant will implement construction and operation Best Management Practices (BMPs) included in the Project's Onshore Construction BMP Plan (**Appendix C-1**), Revegetation Plan (**Appendix C-2**), and Spill Prevention and Response Plan (SPAR Plan, **Appendix C-3**) in Volume IIb.

BMOP PROJECT - FIGURE 4-1 - PROJECT OVERVIEW MAP





LEGEND

- EXISTING OFFSHORE PIPELINE MILEPOSTS
- STINGRAY TAP REMOVAL SITE
- NEDERLAND TANK TERMINAL LOCATION
- NEDERLAND PUMP STATION
- STATION 701 (TO BE CONVERTED TO OIL SERVICE)
- STATION 501 (TO BE CONVERTED TO OIL SERVICE)
- DEEPWATER PORT WC-509B AND CALM BUOYS
- EXISTING PIPELINE TO BE CONVERTED TO OIL SERVICE
- PROPOSED ONSHORE PIPELINE (NEW BUILD)
- DEPTH CONTOUR -108'
- STATE WATERS BOUNDARY
- SAFETY ANCHORAGES
- PROTRACTION AREA
- SHIPPING FAIRWAY
- COUNTY / PARISH
- STATE BOUNDARY

BLUE MARLIN OFFSHORE PORT PROJECT
PROJECT OVERVIEW MAP

COUNTY/PARISH:	VARIOUS	DRAWN BY:	CA
STATE:	TX/LA	CHECKED BY:	CW
DATE:	2020/09/17	PROJECTION:	NAD 1983 UTM Zone 15N

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BLUE MARLIN OFFSHORE PORT PROJECT
FIGURE 4-1

DWG:	0802-01-005	SHEET:	1 OF 1

BMOP PROJECT - FIGURE 4-2 ONSHORE PROJECT COMPONENT OVERVIEW MAP

LEGEND

- MAINLINE VALVE
- NEDERLAND PUMP STATION
- STATION 501 (TO BE CONVERTED TO OIL SERVICE)
- STATION 701 (TO BE CONVERTED TO OIL SERVICE)
- EXISITNG NEDERLAND OIL TERMINAL
- STINGRAY TAP REMOVAL SITE
- EXISTING PIPELINE TO BE CONVERTED TO OIL SERVICE
- PROPOSED 42-INCH PIPELINE
- COUNTY / PARISH

BLUE MARLIN OFFSHORE PORT PROJECT

FIGURE 4-2 - ONSHORE PROJECT COMPONENT OVERVIEW MAP

COUNTY/PARISH:	VARIOUS	DRAWN BY:	CA
STATE:	TX/LA	CHECKED BY:	CW
DATE:	2020/09/17	PROJECTION:	NAD 1983 UTM Zone 15N

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BLUE MARLIN OFFSHORE PORT PROJECT
FIGURE 4-2

DWG:	0802-01-009	SHEET:	1 OF 1

4.1.1 Abandonment and Conversion of Existing Facilities

The Stingray Pipeline is currently comprised of a 36-inch pipeline (Mainline) that is fed natural gas and natural gas liquids by multiple lateral pipelines from various suppliers and producers that feed natural gas into the Mainline. Stingray transports natural gas and liquids on the Mainline from the WC 509 Platform Complex to the onshore compressor station facility (Station 701) near Holly Beach in Cameron, Louisiana, and northward approximately four additional miles to the NGPL/Stingray interconnect (Station 501). The Stingray facilities from WC 509 to Station 501 will be abandoned through a FERC 7(b) Order. This work will be completed by Stingray. Stingray will assign the existing right-of-way (ROW) Grant (and associated facilities—platforms at WC 148 and WC 509) to BMOP or another affiliate of ET for use in the BMOP Project. Details of the existing offshore Stingray Mainline facilities are provided in Topic Report 1 (Volume IIa).

4.1.2 Major Onshore Project Components

All facilities for the proposed BMOP Project will be designed, constructed, tested, operated, and maintained in accordance with the U.S. Department of Transportation (USDOT) regulations in 49 CFR Part 195 (Transportation of Hazardous Liquids by Pipeline) and all other applicable federal and state regulations. Details of the offshore supply components are provided in Topic Report 1 (Volume IIa). The Project will consist of construction and operation of the following onshore components:

<u>New Onshore Facilities</u>

- A new, approximate 37-mile, 42-inch OD pipeline connecting the existing NT in Jefferson County, Texas, to the existing 36-inch OD Mainline at Station 501 in Cameron Parish, Louisiana.
- A new pump station (BMOP Pump Station) located adjacent to the existing NT in Jefferson County, Texas at MP 0.0. The land where the BMOP Pump Station site is located is to be filled as part of the "Nederland Terminal Buildout Project," which is anticipated to commence construction in January 2021, prior to construction of the BMOP Project. The pump station will include:
    - A pipeline header;
    - MLV;
    - Metering and pump equipment;
    - Electrical substation; and
    - Permanent access road.
- Six new MLVs will be installed within the permanent pipeline right-of-way (ROW) of the new build pipeline. MLVs will also be installed at the BMOP Pump Station, Station 501, and Station 701. These valves will be used for isolation and spill control purposes.

<u>Conversion of Existing Onshore Facilities</u>

- The existing Station 501 is located at approximate MP 37 of the new 42-inch pipeline in Cameron Parish, Louisiana. All existing natural gas-related equipment owned by BMOP will be removed from the Station and new pipeline facilities will be installed. The new 42-inch pipeline will tie into the existing 36-inch Mainline at the site. The conversion of Station 501 will be expanded to include:
    - A pig receiver for the new 42-inch pipeline termination;
    - Pig launcher for existing 36-inch Mainline; and
    - MLV.
- The existing compressor Station 701 in Cameron Parish, Louisiana, located at approximate MP 3.9 on the converted Stingray Mainline in Cameron Parish, Louisiana, will be demolished. All existing

natural gas equipment will be removed from the Station except for several large 10,000-barrel storage tanks. Approximately 1,000 feet of new 36-inch pipe, surge tanks, surge valves, and a new MLV will be installed. The existing 10,000-barrel tanks located at Station 701 will be converted to surge relief tanks.

- The existing ANR Tap (Stingray Tap Removal Site) is located at approximate MP 1.6 on the converted Stingray Mainline in Cameron Parish, Louisiana (approximate MP 38.6 on the BMOP pipeline system). BMOP will install a 36-inch OD pipe segment following removal of the tap.
- The existing Mainline from Station 501 to the Station 701 will be converted to crude oil service.

Onshore Support Facilities

- Temporary use of existing pipe and contractor yards; and
- Use of existing public roads, highways, and canals and construction of new temporary and permanent access roads.

4.2 EXISTING ENVIRONMENT

The following sections describe the existing environment in regard to aquatic resources within the onshore Project area, and the fish and invertebrates inhabiting them. Topic Report 5 (Volume IIa) addresses the commercial and recreational fisheries onshore as well as offshore because the onshore fisheries are estuarine and part of the same fishery and landings data as the fisheries in nearshore waters of the GOM.

4.2.1 Aquatic Habitats

4.2.1.1 Waterbodies

All waterbodies traversed by the onshore portions of the Project are discussed in Topic Report 2, "Water and Sediment Quality and Use" (Volume IIb). Larger waterbodies traversed by the Project and discussed here from an aquatic resource perspective include Sabine Lake and the Neches River (**Figure 4-3**).

Sabine Lake

Sabine Lake is an estuary formed by the union of the Sabine River and Neches River. The lake is about 14 miles long, 7 miles wide. The lake has an average water depth of 6.6 feet, with maximum depths of approximately 10 feet occurring near Sabine Pass. A large shipping channel (Port Arthur Ship Canal) lies along the western shoreline, separated from the lake by Pleasure Island, which was formed with the dredged material. The channel is maintained to a depth of 40 feet by the U.S. Army Corps of Engineers (USACE) and is approximately 1,000 feet wide. The lake is connected to the GOM via the Sabine Pass, a dredged channel approximately 7 miles long. Sabine Lake is tidally influenced with a normal tidal range of 19.7-27.6 inches (Scrudato et al., 1976). Weirsma et al. (1976, in Calnan et al., 1981) reported mean monthly salinities in the lake of 0.1 to 10.6 parts per thousand (ppt). The Louisiana Department of Environmental Quality (LDEQ) (2020) reports that water quality in Sabine Lake supports all designated uses with the exception of oyster propagation, which is due to fecal coliform levels thought to be from natural causes / wildlife. The Texas Commission on Environmental Quality (TCEQ) (2020) lists Sabine Lake as impaired due to polychlorinated biphenyls (PCB) levels in edible tissues.

Neches River

The Neches River originates southeast of Dallas, Texas and flows southeastward for approximately 416 miles to Sabine Lake. The Lower Neches River from the Town Bluff Dam in Jasper County downstream to Sabine Lake has been nominated as an ecologically significant stream segment according to a process outlined in Texas Administrative Code (TAC) Section 357 and Texas Water Code (TWC) Section 16.051 (Norris and El-Hage, 2005). The river is dredged from its mouth upstream to the Port of Beaumont. Saltwater intrusion has occurred within Sabine Lake and the Neches River due to dredging and channelization. A saltwater barrier was constructed on the Neches River approximately 11 miles north of the Project crossing and is operated by the Lower Neches Valley Authority. Mean monthly discharges at the barrier location are provided in **Table 4-1**. TCEQ (2020) lists Neches River segment from Sabine Lake upstream to the saltwater barrier as impaired due to PCB levels (Texas Department of State Health Services, 2011) in edible tissues and impaired for recreation use due to bacteria in the water.

TABLE 4-1
Mean Monthly Discharge of the Neches River at the Saltwater Barrier

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge (ft^3/sec)	9,610	11,600	11,300	10,600	9,540	9,090	5,730	4,650	6,970	5,050	7,130	6,610

Notes: Data from USGS (2020c) for 6/2003 through 4/2020 at USGS gage 08041780 at the saltwater barrier accessed on 5/18/20 at: https://waterdata.usgs.gov/tx/nwis/uv/?site_no=08041780&PARAmeter_cd=00065,00060

4.2.1.2 Sediments

Project Benthic Habitat Surveys

Benthic habitat surveys are being conducted in all work areas associated with the Sabine Lake crossing. The primary purpose of these surveys is to determine what types of habitats are within the work area of the Sabine Lake crossing, and specifically to determine if any submerged aquatic vegetation (SAV) or oyster reef habitats will be affected by the Project. Survey protocols were developed in consultation with the Louisiana Department of Wildlife and Fisheries (LDWF), the Texas Parks and Wildlife Department (TPWD) and the National Marine Fisheries Service (NMFS) and are provided in **Volume IIb, Appendix D-3**. These benthic habitat surveys are being conducted in two phases, an initial hydrographic survey followed by quantification, ground-truthing, surveys. The initial hydrographic surveys have been conducted with a suite of geophysical equipment including side-scan sonar, sub-bottom profiler, and fathometer; where the water was too shallow for the vessel, the survey was conducted using visual and tactile (poling) methods. Benthic habitat types were then delineated using the hydrographic data. Preliminary mapping is provided in **Volume IIb, Appendix D-3** and are summarized in **Table 4-2**

TABLE 4-2
Benthic Habitat Types within the Sabine Lake Crossing Workspace

Benthic Habitat Type[a]	Acres within Workspace	Percent of Total Workspace
Soft to firm mud or sand	393.9	87
Buried shells, shell hash, or reef	45.3	10
Exposed shell	11.5	3
Total	450.7	100

Notes:
[a] Data from Project survey and delineation conducted by Benchmark Ecological Services, Inc.

Ground-truthing will be conducted at 280 selected locations within these mapped habitat types. Divers will conduct a quantification study at each location that includes recording the following information from within a 3.28-foot square quadrat: number of live and dead shell, box shell, and oyster measurements by 5 mm group sizes, number of distinct invertebrate predator species in each sample, number of fouling organisms by species, salinity, water temperature, and water depth. The quantitative studies are expected to be completed by November 2020 at which time a final report will be submitted to LDWF and TPWD.

Soft Bottom Sediments

With the exception of oyster reef areas, the floor of Sabine Lake consists of soft bottom sediments. These sediments are clayey silts, sandy silts, and silty sands with low organic content. Calnan et al. (1981) provided a map of Sabine Lake sediments indicating that the eastern half of the lake is silty with sand content below 20 percent while the western portion is 40-60 percent sand and the northern end of the lake near the entrance of the Sabine River is 60-100 percent sand. Data presented by Davies (2005) and attributed to Barry A. Vittor & Associates, Inc. (1997) for six surficial sediment samples for the body which show sand contents of 23-69 percent, gravel 0.0-0.1 percent, and total organic carbon content of 0.4-2.1 percent (remainder silt and clay). Project surveys indicate that approximately 87 percent of the workspace for the Sabine Lake crossing is within typical soft bottom habitats.

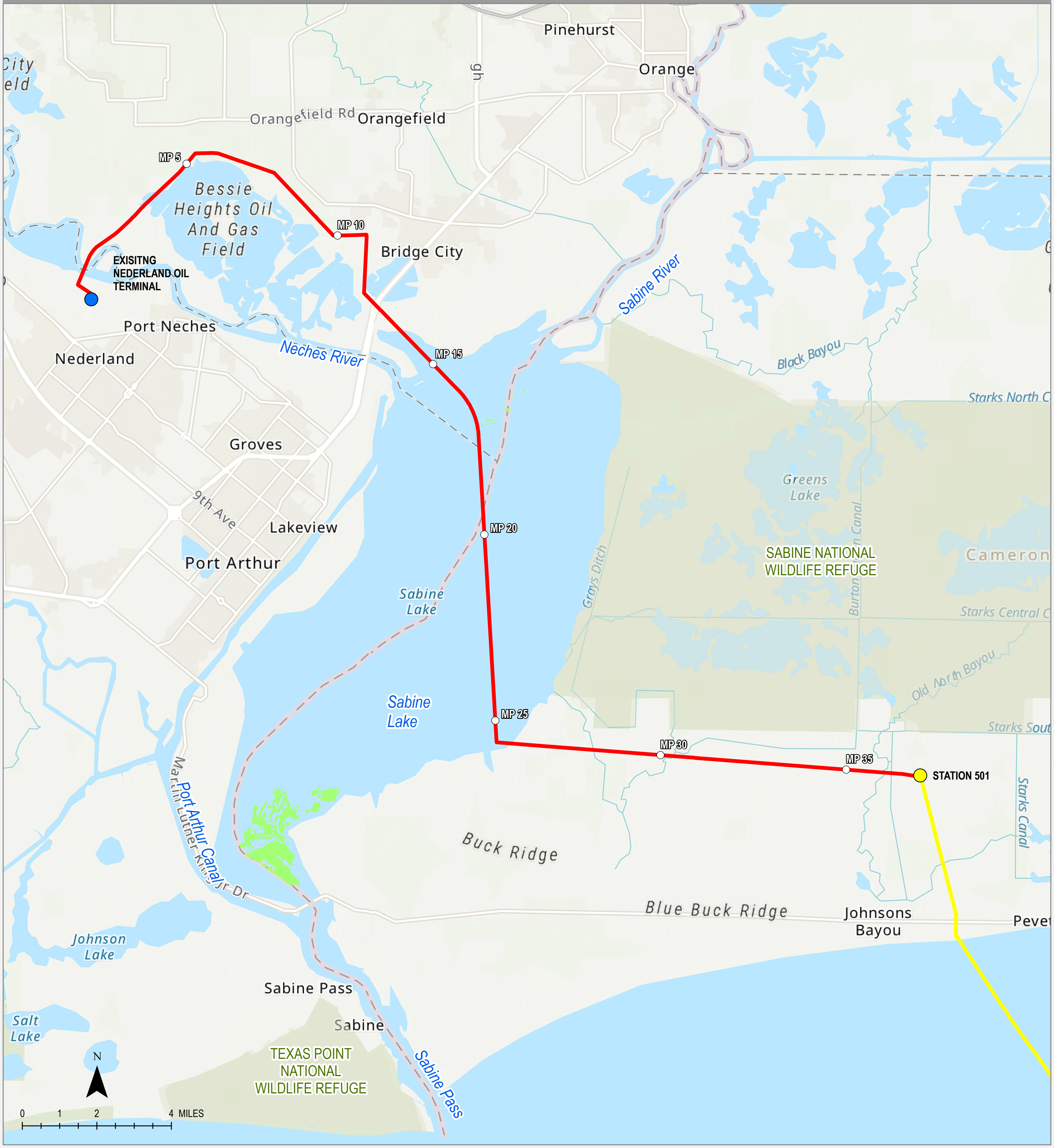
Long et al. (1999) assessed the sediment quality in surficial sediment samples from 66 locations in Sabine Lake and vicinity and concluded they did not appear to be severely degraded. Chemical concentrations rarely exceeded effects-based numerical guidelines, suggesting that toxicant-induced effects would not be expected in most areas. None of the samples was highly toxic in acute amphipod survival tests and a minority of samples was highly toxic in sublethal urchin fertilization tests.

Hard Bottom

The Sabine Lake Estuary houses an extensive oyster reef complex with no record of commercial harvest as far back as the 1960s (Moore, 2008). The reef is believed to have never been commercially harvested and is likely the largest oyster reef in the U.S. to remain in its natural, pristine state (Moore, 2008). The Sabine Lake oyster reef complex is unique in its vertical relief, reaching approximately 3.2 feet above the surrounding sediments. The reef is an estimated 3.9 square miles in total areal extent, with crest depth averaging around 10-13 feet below the water's surface (Morton, 1996). Location of the reef is shown in **Figure 4-3**.

Project geophysical surveys conducted to date have identified some areas of hard bottom in the form of buried and surficial shells / shell hash (see **Table 4-2**). These surveys revealed approximately 45 acres of buried shell or reef within the workspace for the Sabine Lake crossing, and approximately 11 acres of surficial shell. Field surveys are being conducted to determine the absence or presence and amount of live oysters within these habitats but have not yet been completed.

BLUE MARLIN OFFSHORE PORT PROJECT - FIGURE 4-3



VICINITY MAP

LEGEND

- MILE POST
- NEDERLAND TANK TERMINAL LOCATION
- STATION 501 (TO BE CONVERTED TO OIL SERVICE)
- EXISTING PIPELINE TO BE CONVERTED TO OIL SERVICE
- PROPOSED ONSHORE PIPELINE (NEW BUILD)
- USFWS NATIONAL WILDLIFE REFUGE
- OYSTER REEFS

DRAWING INFORMATION

DRAWN BY:	CA	COUNTY/PARISH:	N/A
CHECKED BY:	CW	STATE:	TEXAS/LOUISIANA
DATE:	9/21/2020	SHEET:	1 OF 1
DWG #:	0802-01-031	SCALE:	1:230,000

REVISIONS

PREPARED BY

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BLUE MARLIN OFFSHORE PORT PROJECT
FIGURE 4-3
Sabine Lake and the Neches River

4.2.1.3 Vegetation

Submerged Aquatic Vegetation (SAV)

True seagrasses are not found in Sabine Lake or the Neches River. Wigeon grass (*Ruppia maritima*) a submerged aquatic is sometimes considered a seagrass and does occur in Sabine Lake where it is found in bays and offshore of brackish marshes (USFWS, 2013; Guillen, et al., 2015). Its distribution and abundance within the lake has apparently not been mapped or quantified (Radloff et al., 2013). Benthic habitat surveys have been conducted for the Project. No wigeon grass or other SAV was found within the Project area or within 500 feet of the workspace. Details of the survey methods are provided in **Appendix D-3**.

Emergent Marsh

Most of the eastern and northern shores of Sabine Lake consists of emergent marsh of two types, brackish marsh found along most of the eastern shoreline, and intermediate marsh at the north end of the lake.

Brackish marsh is wetland dominated by emergent, salt-tolerant herbaceous vegetation where salinities average about 8 ppt and generally have lower vascular plant diversity than is found in marshes with lower salinities (Lester et al., 2005). Plant communities in brackish marsh are typically dominated by marsh hay cordgrass (*Spartina patens*), with varying densities of salt grass (*Distichlis spicata*), three-cornered grass (*Schoenoplectus olneyi*), saltmarsh bulrush (*S. robustus*), dwarf spikerush (*Eleocharis parvula*), seashore paspalum (*Paspalum vaginatum*), black needlerush (*Juncus roemarianus*), coastal water-hyssop (*Bacopa monnieri*), smooth cordgrass (*Spartina alterniflora*), and hogcane (*Spartina cynosuroides*) (Lester et al., 2005).

Intermediate, or oligohaline marshes, occur between fresh marsh and brackish marsh, with salinities between 3 and 10 ppt. Plant diversity also is intermediate between that of fresh and brackish marsh (Lester et al. 2005). Dominant emergent plant species in intermediate marsh include marsh hay cordgrass, roseau cane (*Phragmites australis*), bulltongue (*Sagittaria lancifolia*), coastal water-hyssop, Eleocharis spp., three-cornered grass, bullwhip (*Schoenoplectus californicus*), and *S. americanus*. Other plant species found there include wild cowpea (*Vigna luteola*), seashore paspalum, switchgrass (*Panicum virgatum*), sprangletop (*Leptochloa fascicularis*), camphorweed (*Pluchea camphorate*), coast cockspur (*Echinochloa walteri*), rusty flatsedge (*Cyperus odoratus*), southern naiad (*Najas guadalupensis*), hogcane, and Gulf cordgrass (*Spartina spartinae*) (LNHP, 2009). Alligator weed (*Alternanthera philoxeroides*) is a common exotic invader in this habitat type (USFWS, 2013).

4.2.2 Invertebrates

4.2.2.1 Sabine Lake

The benthic fauna across most of Sabine Lake is considered to have relatively low diversity, likely due to natural stress on the benthic communities due to freshwater inflow, variable salinity, and sediment type (low sand content).

Calnan et al. (1981) collected samples with a clam shell grabber at 32 stations across the lake and identified 14 species of molluscs, 12 species of polychaetes, 14 species of crustaceans, and 5 species from other groups. Barnacles (*Balanus* spp.), a polychaete (*Streblospio benedicti*) and the rangia clam (*Rangia cuneata*) accounted for over 50 percent of the numbers of invertebrates collected, with barnacles accounting for 34 percent.

Barry A. Vittor & Associates, Inc. (BVA, 1997) assessed the benthic macroinfauna at 22 sampling stations in the Sabine Lake estuary. Six of the stations (37, 41, 45, 48, 50, and 53) were located in Sabine Lake proper; others were located in Sabine Pass, the Sabine – Neches Waterway, Neches River, or Sabine River. A total of 10 to 20 taxa were identified at each of the samples. Infaunal density ranged from 48 to 250 organisms per square foot of water bottom (See **Table 4-3**). Similar to Calnan et al.'s (1981) findings, BVA (1997) found the benthic community to be dominated by molluscs (See **Table 4-4**). Three species, the rangia clam, the dark false mussel (*Mytilopsis leucophaeata*), and the aquatic snail (*Texadina sphinctostoma*) accounted for approximately half of all the organisms collected at these stations.

TABLE 4-3
Density of Benthic Macroinfauna in Sabine Lake

Station[a,b]	Sediment Type [a]	Sediment Consistency[a] (percent)				Benthic Infauna[a]		
		Gravel	Sand	Silt	Clay	Taxa (number)	Diversity (H')[a,c]	Density (ind/ft^2)
37	Silty sand	0.1	68.5	24.9	6.5	20	2.12	207
41	Clayey silt	0.1	26.5	48.3	25.1	10	1.93	48
45	Silty sand	0.0	69.1	25.3	5.6	28	2.47	250
48	Clayey silt	0.0	23.4	52.0	24.6	13	2.06	50
50	Silty sand	0.0	49.3	36.7	14.0	18	2.61	60
53	Sandy silt	0.0	44.4	38.4	17.2	20	2.35	83
Range	--	0.0 – 0.1	23.4-69.1	24.9-52.0	5.6-25.1	10-20	1.93-2.61	48-250
Mean	--	0.0	46.9	37.6	15.5	18	2.3	116

Notes:

[a] Data from Barry A. Vittor & Associates, Inc. (1997) who assessed benthic community at 20 sampling stations around Sabine Lake.

[b] Stations 37, 41, 45, 48, 50, and 53 were selected for this document as they are located in the lake proper, other samples were in Sabine Pass, the Sabine-Neches Waterway, Neches River, or Sabine River.

[c] Diversity is Pielou's Index H'.

TABLE 4-4
Benthic Macroinfauna in Sabine Lake

Taxon		Percent of Individuals in Sample by Station						
		37	41	45	48	50	53	Mean
Insects		**0.0%**	**11.5%**	**1.3%**	**6.6%**	**2.8%**	**1.9%**	**4.0%**
	Coelotanypus	0.0%	11.5%	0.0%	4.9%	2.8%	1.0%	3.4%
	Cryptochironomus	0.0%	0.0%	1.3%	1.6%	0.0%	1.0%	0.6%
Crustaceans		**2.3%**	**0.0%**	**4.4%**	**0.0%**	**9.7%**	**4.8%**	**3.5%**
	Xanthidae (mud crabs)	0.4%	0.0%	0.6%	0.0%	2.8%	1.9%	1.0%
	Callianassidae	1.2%	0.0%	0.3%	0.0%	6.9%	1.9%	1.7%
	Oedicerotidae	0.4%	0.0%	0.3%	0.0%	0.0%	1.0%	0.3%
	Aoridae	0.4%	0.0%	3.2%	0.0%	0.0%	0.0%	0.6%
Molluscs - Bivalves		**53.9%**	**50.8%**	**28.4%**	**37.7%**	**12.5%**	**36.2%**	**36.6%**
	Mactridae (surf clams)	30.9%	3.3%	0.6%	0.0%	0.0%	1.0%	6.0%
	Rangia cuneata	23.0%	32.8%	14.5%	24.6%	12.5%	17.1%	20.8%
	Mytiopsis leucophaeta	0.0%	14.8%	13.2%	13.1%	0.0%	18.1%	9.9%
Molluscs - Gastropods		**25.0%**	**21.3%**	**34.7%**	**34.4%**	**27.8%**	**28.6%**	**28.6%**
	Odostomia (sea snails)	0.0%	1.6%	0.0%	1.6%	0.0%	0.0%	0.5%
	Hydrobiidae (mud snails)	11.7%	8.2%	21.1%	3.3%	12.5%	4.8%	10.3%
	Texadina sphinctostoma	13.3%	11.5%	13.6%	29.5%	15.3%	23.8%	17.8%

TABLE 4-4
Benthic Macroinfauna in Sabine Lake

Taxon		Percent of Individuals in Sample by Station						
		37	41	45	48	50	53	Mean
Polychaetes		**9.4%**	**16.4%**	**27.8%**	**21.3%**	**41.7%**	**25.7%**	**23.7%**
	Mediomastus sp.	2.0%	0.0%	9.1%	1.6%	15.3%	8.6%	6.3%
	Mediomastus ambiseta	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%
	Nereididae	1.6%	0.0%	1.3%	0.0%	4.2%	0.0%	1.3%
	Nereis sp.	0.0%	0.0%	1.6%	0.0%	0.0%	1.0%	0.7%
	Dipolydora socialis	0.0%	1.6%	0.0%	1.6%	0.0%	0.0%	0.2%
	Parandalia tricuspis	3.9%	14.8%	9.5%	9.8%	8.3%	4.8%	7.6%
	Streblospio benedicti	1.6%	0.0%	1.6%	0.0%	5.6%	7.6%	2.4%
	Glycinde solitaria	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%
	Polydora cornuta	0.0%	0.0%	1.6%	0.0%	4.2%	0.0%	0.9%
	Laeonereis culveri	0.0%	0.0%	1.9%	0.0%	0.0%	1.9%	0.9%
	Hobsonia florida	0.0%	0.0%	0.3%	8.2%	2.8%	1.0%	1.0%
	Ampharetidae	0.4%	0.0%	0.3%	0.0%	1.4%	1.0%	0.5%
Nemerteans		**2.0%**	**0.0%**	**1.9%**	**0.0%**	**2.8%**	**0.0%**	**1.1%**
	Rhynchocoela (ribbon worms)	2.0%	0.0%	1.9%	0.0%	2.8%	0.0%	1.1%
Oligochaetes		**7.4%**	**0.0%**	**1.6%**	**0.0%**	**2.8%**	**2.9%**	**2.4%**
	Tubificoides heterochaetus	7.4%	0.0%	1.6%	0.0%	2.8%	2.9%	2.4%

Notes:
[a] Vittor & Associates (1997) provided assessment of benthic community at 20 sampling stations around Sabine Lake; dominant taxa were defined as all taxa representing 10 percent or more of the individuals in all 20 stations.
[b] Percentage abundance is the percent of all individuals in the station samples that are the referenced taxon.
[c] Data is from Vittor & Associates (1997) who provided assessment of benthic community at 20 sampling stations around Sabine Lake; Stations 37,41,45,48,50,and 53 were selected for this document as they are located in the lake proper, other samples were in Sabine Pass, the Sabine-Neches Waterway, Neches River, or Sabine River.

Nevins (2013) conducted epifaunal surveys at 30 locations in Sabine Lake in 2011-2013 with a modified epibenthic sled and compared the crustaceans found in oyster reef, soft bottom, and emergent marsh edge habitats. The most abundant crustaceans were grass shrimp (*Palaemonetes pugio*), penaeid shrimp (primarily brown shrimp and white shrimp), swimming crabs (primarily blue crab *Callinectus sapidus* and lesser blue crab *Callinectus similis*), and mud crabs (See **Table 4-5**). The blue crab, brown shrimp, and white shrimp are major components of the commercial fisheries; see discussions in Topic Report 5, "Commercial and Recreational Fisheries" (Volume IIa).

TABLE 4-5
Crustaceans Found in Southern Sabine Lake 2011-2013

Crustacean Species[a]	Relative Abundance (% of total caught)	Density (number / square meter)			
		Marsh Edge	Unvegetated Bottom		Oyster Reef
			Deep	Shallow	
Grass shrimp *Palaemonetes* spp	54.50%	23.96	0.08	1.09	0.23
Postlarval penaeid shrimp *Penaeidae*	32.47%	10.34	0.20	3.90	0.16
Brown shrimp *Farfantepenaeus* spp	3.29%	2.58	0.05	0.60	0.02
White shrimp *Litopenaeus setiferus*	3.18%	2.05	0.04	0.71	0.03
Swimming crab *Callinectus* spp	2.44%	0.73	0.04	0.52	0.03
Mud crabs *Xanthidae*	2.18%	0.33	0.05	0.31	0.10
Longeye shrimp *Ogyrides* spp	1.75%	0.50	0.18	--	0.04
Snapping shrimp *Alpheus heterochaelis*	0.08%	0.10	0.03	--	0.01
Porcelain crabs *Porcellanidae*	0.07%	--	--	--	0.02

TABLE 4-5 Crustaceans Found in Southern Sabine Lake 2011-2013					
Crustacean Species[a]	**Relative Abundance (% of total caught)**	**Density (number / square meter)**			
		Marsh Edge	**Unvegetated Bottom**		**Oyster Reef**
			Deep	**Shallow**	
Pea crabs *Pinixxa* spp	0.04%	--	0.03	--	0.01

Notes:
[a] Data from Nevins (2013) collected in 2011-2013 with a modified epibenthic sled at 30 locations within and near the oyster reef at the southern end of Sabine Lake.

A very large submerged oyster reef encompassing approximately 2,500 acres is located in the southern part of the lake (See **Figure 4-3**). No harvest of oysters occurs in the reef or elsewhere in Sabine Lake; however, the reef is part of a public oyster seed ground. Benthic habitat surveys have been conducted for the Project in Sabine Lake with one of the primary purposes being to determine whether there are oyster resources in or bear the Project area. Initial findings included the delineation of approximately 11 acres of water bottom with shell hash, shell, or reef at the surface (See **Table 4-2**). Planned field surveys to determine the presence or absence of oysters within these areas are on-going but have not yet been completed.

The seasonal abundance of invertebrate species in Sabine Lake that are especially important ecologically or for commercial and recreational fisheries are indicated in **Table 4-6**.

TABLE 4-6 Seasonal Abundance of Important Sabine Lake Invertebrates													
Species	**Life Stage[a,b]**	**Abundance / Presence in Sabine Lake by Month [a,c]**											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Brown Shrimp	A	-	-	-	-	C	C	C	C	C	C	-	-
	J	-	-	-	A	A	A	A	A	C	C	C	-
	L	-	-	-	A	A	-	-	-	-	-	-	-
White Shrimp	A	A	A	A	R	R	R	A	A	**HA**	**HA**	**HA**	A
	J	-	-	-	-	HA	HA						
	L	-	-	-	-	HA	HA	-	-	-	-	-	-
Grass Shrimp	A	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA
	S	A	A	HA	HA	HA	HA	HA	HA	HA	HA	HA	A
	J	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA
	L	A	A	HA	HA	HA	HA	HA	HA	HA	HA	HA	A
	E	A	A	HA	HA	HA	HA	HA	HA	HA	HA	HA	A
Blue Crab	A	C	A	HA	HA	HA	HA	HA	HA	HA	HA	HA	
	M	-	-	A	A	A	A	A	A	A	A	A	-
	J	C	A	A	A	A	A	A	A	A	A	C	C
	L	-	-	A	A	A	A	A	A	A	A	A	-
American Oyster	A	R	R	R	R	R	R	R	R	R	R	R	R
	S	-	R	R	R	R	R	R	R	R	R	-	-
	J	R	R	R	R	R	R	R	R	R	R	R	R
	L	-	R	R	R	R	R	R	R	R	R	R	R
	E	-	R	R	R	R	R	R	R	R	R	R	R

TABLE 4-6 Seasonal Abundance of Important Sabine Lake Invertebrates													
Species	**Life Stage[a,b]**	**Abundance / Presence in Sabine Lake by Month [a,c]**											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Rangia Clam	A	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA
	S	-	-	-	HA	HA	HA	HA	HA	HA	HA	-	-
	J	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA	HA
	L	-	-	-	HA	HA	HA	HA	HA	HA	HA	-	-
	E	-	-	-	HA	HA	HA	HA	HA	HA	HA	-	-

Notes:
[a] Data from Nelson et al. 1992
[b] Life stages are A = adult, S = spawning adults, S = spawning, J = juveniles, L = larvae, E = eggs
[c] Abundance is HA = highly abundant, A = abundant, C = common, R = rare event.

4.2.2.2 Neches River

A number of sampling programs have been conducted in the lower Neches River, which provide data on its invertebrate fauna. The Academy of Natural Sciences (2006) has been conducting biological surveys in the lower Neches River at intervals since 1953, with sampling events on 1953, 1956, 1960, 1973, 1996, and 2003. In 2003, they collected macroinvertebrates at four stations (Stations 1-4) along the lower Neches River with Station 3 located approximately 0.2 miles upstream and Station 4 located approximately 2.4 miles downstream of the Project crossing. The sampling was conducted using bag seines, otter trawls, dip nets, and by hand. A total of 40 species were collected at Station 3 and 41 species at Station 4 (See **Table 4-7**). The authors noted that the increase in abundance and diversity since beginning the monitoring program in 1953 were indicative of improvements in water quality, with most such improvement occurring between 1973 surveys and the 1996 and 2003 surveys. Harrel and Smith (2002) conducted quantitative assessments of the benthic macroinvertebrates at stations within the same river reach in 1971-1972, 1984-1985, and 1999, and also reported increases in macroinvertebrate abundance and diversity, which they ascribed to water quality improvement.

TABLE 4-7 Macroinvertebrates in the Lower Neches River near the Project Crossing			
Taxonomic Group[a]	**Station 3 Species[a]**	**Station 4 Species[a]**	**Abundant / Common / Moderately Common Species[a,b]**
Annelid	3	3	tubicolus polychaete *Ficopomatus miamensis*
Mollusk – gastropod	--	1	tadpole physa *Physella gyrina*
Mollusc – bivalve	3	2	Atlantic rangia *cuneata*, dark false mussel *Miathyria marcella,* Carolina marshclam (Station 3 only) *Polymesoda caroliniana*
Insect	17	15	dragonflies, damselflies, waterboatman, biting midges
Crustacean – barnacle	1	1	barnacle *Balanus subalbidus*
Crustacean – mysid	1	1	opossum shrimp *Mysidopsis almyra*
Crustacean – isopod	1	5	sea pill bug (not common in Station3) *Sphaeroma terebrans*
Crustacean – amphipod	7	7	scuds e.g. *Gammarus mucronatus, G. tirginus, G. bonnieroides* (Station 3 only)
Crustacean – shrimp	2	2	white shrimp *Litopenaeus setiferus,* daggerblade grass shrimp *Palaemonetes pugio*
Crustacean – crabs	5	4	blue crab *Callinectus sapidus,* Harris mud crab *Rhithropanopeus harrisii,* heavy marsh crab (Station 4 only) *Sesarma reticulatum,*

TABLE 4-7 **Macroinvertebrates in the Lower Neches River near the Project Crossing**			
Taxonomic Group[a]	**Station 3 Species[a]**	**Station 4 Species[a]**	**Abundant / Common / Moderately Common Species[a,b]**
			squareback marsh crab *Armases cinereum,* spined fiddler crab *Uca spinicarpa*

Notes:
[a] Data from The Academy of Natural Sciences (2006) for Station 4.
[b] Species listed are moderately common (4-5 individuals collected), common (16-30 collected), or abundant (> 31 collected) as identified by the authors.

4.2.3 Fish

4.2.3.1 Sabine Lake Fish

Aquatic habitats of Sabine Lake are used by a large number of fish species. Results of surveys conducted in the lake reveal the common species, but the species vary according to the location and type of equipment used in the surveys, with some equipment being more efficient at collection of either the smaller or larger species. Nevins (2013) conducted fish surveys with a modified epibenthic sled at 30 locations in Sabine Lake in 2011-2013 and compared fish use of oyster reef, soft bottom, and emergent marsh edge habitats. The Atlantic croaker was the most abundant fish in all habitats, followed by the red drum (See **Table 4-8**). Other species commonly captured during the study included darter goby, naked goby, bay anchovy, black drum, silver perch, pinfish, and bay whiff.

The Texas Parks and Wildlife Department (TPWD) routinely conducts surveys in Sabine Lake using bag seines and gill nets. Results of an analysis of these data are presented in **Table 4-9** and indicate red drum, Gulf menhaden, gizzard shad, Atlantic croaker, bay anchovy black drum, white mullet, hardhead catfish, striped mullet, spotted seatrout, red drum, alligator gar, pinfish, Atlantic croaker, inland silverside, and striped mullet are the most abundant fish species in the lake. Black drum and mullet are commercially fished in Sabine Lake; the red drum, Atlantic croaker, black drum, and spotted seatrout are important species in the recreational fishery that takes place in the lake; see Topic Report 5 (Volume IIa) - Commercial and Recreational Fisheries.

TABLE 4-8 **Fish Density by Habitat Type in Lower Sabine Lake in 2011-2013**					
Fish Species [a]	**Relative Abundance (% of total caught)**	**Fish Density (number / square meter)**			
		Marsh Edge	**Unvegetated Bottom**		**Oyster Reef**
			Deep	**Shallow**	
Atlantic croaker *Micropogonias undulatus*	43.87%	4.12	0.11	0.62	0.60
Red drum *Sciaenops occelatus*	17.17%	3.03	0.06	0.62	0.04
Darter goby *Ctenogobius boleosoma*	9.56%	0.34	0.06	0.57	0.03
Naked goby *Gobiosoma bosc*	9.56%	0.87	0.04	0.24	0.03
Bay anchovy *Anchoa mitcheli*	4.25%	0.88	-	0.17	0.02
Black drum *Pogonias cromis*	4.22%	1.53	0.06	0.10	0.02
Silver perch *Bairdiella chrysoura*	4.06%	1.21	-	0.38	-
Pinfish *Lagodon rhomboides*	1.29%	0.29	-	0.14	-
Bay whiff *Citharichthys spilopterus*	1.17%	-	0.04	0.15	0.03
Skilletfish *Gobiesox strumosus*	1.09%	0.28	0.01	0.13	0.01
Green goby *Microgobius thalassinus*	0.98%	-	0.04	-	0.01
Blackcheek tonguefish *Symphurus plagiusa*	0.59%	-	0.04	0.10	0.03
Southern kingfish *Menticirrhus americanus*	0.47%	0.24	-	-	-

TABLE 4-8
Fish Density by Habitat Type in Lower Sabine Lake in 2011-2013

Fish Species [a]	Relative Abundance (% of total caught)	Fish Density (number / square meter)			
		Marsh Edge	Unvegetated Bottom		Oyster Reef
			Deep	Shallow	
Spotted seatrout *Cynoscion nebulosus*	0.43%	0.23	-	-	0.03
Striped mullet *Mugil cephalus*	0.35%	0.14	-	0.10	-
Ladyfish *Elops saurus*	0.16%	0.10	-	0.10	-
Shrimp eel *Ophichthus gomesii*	0.16%	-	0.02	-	-
Pipefish *Syngnathus* spp	0.16%	0.15	-	-	0.01
Gulf menhaden *Brevoortia patronus*	0.12%	0.10	-	0.10	-
Feather blenny *Hypsoblennius hentz*	0.08%	-	0.01	-	0.01
Inland silverside *Menidia beryllina*	0.08%	0.10	-	-	-
Emerald Sleeper *Erotelis smaragdus*	0.04%	0.01	-	-	-
Spot *Leiostomus xanthurus*	0.04%	-	-	0.10	-
Blackwing searobin *Prionotus rubio*	0.04%	0.10	-	-	-
Least puffer *Sphoeroides parvus*	0.04%	-	-	-	0.01
Inshore lizardfish *Synodus foetens*	0.04%	0.10	-	-	-

Notes:
[a] Data from Nevins (2013) collected in 2011-2013 with a modified epibenthic sled at 30 locations within and near the oyster reef at the southern end of Sabine Lake.

TABLE 4-9
Relative Abundance of Fish Species Caught in Fish Surveys in Sabine Lake

Gill Net		Bag Seine	
Fish Species[a]	Relative Abundance[b]	Fish Species[a]	Relative Abundance[b]
Red drum *Sciaenops occelatus*	20.82%	Gulf menhaden *Brevoortia patronus*	33.69%
Gizzard shad *Dorosoma cepedianum*	15.25%	Atlantic croaker *Micropogonias undulatus*	20.92%
Gulf menhaden *Brevoortia patronus*	11.60%	Bay anchovy *Anchoa mitcheli*	7.74%
Black drum *Pogonias cromis*	11.34%	White mullet *Mugil curema*	5.69%
Hardhead catfish *Ariopsis felis*	7.69%	Striped mullet *Mugil cephalus*	5.10%
Spotted seatrout *Cynoscion nebulosus*	6.65%	Red drum *Sciaenops occelatus*	4.00%
Alligator gar *Atractosteus spatula*	6.59%	Pinfish *Lagodon rhomboides*	3.25%
Atlantic croaker *Micropogonias undulatus*	6.07%	Inland silverside *Menidia beryllina*	3.07%
Striped mullet *Mugil cephalus*	5.30%	Spotfin mojarra *Eucinostomus argenteus*	2.16%
Bull shark	3.22%	Hardhead catfish *Ariopsis felis*	1.82%
Spot *Leiostomus xanthurus*	2.27%	Ladyfish *Elops saurus*	1.68%
Southern flounder *Paralichthys lethostigma*	0.91%	Gulf killifish *Fundulus grandis*	1.56%
Threadfin shad *Dorosoma petenense*	0.86%	Spot *Leiostomus xanthurus*	1.37%
Spanish mackerel *Scomberomorus maculatus*	0.56%	Sand seatrout *Cynoscion arenarius*	1.13%
Ladyfish *Elops saurus*	0.38%	Scaled sardine *Harengula jaguana*	0.91%
Skipjack herring *Alosa chrysochloris*	0.15%	Rough silverside *Membras martinica*	0.88%
Sand seatrout *Cynoscion arenarius*	0.10%	Atlantic needlefish *Strongylura marina*	0.64%
Yellow bass *Morone mississippiensis*	0.09%	Leatherjacket *Oligoplites saurus*	0.62%
Atlantic spadefish *Chaetodipterus faber*	0.06%	Bay whiff *Citharichthys spilopterus*	0.57%
Gray snapper *Lutjanus griseus*	0.04%	Black drum *Pogonias cromis*	0.52%
Harvestfish *Peprilus alepidotus*	0.03%	Threadfin shad *Dorosoma petenense*	0.42%
		Silver perch *Bairdiella chrysoura*	0.38%

TABLE 4-9 **Relative Abundance of Fish Species Caught in Fish Surveys in Sabine Lake**			
Gill Net		**Bag Seine**	
Fish Species[a]	**Relative Abundance[b]**	**Fish Species[a]**	**Relative Abundance[b]**
		Crevalle jack *Caranx hippos*	0.32%
		Sheepshead minnow *Cyprinodon variegatus*	0.30%
		Spotted seatrout *Cynoscion nebulosus*	0.28%
		Naked goby *Gobiosoma bosc*	0.21%
		Southern flounder *Paralichthys lethostigma*	0.13%
		Atlantic bumper *Chloroscombrus chrysurus*	0.08%
		Spotted gar *Lepisosteus oculatus*	0.08%
		Sheepshead *Archosargus probatocephalus*	0.07%
		Gafftopsail catfish *Bagre marinus*	0.06%
		Gizzard shad *Dorosoma cepedianum*	0.06%
		Southern kingfish *Menticirrhus americanus*	0.06%
		Inshore lizardfish *Synodus foetens*	0.06%
		Star drum *Stellifer lanceolatus*	0.06%
		Striped anchovy *Anchoa hepsetus*	0.04%
		Atlantic spadefish *Chaetodipterus faber*	0.03%
		Bighead searobin *Prionotus tribulus*	0.02%

Notes:
[a] From Texas Parks and Wildlife Department (USGS, 2020a, 2020b) data collected 2006-2008 in Sabine Lake north of latitude 29.800.
[b] Relative abundance calculated from the relative density / catch per unit effort data for all finfish species captured during the time period.

The seasonal abundance of fish species in Sabine Lake that are especially important ecologically or for commercial and recreational fisheries are indicated in **Table 4-10.**

TABLE 4-10 **Seasonal Abundance of Selected Fish Species in Sabine Lake**													
Species	**Life Stage**	**Abundance / Presence in Sabine Lake by Month**											
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Bull Shark	A	-	-	-	-	-	-	-	-	-	-	-	-
	M	-	-	-	-	-	-	-	-	-	-	-	-
	J	-	-	-	R	R	R	R	R	R	-	-	-
	P	-	-	-	-	-	-	-	-	-	-	-	-
Gulf Menhaden	A									C	C	C	
	S												
	J	C	C	C	C	C	HA	HA	HA	A	A	A	
	L												
	E												
Gizzard Shad		C	C	C	C	C	C	C	C	C	C	C	C
		-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-
Bay Anchovy	A	C	C	A	A	A	A	A	A	A	C	C	C
	S	-	-								-	-	-

TABLE 4-10
Seasonal Abundance of Selected Fish Species in Sabine Lake

Species	Life Stage	Abundance / Presence in Sabine Lake by Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	J	C	C	A	A	A	A	A	A	A	A	A	C
	L	-	-	C	C	C	C	C	C	C	-	-	-
	E	-	-	C	C	C	C	C	C	C	-	-	-
Gray Snapper	A	-	-	-	-	-	-	-	-	-	-	-	-
	S	-	-	-	-	-	-	-	-	-	-	-	-
	J	-	-	-	-	-	-	-	-	-	-	-	-
	L	-	-	-	-	-	-	-	-	-	-	-	-
	E	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Seatrout	A	R	R	R	R	R	R	R	R	R	R	R	R
	S	-	-	-	R	R	R	R	R	R	R	-	-
	J	R	R	R	R	R	R	R	R	C	C	C	R
	L	C	C	C	C	C	C	C	C	C	C	C	C
	E	-	-	-	R	R	R	R	R	R	-	-	-
Atlantic Croaker	A	R	R	R	R	R	R	R	R	A	A	A	C
	S	-	-	-	-	-	-	-	-	-	-	-	-
	J	A	A	A	A	A	A	A	A	A	A	A	A
	L	-	-	-	-	-	-	-	-	-	-	-	-
	E	-	-	-	-	-	-	-	-	-	-	-	-
Black Drum	A	R	R	R	R	R	R	R	R	R	R	R	R
	S	-	-	-	-	-	-	-	-	-	-	-	-
	J	C	C	C	C	C	C	C	C	C	C	C	C
	L	-	-	-	-	-	-	-	-	-	-	-	-
	E	-	-	-	-	-	-	-	-	-	-	-	-
Red Drum	A	R	R	R	R	R	R	R	R	R	R	R	R
	S	-	-	-	-	-	-	-	-	-	-	-	-
	J	C	C	C	C	C	C	C	C	C	C	C	C
	L	-	-	-	-	-	-	-	-	-	-	-	-
	E	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
[a] Data from Nelson et al., 1992
[b] Life stages are A = adult, S = spawning adults, S = spawning, J = juveniles, L = larvae, E = eggs
[c] Abundance is HA = highly abundant, A = abundant, C = common, R -= rare event.

4.2.3.2 Neches River Fish

The Academy of Natural Sciences (2006) conducted fish surveys using bag seines, otter trawls, and dip nets at four stations (Stations 1-4) along the lower Neches River with Station 1 being located approximately 3.4 miles upstream of Interstate 10. One station (Station 3) was located approximately 0.2 miles upstream of the proposed Project crossing, and another, Station 4, was located approximately 2.4 miles downstream of the Project crossing. Fish species captured during the survey as Stations 3 and 4 are listed in **Table 4-11** in order of individuals captured. Over 95 percent of all fish captured at both stations were bay anchovies. Looking at the results of surveys at all four stations, the Academy of Natural Sciences (2006) reported that the species captured reflected a clear estuarine gradient with several freshwater species being common at Station 1 and not found at Station 4. Similarly, a number of estuarine species such as the gulf menhaden, sailfin molly, star drum, and bay whiff were found only at Station 4.

The bay anchovy is an important forage fish but is not fished for in the GOM for commercial or recreational purposes. It is considered the most abundant species of fish in the estuarine waters of northern GOM (Robinette, 1983), with abundance in GOM estuaries varying seasonally as they migrate to deeper waters of the inner Continental Shelf in winter (Griffith and Bechler, 1995). In the GOM peak abundance varies from spring through early winter (Robinette, 1983; Ross et al., 1987; Modde and Ross 1983). In East Galveston Bay, peak abundance occurs from Apri1 to June (Arnold et al., 1960) with Galveston Bay showing an abundance of adults and juveniles from May to November (Nelson et al., 1992; Patillo et al., 1997). In Sabine Lake, adult and juvenile bay anchovies *A. mirchilli* are found from March through October, with juveniles present into November (Nelson et al., 1992; Patillo et al., 1997).

TABLE 4-11
Fish Species in the Neches River Near the Project Crossing

Fish Species[a]	Percent of Total Individuals Captured[b]		
	Station 3[c]	Station 4[d]	Both Stations
Bay anchovy *Anchoa mitchilli*	93.72%	96.93%	96.42%
Sailfin molly *Poecilia latipinna*	--	0.89%	0.75%
Tidewater silverside *Menidia beryllina*	3.59%	0.10%	0.65%
Sand seatrout *Cynoscion arenarius*	1.53%	0.44%	0.61%
Western mosquito fish *Gambusia affinis*	0.04%	0.67%	0.57%
Sheepshead minnow *Cyprinodon variegatus*	--	0.42%	0.35%
Star drum *Stellifer lanceolatus*	0.04%	0.16%	0.14%
Darter goby *Gobionellus boleosoma*	--	0.17%	0.14%
Spot *Leiostomus xanthurus*	0.34%	0.06%	0.10%
Threadfin shad *Dorosoma petenense*	0.11%	0.03%	0.04%
Gulf menhaden *Brevoortia patronus*	--	0.04%	0.03%
Hard head catfish *Arius felis*	--	0.04%	0.03%
White mullet *Mugil curema*	--	0.03%	0.02%
Blue catfish *Ictalurus furcatus*	0.15%	--	0.02%
Rainwater killifish *Lucania parva*	0.04%	0.01%	0.01%
Silver jenny *Eucinostomus gula*	0.04%	0.01%	0.01%
Sheepshead *Archosargus probatocephalus*	0.04%	0.01%	0.01%
Atlantic croaker *Micropogonias undulatus*	0.07%	--	0.01%
Silver seatrout *Cynoscion nothus*	0.07%	--	0.01%
Fat sleeper *Dormitator maculatus*	0.04%	0.01%	0.01%
Bay whiff *Citharichthys spilopterus*	--	0.01%	0.01%
Least killifish *Heterandria formosa*	0.04%	--	0.01%
Black bullhead *Ameiurus melas*	0.04%	--	0.01%
Spotted seatrout *Cynoscion nebulosus*	0.04%	--	0.01%
Mullet *Mugil* sp.	0.04%	--	0.01%
Freshwater goby *Gobionellus shufeldti*	0.04%	--	0.01%

Notes:
[a] Data is from The Academy of Natural Sciences (2006); all species with at least one individual captured by seine, trawl, or dip net are listed.
[b] Percent of individuals captured out of a total of 16,809 fish captured.
[c] Station 3 located in Neches River approximately 0.2 miles upstream of Project crossing.
[d] Station 4 located in Neches River approximately 2.4 miles upstream of the Project crossing.

4.3 ENVIRONMENTAL CONSEQUENCES

This section includes a discussion of the potential impacts that could result from the construction and operation of the onshore components of the Project. The study area within which potential impacts were assessed includes the area that would be affected physically by Project activities during construction and operation. As described in **Table 1-10** in **Section 1.10.2** (Evaluation Criteria) of Topic Report 1 (Volume IIb), the Project's effects on wildlife and protected species have been evaluated based on their potential to:

- Violate a legal standard for protection of a species or its critical habitat;
- Degrade the commercial, recreational, ecological, or scientific viability or significance of a biological resource or its critical habitat;
- Introduce new, invasive, or disruptive species in the proposed Project area; and/or
- Measurably change the population size (density) or change the distribution of an important species in the region.

Activities associated with the construction, operation, and decommissioning of the onshore pipeline components that may have environmental consequences on wildlife and protected species are included in **Table 4-12**. The following sections provide further information and discussion of potential environmental consequences on aquatic resources. Potential effects on commercial and recreation fisheries with landings are discussed in Topic Report 5 (Volume IIa). Potential effects on Essential Fish Habitat (EFH) are described in detail in Appendix D, "EFH Assessment," of Topic Report 6 (Volume IIa). Potential effects on marine mammals in Sabine Lake are described in detail in Appendix E, "Marine Mammal Protection Act (MMPA) Assessment" (Volume IIa).

TABLE 4-12
Potential Impacts on Inshore Aquatic Resources

Activity	Details	Duration of Impact	Mitigation Measures	Anticipated Level of Impact
Construction				
Pipeline Construction Sabine Lake Crossing	• Water bottom habitat modification. • Direct mortality of non-motile fish and invertebrates. • Increased TSS, turbidity, decreased DO. • Entrainment of fish and invertebrates. • Increased noise and discharges from vessel traffic and equipment. • Inadvertent spill, decreased water quality	Short-term to long-term	• Onshore Construction BMPs • SPAR Plan • Compliance with USACE Permit conditions • HDDs of the Neches River, north Sabine Lake shore crossing, ICWW, and foreign pipeline crossing	Negligible to minor and localized
HDD	• Water bottom habitat modification – pit excavation, drilling fluid release. • Inadvertent returns of drilling fluids.	Short-term	• Geotechnical investigations • HDD Contingency Plan • Onshore Construction BMPs	Negligible to minor and localized

TABLE 4-12
Potential Impacts on Inshore Aquatic Resources

Activity	Details	Duration of Impact	Mitigation Measures	Anticipated Level of Impact
			• SPAR Plan • Compliance with USACE Permit conditions	
Hydrostatic Testing	• Entrainment and impingement of eggs, larvae, juvenile fish and invertebrates. • Increased turbidity and suspended solids from discharge.	Short-term	• Onshore Pipeline Construction BMPs • No chemical additives • Discharged to source waterbody • Screening and placement of hydrostatic test water intakes	Negligible to minor and localized
Operations				
Inspections / Repairs / Lowering	• Same as Pipeline Construction but smaller scale / shorter duration,	Short-term to long-term	• Onshore BMPs • SPAR Plan • USACE Permit conditions	Negligible to minor and localized
Upsets and Accidents				
Onshore Pipeline Operations	• Accidental spills • Water quality / habitat modification. • Direct mortality.	Short-term to long-term	• Compliance with Energy Transfer's Coastal Louisiana Pipeline Facility Response Plan (PHMSA Sequence No. 3202), modified to include BMOP • Continuous monitoring of pipeline operations, SCADA, early detection of abnormal operations, and remote shutdown	Minor to major depending on release volume
Decommissioning				
Onshore Pipeline Decommissioning	• Pipeline abandoned in-place	Short-term	• Onshore BMPs • SPAR Plan • MARAD conditions	None

4.3.1 Construction and Installation

4.3.1.1 Onshore Pipeline Construction

Water Bottom Disturbance

The new onshore pipeline will be installed across approximately 12.3 miles of Sabine Lake. The northern Sabine Lake shore crossing will be installed using horizontal direction drill (HDD) technology and the southern shore crossing will be installed using the push/pull method of pipeline construction. An existing foreign pipeline within the lake and the Intracoastal Waterway (ICWW) will be crossed using HDD technology. The remainder of the Sabine Lake crossing will be constructed using the lay barge or push/pull (i.e., open-cut) methods. The Neches River will be crossed using the HDD method.

Motile fish and benthos such as the shrimp (grass shrimp, brown shrimp, white shrimp) and crabs (blue crab and other *Callinectes* species, mud crabs, and pea crabs) may be able to avoid the trenching process (Stevens, 1981), although less mobile larval forms may not be able to. Clamshell dredges have the lowest entrainment rates of any dredge type and also the lowest mortality associated with entrainment. USACE (2001) reported a 10 percent mortality rate for Dungeness crabs entrained by clamshell dredges.

Most sessile benthic infauna in these areas may be killed, either crushed or smothered during the excavation, stock-piling, and burial process. Soft bottom in-fauna in Sabine Lake consists largely of molluscs, crustaceans, and polychaetes, with barnacles, rangia clams, and some polychaetes being dominant organisms. Recovery of the benthic communities would be expected to be rapid given the composition of communities and the habitat type. Recovery of much of the community would occur within weeks or months. These impacts to fish and invertebrates will be minor given the small area and type of habitat affected but long-term based on expected recovery rates of weeks to months.

All Sabine Lake water bottoms that will be directly affected by the pipeline crossing are within areas designated as EFH for shrimp, reef fish, red drum, coastal migratory pelagics, bull shark, and spinner shark. The species and life stages of these species included in the EFH designations are indicated in **Table 4-13**. Potential effects on EFH due to the Sabine Lake crossing as analyzed in Appendix D, "EFH Assessment," (Volume IIa) will be minor but long-term due to the time required for recovery of benthic invertebrates in the EFH areas.

TABLE 4-13
EFH in the Sabine Lake Areas to be Disturbed by Pipeline Installation

EFH	Species	Life Stages
Shrimp	Brown shrimp	Larvae and juveniles[a]
	White shrimp	Eggs, larvae, and juveniles[a]
	Pink shrimp	Larvae and juveniles[a]
Reef fish	Gray snapper	Adults[a]
	Lane snapper	Larvae, juveniles, and adults[a]
Red drum	Red drum	Larvae, juveniles, and adults[a]
Coastal pelagics	Spanish mackerel	Juveniles[a]
Bull shark	Bull shark	Neonates / YPY, juveniles, adults
Spinner shark	Spinner shark	Neonates / YOY

Notes:
[a] Life stages based on descriptions in GMFMC, 2016

Suspended Sediments

The floatation channel and pipeline trench for pipeline installation in Sabine Lake will be excavated with a barge mounted clamshell dredge or similar excavator. Spoil will be temporarily side cast in Sabine Lake during the pre-pipelay trenching and then placed back in the trench on the pipeline post pipelay using the same equipment. Approximately 1,073,230 cubic yards of Sabine Lake sediments consisting of silts, clays, and sands, will be excavated, side-cast, and replace, resulting in increased total suspended solid (TSS) concentrations and turbidity, and decreased dissolved oxygen concentrations in the water column. Davies (2005) conducted modeling of suspended sediment plumes from pipeline trenching in Sabine Lake for a similar project and predicted critical plumes (>25 milligrams per liter (mg/L)) on the order of 1,640 feet wide and 1,640-3,280 feet long depending on current hydrologic conditions but noted ambient TSS levels of 40 mg/L. Above ambient TSS loads could remain for a few hours to a couple days after excavation is stopped. Herbich and Brahme (1999) and Anchor Environmental (2003) provided reviews of published information on TSS concentrations from the use of clamshells and reported maximum TSS concentrations of 150-500 mg/L, with TSS concentrations often returning to normal within 500 meters. These reported TSS concentrations are below levels known to have adverse effects on fish (typically 1,000 mg/L; NOAA, 2020f); however, larvae may be more susceptible.

Sabine Lake waters have relatively high TSS concentrations and are subject to much higher concentrations during storm events. Most of the invertebrate and fish are accustomed to or can tolerate high TSS concentrations. White shrimp, brown shrimp, blue crab, and others may actually prefer or be attracted to turbid waters including those associated with dredging (Palermo et al., 1990; May, 1973). Dissolved oxygen concentrations at clamshell dredging sites are generally not low enough to be detrimental to fish or shellfish (Palermo et al., 1990) but demersal eggs are of concern. The decreases in dissolved oxygen are very short-term events and motile organisms can avoid the area (Palermo et al., 1990). Deposition of the suspended sediments could also have deleterious effects on sessile invertebrates and eggs. Sabine Lake sediments are considered uncontaminated, but deposition can result in smothering of sessile infauna and demersal eggs. Pipelay across Sabine Lake is expected to take approximately 150 days with most TSS / turbidity effects ameliorating within hours. The effects of re-deposited sediments may last weeks or months depending on weather events and re-colonization rates. Effects on fish and invertebrates from sediment suspended by the pipeline installation and/or redeposited during construction of the Sabine Lake crossing will be minor and short-term to long-term.

Underwater Noise

Underwater sound generated by the trenching will not be sufficient to cause physiological damage or injury but may be sufficient to result in avoidance of the immediate area. The analysis of potential effects of underwater sound on fish Appendix D, "EFH Assessment," (Volume IIa), indicates that underwater sound levels will be reduced through transmission loss to less than 150 dB (effective quite – lack of fish behavioral response; NMFS GARFO, 2019) within a distance of 27 feet. Use of these areas by fish would be expected to resume immediately after activity cessation. These effects will be negligible given the small area affected and short-term.

Invasive Species

Exotic plant communities, invasive species, and noxious weeds can out-compete and displace native species, thereby negatively altering the appearance, composition, and habitat value of affected areas. In order to minimize the spread of invasive species in aquatic habitats, the Applicant will construct the Project in compliance with its Project-specific Onshore Construction BMP Plan (**Volume IIb, Appendix C-1**) which includes training construction personnel regarding noxious weed and invasive species identification and the protocols to prevent or control the spread of invasive species.

4.3.1.2 HDD

Construction of the foreign pipeline crossing for the onshore pipeline in Sabine Lake will require the excavation of a pit at both the entry and exits. The water bottom areas and volumes of these sediment displacements, and the effects thereof are included in the discussions above for excavation of the floatation ditch and the pipeline trench. The net result of the HDD is a reduction in the area of water bottom disturbed, the volume of sediment displaced, and the amount of suspended solids in the water column.

A slurry of bentonite clay will be used to lubricate the bit, maintain the bore, and carry cuttings to the surface. Some of the slurry may escape the borehole during reaming and pull back. Most will be captured by the pits, but some bentonite may also escape the pit, and some may be suspended in the water column, with effects on fish and invertebrates similar to those described above for clay particles in Sabine Lake sediments disturbed during pipe installation. Underwater noise generated by HDD is not sufficient to result in injury or behavioral responses by fish. The effects of HDD on fish and invertebrates will be negligible and short-term.

An inadvertent return of the slurry to the surface could also occur somewhere along the bore path. If a release were to occur in Sabine Lake from the Project HDD, some bentonite may be suspended in the water column and increase TSS and turbidity, but most would pool on the water bottom.

Bentonite is a non-toxic naturally occurring clay mineral. There could be minor short-term turbidity effects on water column. Sessile benthic invertebrates and demersal fish eggs at the release could be smothered. Mitigation measures designed to reduce the potential for inadvertent returns include geotechnical investigations along the borehole path, development of an HDD Contingency Plan, and measures such as conducting monitoring for loss of fluids during the HDD process.

4.3.1.3 Hydrostatic Test

Approximately 14,650,000 gallons of water will be withdrawn from the Neches River and Sabine Lake, used for hydrotesting, and discharged back to the same water body (see **Table 4-14**). All pipe being tested is new pipe. No chemicals will be added to the test waters.

TABLE 4-14
Project Water Withdrawals from Sabine Lake / Neches River for Hydrostatic Tests

Component Test	Gallons	Source / / Receiving Waterbody
HDD-01[a]	231,231	Neches River
HDD-02 [a]	137,087	Neches River
HDD-06 [a]	226,038	Old River Cove (Sabine Lake)
HDD-07 [a]	164,518	Old River Cove (Sabine Lake)
HDD-08 [a]	318,051	Sabine Lake
HDD-09 [a]	140,882	Sabine Lake
Complete Pipeline [b]	13,373,424	Neches River or Sabine Lake or Station 501
BMOP Pump Station Pig Launcher	19,300	Neches River
Station 501	33,350	Neches River or Sabine Lake or Station 501
Total	**14,643,881**	--

During withdrawal, water will be pumped into the pipe and filtered with a size 100 mesh screen (mesh opening of 0.0059 inches to prevent solids and foreign materials from entering the pipeline). To minimize entrainment, intake pipes for hydrostatic tests will be placed at locations and screened as recommended during consultations with NMFS, LDWF, and TPWD. Fish and invertebrate larvae and eggs will be entrained in the water and some may be impinged on the screen. Mortality of any entrained larvae and eggs may be close to 100 percent. Entrainment will be reduced by proper placement of the intake and by the screening of the intake pipe. No chemicals will be added to these test waters. The test waters will be discharged back to the same waterbody they were withdrawn from, minimizing any possibility of introducing invasive plants or animals. The level of potential impact will depend on the location and timing of the intake with species composition and abundance varying by season. These potential effects on fish and invertebrates will be minor given the volume of water withdrawn in comparison to the volume of Sabine Lake as most of the entrained eggs and larvae are found throughout the water column and will be short-term lasting as long as the withdrawal is on-going. Potential effects on fish and shellfish populations will be negligible given the natural mortality rates of these organisms.

4.3.2 Operations

4.3.2.1 Onshore Pipeline Operation

Routine operation of the onshore pipeline within Sabine Lake and under the Neches River will have no effect on aquatic resources. It is possible that some excavation could be required during inspections or for lowering of the pipeline during the life of the Project. If this is required, the potential effects will be similar to those described above for construction but at a much smaller scale. Any such effects on aquatic resources will be negligible and short-term.

4.3.3 Upsets and Accidents

Onshore Pipeline

Unanticipated releases of petroleum products, such as fuel, during operations could lead to contamination of the surface water with resulting effects on fish and invertebrates. All leaks and spills potentially resulting in contamination will be contained and remedied on site as soon as practicable, and in compliance Energy Transfer's Coastal Louisiana Pipeline Facility Response Plan (PHMSA Sequence No. 3202), modified to include BMOP. Volume IIa, Appendix F details the potential for an oil spill from the DWP or pipeline and the potential impacts that could result from the Project.

The pipeline will be constructed with MLVs (i.e., shut-off valves) to allow sections of the pipeline to be isolated, thereby minimizing the potential occurrence of a large spill. The volume of oil that could be released due to a leak would be limited to the amount of oil that leaked prior to detection and the volume remaining in the isolatable section. Overall, the risk of a pipeline crude oil release is low due to safety mechanisms built into the pipeline system which will prevent a continuous release of oil. Furthermore, the Applicant will with its Coastal Louisiana Pipeline Facility Response Plan during operations. With implementation of the safety design features for onshore facilities and the mitigation measures, potential impacts on surface water resources due to an oil spill are anticipated to be direct and adverse, and depending on the size of the spill, could be short-term or long-term and minor to major. Topic Report 12 (Volume IIa) details the potential for an oil spill from the pipeline and the potential impacts that could result. In addition, Appendix F (Volume IIa) contains a Project-specific Oil Spill Consequence Analysis and Fate Modeling Report.

4.3.4 Decommissioning

Onshore Pipeline

The onshore pipeline, including the sections under Sabine Lake and the Neches River, will be cleaned with a pigging operation, filled with seawater, and abandoned in place, which will result in no effects on fish and invertebrates.

4.4 CUMULATIVE IMPACTS

A complete discussion of cumulative impacts is included in Volume IIa, Appendix C, "Framework for Cumulative Impacts Analysis."

4.5 MITIGATION MEASURES

Construction, operation, and maintenance of the Project facilities will be in accordance with all applicable rules and regulations, permits, and approvals. To avoid and minimize potential impacts to fish and invertebrates during construction and operation of the Project, the Applicant has minimized the footprint of the proposed work activities and the duration of disturbances to the extent practicable to reduce impacts on aquatic resources and habitat, including the crossing of waterbodies (i.e., Neches River) by using the HDD construction method.

The Applicant will implement the following plans (included in **Volume IIb, Appendix C**) to ensure adequate protection of wildlife and environmental resources during onshore construction. Offshore threatened and endangered species mitigation measures are fully discussed in Volume IIa, Topic Report 6.

- Project's Onshore Construction BMP Plan to avoid, minimize, and mitigate environmental impacts as they relate to the construction and operation of the Project (**Volume IIb, Appendix C-1**).
- Revegetation Plan to avoid and minimize introduction of invasive species (**Volume IIb, Appendix C-2**).
- SPAR Plan to avoid and minimize inadvertent spills and releases of oil and hazardous materials (**Volume IIb, Appendix C-3**).
- HDD Contingency Plan to reduce the likelihood of inadvertent releases of drilling fluid/mud and will follow cleanup procedures should an inadvertent release occur (**Volume IIb, Appendix C-7)**.
- To minimize potential impacts due to entrainment of fish and invertebrate eggs and larvae, intake pipes for hydrostatic tests will be placed locations and screened as recommended during consultations with NMFS, LDWF, and TPWD.

4.6 SUMMARY OF POTENTIAL IMPACTS

The Project's effects on aquatic resources have been evaluated based on the criteria listed in **Table 1-10** in **Section 1.10.2** (Evaluation Criteria) of Topic Report 1 (Volume IIb). The Project is NOT expected to:

- Violate a legal standard for protection of a species or its habitat;
- Degrade the commercial, recreational, ecological, or scientific viability or significance of a biological resource or its critical habitat; and/or
- Measurably change the population size (density) or change the distribution of an important species in the region; or
- Introduce new, invasive, or disruptive species in the proposed Project area.

Activities associated with the construction, operation, and decommissioning of the onshore pipeline components with the potential to have environmental consequences on aquatic resources and use are summarized in **Table 4-12**. Potential impacts on aquatic resources from construction, operation, and decommissioning of the onshore pipeline are expected to be negligible to minor based on the proposed activities and the application of mitigation measures as listed in Section 4.5.

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