Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

Texas LNG Project
Draft Environmental Impact Statement
Volume I

Texas LNG Brownsville LLC

October 2018
Docket No. CP16-116-000
FERC/EIS-0288D

Cooperating Agencies:

U.S. Environmental Protection Agency

U.S. Department of Transportation

U.S. Coast Guard

U.S. Department of Energy

U.S. Army Corps of Engineers

U.S. Fish and Wildlife Service

Federal Aviation Administration

National Park Service

National Oceanic Atmospheric Administration - National Marine Fisheries Service

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas 1
Texas LNG Brownsville, LLC
Texas LNG Project
Docket No. CP16-116-000

TO THE INTERESTED PARTY:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared a draft environmental impact statement (EIS) for the Texas LNG Project, proposed by Texas LNG Brownsville, LLC (Texas LNG) in the above-referenced docket. Texas LNG requests authorization to site, construct, modify, and operate liquefied natural gas (LNG) export facilities on the Brownsville Ship Channel in Cameron County, Texas. The Texas LNG Project would include a new LNG export terminal capable of producing up to 4 million tonnes per annum of LNG for export. The terminal would receive natural gas to the export facilities from a third-party intrastate pipeline.

The draft EIS assesses the potential environmental effects of the construction and operation of the Texas LNG Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the Texas LNG Project would result in adverse impacts on the environment. However, the mitigation measures recommended in the EIS, impacts in the project area would be avoided or minimized and would not be significant, with the exception of visual resources when viewed from the Laguna Atascosa National Wildlife Refuge. In addition, the Texas LNG Project, combined with other projects in the geographic scope, including the Rio Grande LNG and Annova LNG Projects, would result in significant cumulative impacts from sediment/turbidity and shoreline erosions within the Brownsville Ship Channel during operations from vessel transits; on the federally listed ocelot and jaguarundi from habitat loss and potential for increased vehicular strikes during construction; and on visual resources from the presence of aboveground structures. Construction and operation of the Texas LNG Project would result in mostly temporary or short-term environmental impacts; however, some long-term and permanent environmental impacts would occur.

The U.S. Department of Energy, U.S. Coast Guard, U.S. Army Corps of Engineers, U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, National Park Service, National Oceanic and Atmospheric Administration's National Marine Fisheries Service, and Federal Aviation Administration participated as cooperating agencies in the preparation of the EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis. Although the cooperating agencies provided input to the conclusions and recommendations presented in the draft EIS, the agencies will present their own conclusions and recommendations in their respective Records of Decision for the project.

The draft EIS addresses the potential environmental effects of the construction and operation of the following project facilities:

- gas gate station and interconnect facility;
- pretreatment facility for carbon dioxide removal and dehydration;
- turbo-expander for pentane plus heavy carbon removal;
- a Liquefaction Plant consisting of two liquefaction trains and ancillary support facilities;
- two approximately 210,000 m^3 aboveground full containment LNG storage tanks with cryogenic pipeline connections to the Liquefaction Plant and berthing dock;
- an LNG carrier berthing dock capable of receiving LNG carriers between approximately 130,000 m^3 and 180,000 m^3 in capacity;
- a permanent material offloading facility to allow waterborne deliveries of equipment and materials during construction and mooring of tug boats while an LNG carrier is at the berth;
- thermal oxidizer, warm wet flare, cold dry flare, spare flare, acid gas flare, and marine flare; and
- administration, control, maintenance, and warehouse buildings and related parking lots; electrical transmission line and substation, water pipeline, septic system, natural gas pipeline, and stormwater facilities/outfalls.

The Commission mailed a copy of the *Notice of Availability* to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Native American tribes; potentially affected landowners and other interested individuals and groups; and newspapers and libraries in the project area. The draft EIS is only available in electronic format. It may be viewed and downloaded from the FERC's website (www.ferc.gov), on the Environmental Documents page (https://www.ferc.gov/industries/gas/enviro/eis.asp). In addition, the draft EIS may be accessed by using the eLibrary link on the FERC's website. Click on the eLibrary link (https://www.ferc.gov/docs-filing/elibrary.asp), click on General Search, and enter the docket number in the "Docket Number" field, excluding the last three digits (i.e., CP16-116). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659.

Any person wishing to comment on the draft EIS may do so. Your comments should focus on draft EIS's disclosure and discussion of potential environmental effects, reasonable alternatives, and measures to avoid or lessen environmental impacts. To ensure consideration of your comments on the proposal in the final EIS, it is important that the Commission receive your comments on or before 5:00pm Eastern Time on **December 17, 2018**.

For your convenience, there are four methods you can use to submit your comments to the Commission. The Commission will provide equal consideration to all comments received, whether filed in written form or provided verbally. The Commission encourages electronic filing of comments and has staff available to assist you at (866) 208-3676 or FercOnlineSupport@ferc.gov. Please carefully follow these instructions so that your comments are properly recorded.

1) You can file your comments electronically using the eComment feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. This is an easy method for submitting brief, text-only comments on a project;

2) You can file your comments electronically by using the eFiling feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. With eFiling, you can provide comments in a variety of formats by attaching them as a file with your submission. New eFiling users must first create an account by clicking on "eRegister." If you are filing a comment on a particular project, please select "Comment on a Filing" as the filing type; or

3) You can file a paper copy of your comments by mailing them to the following address. Be sure to reference the project docket number (CP16-116-000) with your submission: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 888 First Street NE, Room 1A, Washington, DC 20426

4) In lieu of sending written or electronic comments, the Commission invites you to attend the public comment session its staff will conduct in the project area to receive comments on the draft EIS, scheduled as follows:

Date and Time	**Location**
Thursday, November 15, 2018 5:00 – 9:00 pm local time	Port Isabel Convention Center 309 E. Railroad Ave, Port Isabel, TX 78578 956-433-7195

The primary goal of this comment session is to have you identify the specific environmental issues and concerns with the draft EIS. Individual verbal comments will be taken on a one-on-one basis with a court reporter. This format is designed to receive the maximum amount of verbal comments, in a convenient way during the timeframe allotted.

The scoping session is scheduled from 5:00 pm to 9:00 pm local time. You may arrive at any time after 5:00 pm. There will not be a formal presentation by Commission staff when the session opens. If you wish to speak, the Commission staff will hand out numbers in the order of your arrival. Comments will be taken until the closing hour for the comment session. However, if no additional numbers have been handed out and all individuals who wish to provide comments have had an opportunity to do so, staff may conclude the session 30 minutes before the closing hour.

Your verbal comments will be recorded by the court reporter (with FERC staff or representative present) and become part of the public record for this proceeding. Transcripts will be publicly available on FERC's eLibrary system (see below for instructions on using eLibrary). If a significant number of people are interested in providing verbal comments in the one-on-one settings, a time limit of 5 minutes may be implemented for each commenter.

It is important to note that verbal comments hold the same weight as written or electronically submitted comments. Although there will not be a formal presentation, Commission staff will be available throughout the comment session to answer your questions about the environmental review process.

Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the Commission's Rules of Practice and Procedures (18 CFR Part 385.214). Motions to intervene are more fully described at http://www.ferc.gov/resources/guides/how-to/intervene.asp. Only intervenors have the right to seek rehearing or judicial review of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this proceeding which no other party can adequately represent. **Simply filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered.**

Questions?

Additional information about the project is available from the Commission's Office of External Affairs, at **(866) 208-FERC**, or on the FERC website (www.ferc.gov) using the eLibrary link. The eLibrary link also provides access to the texts of all formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to www.ferc.gov/docs-filing/esubscription.asp.

TABLE OF CONTENTS

TEXAS LNG PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME I

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

VOLUME II

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
ACHP	Advisory Council on Historic Preservation
AEP	American Electric Power
AIChE	American Institute of Chemical Engineers
APCI	Air Products and Chemicals, Inc.
APE	area of potential effect
API	American Petroleum Institute
AQCR	Air Quality Control Regions
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BA	biological assessment
BACT	best available control technology
BCC	Birds of Conservation Concern
Bcf/d	billion cubic feet per day
Bcf/y	billion cubic feet per year
BCR	Bird Conservation Regions
BGEPA	Bald and Golden Eagle Protection Act
BLEVE	boiling liquid expanding vapor explosion
BND	Brownsville Navigation District
BOG	boil-off gas
BPUB	Brownsville Public Utilities Board
Btu/ft^2-hr	British thermal units per square foot per hour
C+	pentane plus
C5+	pentane and heavier
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalents
Coast Guard	U.S. Coast Guard
COE	U.S. Corp of Engineers
Commission	Federal Energy Regulatory Commission
COTP	Captain of the Port
CWA	Clean Water Act
CZMA	Coastal Zone Management Act

dBA	A-weighted decibels
DCS	Distributed Control System
DFE	Design Flood Elevation
DHS	Department of Homeland Security
DOD	U.S. Department of Defense
DOE	Department of Energy
DOT	U.S. Department of Transportation
DPS	distinct population segments
ECD	erosion control devices
ECP	Environmental Construction Plan
EFH	essential fish habitat
EI	environmental inspector
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
EPAct 2005	Energy Policy Act of 2005
ERP	Emergency Response Plan
ESA	Endangered Species Act of 1973
ESD	emergency shutdown
FAA	Federal Aviation Administration
FDCP	Fugitive Dust Control Plan
FEED	front-end-engineering-design
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIS	Flood Insurance Study
FR	Federal Register
FSA	Facility Security Assessment
FSP	Facility Security Plan
FTA	free trade agreement
FWS	U.S. Fish and Wildlife Services
GHG	greenhouse gases
GIWW	Gulf Intracoastal Waterway
GMD	geomagnetic disturbances
GMFMC	Gulf of Mexico Fishery Management Council
GRP	gross regional product
GWP	global warming potential
H_2S	hydrogen sulfide
HAP	hazardous air pollutants
HAZOP	hazard and operability review
HGB	Houston-Galveston-Brazoria
HMI	human machine interfaces

hp	horsepower
HTF	heat transfer fluid
HUC	hydrologic unit code
IMO	International Maritime Organization
KOP	key observation points
ISA	International Society for Automation
kPa	kilopascals
kW/m^2	kilowatt per square meter
lb/hr	pounds per hour
L_{dn}	day-night sound level
L_{eq}	equivalent-continuous sound level
L_{max}	maximum sound levels
LNG	liquefied natural gas
LOD	Letter of Determination
LOI	Letter of Intent
LOR	Letter of Recommendation
m^3	cubic meters
MCHE	main cryogenic heat exchanger
mg/l	milligrams per liter
MLLW	mean lower low water
MMBtu/hr	million British Thermal Units per hour
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MOF	material offloading facility
MOU	Memorandum of Understanding
MOV	motor operated valve
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MR	mixed refrigerant
MBTA	Migratory Bird Treaty Act
MTPA	million tonnes per annum
MTSA	Maritime Transportation Security Act
MW	megawatts
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAVD 88	North American Vertical Datum of 1988
NBSIR	National Bureau of Standards Information Report
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association

NGA	Natural Gas Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NMFS	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NOI	Notice of Intent
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRG	Natural Resources Group
NRHP	National Register of Historic Places
NSA	noise-sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
OBE	operating basis earthquake
ODMDS	ocean dredge material disposal site
OEP	Office of Energy Projects
P&ID	piping and instrument diagrams
PA 5A	placement area 5A
PEM	palustrine emergent
PFD	process flow diagrams
PGA	peak ground acceleration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIR	Potential Impact Radius
Plan	FERC Upland Erosion Control, Revegetation, and Maintenance Plan
PM_{10}	particulate matter with a diameter less than or equal to 10 microns
$PM_{2.5}$	particulate matter with a diameter less than or equal to 2.5 microns
PM	inhalable particulate matter
PMC	Plant Materials Center
Procedures	FERC Wetland and Waterbody Construction and Mitigation Procedures
Project	Texas LNG Project
PSD	Prevention of Significant Deterioration
PSI	Professional Services, Inc.
PTE	potential to emit
PUCT	Public Utilities Commission of Texas
RHA	Rivers and Harbors Act

RMP	Risk Management Plan
RRC	Railroad Commission of Texas
SBCP	South Bay Coastal Preserve
S_{DS}	0.2-second spectral acceleration
S_{D1}	1.0-second spectral
SH	state highway
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SIS	Safety Instrument System
SMMP	Site Management and Monitoring Plan
SO_2	sulfur dioxide
SPAR Plan	Spill Prevention and Response Plan
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
SSE	safe shutdown earthquake
SSURGO	Soil Survey Geographic database
SWPPP	Stormwater Pollution Prevention Plan
SWEL	standing water elevation
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCMP	Texas Coastal Management Program
TEMA	Tubular Exchanger Manufacturers Association
Texas LNG	Texas LNG Brownsville, LLC
THC	Texas Historical Commission
THPO	Tribal Historic Preservation Officer
TPWD	Texas Parks and Wildlife Department
tpy	tons per year
TSS	total suspended solids
TWDB	Texas Water Development Board
TWIC	Transportation Worker Identification Credential
TXDOT	Texas Department of Transportation
TXNDD	Texas Natural Diversity Database
U.S.	United States
UDP	Unanticipated Discovery Plan
USC	United States Code
USGS	U.S. Geological Survey
VCP	Valley Crossing Pipeline
VOC	volatile organic compounds
WSA	Water Suitability Assessment

EXECUTIVE SUMMARY

On March 31, 2016, Texas LNG Brownsville, LLC (Texas LNG) filed an application in Docket No. CP16-116-000 with the Federal Energy Regulatory Commission (FERC or Commission) under Section 3(a) of the Natural Gas Act and Part 153 of the Commission's regulations. Texas LNG requests authorization to site, construct, and operate a liquefied natural gas (LNG) terminal (LNG terminal) to liquefy and export natural gas at a proposed site on the Brownsville Ship Channel in Cameron County, Texas.

The purpose of this environmental impact statement (EIS) is to inform FERC decision-makers, the public, and the permitting agencies about the potential adverse and beneficial environmental impacts of the proposed Texas LNG Project (Project) and potential alternatives to the proposed action, and recommended mitigation measures that would reduce adverse impacts. We[1] prepared this EIS to assess the environmental impacts associated with construction and operation of the Project as required under the National Environmental Policy Act of 1969, as amended. Our analysis is based on information provided by Texas LNG, and further developed from data requests; field investigations; scoping; literature research; contacts with or comments from federal, state, and local agencies; and comments from individual members of the public.

FERC is the lead agency for the preparation of the EIS. The U.S. Army Corps of Engineers, U.S. Coast Guard, U.S. Department of Energy (DOE), U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration and Federal Aviation Administration, the U.S. Fish and Wildlife Service (FWS), the National Park Service, the U.S. Environmental Protection Agency, and the National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS) are participating in the National Environmental Policy Act review as cooperating agencies.[2]

PROPOSED ACTION

Texas LNG's stated purpose for the proposed Project is to convert domestically produced natural gas to LNG for storage and export. Texas LNG is developing the Project to produce up to 4 million tonnes per annum of LNG for export. The Project would be constructed in two phases, each with a capacity of 2 million tonnes per annum. Texas LNG plans to initiate construction of Phase 1 upon receipt of all required authorizations and Phase 2 once a customer for the production enters into a long-term tolling agreement that is sufficient to support the financing of the Phase 2 construction cost.

Section 3 of the Natural Gas Act requires that authorization be obtained from the DOE prior to importing or exporting natural gas, including LNG, from or to a foreign country. On September 24, 2015,[3] the DOE issued an order granting authorization to Texas LNG to export LNG by vessel from the LNG terminal to free trade agreement countries. The DOE is currently

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1 "We," "us," and "our" refer to the environmental staff of the FERC's Office of Energy Projects.

2 A cooperating agency is an agency that has jurisdiction over all or part of a project area and must make a decision on a project and/or an agency that provides special expertise with regard to environmental or other resources.

3 Fossil Energy Docket No. 15-62-LNG

conducting its review of Texas LNG's application to export LNG to non-free trade agreement countries.

The Texas LNG Project consists of a new LNG terminal on the north side of the Brownsville Ship Channel, 2.5 miles southwest of the Town of Port Isabel, Texas and 19 miles northeast of the City of Brownsville, Texas population center. Texas LNG would construct the LNG terminal on a 625-acre parcel owned by the Brownsville Navigational District, with an additional 26.5 acres necessary outside of the parcel within the banks of the Brownsville Ship Channel to allow for deep water access to the Brownsville Ship Channel. The Project consists of the following facilities:

- gas gate station and interconnect facility;
- pretreatment facility;
- turbo-expander for pentane plus heavy carbon removal;
- a Liquefaction Plant consisting of two liquefaction trains and ancillary support facilities;
- two approximately 210,000 cubic meter (m^3) aboveground full containment LNG storage tanks with cryogenic pipeline connections to the Liquefaction Plant and berthing dock;
- LNG carrier berthing dock capable of receiving LNG carriers between approximately 130,000 m^3 and 180,000 m^3 capacity;
- a permanent material offloading facility to allow waterborne deliveries of equipment and materials during construction and mooring of tug boats while an LNG carrier is at berth;
- thermal oxidizer, warm wet flare, cold dry flare, spare flare, acid gas flare, and marine flare; and
- administration, control, maintenance, and warehouse buildings and related parking lots; electrical transmission line and substation, water pipeline, septic system, and stormwater facilities/outfalls.

Natural gas would be delivered to the Texas LNG Project site via a non-jurisdictional intrastate, 30-inch-diameter natural gas pipeline that would be constructed, owned, and operated by a third party, separate from Texas LNG.

PUBLIC INVOLVEMENT

On March 9, 2015, Texas LNG filed a request with FERC to use our pre-filing review process. We approved this request on April 14, 2015, and pre-filing Docket No. PF15-14-000 was established in order to place information filed by Texas LNG and related documents issued by FERC into the public record. Texas LNG held open houses in Brownsville and Port Isabel on

May 5 and 6, 2015, respectively, to provide information to the public about the Project. FERC staff participated in the open houses, explaining the FERC environmental review process to the public and providing those attending with information on how to file comments with FERC.

On July 23, 2015, FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Texas Liquefied Natural Gas Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (NOI). This notice was sent to about 375 interested parties, including federal, state, and local officials; agency representatives; conservation organizations; Native American tribes; local libraries and newspapers; and property owners in the vicinity of proposed Project facilities. Publication of the NOI for the Project established a 30-day public comment period ending on August 24, 2015, for the submission of comments, concerns, and issues related to the environmental aspects of the Project. On August 11, 2015, FERC conducted a joint public scoping meeting in Port Isabel, Texas to provide an opportunity for the public to learn more about the Texas LNG Project, Annova LNG Project, and Rio Grande LNG Project and to participate in our analysis by providing oral comments on environmental issues to be included in the EIS.

During the scoping period, we received comments on a variety of environmental issues. Substantive environmental issues identified through this public review process are addressed in this EIS. The transcripts of the public comment meeting and all written comments are part of the FERC's public record for the Texas LNG Project and are available for viewing on the FERC website (http://www.ferc.gov).[4]

PROJECT IMPACTS

We evaluated the potential impacts of construction and operation of the Project on geology; soils; water use and quality; wetlands; vegetation; wildlife, aquatic resources, and essential fish habitat; threatened, endangered, and special status species; land use, recreation, and visual resources; socioeconomics; cultural resources; air quality and noise; reliability and safety; and cumulative impacts. Where necessary, we recommend additional mitigation to minimize or avoid these impacts. Section 5 of the EIS contains a compilation of our recommendations.

Overall, construction and installation of facilities for the Project would require disturbance of about 311.5 acres of land. Following construction, Texas LNG would maintain or would revegetate, but not restore contours within 282 acres of land. The remaining 29.5 acres would be restored to pre-construction conditions and uses. Based on our analysis, scoping, and agency consultations, the major issues associated with the Project consist of impacts on surface water resources; wetlands; wildlife and aquatic resources; threatened and endangered species; land use, recreation, and visual resources; cultural resources; air quality; noise; and cumulative impacts.

[4] To access public documents on the FERC website, use the "eLibrary" link, select "General Search" from the eLibrary menu, and enter the docket number, excluding the last three digits, in the "Docket Number" field (i.e., PF15-14 or CP16-116). Be sure to select an appropriate date range.

Surface Water Resources

Texas LNG would dredge approximately 3.9 million cubic yards of material from existing tidal flats and the bank of the Brownsville Ship Channel to create the proposed marine berth. Dredging would be conducted by a hydraulic cutterhead dredge, which would minimize turbidity compared with a mechanical dredge within the Project area. Texas LNG would dispose of dredge material at placement area 5A, an existing confined dredge disposal site, in a way to ensure maximum settlement of sediment prior to discharge of water at the existing placement area 5A outfall. We conclude that Texas LNG's proposed dredge disposal methods would sufficiently minimize Project-related turbidity and sedimentation within the Brownsville Ship Channel. Texas LNG would conduct maintenance dredging of the marine berth every 3 to 5 years, generating 300,000 to 500,000 cubic yards of dredge material that would be disposed of at an existing placement area.

Dredge plume propagation modeling conducted by Texas LNG indicates that water quality parameters would be met within 460 feet of dredging activities. Texas LNG would conduct all dredging activities during construction and operation (maintenance dredging) in accordance with permits issued by the U.S. Army Corps of Engineers. Based on the use of the hydraulic dredge method, placement of dredge material in an existing disposal area, and the ongoing maintenance dredging within the Brownsville Ship Channel, we conclude that impacts on surface water quality as a result of dredging would be temporary, minor, and not significant.

Prior to commencement of operation, Texas LNG would hydrostatically test the LNG terminal piping and the storage tanks, obtaining most of the hydrostatic test water (approximately 34.4 million gallons) from the Brownsville Ship Channel. Texas LNG would use additives to limit bacteria and other corrosive components in seawater used for hydrostatic testing. Before returning the water to the Brownsville Ship Channel, Texas LNG would filter the water to remove suspended solids and neutralize or biodegrade the chemical additives into non-hazardous materials. In addition, Texas LNG would implement measures to minimize the potential for scour during discharge. Therefore, impacts on surface water as a result of hydrostatic testing are not anticipated to be significant.

During operation of the Project, an estimated 74 LNG carriers would call on the LNG terminal annually. LNG carriers would discharge ballast water as well as cooling water within the maneuvering basin during LNG loading. Discharged ballast water and cooling water could have different salinity, pH, temperature, and dissolved oxygen concentrations than the Brownsville Ship Channel. Due to the volume of water that would be discharged and the limited number of LNG carriers that would call on the LNG terminal annually, we conclude that impacts on surface water quality as a result of ballast water and cooling water discharges would be limited to the area immediately adjacent to the LNG carrier and not significant.

Wetlands

Construction of the Project would impact 45.2 acres of wetlands, primarily consisting of tidal flats, of which, 42.9 acres would be permanently impacted as a result of dredging of the maneuvering basin, and to a lesser extent, fill for permanent structures. While the Project would result in the permanent impact of tidal flats, dredging of the maneuvering basin would also restore tidal exchange to adjacent tidal flats, resulting in a beneficial impact on wetlands. Texas LNG has prepared a Compensatory Mitigation Plan to mitigate for permanent wetland impacts with preservation of 405 acres southeast of the proposed Project site. All necessary wetland mitigation would be finalized in accordance with Texas LNG's U.S. Army Corps of Engineers Section 404 permit. Temporary wetland impacts would be minimized through the implementation of mitigation measures outlined in the Project-specific Environmental Construction Plan and would be restored following the completion of construction activities. Therefore, we conclude that the Project would not significantly impact wetlands.

Wildlife and Aquatic Resources

The removal of 263.2 acres of vegetation within the Project site and conversion of the site to industrial use would permanently affect wildlife and wildlife habitats. Impacts on wildlife from construction of the Project would include displacement, stress, and direct mortality of some less mobile species. Vegetation clearing would reduce suitable cover, nesting, and foraging habitat for some wildlife species; however, dredging of the maneuvering basin would restore tidal connectivity to the tidal flats north of the Project site, improving habitat for aquatic species as well as shorebirds.

During construction and operation, increases in lighting and noise would likely deter wildlife from the area; however, there is abundant available habitat in the surrounding areas. The greatest noise impacts would be during construction, especially pile driving; however, these impacts would be short-term. Texas LNG would implement measures outlined in its Facility Lighting Plan to minimize the effects of lighting on wildlife during operation. Impacts on wildlife would be further minimized through the implementation of the Project-specific Environmental Construction Plan; therefore, we conclude impacts on wildlife would not be significant.

Suitable habitat for migratory birds of conservation concern is present within the Project site and Texas LNG observed several birds of conservation concern during surveys. In addition to disturbance of habitat and potential sensory disturbances, elevated structures such as the storage tanks and flares would also affect migratory birds by increasing the potential for collisions. Texas LNG would implement measures in coordination with the FWS, as recommended by FERC staff, to minimize impacts on migratory birds during construction and operation, including pre-construction bird surveys and vegetation clearing restrictions during construction and operation. Based on the potential impacts on migratory bird habitat and the measures that Texas LNG would implement during construction and operation to minimize impacts on migratory birds in the area, including our recommendation, we conclude that the Project would not have a significant impact on migratory bird populations.

The proposed Project site is across State Highway 48, but approximately 200 feet from the Laguna Atascosa National Wildlife Refuge (NWR). Due to the proximity of the Project site to the NWR, wildlife within the NWR would likely be impacted by increased noise and light during both construction and operation. Further, wildlife displaced from the Project site during construction and operation could relocate to the NWR, increasing competition for resources. Impacts on wildlife within the Laguna Atascosa NWR would be greatest during the construction phase, due to increased traffic on State Highway 48 and increased noise from construction activities. During operation, noise impacts on wildlife within the Laguna Atascosa NWR would be much less and would decrease as distance from the Project site increases. Therefore, we conclude that impacts on wildlife within the Laguna Atascosa NWR would not be significant.

Dredging of the maneuvering basin during construction, as well as maintenance dredging during operation, would temporarily increase noise, turbidity, and sedimentation within the Brownsville Ship Channel, reducing light penetration and decreasing dissolved oxygen concentrations, adversely affecting fish eggs and juvenile fish survival, benthic community diversity and health, foraging success, and suitability of spawning habitat. Further, sediments in the water column could be deposited on nearby substrates, burying aquatic macroinvertebrates. Texas LNG would use a hydraulic cutterhead dredge to minimize the impacts from turbidity and sedimentation. Based on the estimates of underwater sound that would occur during dredging, behavioral disturbance of fish would occur within 96 feet of the dredge and injury would occur within 89 feet.

Dredging of the maneuvering basin would permanently convert 39.4 acres of tidal flats to open water habitat and would impact the existing open water areas associated with the Brownsville Ship Channel, all of which is characterized as essential fish habitat. However, tidal flats within and surrounding the Project site have been cut off from the influences of natural tidal exchange. Dredging is anticipated to restore tidal flows to the tidal flats surrounding the Project site improving the overall aquatic habitat and enhancing essential fish habitat in the area. This EIS serves as our initiation of the essential fish habitat consultation with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act.

Project in-water pile driving would create sound waves that would adversely affect fish and other aquatic resources. Behavioral and injury thresholds for fish would be exceeded within 7,065 feet and 1,522 feet of the pile driving activities, respectively. Texas LNG would minimize impacts on aquatic resources from pile driving by conducting most pile driving activities prior to dredging the maneuvering basin, with only 12 piles proposed to be installed in the water over 12 days. In addition, Texas LNG would utilize bubble curtains and cushion blocks to minimize underwater sound pressures. Further, we recommend that Texas LNG conduct test pile drives and measure the actual underwater noise prior to initiating pile driving activities to ensure that the underwater sound pressures are not more than predicted.

Cooling water intakes and intakes associated with the seawater firewater systems would result in in the entrainment of small organisms, such as fish larvae and eggs. All intakes would be screened; however, direct mortality of smaller organisms is anticipated to occur. Due to the limited frequency of LNG carriers calling on the LNG terminal (74 per year) and the infrequent use of the seawater firewater system, impacts on aquatic resources from entrainment would not be significant. Increased vessel traffic during construction and operation of the Project would also result in an increased potential for spills of hazardous materials; however, all ships are required to maintain a Ship Oil Pollution Emergency Plan to minimize impacts on aquatic resources.

Through the implementation of Texas LNG's minimization measures, as well as our recommendation, the Project would not have significant impacts on aquatic resources.

Threatened and Endangered Species

There are 18 federally listed threatened and endangered species, one species proposed for listing, and one candidate species that could occur within the Project site or along vessel transit routes. Suitable habitat is present for all 20 species; however, during species-specific surveys conducted for federally listed plants (South Texas ambrosia and Texas ayenia), no specimens were documented. Therefore, we conclude that the Project would have no effect on these two species.

Impacts on federally listed marine species such as sea turtles, West Indian manatee, and whales, as well as other marine mammals protected under the Marine Mammal Protection Act of 1972, would primarily occur due to increased potential for vessel strikes along the LNG carrier transit routes as well as increases in turbidity and noise during dredging and pile driving. Impacts from the Project on federally listed birds and terrestrial mammals would primarily result from the removal of suitable habitat, as well as the increased lighting and noise associated with construction and operation of the Project. Texas LNG has proposed measures to minimize and avoid impacts on federally listed species, including but not limited to conducting species-specific surveys for birds prior to construction, implementing the NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008), and utilization of bubble curtains and cushion blocks during in-water pile driving. In addition, we recommend that Texas LNG utilize biological monitors for all in-water construction activities to further minimize impacts on aquatic threatened and endangered species.

As consultations with FWS and NMFS are ongoing, we recommend that Texas LNG not begin any Project construction until FERC staff completes Endangered Species Act consultations with these agencies. While suitable habitat is present within the proposed Project site and there is potential for federally listed species to occur in the Project area or along the vessel transit routes, but not be directly impacted by the Project, we conclude that the Project *is not likely to adversely affect* federally listed species, including the ocelot and Gulf Coast jaguarundi, would not result in the *adverse modification of critical habitat*, and would not significantly impact marine mammals.

Several state-listed species also have the potential to occur within the Project site. Texas LNG has coordinated with the Texas Parks and Wildlife Department regarding the measures that would be implemented to minimize impacts on state-listed species. The Texas Parks and Wildlife Department is particularly concerned with Texas tortoises and has recommended that Texas LNG develop a plan for the capture and relocation of tortoises prior to construction. We recommend that Texas LNG prepare this plan in coordination with the Texas Parks and Wildlife Department prior to construction. Through the implementation of measures identified by the Texas Parks and Wildlife Department and committed to by Texas LNG, as well as our recommendation, impacts on state-listed species would not be significant.

Land Use, Recreation, and Visual Resources

Land use within the Project site consists of wetlands, scrub shrub, open land, and open water. The Project would impact 311.5 acres, of which 282.0 acres would be converted to industrial land for operation or would be permanently impacted by grading and dredging activities. Although the Project would result in the conversion of a large portion of currently undeveloped land into industrial land, the Project site is zoned for industrial use; therefore, we conclude that Project impacts on land use in the area would not be significant.

A total of nine recreational use areas were identified within five miles of the Project site, including the Laguna Atascosa NWR that is across State Highway 48, 200 feet from the Project site. All designated recreation areas within the Laguna Atascosa NWR are more than two miles from the proposed Project site. However, two designated recreation areas in the Bahia Grande Unit are directly off of State Highway 48 which would be affected by increased traffic during construction of the Project. Texas LNG anticipates that traffic would be greatest during non-peak times (prior to 7 am and after 5 pm).

Other recreation areas including the South Bay Coastal Preserve and South Bay Paddling Trail, Isla Blanca Park, and Loma Ecological Preserve are further from the Project site, but are near the vessel transit routes. Increased ship traffic during construction and operation, including LNG carriers, could adversely affect recreational boaters accessing the areas by delaying or temporarily restricting access across the Brownsville Ship Channel; however, because the proposed Project would only result in an incremental increase in ship traffic within an existing ship channel, impacts on recreation areas as a result of ship traffic would be minor. Due to the distance from the Project site, impacts on the remaining five recreation areas would be primarily limited to increases in roadway traffic during construction and visual impacts during operation.

There are also several recreational tour operators based in Port Isabel and South Padre Island which utilize waterways near the Project site, including the Brownsville Ship Channel. The Project facilities would result in a change in the land use, which would adversely affect recreation activities, such as dolphin watching, that may occur relatively close to the Project site. It is likely that increased noise during construction and operation could deter some of these activities in the immediate area and cause them to move to other less developed areas. In addition, increased ship traffic during construction and operation would increase the time it takes for recreational vessels to transit the Brownsville Ship Channel. Construction and operation could have moderate, but not significant, temporary and permanent impacts on recreation activities that may currently operate, at least partially, near the Project site within the Brownsville Ship Channel.

During construction, visual impacts would primarily result from the use of large construction equipment such as cranes. Texas LNG assessed potential operational impacts on the viewshed from several key observation points including recreation areas, residential areas, and roadways, by producing visual simulations of the Project facilities during the day, at night, and during flaring events. While the LNG terminal, especially the storage tanks and flares, would be visible from most of the key observation points, it would generally not dominate the viewshed. However, the LNG terminal would dominate the daytime and nighttime viewshed at key observation point 6 (State Highway 48 and the Laguna Atascosa NWR) and likely at the Loma Ecological Preserve.

The Project facilities would likely be visible from some residences in Port Isabel and South Padre Island. South Padre Island, in particular, has numerous high rise condominiums that would have views of the Project facilities, especially from the higher floors. In addition to residences, the Project facilities would be visible from sightseeing tours that operate within the Brownsville Ship Channel.

Due to the relatively undeveloped nature of the Project area, the visual sensitivity of nearby recreation areas, and the inability to implement visual screening measures, the Project would result in a significant impact on visual resources when viewed from the Laguna Atascosa NWR and would have a negligible to moderate permanent impact on the other visual resources evaluated.

Cultural Resources

One previously recorded cultural resource site, Site 41CF8 (Garcia Pasture Site), is within the Project site and the direct area of potential effect, and is listed on the National Register of Historic Places. Cultural resource surveys of the site conducted for the Project identified two areas within the site that contain intact buried cultural deposits that would be considered contributing elements to the Garcia Pasture Site. No other cultural resource sites were identified within the Project area of potential effect. We have identified site 41CF8 as a historic property in the area of potential effect that would be adversely affected. Texas LNG has produced a treatment plan that the Texas Historical Commission found acceptable. We have not yet completed consultations with the Advisory Council on Historic Preservation regarding the adverse impacts on the Garcia Pasture Site; therefore, we recommend that consultations with Advisory Council on Historic Preservation be completed prior to the start of construction. With the implementation of our recommendation as well as Texas LNG's treatment plan, we have determined that impacts on cultural resources would not be significant.

Air Quality

Construction of the Project would result in temporary impacts on air quality associated with the emissions generated from fossil-fuel fired construction equipment and fugitive dust. Emissions from construction activities over the nearly 5-year construction period for the Project would be temporary and localized and, therefore, not have a long-term effect on regional air quality. The Project would be in an area currently classified as being in attainment for all criteria pollutant standards. Fugitive dust emissions would be minimized through implementation of Texas LNG's Fugitive Dust Control Plan.

During operation of Phase 1 and before completion of construction and commissioning of Phase 2, when commissioning and/or operational activities are occurring concurrent with construction activities, impacts could be greater than those from the Project operations alone. The combination of construction, commissioning, and operational short-term emissions would, at times, be in excess of the modeled operational emissions alone in 2022, 2023, and 2024. During the concurrent construction, commissioning, and operational activities, the higher level of emissions could result in intermittent exceedances of certain National Ambient Air Quality Standards. These exceedances would not be persistent at any one time during these years due to the dynamic and fluctuating nature of construction activities within a day, week, or month.

The Project is not subject to the federal Prevention of Significant Deterioration review/permitting; as a result, the LNG terminal is subject to the New Source Review minor source construction permitting program under Texas regulations. Because potential operating emissions for the Project exceed the Title V major source threshold for at least one criteria air pollutant, the LNG terminal is subject to the Title V operating permit program. Texas LNG submitted an air quality impact analysis demonstrating that for operational emissions of each criteria air pollutant, the model-predicted impact plus background concentration does not cause or contribute to an exceedance of the National Ambient Air Quality Standards.

We analyzed the estimated emissions from construction and operation of the Project, and the potential air quality impacts from operation of the LNG facility and other nearby proposed sources. Based on our independent review of the analyses conducted and Texas LNG's proposed mitigation measures, we conclude that construction of the Project would result in elevated emissions near construction areas and would impact local air quality. Through use of mitigation measures during construction activities and application of best available control technologies during operation, we conclude that there would be no regionally significant impacts on air quality.

Noise

Noise levels associated with construction activity would vary depending on the phase of construction in progress at any time. The highest level of construction noise at the Project typically occurs during earth-moving and pile-driving work. The predicted sound levels at nearby noise sensitive areas during Project construction were lower than the Commission's noise standard of 55 decibels on the A-weighted scale (dBA) day-night sound level (L_{dn}).

Pile driving, which would occur for approximately 13 months, with peak pile driving activities occurring over 4 months, was calculated to produce L_{eq}24-hour equivalent sound levels that are below our noise criterion of 55 dBA at the nearest noise sensitive area. The calculated maximum sound levels or L_{max} of pile driving (i.e., highest sound level during each hammer strike) would be similar to, to slightly above, the existing ambient levels. Although pile driving would be clearly audible at nearby residences when ambient sound levels are low, it would only occur during daytime construction hours (typically 7 a.m. to 5 p.m.). The impulsive noise of pile driving would be audible outside of residences, and potentially indoors in the homes closest to the Project. Therefore, to ensure that impacts due to maximum pile driving noise levels at the Project would be minimized, we recommend that Texas LNG monitor sound levels during the start of pile driving activities. If the sound levels due to pile driving are greater than 10 dBA over the ambient sound levels, then Texas LNG would cease activities, implement noise mitigation, and file evidence of reduced pile driving sound levels. Additionally, Texas LNG committed to implementing noise mitigations during pile driving, such as cushion blocks or bubble curtains, that will reduce the pile driving sound levels.

During operation, the LNG terminal would generate noise levels that would occur throughout the life of the Project. Noise would be produced continually by a number of sources that include various types of compressors, combustion turbines, cooling fans, pumps and piping. The LNG terminal would be constructed in two phases, and each phase would be commissioned and brought online as it is completed. Operational noise levels were modeled for Phase 1 and for Phases 1 and 2 in simultaneous operation. The predicted sound levels for operations for Phase 1 and for the combination of Phases 1 and 2 were below our 55 dBA L_{dn} criteria at the nearest noise sensitive area, and resulted in potential increases in the ambient sound levels of 0.1 to 0.7 for Phase 1 and 0.1 to 1.0 dBA L_{dn} for Phase 1 and 2. These increases would be considered imperceptible to most listeners. Therefore, noise impacts due to operation of the Project would not be significant.

In order to ensure that the sound levels due to the Project are consistent with the modeling used in our analysis, we recommend that Texas LNG perform a full load noise survey within 60 days of placing each liquefaction train into service. In addition, we recommend that a full load noise survey be conducted for the facility, after the completion of Phases 1 and 2. All post-construction survey recommendations require noise mitigation to be implemented if the noise attributable to the Project is greater than 55 dBA L_{dn} at any nearby noise sensitive areas. Based on the noise analysis above, and our recommendations, we conclude that construction and operation of the Project would not have a significant impact on the noise environment near the Project.

Reliability and Safety

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact to the human environment in terms of safety and whether the proposed facilities would be in the public interest based on whether it would operate safely, reliably, and securely.

As a cooperating agency, the DOT assists FERC staff in evaluating whether Texas LNG's proposed design would meet the DOT's 49 CFR 193 Subpart B siting requirements. The DOT reviewed the design spill information submitted by Texas LNG and on June 22, 2018, provided a letter to FERC staff stating that the DOT had no objection to Texas LNG's design spill selection methodology to comply with the Part 193 siting requirements for the proposed LNG liquefaction facilities, but would need to resolve legal control of exclusion zones. DOT will provide a LOD on the Project's compliance with 49 CFR 193 Subpart B. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the DOT's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG carrier traffic. The Coast Guard reviewed a WSA submitted by Texas LNG that focused on the navigation safety and maritime security aspects of LNG carrier transits along the affected waterway. On February 14, 2018, the Coast Guard issued a LOR to FERC staff indicating the Brownsville Ship Channel would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project, based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized and constructed, the facility would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, FAA assisted FERC staff in evaluating impacts to and from the SpaceX rocket launch facility. Specific recommendations are included to address potential impacts from rocket launch failures to the Project. However, the extent of impacts to SpaceX operations, National Space Program, and to the federal government would not fully be known until SpaceX submits an application requesting to launch with the FAA and whether the LNG plant is under construction or in operation.

FERC staff conducted a preliminary engineering and technical review of the Texas LNG design, including potential external impacts based on the site location. Based on this review, we recommend the Commission consider incorporating into the order a number of proposed mitigation measures and continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, FERC staff believe that the Texas LNG Project design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

Cumulative Impacts

We considered the potential contributions of Project-related impacts on cumulative impacts in the defined geographic scope and within the same timeframe as the proposed Project for the affected resources. As part of that assessment, we identified existing projects, projects under construction, projects that are proposed or planned, and reasonably foreseeable future projects – including proposed LNG terminals, currently operating and future oil and gas projects, land transportation projects, commercial and industrial developments, and dredging projects.

The greatest potential for cumulative impacts associated with surface water resources would be during dredging activities, as well as during operation. Concurrent dredging of the maneuvering basin for the proposed Project as well as the Rio Grande LNG, Annova LNG, Bahia Grande Estuary Channel Widening/Restoration, and Brazos Island Harbor Channel Improvement Project would result in increased turbidity and sedimentation, resulting in short-term impacts on water quality. Due to the distance between the Annova and Texas LNG Projects, they are not expected to have significant overlapping effects. However, up to 0.63 inch of sedimentation could occur if the Texas LNG and Rio Grande Projects were to conduct construction dredging at the same time. The Bahia Grande Estuary Channel Widening/Restoration could also contribute an estimated 0.5 inch of additional sedimentation. The Brazos Island Harbor Channel Improvement project is not expected result in sediment accumulation during dredging as the purpose of the project is to deepen the main channel and any accumulated sediments would likely be accounted for with the allowed over-dredge depth to achieve the final design depth. While the Brownsville Ship Channel is a routinely maintained, manmade channel, concurrent dredging activities and other impacts on surface water resources during construction activities, as described above, are anticipated to be temporary and moderate.

The operation of all three proposed Brownsville LNG projects would also result in a substantial increase in the number of large, ocean-going vessels transiting the Brownsville Ship Channel (estimated to be about 511 LNG carriers per year combined). During operation, increased vessel traffic would result in a cumulative impact on surface water resources from increases in turbidity and shoreline erosion. Each of the three LNG projects has designed its respective facilities to minimize shoreline erosion through placement of rock riprap along the shoreline, or similar measures. Cumulative impacts on surface water quality during operation would be permanent and moderate to significant due to the persistent transit of LNG carriers and other large vessels within the Brownsville Ship Channel resulting in the increased erosion of shorelines along unarmored portions of the Brownsville Ship Channel.

The proposed Project, Rio Grande LNG and Annova LNG Projects, as well as the pipeline projects proposed in the area, are anticipated to have the greatest cumulative impacts on ocelot habitat through removal and conversion to industrial uses and fragmentation, respectively. In addition, these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross, thus increasing the potential for vehicle strikes. The current remaining habitat corridor in the region to connect U.S. and Mexico populations of these federally listed species is adjacent to and within the proposed Rio Grande LNG and Texas LNG Project sites north of the Brownsville Ship Channel and within and adjacent to the proposed Annova LNG Project site south of the Brownsville Ship Channel. Other impacts, such as those associated with noise, would be minimized by the projects to the extent practicable; however, due to the proximity of the Annova LNG and Rio Grande LNG Projects to the wildlife corridors, facility-generated noise during construction and operation would still be audible to ocelots and jaguarundis utilizing the wildlife corridor. Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would be permanent and significant.

Projects with permanent aboveground components, such as the Annova and Rio Grande LNG terminals, have the most potential to contribute to cumulative impacts on visual resources. In particular, motorists on State Highway 48 and visitors to the nearby recreation areas where two or three LNG Terminals would be visible (including the NWRs, Loma Ecological Preserve, and South Bay Coastal Preserve and South Bay Paddling Trail) would experience a permanent change in the existing viewshed during construction and operation of the projects. The proposed Project would significantly impact visual resources in the area. Due to the proximity of the Rio Grande LNG and Annova LNG Projects to the same visual receptors as the Texas LNG Project, significant cumulative impacts on visual resources are anticipated.

Cumulative noise impacts would primarily occur as a result of the concurrent construction and operation of the Texas LNG, Rio Grande LNG, and Annova LNG Projects. For simultaneous construction activities at all three LNG projects, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 dBA L_{dn} at the noise sensitive areas and sound levels of slightly over 55 dBA L_{dn} are predicted for several noise sensitive areas, and range from less than noticeable increases in ambient noise to a doubling of noise at specific noise sensitive areas. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the noise sensitive areas. These increases would result in a minor to moderate impact; however, all levels would be below 55 dBA L_{dn}. For the Palmito Ranch Battlefield National Historic Landmark, the predicted cumulative construction increase was 10.1 dBA L_{dn} over the existing ambient, which could result in periods of perceived doubling of noise. At the Laguna Atascosa NWR there is a higher ambient sound level so the predicted increase due to cumulative construction noise would be 2.7 dBA L_{dn}, resulting in a minor impact.

For operational noise with all three projects fully operational, the predicted sound level impacts are much lower than construction impacts, with potential increases over the existing ambient of between 0.3 and 1.5 dBA L_{dn} at noise sensitive areas, resulting in minor impacts. Operational impacts are slightly higher at the Palmito Ranch Battlefield National Historic Landmark and the Laguna Atascosa NWR, with possible increases in sound levels due to operations of between 1.3 and 4.8 dBA L_{dn}. This is generally considered a minor to moderate long-term impact.

ALTERNATIVES

In accordance with National Environmental Policy Act and FERC policy, we evaluated the no-action alternative, system alternatives, and other siting and design alternatives that could achieve the Project objectives. Alternatives were evaluated and compared to the proposed Project to determine whether these alternatives provided a significant environmental advantage over the proposed Project. While the no-action alternative would avoid the environmental impacts identified in this EIS, adoption of this alternative would preclude meeting the Project objectives. If the Project is not approved and built, other LNG export projects could be developed in the Gulf Coast region or elsewhere in the U.S., resulting in both adverse and beneficial environmental impacts. LNG terminal developments of similar scope and magnitude to the proposed Project would likely result in environmental impacts of comparable significance, especially those projects in a similar regional setting.

Texas LNG did not identify specific geographic markets that would require the proposed Project to be constructed within Texas. Therefore, we evaluated 16 system alternatives that would utilize existing, proposed, or planned LNG export terminals along the Texas and Louisiana Gulf Coast. To meet all or part of Texas LNG's DOE-approved export volume, additional facilities similar to those of the proposed Project would be required. Any such project would require review and authorization of the additional facilities, would likely result in similar impacts to the proposed Project, and would not result in a significant environmental advantage. Therefore, the system alternatives were not evaluated further.

We also evaluated alternative sites within several ports along the Gulf Coast. Of the sites evaluated, those only those within the Port of Brownsville were considered feasible, based on the availability of land, proximity to existing natural gas pipeline systems, and distance from residences. We then evaluated four sites along the Brownsville Ship Channel; however, two of the sites were determined to be too small and were dismissed from further evaluation. The remaining two sites that we evaluated include the proposed site and Alternative Site 2. While Alternative Site 2 would have an adequate amount of land available for construction of the LNG terminal, it would require a greater amount of fill to raise the site elevation, would require a greater amount of dredging for the turning basin, and would result in greater impacts on wetlands. Due to the reasons listed above, we do not consider Alternative Site 2 to provide a significant environmental advantage to the proposed Project.

CONCLUSION

We determined that the construction and operation of the Texas LNG Project would result in adverse environmental impacts. We conclude that impacts on the environment from the proposed Project would be reduced to less than significant levels with the implementation of Texas LNG's proposed impact avoidance, minimization, and mitigation measures and the additional measures recommended by FERC staff, with the exception of impacts on visual resources which would be significant when viewed from the Laguna Atascosa NWR. In addition, the Texas LNG Project, combined with other projects in the geographic scope, including the Rio Grande LNG and Annova LNG Projects, would result in significant cumulative impacts from sedimentation/turbidity and shoreline erosions within the Brownsville Ship Channel during operations from vessel transits; on the federally listed ocelot and jaguarundi from habitat loss and potential for increased vehicular strikes during construction; and on visual resources from the presence of aboveground structures. We based on conclusions upon information provided by Texas LNG and through data requests; field investigations; literature research; geospatial analysis; alternatives analysis; public comments and scoping sessions; and coordination with federal, state, and local agencies and Native American tribes. The following factors were also considered in our conclusions:

- The LNG terminal would be constructed in an area currently zoned for commercial and industrial use, along an existing, man-made ship channel.

- Texas LNG would follow its Spill Prevention and Response Plan (construction), Spill Prevention Control and Countermeasures Plan (operation), Stormwater Pollution Prevention Plan, Noxious Weed and Invasive Plant Plan, Facility Lighting Plan, Migratory Bird Plan, Terrestrial Reptile and Amphibian Conservation Plan, Unanticipated Discovery Plan for cultural resources, and Fugitive Dust Control Plan.

- The U.S. Coast Guard issued a Letter of Recommendation indicating that the Brownsville Ship Channel would be considered suitable for the LNG marine traffic associated with the Project.

- The U.S. Department of Transportation has no objection to Texas LNG's methodology to comply with the 49 CFR 193 siting requirements for the LNG terminal.

- All appropriate consultations with the FWS and NMFS regarding federally listed threatened and endangered species would be completed before construction is allowed to start.

- All appropriate National Historic Preservation Act consultations with the Texas State Historic Preservation Office and Advisory Council on Historic Preservation would be completed before construction is allowed to start in any given area.

- Texas LNG would implement its Project-specific Environmental Construction Plan, which incorporates our *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Procedures*, to minimize impacts on soils, wetlands, and waterbodies.

- The FERC's environmental and engineering inspection and mitigation monitoring program for this Project would ensure compliance with all mitigation measures and conditions of any FERC authorization.

In addition, we developed site-specific mitigation measures that Texas LNG should implement to further reduce the environmental impacts that would otherwise result from construction of the Project. We recommend that these mitigation measures, presented in section 5.2 of the EIS, be attached as conditions to any authorization issued by the Commission for the Project.

1.0 INTRODUCTION

On March 31, 2016, Texas LNG Brownsville, LLC (Texas LNG) filed an application with the Federal Energy Regulatory Commission (FERC or Commission) for authorization under to Section 3(a) of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. In Docket No. CP16-116-000, Texas LNG requests authorization to site, construct, and operate a liquefied natural gas (LNG) terminal (LNG terminal) to liquefy and export natural gas at a proposed site on the Brownsville Ship Channel in Cameron County, Texas.

As part of the Commission's consideration of this application, we[5] prepared this environmental impact statement (EIS) to assess the potential environmental impacts resulting from construction and operation of the facilities proposed by Texas LNG in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA).

Texas LNG's proposal, referred to as the Texas LNG Project (Project), would be constructed on approximately 285 acres (including temporary workspace) of a 625-acre parcel of land leased from the Brownsville Navigation District (BND), with an additional 26.5 acres outside of the 625-acre parcel necessary to provide deep water access to the Brownsville Ship Channel. The Project would be approximately 2.5 miles southwest of the Town of Port Isabel, Texas and 19 miles northeast of the City of Brownsville, Texas population center (figure 1-1). Subject to the receipt of FERC authorization and all other applicable permits, authorizations, and approvals, Texas LNG would construct its Project in two phases, with Phase 1 expected to be operating in 2023. Phase 2 would only be constructed if a customer for production of liquefied natural gas (LNG) enters into an agreement sufficient to finance the Phase 2 construction cost. Each phase would produce approximately 2 million tonnes per annum (MTPA) of LNG for a total of 4 MTPA. This EIS evaluates the environmental impacts that would occur if both phases were constructed.

5 "We," "us," and "our" refer to the environmental staff of FERC's Office of Energy Projects.

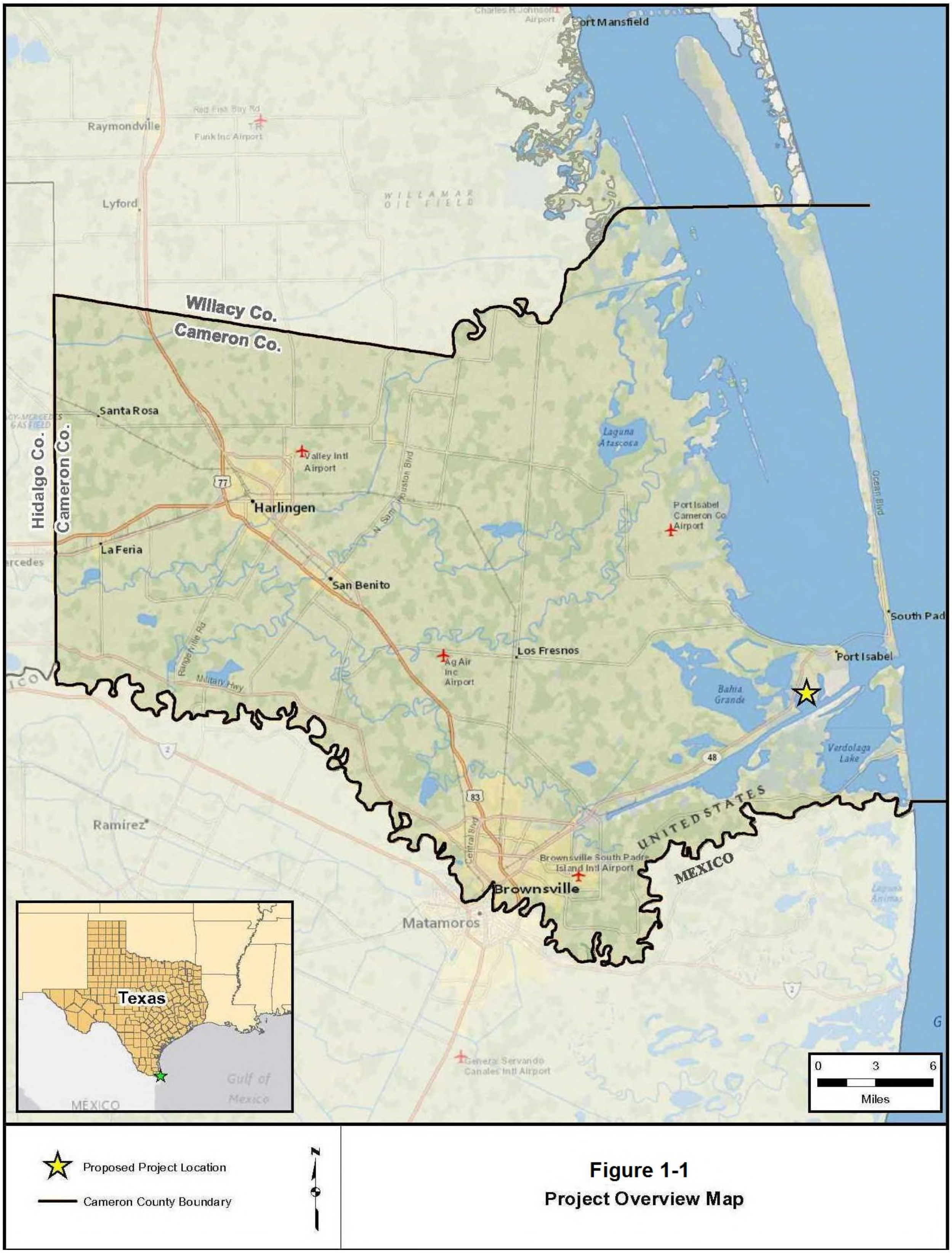

FIGURE 1-1 **Project Overview Map**

1.1 PURPOSE AND NEED

The purpose of the Project is to convert domestically produced natural gas to LNG for storage and export. Texas LNG is developing the Project to produce up to 4 MTPA of LNG of LNG for export, consistent with authorizations from the DOE.

Section 3 of the NGA, as amended, requires that authorization be obtained from the Department of Energy (DOE) prior to importing or exporting natural gas, including LNG, from or to a foreign country. For applicants that have, or intend to have, a signed gas purchase or sales agreement/contract for a period of time longer than 2 years, long-term authorization is required. Under Section 3 of the NGA, FERC considers, as part of its decision to authorize natural gas facilities, all circumstances bearing on the public interest. Specifically, regarding whether to authorize natural gas facilities used for importation or exportation, FERC shall authorize the proposal unless it finds that the proposed facilities would not be consistent with the public interest.

1.2 PURPOSE AND SCOPE OF THIS STATEMENT

The analysis in this EIS focuses on the facilities that are under FERC's jurisdiction (that is, the facilities proposed by Texas LNG within the Project site), and to a lesser extent, the non-jurisdictional facilities that are integrally related to the development of the Project (i.e., potable waterline, electric transmission lines, and natural gas pipeline [see detailed discussion in section 1.4]).

This EIS describes the affected environment as it currently exists, discusses the potential environmental consequences of the proposed Project, and compares the Project's impact to that of alternatives. The topics addressed in this EIS include alternatives; geology; soils; water use and quality; wetlands; vegetation; wildlife; fisheries and essential fish habitat (EFH); threatened, endangered, and special status species; land use, recreation, and visual resources; socioeconomics; cultural resources; air quality; noise; reliability and safety; and cumulative impacts. This EIS also presents our conclusions and recommended mitigation measures.

Our principal purposes in preparing an EIS are to:

- identify and assess potential impacts on the human environment that would result from implementation of the proposed action;
- identify and assess reasonable alternatives to the proposed action that would avoid or minimize effects on the human environment;
- facilitate public involvement in identifying significant environmental impacts; and
- identify and recommend specific mitigation measures to avoid or minimize environmental impacts.

Our description of the affected environment is based on a combination of data sources, including desktop resources (such as scientific literature and regulatory agency reports) as well as field data collected by Texas LNG. When considering the environmental consequences of constructing and operating the Project, the duration and significance of potential impacts are described according to the following four levels:

- Temporary – impacts generally occur during construction, with the resources returning to preconstruction conditions almost immediately after construction;
- Short-term – impacts could continue for approximately 3 years following construction;
- Long-term – impacts require more than 3 years to recover, but eventually would return to preconstruction conditions; and

Permanent – impacts could occur as a result of activities that modify resources to the extent that they may not return to preconstruction conditions during the life of the Project, such as with the construction of an aboveground facility.

1.2.1 Cooperating Agencies

The Energy Policy Act of 2005 (EPAct 2005) provides that FERC shall act as the lead agency for coordinating all applicable authorizations related to jurisdictional natural gas facilities. FERC, as the "lead federal agency," is responsible for preparation of this EIS. This effort was undertaken with the participation and assistance of the DOE, U.S. Coast Guard (Coast Guard), U.S. Army Corps of Engineers (COE), U.S. Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA), U.S. Fish and Wildlife Service (FWS), U.S. Environmental Protection Agency (EPA), National Park Service (NPS), National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), and Federal Aviation Administration (FAA) as the "cooperating agencies" under NEPA. Cooperating agencies have jurisdiction by law or provide special expertise with respect to environmental impacts involved with a proposal. The roles of FERC, DOE, Coast Guard, COE, PHMSA, FWS, NPS, NOAA Fisheries, FAA, and EPA as cooperating agencies in the review and authorization process are described below. The EIS provides a basis for coordinated federal decision making in a single document, thereby avoiding duplication among federal agencies in the NEPA environmental review processes. In addition to the lead and cooperating agencies, other federal, state, and local agencies may use this EIS in approving or issuing permits for all or part of the proposed Project. Federal, state, and local permits, approvals, and consultations for the proposed Project are discussed in section 1.5.

1.2.1.1 Federal Energy Regulatory Commission

Based on its authority under the NGA, FERC is the lead agency for preparation of this EIS in compliance with the requirements of NEPA, the Council on Environmental Quality's (CEQ) regulations for implementing NEPA (Title 40 of the Code of Federal Regulations [CFR], Parts 1500-1508 [40 CFR 1500-1508]), and the FERC regulations implementing NEPA (18 CFR 380).

As the lead federal agency for the Project, FERC is required to comply with Section 7 of the Endangered Species Act of 1973 (ESA), as amended; the Magnuson-Stevens Fishery

Conservation and Management Act (MSA); Section 106 of the National Historic Preservation Act (NHPA); and Section 307 of the Coastal Zone Management Act (CZMA). Each of these and other statutes have been taken into account in the preparation of this EIS and are further discussed by applicable resource in section 4.0. FERC will use this document to consider the environmental impacts that could result if it issues an authorization to Texas LNG under Section 3(a) of the NGA. The Commission may accept the application in whole or in part, and can attach engineering and environmental conditions to the Order that would be enforceable actions to assure that the proper mitigation measures are implemented during construction and prior to the Project going into service.

1.2.1.2 United States Department of Energy

Section 3(c) of the NGA, as amended by Section 201 of the Energy Policy Act of 1992 (Public Law 102-486), requires that applications to the DOE requesting authorization of the import and export of natural gas, including LNG, from and to a nation with which there is in effect a free trade agreement (FTA) requiring national treatment for trade in natural gas, be deemed consistent with the public interest and granted without modification or delay. The DOE, Office of Fossil Energy must meet its obligation under Section 3 of the NGA to authorize the import and export of natural gas, including LNG, unless it finds that the import or export is not consistent with the public interest. Texas LNG filed an application with the DOE on April 15, 2015, (Fossil Energy Docket No. 15-62-LNG) seeking authorization to export up to 4 MTPA LNG to any country 1) with which the U.S. currently has, or in the future may enter into, a FTA requiring national treatment for trade in natural gas; 2) any country with which the U.S. does not have a FTA requiring national treatment for trade in natural gas and LNG; 3) that has, or in the future develops, the capacity to import LNG; and 4) with which trade is not prohibited by U.S. law or policy (non-FTA countries).

On September 24, 2015[6], the DOE issued an order granting authorization to Texas LNG to export LNG by vessel from the LNG terminal to FTA countries. The DOE is currently conducting its review of Texas LNG's application to export LNG to non-FTA countries.

1.2.1.3 United States Coast Guard

The Coast Guard is the principal federal agency responsible for maritime safety, security, and environmental stewardship in U.S. ports and waterways. As such, the Coast Guard is the federal agency responsible for assessing the suitability of the Project Waterways (defined as the waterways that begin at the outer boundary of the navigable waters of the U.S.) for LNG marine traffic. The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 United States Code [USC] 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC 1221 et seq.); and the Maritime Transportation Security Act of 2002 (MTSA) (46 USC 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment in or adjacent to navigable waters up to the last valve immediately before the

6 Fossil Energy Docket No. 15-62-LNG

receiving LNG tanks. As appropriate, the Coast Guard (acting under the authority in 33 USC 1221 et seq.) also would inform FERC of design- and construction-related issues identified as part of safety and security assessments. If the Project is approved, constructed, and operated, the Coast Guard would continue to exercise regulatory oversight of the safety and security of the LNG terminal facilities in compliance with 33 CFR 127.

As required by its regulations, the Coast Guard is responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic following a Waterway Suitability Assessment (WSA). The process of preparing the LOR begins when an applicant submits a Letter of Intent to the Captain of the Port. In a letter dated February 16, 2015, Texas LNG submitted its Letter of Intent and preliminary WSA to the Coast Guard as required by 33 CFR 127.007. The Coast Guard requested additional information and a follow-on WSA was submitted by Texas LNG February 25, 2016. In a letter dated February 14, 2018, the Coast Guard issued the LOR for the Project, which stated that the Brownsville Ship Channel is considered suitable for LNG marine traffic in accordance with the guidance in the Coast Guard Navigation and Vessel Inspection Circular 01-2011.

1.2.1.4 United States Army Corps of Engineers

The COE has jurisdictional authority pursuant to Section 404 of the Clean Water Act (CWA) (33 USC 1344), which governs the discharge of dredged or fill material into waters of the U.S., and Section 10 of the Rivers and Harbors Act (RHA) (33 USC 403), which regulates any work or structures that potentially affect the navigable capacity of a waterbody. Because the COE would need to evaluate and approve several aspects of the Project and must comply with the requirements of NEPA before issuing permits under the above statutes, it has elected to participate as a cooperating agency in the preparation of this EIS. The COE would adopt the EIS in compliance with 40 CFR 1506.3 if, after an independent review of the document, it concludes that the EIS satisfies the COE's comments and suggestions. The Project is within the Galveston District of the COE Southwestern Division. Staff from the Galveston District participated in the NEPA review and will evaluate COE authorizations, as applicable.

The primary decisions to be addressed by the COE include:

- issuance of a Section 404 permit for impacts on waters of the U.S. associated with construction and operation of the Project; and
- issuance of a Section 10 permit for construction activities within navigable waters of the U.S. associated with the Project.

According to the COE, this EIS contains the information it needs to reach decisions on these issues. Through the coordination of this document, the COE will obtain the views of the public and natural resource agencies prior to reaching its decision on the Project.

As an element of its review, the COE must consider whether a proposed action avoids, minimizes, and compensates for impacts on existing aquatic resources, including wetlands, to strive to achieve a goal of no overall net loss of values and functions. The COE must also evaluate whether or not a project has "water dependency." The COE would issue a Record of

Decision to formally document its decision on the proposed action, including Section 404(b)(1) analysis and required environmental mitigation commitments.

1.2.1.5 United States Department of Transportation

The DOT has prescribed the minimum federal safety standards for LNG facilities in compliance with 49 USC 60101. Those standards are codified in 49 CFR 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. The National Fire Protection Association (NFPA) Standard 59A (NFPA 59A), *Standard for the Production, Storage, and Handling of Liquefied Natural Gas,* is incorporated into those requirements by reference, with regulatory preemption in the event of conflict. In accordance with the 1985 Memorandum of Understanding (MOU) on LNG facilities and the 2004 Interagency Agreement on the safety and security review of waterfront import/export LNG facilities,[7] the DOT participates as a cooperating agency. The DOT participates as a cooperating agency but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, and operation. On June 22, 2018, the DOT provided a letter to FERC staff regarding the information DOT reviewed for the analysis of the Texas LNG Project to determine it had no objection to the design spill methodologies being used for the selection of single accidental leakage sources as part of the requirements under 49 CFR Part 193 Subpart B.[8] On August 31, 2018, FERC and DOT signed an MOU to streamline LNG project reviews and eliminate duplicative efforts.[9] DOT will issue a Letter of Determination (LOD) to FERC on the 49 CFR Part 193 Subpart B regulatory requirements, which would be filed with the Commission as part of the consolidated record for the Project and would be one of the considerations for the Commission to deliberate in its decision to authorize, with or without modification or conditions, or deny an application. The LOD will provide DOT's analysis and conclusions regarding 49 CFR Part 193 Subpart B regulatory requirements.

The DOT also houses the FAA, which is a federal agency responsible for regulating all aspects of civil aviation including management of airports, air traffic control, and protection of the public, property, and the national security and foreign policy interests of the U.S. during commercial space launch and reentry activities. In its mission to safely manage U.S. airspace and air traffic, the FAA requires that certain elevated structures with the potential to affect navigable airspace are placed on public notice (14 CFR 77). Due to the height of facilities associated with the Project, Texas LNG submitted a Notice of Proposed Construction or Alteration of Objects that may affect the Navigable Airspace and ensure that marking and lighting of all elevated structures is in compliance with FAA standards. On April 19, 2017 Texas LNG received a DOT FAA Determination of No Hazard to Air Navigation in accordance with 14 CFR Part 77.

In addition to its role in maintaining navigable air space, the FAA is also responsible for the protection of U.S. assets during commercial space launches and reentry. The FAA is the

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7 These documents can be viewed online at http://ferc.gov/industries/gas/indus-act/lng/1985-mou/1985-mou.pdf and http://www.ferc.gov/industries/gas/indus-act/lng/2004-interagency.asp, respectively.

8 June 22, 2018 letter "Re: Texas LNG Liquefaction Project (Project), FERC Docket CP16-116" from Kenneth Lee to Rich McGuire. Filed in Docket Number CP16-116-000 on June 29, 2018. Accession Number 20180629-3018.

9 August 31, 2018 Memorandum of Understanding between the Department of Transportation and the Federal Energy Regulatory Commission Regarding Liquefied Natural Gas Transportation Facilities, https://www.ferc.gov/legal/mou/2018/FERC-PHMSA-MOU.pdf.

regulating federal authority for the commercial space company SpaceX, which is constructing a launch facility approximately 4.5 miles west of the proposed Project site. Due to the proximity of the Project to the SpaceX facility, which is currently under construction, the FAA elected to participate in the review process for the Project as a cooperating agency. Additional information regarding the proximity of the Project to the SpaceX facility is provided in section 4.13.

1.2.1.6 United States Fish and Wildlife Service

The FWS is responsible for ensuring compliance with the ESA. Section 7 of the ESA, as amended, states that any project authorized, funded, or conducted by any federal agencies should not "…jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical…" (16 USC 1536(a)(2)). The FWS also reviews project plans and provides comments regarding protection of fish and wildlife resources under the provisions of the Fish and Wildlife Coordination Act (16 USC 661 et seq.). The FWS is also responsible for the implementation of the provisions of the Migratory Bird Treaty Act (MBTA) (16 USC 703) and the Bald and Golden Eagle Protection Act (BGEPA) (16 USC 688).

The ultimate responsibility for compliance with Section 7 remains with the lead federal agency (i.e., FERC for this Project). As the lead federal agency for the Project, FERC consulted with the FWS, a cooperating agency, pursuant to Section 7 of the ESA to determine whether federally listed endangered or threatened species or designated critical habitat under the FWS jurisdiction are found in the vicinity of the Project, and to evaluate the proposed action's potential effects on those species or critical habitats. As required by Section 7 of the ESA, we prepared a Biological Assessment (BA) for the Project, which is provided in appendix D. Furthermore, we are requesting concurrence from the FWS with our determinations of effect for the federally listed species presented in the BA and further discussed in section 4.7.

1.2.1.7 National Marine Fisheries Service

NMFS is a federal agency within the U.S. Department of Commerce responsible for stewardship of the nation's living marine resources and their habitat. NMFS is charged with the management, conservation, and protection of living marine resources within coastal waters as well as the U.S.' Exclusive Economic Zone, which extends from 3 to 200 miles offshore. NMFS has regulatory authority over the implementation of the ESA for marine species, including Section 7 consultations, the Marine Mammal Protection Act (MMPA), and the MSA.

The FERC staff is consulting with NMFS to assess impacts on living marine resources. As an element of its review, NMFS will evaluate potential impacts to living marine resources and habitat and the proposed mitigation and monitoring measures for reducing those impacts. Project impacts on resources managed by NMFS are further discussed in sections 4.6 and 4.7. As discussed above for FWS, we are requesting concurrence from the NMFS with our determinations of effect for the federally listed species presented in the BA and further discussed in section 4.7.

1.2.1.8 United States Environmental Protection Agency

The EPA is the federal agency responsible for protecting human health and safeguarding the natural environment. It sets and enforces national standards under a variety of environmental laws and regulations in consultation with state, tribal, and local governments. The EPA has delegated water quality certification (Section 401 of the CWA) to the jurisdiction of individual state agencies; within Texas, jurisdictional authority under Section 401 of the CWA has been delegated to the Railroad Commission of Texas (RRC) (for certain oil and gas activities, including LNG). The EPA also oversees the issuance of a National Pollutant Discharge Elimination System (NPDES) permit for point source discharge of water into waterbodies (Section 402 of the CWA). The EPA shares responsibility for administering and enforcing Section 404 of the CWA with the COE, and has authority to veto COE permit decisions.

The EPA has jurisdictional authority to control air pollution under the *Clean Air Act* (CAA) (42 USC 85) by developing and enforcing rules and regulations for all entities that emit pollutants into the air. Under this authority, the EPA has developed regulations for major sources of air pollution and certain source categories, and has established general conformity applicability thresholds. The EPA has delegated the following jurisdictional authority under the CAA to the Texas Commission on Environmental Quality (TCEQ), unless the source would be on Indian lands:

- Title 1 Part A Section 111 – New Source Performance Standards (NSPS); and
- Title 1 Part A Section 112 – National Emission Standards for Hazardous Air Pollutants (NESHAP).

Additionally, the EPA has formally approved the following TCEQ permitting programs, as detailed in the State Implementation Plan (SIP):

- Title 1 Part C – Prevention of Significant Deterioration (PSD); and
- Title V – operating permits.

In addition to permitting oversight and management of air quality and emission limitations, the EPA is required under Section 309 of the CAA to review and publicly comment on the environmental impacts of major federal actions including actions that are the subject of draft and final EISs, and is responsible for implementing certain procedural provisions of NEPA (e.g., publishing the Notices of Availability of the draft and final EISs in the federal register) to establish statutory timeframes for the environmental review process.

1.2.1.9 National Park Service

The NPS is a land managing agency within the Department of the Interior with jurisdiction over 84 million acres of federal land in the U.S. It manages these lands to protect and preserve natural and cultural resources for the benefit of current and future generations. No land owned by the NPS would be directly affected by the Project; however, due to the proximity of the Project and potential indirect adverse effects on the Palo Alto Battlefield National Historic Park (NHP) and National Historic Landmark (NHL) and Palmito Ranch Battlefield National Historic Landmark, the NPS is a cooperating agency for the Project.

1.3 PUBLIC REVIEW AND COMMENT

1.3.1 Pre-filing Process and Scoping

On March 9, 2015, Texas LNG filed a request with FERC to use our pre-filing review process. We approved this request on April 14, 2015, and pre-filing Docket No. PF15-14-000 was established in order to place information filed by Texas LNG and related documents issued by FERC into the public record. The pre-filing review process provides opportunities for interested stakeholders to become involved early in project planning, facilitates interagency cooperation, and assists in the identification and resolution of issues prior to a formal application being filed with FERC.

Texas LNG held open houses in Brownsville and Port Isabel on May 5 and 6, 2015, respectively, to provide information to the public about the Project. FERC staff participated in the open houses, explaining the FERC environmental review process to the public and providing those attending with information on how to file comments with FERC.

On July 23, 2015, FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Texas Liquefied Natural Gas Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (NOI). This notice was sent to about 375 interested parties, including federal, state, and local officials; agency representatives; conservation organizations; Native American tribes; local libraries and newspapers; and property owners in the vicinity of proposed Project facilities. Publication of the NOI for the Project established a 30-day public comment period ending on August 24, 2015, for the submission of comments, concerns, and issues related to the environmental aspects of the Project.

We received comments from four federal agencies including FWS, COE, EPA, and NPS, in response to the NOI for the Project. The Commission also received written comments from elected officials, public officials, individuals, and non-governmental agencies.

On August 11, 2015, FERC conducted a joint public scoping meeting in Port Isabel, Texas to provide an opportunity for the public to learn more about the Texas LNG Project, Annova LNG Project, and Rio Grande LNG Project and to participate in our analysis by providing oral comments on environmental issues to be included in the EIS. A total of 47 individuals provided verbal comments at the scoping meeting. A transcript of these comments is part of the public record for the Texas LNG Project and is available for viewing on the FERC eLibrary (http://elibrary.ferc.gov/idmws/search/fercgensearch.asp) under Docket No. PF15-14.).

Environmental issues identified during public scoping are summarized in table 1.3-1 along with a listing of the EIS sections that address the comments. The most frequently received comments relate to LNG safety; threatened and endangered species, land use, water quality, air quality, and cumulative impacts. Issues identified that are not considered environmental considerations or are outside the scope of the EIS process are summarized in table 1.3-2 and are not addressed further in this EIS.

TABLE 1.3-1 Environmental Issues Identified During the Public Scoping Process for the Texas LNG Project	
Issue/Specific Comment	**EIS Section Addressing Comment**
Alternatives	
Alternative facility locations	3.3.1
Renewable energy alternatives	3.1
Alternative energy sources	3.1
Soils and Geology	
Impacts on soils	4.2.3
Water Resources	
Water use during construction and operation, including source and discharges	4.3.1.4; 4.3.2.3
Surface water and groundwater contamination	4.3.1.4; 4.3.2.3
Turbidity and resuspension of bottom sediments	4.3.2.3
Wetland impacts	4.4.2
Impacts from dredging	4.3.2.3
Bahia Grande impacts	4.3.2.3
Mitigation measures	4.3.1.4; 4.3.2.3; 4.4.2.1
Wildlife and Aquatic Resources	
Impacts of water discharges on aquatic species	4.6.2.2
Migratory birds	4.6.1.3
Habitat impacts and loss	4.5.2; 4.6.1.2; 4.6.2.2
Impacts on marine life, seagrass, and seaweed	4.6.2.2
Mitigation measures	4.6.1.2; 4.6.2.2
Impacts on commercial fisheries and shrimping	4.6.2.1; 4.6.2.2
Threatened and Endangered Species	
Impacts on endangered, threatened, and sensitive species	4.7
Land Use, Recreation, and Aesthetics	
Light pollution	4.8.5
Impacts on visual resources	4.8.5
Impacts on outdoor recreation opportunities	4.8.4
Recreational fishing and boating	4.6.2.2; 4.8.4
Changes in land use	4.8.1
Impacts on federal and state lands	4.8.4
Mitigation measures	4.8.1.2; 4.8.4
Socioeconomics	
Available workforce	4.9.1
Economic impacts of LNG exports	4.9.2
Property values	4.9.7
Job growth and loss	4.9.2
Impacts on tourism	4.9.2
Impacts on the minority populations	4.9.8
Tax revenue	4.9.3
Tax abatements	4.9.3
Impacts on public services	4.9.5

TABLE 1.3-1 Environmental Issues Identified During the Public Scoping Process for the Texas LNG Project	
Issue/Specific Comment	**EIS Section Addressing Comment**
Environmental justice	4.9.8
Transportation and Traffic	
Safe navigation of ship channel	4.9.6.2
Impacts of increased ship traffic	4.9.6.2
Impacts of increased road traffic	4.9.6.1
Cultural Resources	
Proximity to prehistoric cemeteries and scattered surface sites	4.10.2
Proximity to culturally significant site	4.10.2
Proximity to Palmito Ranch Battlefield National Historic Landmark, Palo Alto Battlefield National Historic Park and National Historic Landmark	4.8.4.8; 4.8.4.9
Air Quality	
Greenhouse gas emissions and mitigation	4.11.1.4; 4.11.1.5
Impacts of emissions on human health	4.11.1.2
Climate change	4.11.1.2
Noise	
Impacts from noise during construction	4.11.2.3
Impacts from noise during operations	4.11.2.4
Reliability and Safety	
Spill contingency plan	4.13.6
Hurricane response plan	4.13.6
Safety of flares	4.13.6
Emergency notification systems and preparedness	4.13.6
Catastrophic system failures	4.13.6
Potential terrorist target	4.13
Proximity to a densely populated area	4.13
LNG carrier safety zones	4.13.4.3
Proximity to SpaceX	4.13.6.1
Impacts from extreme weather (hurricane, flooding, wind)	4.13.6.2
Vapor dispersion	4.13.6.1
Security	4.13
Cumulative Impacts	
Analysis of cumulative impacts associated with multiple LNG projects in the region	4.13

In response to comments received regarding minimizing impacts on wetlands as well as impact on threatened and endangered species habitat, Texas LNG modified the facility layout. To minimize impacts on wetlands in accordance with Section 404 of the CWA, Texas LNG reconfigured the Project facilities and associated workspaces to minimize the permanent fill of wetlands within the site. In addition to modifying the Project layout to avoid and/or minimize wetland impacts, Texas LNG also reconfigured the Project layout to avoid placement of permanent structures on the western portion of the site to minimize impacts on suitable nesting and foraging habitat for the aplomado falcon.

TABLE 1.3-2 Issues Identified and Comments Received That Are Outside the Scope of the EIS	
Issue/Specific Comment	**Explanation**
Effects of hydraulically fractured shale gas production	The development of natural gas in shale plays by hydraulic fracturing is not the subject of this EIS nor is the issue directly related to the proposed Project.
Environmental and economic consequences of any induced production, especially in shale gas plays, as a result of increased natural gas exports	Production and gathering activities, and the pipelines and facilities used for these activities, are not regulated by FERC, but are overseen by the affected region's state and local agencies with jurisdiction over the management and extraction of the shale gas resource. Further, the volume of induced production as well as the source of induced production, should it occur, would be speculative as the proposed LNG terminal would tie-into an existing intrastate natural gas pipeline system that ranges outside of the Project area. Therefore, the environmental and economic consequences of induced production are outside the scope of this EIS.
Consideration of other pending LNG export proposals before the DOE and FERC in the Brownsville area through the development of a programmatic EIS	The Commission does not intend to conduct a region-wide analysis of proposed LNG export terminals. The DOE determines the public benefits of exporting LNG from terminals in the U.S. FERC's review and approval of individual projects under the NGA does not constitute a coordinated federal program.
Economic impacts of export of LNG and domestic use of LNG	Economic conditions regarding export and domestic use of LNG are assessed by the DOE and are not under the jurisdiction of FERC. Further, the DOE determines the public benefits of exporting LNG from terminals in the U.S. Therefore, this discussion is outside the scope of this EIS.
Insurance rates	Insurance rates are determined by private insurance companies based on several factors. The Commission has no authority to influence changes in insurance rates that may or may not occur as a result of the proposed Project; therefore, this discussion is outside the scope of this EIS.
Natural gas prices	The review of the Project is limited to the economic and environmental impacts of the proposal before the Commission; therefore, changes in natural gas prices as a result of exports are outside the scope of this EIS.

1.4 NON-JURISDICTIONAL FACILITIES

Under the provisions of the NGA, FERC is required to consider, as part of a decision to authorize FERC-jurisdictional facilities, all facilities that are directly related to a proposed project where there is sufficient federal control and responsibility to warrant environmental analysis as part of the NEPA environmental review for the proposed Project. Some proposed projects have associated facilities that do not come under the jurisdiction of the Commission. These "non-jurisdictional" facilities may be integral to the need for the proposed facilities, or they may be merely associated as minor components of the jurisdictional facilities that would be constructed and operated as a result of authorization of the proposed facilities.

The following non-jurisdictional actions were identified in association with the Project:

- construction of an intrastate natural gas pipeline from an interconnect with another intrastate natural gas pipeline (Valley Crossing Pipeline[VCP]) to the Project site;

- construction of an electric transmission line from the existing American Electric Power (AEP) Union Carbide Substation to the Project site;
- construction of a potable water line from the BND’s existing Fishing Harbor potable water line to the Project site; and
- construction of an auxiliary lane off of State Highway (SH) 48 to facilitate management of traffic during construction and operation of the Project.

These facilities are described below and depicted in figure 1.4-1. Non-jurisdictional facilities are also addressed in our cumulative impacts analysis in section 4.13 of this EIS.

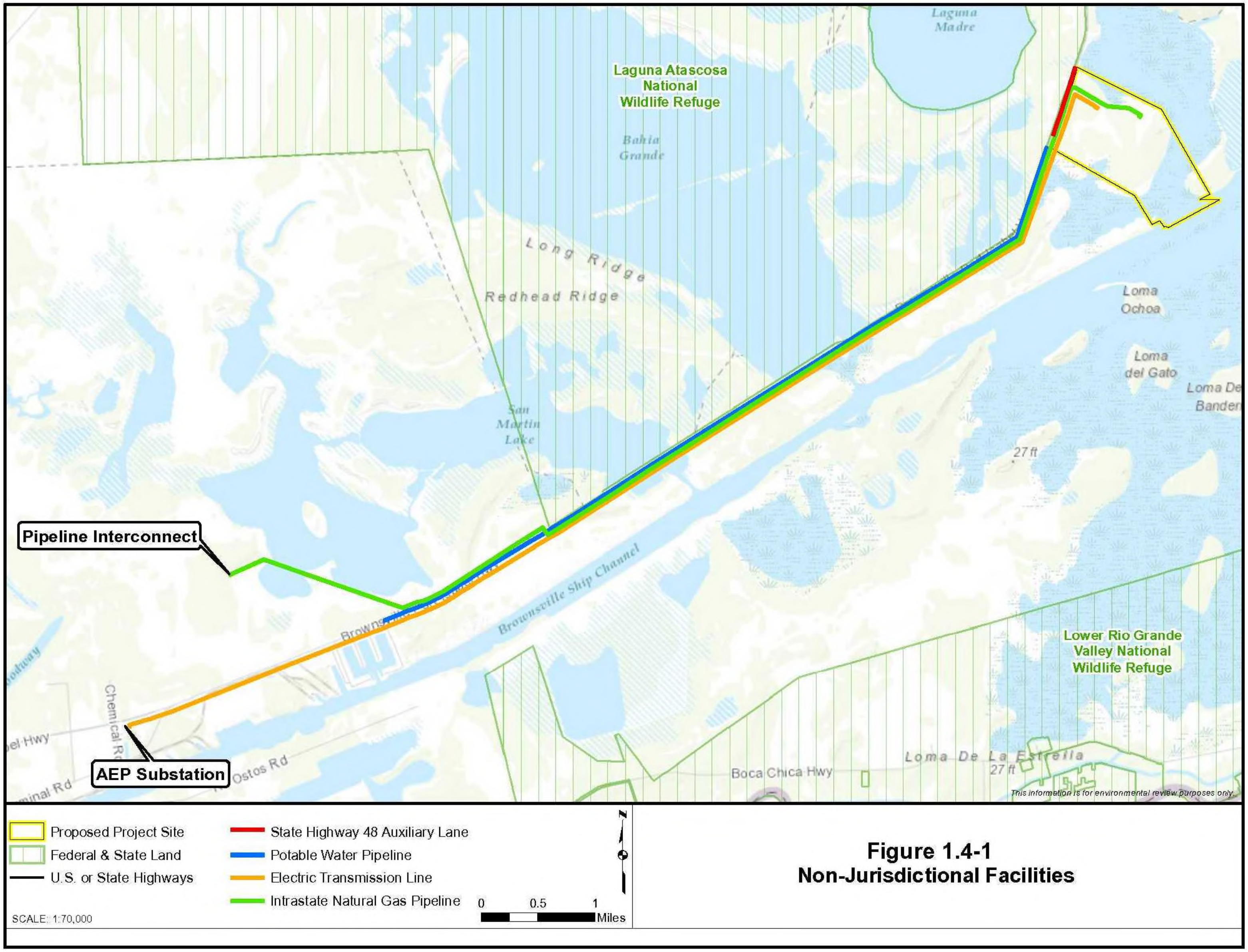

FIGURE 1.4-1 Non-jurisdictional Facilities Associated with the Proposed Texas LNG Project

1.4.1 Intrastate Natural Gas Pipeline

Natural gas would be delivered to the Texas LNG Project site via a non-jurisdictional intrastate natural gas pipeline that would be constructed, owned, and operated by a third party, separate from Texas LNG. Texas LNG anticipates that the 30-inch-diameter pipeline would be approximately 10.2 miles long (1.3 miles of which would be within the Project site) and would interconnect with the VCP. Texas LNG also anticipates that an additional 15,000 horsepower (hp) of compression would be needed to move the incremental gas destined for Texas LNG near the Agua Dulce Hub in Kleberg County, Texas at a compressor station constructed for the VCP. Texas LNG also estimates that an additional 50,000 hp compression would be needed about halfway between the Agua Dulce Hub and Brownsville. As of the writing of this EIS, Texas LNG has not identified the third-party company that would be contracted to construct and operate the intrastate natural gas pipeline. Drawings of the proposed intrastate natural gas pipeline are provided in appendix H.

Construction of the 10.2-mile-long, 30-inch-diameter intrastate natural gas pipeline would likely require a 100-foot-wide construction right-of-way and would be primarily collocated with other non-jurisdictional facilities associated with the proposed Project, and just south of SH 48. The pipeline would then deviate to the northwest near the Brownsville Fishing Harbor for approximately 1.5 miles, traversing just west of San Martin Lake before turning southwest to connect with the VCP. Construction of the intrastate natural gas pipeline would impact an estimated 108.3 acres outside of the Project site, including 56.3 acres of wetland impacts. In addition, the intrastate natural gas pipeline would cross a portion of San Martin Lake as well as one other waterbody.

Texas LNG anticipates that construction on the intrastate natural gas pipeline would take three months to complete and would be in-service by the proposed LNG terminal in-service date of 2023. The RRC is the lead state agency for permitting construction and operation of intrastate oil and gas facilities. In addition to required RRC permits, the third-party company selected to construct and operate the intrastate natural gas pipeline would be required to obtain all other applicable permits including those pertaining to the CWA, threatened and endangered species, cultural resources, and impacts on state or federal lands.

1.4.2 Electric Transmission Line

To provide electrical power to the LNG terminal, AEP would install a new, approximately 11-mile-long electric transmission line from the existing AEP Union Carbide Substation west of the Project site and south of SH 48. Each phase of the Project would require at least 120 megawatts (MW) of power; therefore, following the completion of Phase 2, a 240 MW electric transmission line would be necessary to provide power to the LNG terminal. The new transmission line would be placed on single pole structures within a 100-foot-wide permanent right-of-way that would be constructed primarily adjacent to SH 48. Each pole structure would require construction workspace measuring 100 feet by 400 feet and would be spaced every 500 to 1,000 feet.

Impacts associated with the electric transmission line would primarily result from the placement of the pole structures and the clearing of trees and shrubs along the right-of-way. The electric transmission line right-of-way would impact approximately 120.6 acres outside of the Project site, including 48.3 acres of wetlands. Additionally, the electric transmission line would cross four waterbodies, including the coastline.

Siting of the electric transmission line would be regulated by the Public Utilities Commission of Texas (PUCT). AEP would submit an application to the PUCT for a Certificate of Public Convenience and Necessity to construct, own, operate, and maintain the electric transmission line. AEP would conduct the necessary consultations and obtain applicable permits and approvals for the electric transmission line including CWA authorization, threatened and endangered species consultations, and cultural resources consultations. AEP expects to begin construction of the new electric transmission line in 2019.

1.4.3 Potable Water Line

To provide potable water to the LNG terminal, the BND would install an approximately 7.4-mile-long, 6-inch-diameter potable water line from an existing potable water line near Fishing Harbor, west of the Project site. The entirety of the potable water line would be constructed parallel to and within the construction corridor of the intrastate natural gas pipeline on the south side of SH 48. Texas LNG anticipates that the potable water line would be installed concurrently with the intrastate natural gas pipeline. The Port of Brownsville would own, operate, and maintain the potable water line as part of its existing water distribution system. Because the water line would be constructed within the anticipated 50-foot-wide permanent easement for the intrastate natural gas pipeline and construction would be concurrent, no additional environmental impacts to those already discussed for the intrastate natural gas pipeline would occur as a result of the construction and operation of the potable water line.

Similar to the electric transmission line, the potable water line would be subject to the jurisdiction of the PUCT and the BND would be required to obtain a Certificate of Public Convenience and Necessity from the PUCT, in addition to all other applicable permits and approvals. According to Texas LNG, the potable water line would begin construction concurrent with the intrastate natural gas pipeline.

1.4.4 State Highway 48 Auxiliary Lane

Texas LNG commissioned a traffic impact analysis to determine potential Project-related impacts on road use and traffic on SH 48. The traffic impact analysis also provided recommendations for highway improvement, based on current and anticipated vehicular volumes. Those recommendations included the following modifications:

- An auxiliary lane with deceleration, storage, and taper on the SH 48 northbound approach to the main driveway at the Project site. The auxiliary lane would be 6 feet-wide, and would consist of a 150-foot taper, 830 feet of deceleration length, and 100 feet of storage area.

- The auxiliary lane would be continued to approximately 1,100 feet north of the northern proposed driveway to provide for acceleration of vehicles exiting the Project site.

Texas LNG would construct, own, and operate the auxiliary lane on SH 48 in coordination with Texas Department of Transportation (TXDOT). Construction of the auxiliary lane would impact approximately 0.5 acre of previously disturbed areas within the existing road easement. Texas LNG would obtain a Permit to Construct Access Driveway Facilities on Highway Right-of-Way from TXDOT prior to initiating construction activities. Construction of the SH 48 auxiliary lane is anticipated to begin and be completed in 2019.

1.5 PERMITS AND APPROVALS

As the lead federal agency, FERC is required to comply with Section 7 of the ESA, the MSA, Section 106 of the NHPA, Section 307 of the CZMA, EPAct 2005, and Section 3 of the NGA. Each of these statutes has been taken into account in the preparation of this EIS. Table 1.5-1 lists the major federal, state, and local permits, approvals, and consultations identified for the construction and operation of the Project. Table 1.5-1 also identifies when Texas LNG commenced or anticipates commencing formal permit and consultation procedures.

TABLE 1.5-1 Major Permits, Approvals, and Consultations Required for the Projects		
Agency	**Permit/Approval/Consultation**	**Status**
FEDERAL		
Federal Energy Regulatory Commission	Authorization under Section 3(a) of the NGA	Submitted March 2016
United States Department of Energy	Application for Long Term, Multi-Contract Authorization to Export Natural Gas to FTA Countries	Authorization received September 24, 2015
	Application for Long Term, Multi-Contract Authorization to Export Natural Gas to Non-FTA Countries	Authorization pending
United States Coast Guard	LOR as to the suitability of the waterway for LNG marine transit	Preliminary WSA submitted February 16, 2015 Follow-on WSA submitted February 25, 2016 LOR issued February 14, 2018
United States Army Corps of Engineers	Section 404, CWA Permit	Submitted March 2016
	Section 10, RHA Permit	Submitted March 2016
	Section 408, Alteration of Public Works Project Authorization	Submitted March 2016
United States Fish and Wildlife Service	Section 7 ESA Consultation	Consultation on-going
	MBTA Consultation	Consultation on-going
National Marine Fisheries Service	Section 7 ESA Consultation	Consultation on-going
	Marine Mammal Protection Act Consultation	Consultation on-going
	MSA Consultation	Consultation on-going
United States Environmental Protection Agency	NPDES Hydrostatic Test Water Discharge Permit	Prior to discharge
	NPDES Process Waste Water/Industrial Stormwater Discharge Permit	Prior to construction
	NPDES General Permit for Stormwater Discharges from Construction Activities	Prior to construction
Federal Aviation Administration	Notice of Proposed Construction or Alteration that may affect Navigable Airspace	Issued April 19, 2017
STATE		
Texas Commission on Environmental Quality	Permit to Construct and Operating Permit	Submitted March 2016
	Temporary Water Use Permit (hydrostatic test water)	Prior to withdrawal
	Water Use Permit (marine water intake)	Prior to withdrawal
	Air Quality Standard Permit for Concrete Batch Plants	Prior to construction
	Texas Pollutant Discharge Elimination System General Permit TXR150000 Stormwater Discharges Associated with Construction Activity (Dredged Material Placement)	Prior to construction
Railroad Commission of Texas	Section 401, Water Quality Certification	Submitted March 2016

TABLE 1.5-1		
Major Permits, Approvals, and Consultations Required for the Projects		
	Coastal Management Plan Consistency Determination	Submitted March 2016
	Hydrostatic and Wastewater Discharge Permits	Prior to discharge
Texas Historical Commission	Section 106 NHPA Consultation	Consultation on-going
Texas Parks and Wildlife Department	State Listed Species Consultation	Consultation on-going

Section 7 of the ESA states that any project authorized, funded, or conducted by any federal agency should not "…jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical…" (16 USC 1536(a)(2)(1988)). To comply with Section 7, FERC is required to determine whether any federally listed or proposed threatened or endangered species or their designated critical habitat occur in the vicinity of the proposed Project and conduct consultations with the FWS and/or NOAA Fisheries, if necessary. If, upon review of existing data or data provided by Texas LNG, FERC determines that these species or habitats may be adversely affected by the Project, FERC is required to prepare a BA to identify the nature and extent of adverse impacts, and to recommend measures that would avoid the habitat and/or species, or would reduce potential impacts to acceptable levels. Section 4.7 and the BA (provided in appendix D) provides information on the status of this review.

The MSA, as amended by the *Sustainable Fisheries Act* of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. The MSA requires federal agencies to consult with NOAA Fisheries on proposed actions authorized, funded, or undertaken by any agency that may adversely affect EFH (MSA Section 305(b)(2)). Although absolute criteria have not been established for conducting EFH consultations, NOAA Fisheries recommends consolidating EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the *Fish and Wildlife Coordination Act*, or the ESA (50 CFR 600.920(e)), to reduce duplication and improve efficiency. As part of this consultation process, the FERC staff prepared an EFH Assessment. This assessment and the status of the EFH consultation are provided in section 4.6.3.

Section 106 of the NHPA requires that FERC take into account the effects of its undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. Historic properties include prehistoric or historic sites, districts, buildings, structures, objects, or properties of traditional religious or cultural importance that are listed or eligible for listing on the National Register of Historic Places (NRHP). Texas LNG, as a non-federal party, is assisting the FERC in meeting its obligations under the NHPA, by providing information, analyses, and recommendations, in accordance with 36 CFR 800.2(a)(3) of the ACHP regulations implementing Section 106. Section 4.10 of this EIS provides additional information on the status of our compliance with the NHPA.

The COE has responsibility for determining compliance with all regulatory requirements associated with Section 404 of the CWA. The EPA also independently reviews Section 404 applications for wetland dredge and fill and has Section 404(c) veto power for wetland permits issued by the COE. The Section 404 permitting process regulates dredging and/or filling waters of the U.S. Before an individual Section 404 permit can be issued, the CWA requires completion of a Section 404(b)(1) guideline analysis. In coordination with the COE, FERC, in the NEPA review represented by this EIS, has analyzed technical issues required for the Section 404(b)(1) guideline analyses, including analysis of natural resources and cultural resources that would be affected by the Project, as well as analysis of alternatives. The results of our analysis of alternatives are provided in section 3.0 of this EIS; a summary of impacts on surface waters, wetlands, and cultural resources are provided in sections 4.3.2, 4.4, and 4.10 of this EIS, respectively.

In addition to CWA responsibilities, the COE has jurisdiction over Section 10 of the RHA, which requires authorization for excavation, fill, or modification within or beneath navigable waterways. Texas LNG's Section 10 application was submitted to the COE concurrent with its Section 401/404 application on March 23, 2016. Impacts on Section 10 waterbodies are summarized in section 4.3.2 of this EIS.

Texas LNG must comply with Sections 401 and 402 of the CWA. Water quality certification (Section 401) has been delegated to the state agencies, with review by the EPA. Point source discharges into waterbodies, such as those associated with hydrostatic test water and industrial waste water, require NPDES permits (Section 402 of the CWA), which would be issued by the EPA. Potential impacts on water quality as a result of construction and operation of the Project are discussed in section 4.3.2.3 of this EIS. Texas LNG is also required to obtain a discharge permit from the RRC for all hydrostatic and other wastewater discharges.

The CZMA calls for the "effective management, beneficial use, protection, and development" of the nation's coastal zone and promotes active state involvement in achieving those goals. As a means to reach those goals, the CZMA requires participating states to develop management programs that demonstrate how those states will meet their obligations and responsibilities in managing their coastal areas. In Texas, the Texas General Land Office accordingly administers the Texas Coastal Management Program (CMP). Texas LNG submitted a request to the CMP for coastal zone consistency review for the Project as part of its Section 401/404 application on March 23, 2016. Project impacts on the Coastal Zone are further discussed in section 4.8.6.

The CAA was enacted by the U.S. Congress to protect the health and welfare of the public from the adverse effects of air pollution. The CAA is the basic federal statute governing air pollution. Federal and state air quality regulations established as a result of the CAA include, but are not limited to, Title V operating permit requirements and PSD Review. The EPA is the federal agency responsible for regulating stationary sources of air pollutant emissions; however, the federal permitting process has been delegated to the TCEQ in Texas. Texas LNG would be required to obtain a State New Source Review minor source construction permit, Title V operating permit, and State Standard Permit (for the temporary concrete batch plant used during construction). Texas LNG submitted a New Source Review Permit application to the TCEQ on March 22, 2016. The Standard Permit for the concrete batch plant would be submitted prior to construction and the Title V permit application would be submitted prior to operation. Air quality impacts that could occur as a result of construction and operation of the Project are evaluated in sections 4.11.1.4 and 4.11.1.5 of this EIS, respectively.

EPAct 2005 and Section 3 of the NGA require us to consult with the U.S. Department of Defense to determine if there would be any impacts associated with the Project on military training or activities on military installations. In a letter dated June 4, 2018, the U.S. Department of Defense indicated that there would likely be minimal impacts from the proposed action.

Texas LNG is responsible for all permits and approvals required to implement the Project regardless of whether they appear in table 1.5-1. However, any state or local permits issued with respect to jurisdictional facilities must be consistent with the conditions of any authorization the Commission may issue.

2.0 PROPOSED ACTION

2.1 PROPOSED FACILITIES

The Texas LNG Project consists of a new LNG terminal on the north side of the Brownsville Ship Channel 2.5 miles southwest of the Town of Port Isabel, Texas and 19 miles northeast of the City of Brownsville, Texas population center (figure 1-1). The Project would be constructed in two phases. Texas LNG plans to initiate construction of Phase 1 upon receipt of all required authorizations and Phase 2 would be constructed when a customer for the production enters into a long-term tolling agreement that is sufficient to support the financing of the Phase 2 construction cost. Each phase would produce approximately 2 MTPA of LNG for export. Phase 1 and Phase 2 would each include a system that liquefies natural gas (or train) and full containment storage tank with the capacity of approximately 210,000 cubic meters (m^3). An artist rendering of the proposed Project is provided in figure 2.1-1. The following facilities, discussed in greater detail below, would be constructed as part of the Project:

- gas gate station and interconnect facility;
- pretreatment facility utilizing Honeywell/UOP technology for carbon dioxide removal and dehydration;
- turbo-expander for pentane plus heavy carbon removal;
- a Liquefaction Plant consisting of two liquefaction trains utilizing Air Products and Chemicals, Inc. (APCI) C3MR technology and ancillary support facilities;
- two approximately 210,000 cubic meter (m3) aboveground full containment LNG storage tanks with cryogenic pipeline connections to the Liquefaction Plant and berthing dock;
- LNG carrier berthing dock capable of receiving LNG carriers between approximately 130,000 m3 and 180,000 m3 capacity;
- a permanent material offloading facility (MOF) to allow waterborne deliveries of equipment and materials during construction and mooring of tug boats while an LNG carrier is at berth;
- thermal oxidizer, warm wet flare, cold dry flare, spare flare, acid gas flare, and marine flare; and
- administration, control, maintenance, and warehouse buildings and related parking lots; electrical transmission line and substation, water pipeline, septic system, and stormwater facilities/outfalls.

FIGURE 2.1-1 Artist Rendering of Proposed LNG Terminal

2.1.1 Gas Gate Station and Interconnect Facility

The Project would receive natural gas from a non-jurisdictional intrastate natural gas pipeline (see sections 1.4.1 and 4.13) at the gas gate station, which would be constructed on the proposed terminal site (see figure 2.1.2-1). The gas gate station would contain piping, a connection for a pig receiver[10], a filter/separator, custody transfer meters, an emergency shut down valve, and a gas analyzer. The Interconnect Facility, which would be constructed at the gas gate station in the LNG terminal would include a tie-in to the inlet flange of the LNG terminal meter, an emergency shutdown valve, a flange insulating kit, and a gas analyzer.

2.1.2 Liquefaction Plant

The main process components and associated support facilities of the LNG terminal include a gas pretreatment facility necessary to remove unwanted gas components from the supply gas stream, and LNG trains using the APCI C3MR propane precooled mixed refrigerant technology, as further described below. These facilities are collectively referred to as the "Liquefaction Plant." The design of the Liquefaction Plant is based on a feed gas delivery pressure of approximately 615 pounds per square inch gauge, for both the Phase 1 and Phase 2 facility at the inlet of the gas gate station.

2.1.1.1 Pretreatment Process

Pipeline-quality feed gas arriving at the LNG terminal would require the removal of various constituents ahead of the liquefaction process, including mercury, carbon dioxide (CO_2), water, and heavy hydrocarbons (pentane and heavier [C5+]). The natural gas delivered to the LNG terminal would be composed primarily of methane (between 91 and 98 percent), but would also contain other gas components; ethane, propane, butane, and other heavy end hydrocarbons (between 2 and 9 percent), in addition to small quantities of nitrogen, oxygen, CO_2, and water. Pipeline-quality natural gas typically contains very small quantities of these constituents, the presence of which has no significant effect on operational efficiency when the gas is used as an energy source for domestic, commercial, or industrial applications. However, these constituents can negatively affect liquefaction equipment when the same gas is used as feed stock for LNG production. The pretreatment process is designed to remove a range of unwanted components from the feed gas to enable the liquefaction process to operate reliably.

[10] A pipeline "pig" is an internal device to clean or inspect the pipeline. A pig launcher/receiver is an aboveground facility where pigs are inserted into or retrieved from the pipeline.

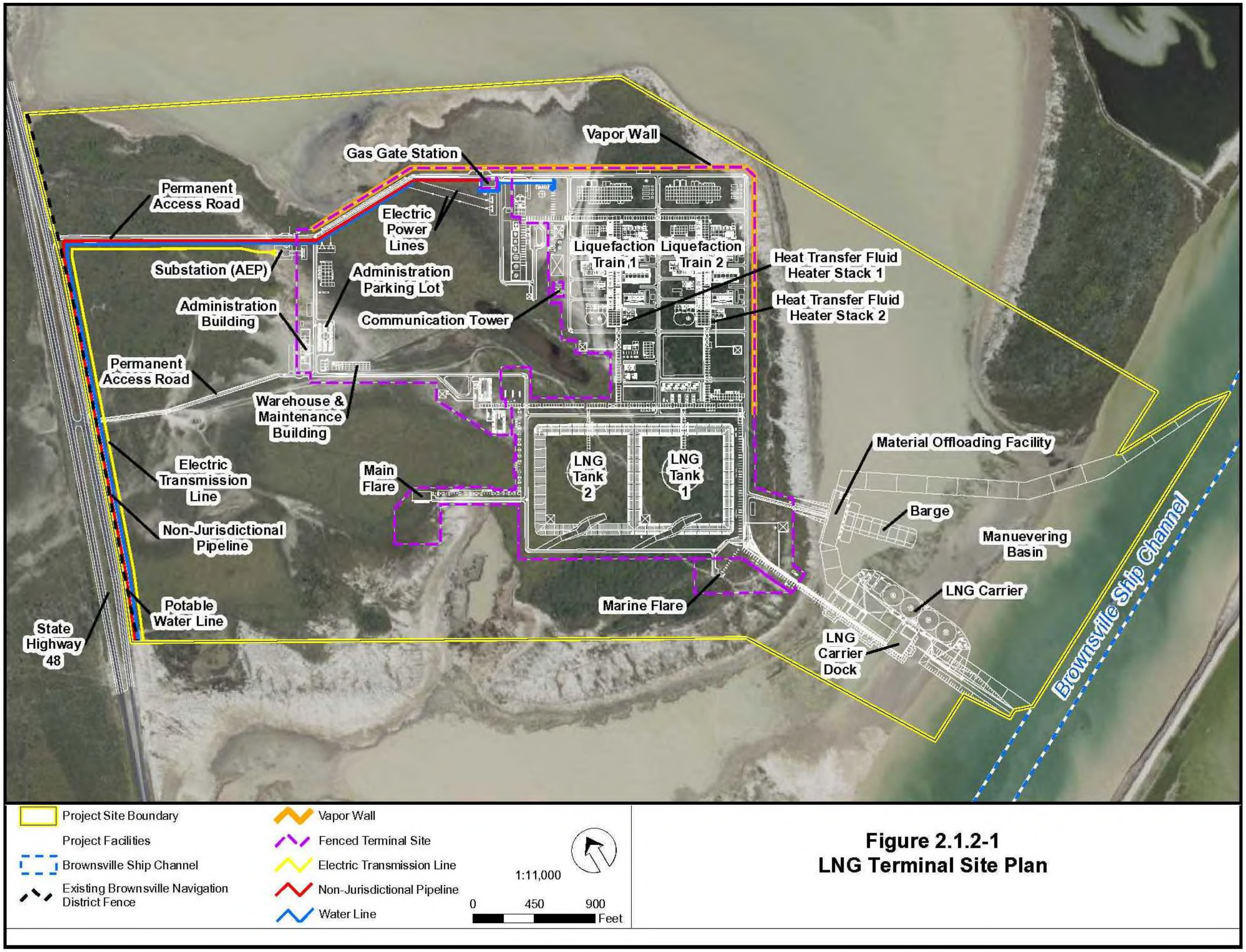

FIGURE 2.1.2-1 LNG Terminal Site Plan

The pretreatment process involves five sequential steps:

1. inlet facilities to remove pipeline debris (dirt, scale, dust, and oil);
2. treatment to remove mercury in mercury guard bed;
3. treatment to remove CO_2 in an amine acid gas removal system;
4. treatment to remove water in molecular sieve dehydration vessels; and
5. treatment to remove heavy hydrocarbons in a heavy hydrocarbon removal system.

From the Gas Gate Station at the LNG terminal, feed gas would be piped to the pretreatment facilities. The gas would flow first through the inlet facilities, then a mercury guard bed, an acid gas removal unit, a dehydration unit, and finally a heavy hydrocarbon removal unit. A more detailed description of this process is provided below.

The inlet facilities consist of a shell and tube heat exchanger, a pressure control station, and an inlet filter coalesce. The heat exchanger heats the feed gas by exchanging the heat with heat transfer fluid. The feed gas exiting the heat exchanger flows to the pressure control station that controls the inlet pressure to the plant. From the pressure control station, the gas flows through the inlet filter coalescer to remove any debris that might be entrained in the pipeline gas.

From the coalescer, the gas would flow to the mercury removal bed. Mercury naturally occurs in natural gas and may be present in very small quantities. To avoid the potentially damaging effects of mercury on plant equipment, the natural gas would flow through a bed of non-regenerable metallic sulfides wherein the mercury is removed from the natural gas stream. The mercury bed life is 4 years minimum at the design flow-rate. Once expired, the adsorbent would be removed and shipped to an authorized recycling center for recovery of spent metallic sulfides and mercury.

In the acid gas removal unit, acid gases (primarily CO_2 with small quantities of hydrogen sulfide [H_2S]) would be removed from the feed gas. The feed gas flows upward through a packed tower and is contacted by an amine solution flowing downward through the packing. The amine solution absorbs the acid gases from the feed gas. Saturated amine solution from the bottom of the contactor is depressurized and heated for regeneration in a separate stripping tower. Texas LNG would remove the water vapor, H_2S, $CO_{2,}$, and trace hydrocarbons in the stripping tower and send them from the top of the vessel to an acid gas thermal oxidizer where the H_2S is oxidized to sulfur dioxide (SO_2) and the trace hydrocarbons are oxidized to CO_2 and water. The incinerated gas is vented to the atmosphere. Texas LNG would cool and pump the clean, lean amine solution (amine stripped of H_2S and CO_2) from the stripping tower back to the contactor absorbing tower in a closed loop. The "sweet" water-saturated feed gas (gas that has been stripped of H_2S and CO_2) from the top of the contactor would then be cooled and sent to the dehydration unit. The amine system is designed to reduce the CO_2 content in the feed gas to 50 parts per million or less by volume. The CO_2 stream exiting the stripping tower is saturated with water that cannot be recovered. To account for the lost water, a demineralized water treatment system would provide purified makeup water for the amine system.

The dehydration unit would be located downstream of the acid gas removal unit and designed to remove water from the saturated feed gas that would otherwise freeze during natural gas liquefaction. The gas dehydration system would consist of three vertical molecular sieve beds. At any given time, two sieve beds would be in water adsorption mode, while the third would be in regeneration mode. The water content of the feed gas is reduced to less than 1 part per million by volume. The plant control system would sequence valves and equipment based on a time cycle to control the dehydration pretreatment process. For regeneration, a small reverse flow of dry hot gas from a regeneration gas heat exchanger would flow through the water saturated bed to heat the molecular sieve material. As the molecular sieve is heated, the water adsorbed onto the bed during the dehydration cycle is released. The hot regenerated gas would carry the water vapor out of the bed. An air cooler then causes the water vapor to condense and cool the hot regeneration gas discharged from the vessel. The condensed water is separated from the regeneration gas in a separator downstream of the air cooler. The water discharged from the separator would be treated by the process water recovery system and reused as amine make-up water. The process water recovery system removes any condensed hydrocarbons contained in the water discharged from the regeneration gas separator. The hydrocarbons recovered from the process water would be sent to the waste oil tank and disposed of at a licensed off-site disposal area. Dry purified feed gas from the molecular sieve beds, operating in dehydration mode, would be filtered to remove any molecular sieve dust. The bulk of the dry feed gas exiting the molecular sieve dust filters would be sent to the heavy hydrocarbon removal unit and the balance used as make-up for the regeneration gas system.

The last step in the pretreatment process is to remove the pentane plus (C5+), some components of which (e.g., benzene) would freeze during the liquefaction process if not removed. The feed gas would enter the heavy hydrocarbon removal unit where it would chill to a point where most of these heavy components condense and are then separated. As part of the heavy hydrocarbon extraction process, light hydrocarbons would condense along with the heavy hydrocarbons. A distillation process separates the lighter hydrocarbons and produces a C5+ mixture that has a low vapor pressure. The small quantities of C5+ product would temporarily collect in C5+ storage tanks with secondary containment. Texas LNG would then truck the C5+ to an offsite buyer and inject light hydrocarbons separated during distillation into the gas entering the liquefaction process as residue gas.

2.1.1.2 Liquefaction

Following pretreatment and heavy hydrocarbon removal, the natural gas would be condensed into a liquid at close to atmospheric pressure by cooling it to -260 degrees Fahrenheit utilizing APCI C3MR technology. A schematic of the C3MR Process is shown on figure 2.1.2-2. To achieve this, Texas LNG would boost treated gas pressure, as necessary, by an electric motor-driven residue gas compressor to the necessary operating pressure at the inlet to the liquefaction system. Air-cooled heat exchangers would cool the gas to remove the heat of compression. In each liquefaction train, gas leaving the residue gas compressor would be processed to produce LNG. Once both phases of the Project are operational, the average production rate would be 4 MTPA of LNG.

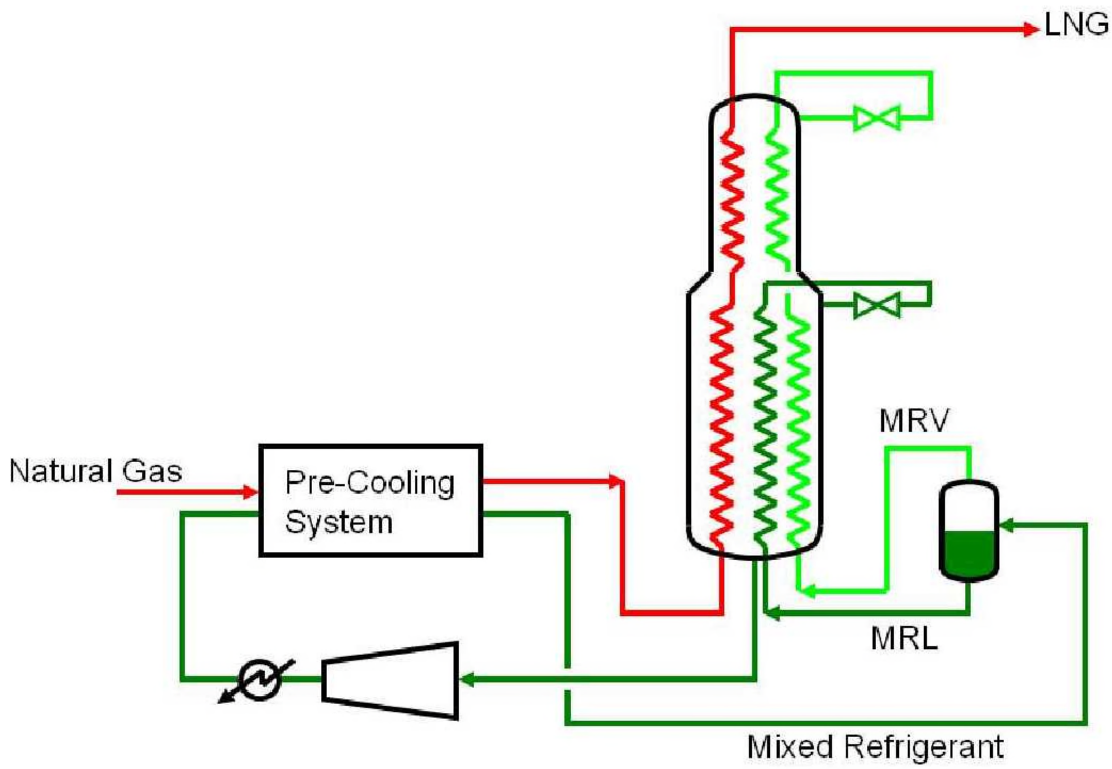

FIGURE 2.1.2-2 C3MR Process Schematic [11]

When the pretreated gas enters the liquefaction unit, it is cooled by the propane refrigerant in four kettle type shell and tube heat exchangers. Each of the kettle exchangers would contain propane refrigerant on the shell side and feed gas on the tube side. The heat removed from the feed gas would vaporize propane. The propane compressors would compress the vaporized propane to the condensing pressure. The propane discharged from the propane compressors would be condensed by air coolers.

The feed gas discharged from the tube side of the propane kettle vaporizers would flow to the main cryogenic heat exchanger (MCHE). The MCHE is a spiral wound heat exchanger. The feed gas flows through the tube side of the MCHE and exits as LNG. Mixed refrigerant consisting of nitrogen, methane, ethylene, and propane, would flow from the top to the bottom of the shell side of the MCHE. As the mixed refrigerant flows through the MCHE on the shell side of the exchanger, the mixed refrigerant cools the natural gas. The mixed refrigerant is vaporized as a result of cooling the feed gas to produce LNG.

The LNG exits the MCHE as a subcooled liquid and flows to the LNG hydraulic turbine. The turbine extracts work from the high pressure sub-cooled LNG exiting the MCHE and produces electrical power that is consumed on site. The LNG discharged from the hydraulic turbine is then sent to the LNG storage tank. The LNG stored in the LNG storage tank then can be pumped from the storage tanks through the cryogenic transfer piping to the LNG carrier berthing dock, to be loaded onto LNG carriers for export.

[11] MRL = mixed refrigerant vapor; MRL = mixed refrigerant liquid

Each liquefaction unit would contain a refrigerant make-up system with gas analyzers and controls that allow plant operations to keep the refrigerant components in proper proportion. The propane refrigerant make-up system is also designed to recover the propane refrigerant during equipment shutdown. Distribution piping would connect vessels in the common refrigerant storage area to each liquefaction unit. Except for certain safety systems, one distributed control system in the control building would be used for all process control.

2.1.3 LNG Storage

The LNG storage tanks would be approximately 290 feet in outer tank diameter and 190 feet in height from grade to the top of the dome roof, with a net usable capacity of approximately 210,000 m^3. The tanks would be a full containment design featuring a 9 percent nickel inner tank surrounded with a reinforced concrete outer tank to contain the LNG vapors. The outer reinforced concrete container of a full containment LNG tank is capable of containing the LNG in the event that the 9 percent nickel steel inner container fails. The tanks would be placed within earthen berms that would provide additional containment in the event of a spill. The storage tanks, like all of the facilities at the LNG terminal, would be built to the requirements of the NFPA Standard 59A, DOT regulations at 49 CFR 193, and all other applicable regulations, codes, and standards. Prior to being placed in service, the LNG storage tanks would be hydrostatically tested in accordance with the requirements of American Petroleum Institute (API) Standard 620, Q8.3. Hydrostatic testing is further discussed in section 4.3.2.3.

2.1.4 LNG Carrier Loading

As indicated on figure 2.1.2-1, the LNG carrier maneuvering basin would be recessed into the shoreline of the Brownsville Ship Channel. The LNG carrier maneuvering basin would feature a 140-foot by 150-foot concrete jetty head platform, which would be supported on piles. The platform would support three loading arms and one vapor return arm to allow LNG transfer to berthed LNG carriers. The three liquid loading arms are composed of two dedicated liquid loading arms and one hybrid arm also capable of unloading vapor. The hybrid arm is a backup to the vapor return arm and would normally be used to load LNG. Texas LNG would fit each arm with a hydraulically interlocked double ball valve and powered emergency release coupling to isolate the arm and the ship in the event of any condition requiring rapid disconnection.

The LNG carrier berthing dock would also include four breasting dolphins (each with 48-inch battered piles) and six mooring dolphins (each with 48-inch battered piles) to secure the LNG carrier while docked. A grated pedestrian walkway would extend in both directions from the loading platform to provide access to the dolphins. The main access trestle would provide a concrete-surfaced access road for vehicles separated by a barrier from the process and utility pipelines. The dock would be oriented perpendicular to the Brownsville Ship Channel to minimize the forces of wakes from passing ships. Approximately 130 feet of the dock would extend past the shoreline; however, the structure would be greater than 500 feet from the northern edge of the maintained navigation channel.

During LNG carrier loading, LNG would be pumped from the LNG storage tank(s) to the LNG carrier berthing dock using in-tank pumps, where it would be transferred to ocean-going carriers and exported. The LNG carrier would be at the loading dock for approximately 24 hours depending on the size of the LNG carrier. Regardless of the size of the LNG carrier, the LNG transfer rate to the LNG carrier would not exceed 12,000 m^3 per hour. At the LNG carrier berthing dock, transfer to the carrier would be achieved through the hydraulic-operated LNG loading arms. The vapor return arm is provided to route displaced gas back to the LNG storage tanks.

Texas LNG's current projections indicate that one LNG carrier per 10 to 11 days would make port calls at the LNG terminal when operating at the completion of Phase 1 and twice that frequency at the completion of Phase 2. The actual number of port calls would depend on the export volume and the capacity of the specific vessels. The maximum number of vessel calls per year is expected to be 74 when the facility is producing 4 MTPA of LNG.

The maneuvering basin would be dredged and maintained to -43 feet mean lower low water (MLLW) with a 2-foot allowable over depth to accommodate LNG carriers with capacities up to approximately 180,000 m^3 of LNG. The maneuvering basin would be dredged with sidewalls sloped to a 3 to 1 ratio in order to match the sidewall slope of the Brownsville Ship Channel. Portions of the slopes would be armored with riprap to prevent erosion or slumping of the slopes during operation of vessels.

Texas LNG would design the MOF to receive ocean going barges and larger vessels such as heavy load carriers. During construction, the MOF would be used for delivery of a portion of the materials, equipment, and modular plant components necessary for the Project via barge or other ocean-going vessels. During operation, Texas LNG would maintain the MOF to import large replacement parts for ongoing facility maintenance and serve as the tug berth while an LNG carrier is docked. The MOF would consist of a 400-foot-long and 122-foot-wide, rectangular platform. The barges and other vessels would dock along the 400-foot side, which would face the Brownsville Ship Channel.

The MOF would also support the backup seawater pumps for the firewater system, which is comprised of five pumps with separate suction intakes. Construction of Phase 1 of the Project would include installation of two pumps, each with a maximum pumping rate of 3,000 gallons per minute using an intake approximately 12 inches in diameter. During Phase 2, three additional pumps would be installed, each with a maximum pumping rate of 4,500 gallons per minute utilizing an intake of approximately 16 inches in diameter. The intakes would include screens with mesh sizes ranging from 0.25 to 1.0 inch to prevent entrainment of fish and other aquatic life. Further, the intake pipes would be placed a minimum of 5 feet below the water surface. Additional information regarding water intake is provided in section 4.3.2.3.

2.1.5 Buildings and Facility Roads

The LNG terminal would include separate permanent buildings for administration, control room, warehousing, and maintenance shop functions. Texas LNG would construct the administration building, warehouse, and maintenance shop located near the center of the LNG terminal; whereas, the control room would be near the Liquefaction Plant, as shown on figure 2.1.2-1.

Texas LNG would access the LNG terminal during construction and operation using SH 48. Because there are no existing roads within the LNG terminal site, internal roads would be constructed, including roads providing ingress and egress routes to the LNG terminal. As shown on figure 2.1.2-1, the westernmost facility road would be the primary permanent road providing access to the administration area as well as the LNG facilities (e.g., liquefaction trains, LNG storage tanks, and LNG carrier berthing dock). The easternmost facility road would provide access to the utility areas on site as well as provide secondary access to the LNG facilities. Texas LNG would control both access points with a security gate.

2.1.6 Water, Power, and Communications

Texas LNG anticipates that water supply during construction would be imported from off-site and sanitary waste would be handled by self-contained portable facilities. The BND would supply water necessary for industrial processes and domestic water supply using a water supply line. The water supply line is further discussed in sections 1.4.3 and 4.13 and water use associated with the Project is further discussed in section 4.3.2.3.

Sanitary waste water would be treated by an onsite septic system. Texas LNG would use a freshwater fire tank to charge the firewater main and as first response in the event firewater is needed. The firewater tank is designed to provide firewater at the design supply rate for at least two hours. A seawater firewater back-up system is also included in the design and would automatically activate on detection of a low water level in the freshwater firewater tank.

AEP would supply electric power for the Project connected to the local electric transmission grid. AEP would construct a substation within the LNG terminal (see figure 2.1.2-1). The main power load would be the electric motor drivers coupled to refrigeration compressors. Other primary plant electrical loads would include: in-tank LNG pumps, boil-off gas compressors and residue compressors, and the multiple fin-fan motors that Texas LNG would use for air cooling of the process during liquefaction. Electric power facilities necessary for the Project are further discussed in section 1.4.3 and 4.13.

The telecommunications systems for the Project would include a telephone connection, internet connection, operations very high frequency radio system, marine very high frequency radio system, operation back-up communication (phone), computer network, plant telecommunications network, and closed-circuit television system. Texas LNG would construct an approximately 150-foot-high radio communication tower near the main control building. In addition, marine band very high frequency radios would facilitate communication with the LNG carriers.

2.1.7 Flares

The process flares would be infrequently used for start-up, shutdown, and non-routine venting of excess pressure. The warm wet flare, cold dry flare, acid gas flare, and spare flare would all be mounted on one, 315-foot-high structure called the main flare (see figure 2.1.2-1). A second 180-foot-high flare structure, the marine flare, would be southwest of the LNG storage tanks (see figure 2.1.2-1). Texas LNG estimates that each train would have one shutdown/start up per year requiring a total of 372 hours of flaring with the main flare and 264 hours of flaring with the marine flare, annually. To the extent practicable, use of the flares during these processes would be planned. Scheduled shutdown activities would likely occur during the summer months due to additional daylight hours and when ambient air temperatures are higher. Higher temperatures reduce the amount of LNG that can be produced by the facility and consequently reduce the cost associated with shutdown activities.

Emergency situations may also require flaring, including emergency shutdown of the Thermal Oxidizer Package, general power failure, instrument air/electrical supply failure, control valve failure, checked valve failure, blocked outlet, and fire. Emergency flaring could occur at any time, but would generally be a rare event of short duration.

2.1.8 Ancillary Facilities

Ancillary facilities and structures at the LNG terminal would include flare knock-out drums, boil-off gas (BOG) compressors, an instrument air system, truck loading and unloading facilities, and an oily water treatment unit. Each of these ancillary facilities is further described below.

The Project would utilize warm wet, cold, spare, and acid gas flare knock-out drums, designed to separate liquids from the gas stream so that it does not reach the flare. A flare condensate transfer pump would move the liquid hydrocarbons and water collected from the wet and spare flare knock-out drums to the waste oil drum. The cold dry and spare flare knock-out drums would also be equipped with electric heaters designed to vaporize the liquids. Texas LNG would only use the acid gas flare knock-out drum when the thermal oxidizer is out of service. The marine flare header is connected to the marine flare and is not equipped with a knock-out drum, as the major source of BOG is the storage tanks that are already acting as a knock-out drum.

BOG is produced due to heat absorbed from the environment into the LNG storage tanks and piping. BOG is managed to minimize the production loss of LNG and increase the production efficiency of the LNG facility. The BOG header, which is downstream of the vapor outlet of the BOG knock-out drum, acts as a pressure equalizing line by sending or receiving BOG to or from the LNG storage tanks. This BOG is then sent to the BOG compressor and aftercooler, which compresses and cools the BOG to be used as fuel gas or to be recycled to the residue gas compressor.

The instrument air system is required to support plant operations by providing air for instrumentation, motor purging, and for the low purity nitrogen generation unit. Air is compressed by the package air compressors and dried by the air drying package.

Several of the LNG process components require material deliveries or waste disposal by truck; therefore, truck loading and unloading facilities would be constructed at the Project site. Deliveries would include materials such as fresh amine solvent, heat transfer fluid, high purity nitrogen, and ethylene and propane refrigerants necessary for the liquefaction process. Texas LNG would load other materials, such as heavy condensate that is produced through the liquefaction process, onto trucks for proper disposal.

In certain areas within the LNG facility, there would be potential for stormwater to become contaminated with oil, such as the package oil retention sumps. The sumps would be designed to contain a 25-year, 24-hour precipitation event or 110 percent of the lube oil circuit volume, whichever is greater. Texas LNG would install the package oil retention sump underground and divide it into three compartments to separate and collect oil and water. Texas LNG would pump the water to a centralized oil contaminated water tank for further purification and pump the recovered oil to a centralized waste oil drum for offsite disposal. The treated water would be transferred to the treated water discharge tank and discharged into the marine berth via an NPDES-permitted outfall on the LNG carrier dock.

2.2 LAND REQUIREMENTS

Texas LNG would construct the LNG terminal on a 625-acre parcel owned by the BND, with an additional 26.5 acres necessary outside of the parcel to allow for deep water access to the Brownsville Ship Channel (collectively referred to as the Project site) (see figure 2.2-1). In total, construction of the Project would require 311.5 acres, with 282.0 acres permanently maintained for operation of the LNG terminal (referred to herein as the Project footprint). The remaining 340.0 acres of the Project site would be undisturbed, although approximately 36 acres (including approximately 7 acres of temporary workspace) would be enclosed within the Project fence (see figure 2.1.2-1). In addition to the land requirements at the Project site, Texas LNG would utilize the existing 704-acre placement area 5A (PA 5A) for disposal of dredge material associated with construction of the Project, as further discussed in section 2.5.4.2. Land requirements for the Project are summarized in table 2.2-1 and further discussed in section 4.0.

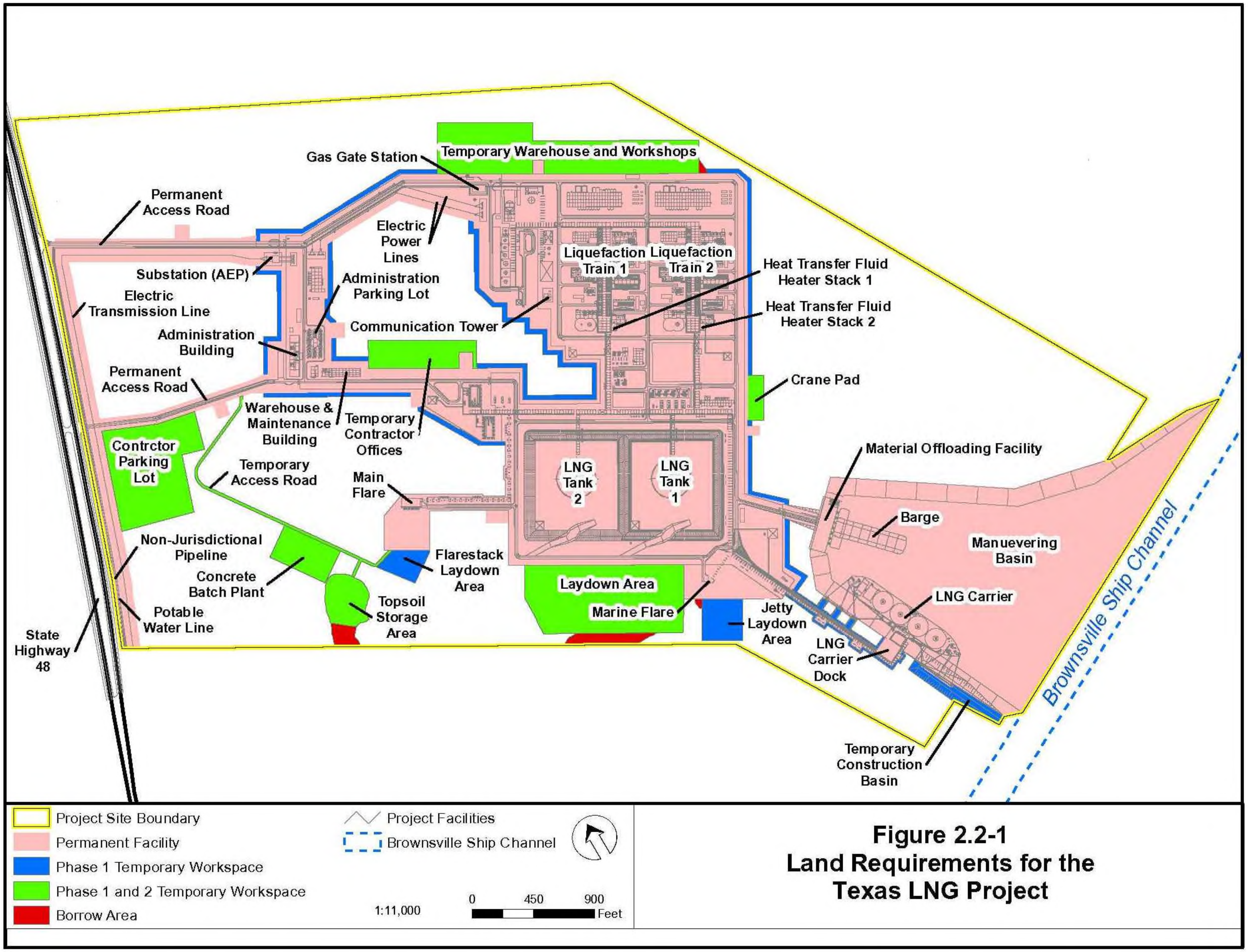

FIGURE 2.2-1 Land Requirements for the Texas LNG Project

TABLE 2.1.8-1 Land Requirements for the Texas LNG Project		
Facility	**Land Required for Construction (acres)**	**Land Required for Operation (acres)**
PERMANENT FACILITIES		
Liquefaction Process Area and LNG Storage Tanks [a]	156.6	156.6
Maneuvering Basin [b]	72.0	72.0
LNG Carrier Berthing Dock	1.5	1.5
Permanent Access Road	6.7	6.7
Non-jurisdictional Facilities within the Project Site [c]	11.4	11.4
Permanent Facilities Subtotal	**248.2**	**248.2**
TEMPORARY WORKSPACE AND LAYDOWN AREAS [d]		
Phase 1 Temporary Workspace		
Temporary Construction Basin	1.5	0.0
Jetty and Flarestack Laydown Areas	3.4	0.2
LNG Carrier Berthing Dock	1.0	0.0
Site Preparation Temporary Workspace	9.0	0.0
Borrow Areas	2.0	2.0
Phase I Temporary Workspace Subtotal	**16.9**	**2.2**
Phase 1 and 2 Temporary Workspace		
Concrete Batch Plant	2.7	0.0
Warehouse and Workshops	12.8	12.8
Laydown Areas	12.9	12.9
Contractor Offices	3.5	3.5
Contractor Parking Lot	10.0	0.0
Crane Pad	1.0	0.0
Topsoil Storage Area	2.4	2.4
Temporary Access Road	1.1	0.0
Phase I and 2 Temporary Workspace Subtotal	**46.4**	**31.6**
PROJECT SITE TOTAL	**311.5**	**282.0**
DREDGE MATERIAL PLACEMENT AREA		
PA 5A	704.0	704.0

[a] Includes all areas contained within the liquefaction and storage tank areas of the fenced LNG terminal, including but not limited to the administration building, gas gate station, utility substation, and communication tower.
[b] Includes the acreage associated with the MOF.
[c] Includes the portions of the non-jurisdictional natural gas pipeline, electric transmission line, and potable water line within the Project site.
[d] Impacts presented in the "Operation" column under "Temporary Workspace and Laydown Areas" represent areas used for construction in which contours would not be restored. Following construction in these areas, all temporary buildings and equipment would be removed and the area would be revegetated; however, contours would not be restored, resulting in a permanent impact.

2.3 CONSTRUCTION SCHEDULE AND WORKFORCE

Texas LNG plans to begin construction of Phase 1 of the Project in 2019 and begin production in 2023. During the peak construction period of Phase 1, Texas LNG estimates that 1,000 workers would be required; however, the number of workers present at different stages of construction would vary. Texas LNG anticipates approximately 40 to 100 workers would be necessary during initial mobilization. As site activity increases, the workforce would average 600 workers for the anticipated 44 months of construction, increasing during installation of the liquefaction train components and decreasing as the facilities near completion and pre-commissioning, commissioning, and start-up.

Construction of Phase 2 of the Project would require a similar workforce to that used for Phase 1 with the exception that site preparation and installation of the marine facilities, substation, gas gate station, refrigerant storage, flares, firewater storage and pumps, and utilities would not be required. Phase 2 construction is anticipated to take 43 months and could begin as soon as 18 months after the start of Phase 1 construction. Texas LNG anticipates that during the peak construction of Phase 2, approximately 900 workers would be required. Initial mobilization would involve 30 to 80 workers. As site activity increases, the workforce would average approximately 400 workers, increasing during installation of the liquefaction train components and decreasing as the facilities near completion and pre-commissioning, commissioning, and start-up. The anticipated workforce necessary for construction and operation of the Project is discussed in greater detail in section 4.9, including the necessary workforce for the Peak Impact Scenario, in which construction of Phase 1 and Phase 2 overlap.

2.4 ENVIRONMENTAL COMPLIANCE

FERC may impose conditions on any authorization it grants for the Project. These conditions may include additional requirements or mitigation measures recommended in this EIS to avoid and minimize the environmental impacts that would result from construction and operation of the Project (see sections 4.0 and 5.0). We will recommend that these additional requirements and mitigation measures (presented in bold type in the text of the EIS) be included as specific conditions to any authorization issued for the Project. We will also recommend that the Commission requires Texas LNG to implement the mitigation measures they proposed as part of the Project unless they are specifically modified by other authorization conditions. Texas LNG would incorporate all environmental conditions and requirements of the FERC authorization and associated construction permits into the construction documents for the Project.

Texas LNG would employ at least one environmental inspector (EI) to monitor construction activities at the LNG terminal during all phases of construction, including clean-up and restoration. The responsibilities of the EI employed by Texas LNG are outlined in its Project-specific Environmental Construction Plan (ECP) (included in appendix B). The ECP is based on the 2013 FERC *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Procedures),[12] which are

[12] The FERC Plan and Procedures can be viewed on the FERC website at http://www.ferc.gov/industries/gas/enviro/plan.pdf and http://www.ferc.gov/industries/gas/enviro/procedures.pdf.

a set of construction and mitigation measures developed in collaboration with other federal and state agencies and the natural gas industry to minimize the potential environmental impacts of the construction of natural gas projects, in general.

Texas LNG has requested deviations from the FERC Plan and Procedures, as described in sections 2.5 and 4.4.3. Although adequate justification has been provided for these alternative measures, Texas LNG would be required to otherwise comply with the requirements of the Plan and Procedures.

The EI's duties include ensuring compliance with environmental conditions, construction procedures, techniques and plans, and permit conditions and requirements. The EI would also verify construction workspaces prior to use, confirm that all sensitive resources are properly marked, and ensure proper installation and maintenance of all erosion controls. The EIs would have peer status with all other inspectors, would have the authority to enforce permit and FERC environmental conditions, to issue stop-activity orders, and impose corrective actions to maintain environmental compliance.

In addition to monitoring compliance, the EI would assist with environmental training for Project personnel and report compliance status on a daily, weekly, and bi-weekly basis. The environmental training program would be designed to ensure that all individuals receive training before beginning onsite work. Adequate training records would be maintained and refresher training provided, as necessary. Project-specific environmental requirements including applicable permits, the ECP, and other relevant environmental conditions would be part of the construction contract documents that Texas LNG would provide to the contractor.

In addition to Texas LNG's environmental compliance activities, FERC staff would conduct periodic field inspections during construction. Following the inspection, we would enter inspection reports into the Commission's public record. Other federal and state agencies may also conduct oversight or inspections to the extent determined necessary by the individual agency. After construction is completed, FERC staff would continue to monitor affected areas during operation to verify successful restoration (as defined by the FERC Plan and further discussed in section 4.0 of this EIS). Additionally, FERC staff would conduct annual engineering safety inspections of the LNG terminal throughout the life of the facility.

In our experience, necessary modifications to a project, both spatial and procedural, are often identified after it is authorized. These changes may include additional or different minor workspace configurations, changes to access roads, or even specific construction techniques. Any project modifications would be subject to review and approval from the Director of the Office of Energy Projects (Director of OEP) and any other permitting/authorizing agencies with federal or federally delegated jurisdiction.

2.5 CONSTRUCTION PROCEDURES

This section describes the general procedures proposed by Texas LNG for construction activities within the Project site. Refer to section 4.0 for more detailed discussions of proposed construction and restoration procedures as well as additional measures that we are recommending to avoid or reduce environmental impacts.

Under the provisions of the Natural Gas Pipeline Safety Act of 1968, as amended, the proposed LNG terminal would be designed, constructed, operated, and maintained in accordance with the DOT PHMSA's *Liquefied Natural Gas Facilities: Federal Safety Standards* (49 CFR 193) and the NFPA's *Standards for the Production, Storage, and Handling of LNG* (NFPA 59A). These standards specify siting, design, construction equipment, and fire protection requirements for new LNG facilities. The LNG carrier loading facilities and any appurtenances between LNG carriers and the last valve immediately before the LNG storage tanks would comply with applicable sections of the Coast Guard regulations in *Waterfront Facilities Handling Liquefied Natural Gas* (33 CFR 127) and Executive Order 10173.

Texas LNG would be required to implement all conditions in the authorization issued by the Commission for the Project. Texas LNG would implement its ECP, which is based on the 2013 FERC Plan and Procedures. Texas LNG has requested several deviations to the FERC Procedures related to placement of temporary workspace within wetlands. Texas LNG has presented equal compliance measures to ensure that impacts on wetlands are minimized. We have reviewed Texas LNG's ECP, including the requested deviations from the FERC Procedures, and found it to be acceptable. Detailed information regarding the requested deviations is provided in section 4.4.3.

To prevent contamination of soils, nearby wetlands, waterbodies, and other sensitive resources during construction, Texas LNG would implement its Project-specific Spill Prevention and Response Plan (SPAR) during construction and its Spill Prevention, Control, and Countermeasures Plan (SPCC Plan) during operation in accordance with the requirements of 40 CFR 112. These plans identify potential sources of releases of hazardous materials, outline measures that Texas LNG would take to prevent such releases to the environment, and describes initial responses in the event of a spill.

2.5.1 Site Preparation

The proposed Project site would require significant site preparation work, including clearing, grubbing, grading, soil stabilization, and filling to increase ground elevation, some of which must be performed prior to foundation development and terminal construction. Texas LNG has sited most of the LNG facility components (e.g., storage tanks, liquefaction trains) on the highest portion of the site, which currently has elevations ranging between 0 and 25 feet North American Vertical Datum of 1988 (NAVD 88)[13]. As part of the site preparation, Texas LNG would modify the proposed LNG facilities site by cut and fill activities to an elevation of 16 feet NAVD 88. The LNG storage tank area would be at an elevation of 10 feet NAVD 88, but would have secondary containment berms at 22 feet NAVD 88. Non-critical components of the LNG terminal, such as access roads, would be constructed at 7 feet NAVD 88. Figure 2.5.1-1 identifies the final grade of proposed facilities within the Project site. Prior to grading, Texas LNG would remove topsoil from the locations where it would install permanent facilities. Much of the topsoil within the Project site has limited potential for restoration due to high salinity (Natural Resources Conservation Service [NRCS], 2013), as further discussed in

[13] A vertical datum is an elevation of "0 feet" that is used as a reference point so that heights of other points can be assigned using a consistent system of measurement. NAVD 88 is the official vertical datum for the conterminous United States and Alaska (National Geodetic Survey, 2014).

section 4.2.3. Texas LNG plans to segregate topsoil from areas within the Project workspace with the greatest potential for successful revegetation of disturbed areas following construction. Stockpiled topsoil not suitable for reuse on the site would be disposed of at an approved off-site disposal facility in compliance with local requirements.

Texas LNG estimates that it would require 1.22 million cubic yards of fill to achieve the intended elevations. Additionally, soils would require improvement and stabilization to provide a load-bearing surface suitable for construction. Commonly used stabilizers include portland cement and hydrated lime. The source of fill material on site would include local commercial sources, material excavated from the maneuvering basin, and borrow areas within the Project site (see figure 2.5.1-1). Texas LNG would borrow from areas on site that are above 16 feet NAVD 88 and anticipates using up to 10 percent of dredge material for reuse on site. The use of dredge material for general construction is limited by structural requirements. Aggregate materials such as gravel, shells, and/or crushed stone sourced from regional commercial operations would be delivered to the site by truck and used to level and finish temporary workspace and operational areas, as necessary.

Temporary workspace that contains temporary workshops, contractor offices, etc. would be graded to an elevation of 7 feet NAVD 88. Temporary site roads and parking areas would be constructed at existing grade and would be stabilized and compacted for heavy load traffic. The final grade for these areas is shown on figure 2.5.1-1.

Grading of the site would be conducted so as to ensure efficient and environmentally protective stormwater drainage in accordance with Section 402 of the CWA. Texas LNG would slope the site to direct stormwater discharges towards perimeter outfalls through a system of ditches and filtration devices during construction to prevent high sediment loads from reaching receiving waterbodies. Stormwater controls would be installed as necessary.

During operation, stormwater would convey from areas that do not have a potential for contamination directly to an outfall on the pilings on the LNG carrier loading dock. Stormwater conveyance from areas that have potential for oil contamination or amine contamination would be designed to prevent untreated stormwater from flowing to the environment. The oil contaminated water would flow to the oily water treatment system, which is further discussed in section 4.3.2.3. Areas with potential for oil contamination include oil storage tanks, areas containing compressors using lubricating oil, water from the flare knock-out drum, and water from the plant air compressor. If the stormwater is contaminated with amine, the water would drain to the amine contaminated stormwater tank, Texas LNG would repair the source of the amine leak, and a licensed contractor would truck the amine contaminated water off-site for disposal of in accordance with applicable federal, state, and local regulations.

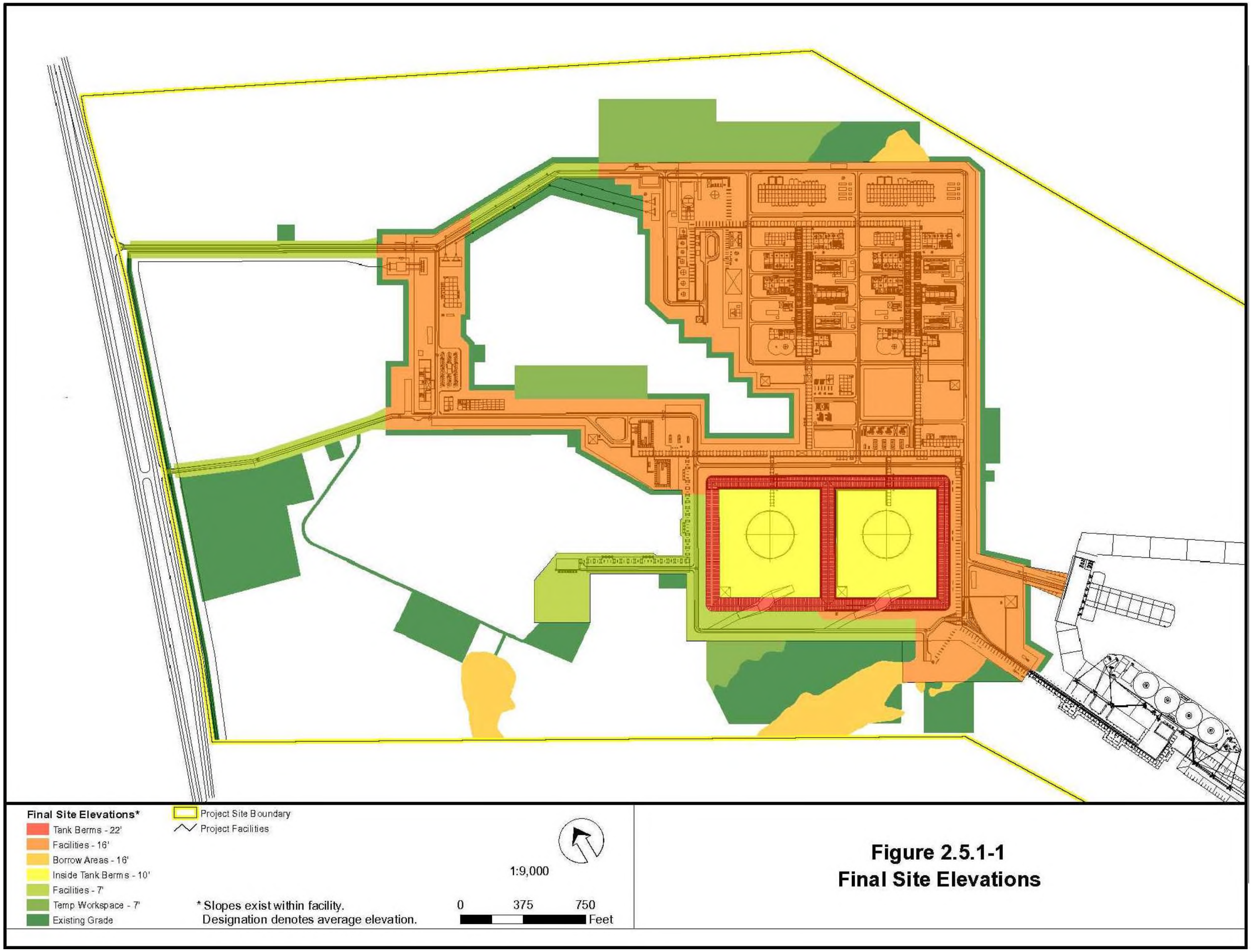

FIGURE 2.5.1-1 Final Site Elevations

Following the cutting, filling, and soil stabilization activities described above, Texas LNG would install temporary fencing to isolate construction areas from other areas of the Project site that would not be disturbed. The temporary site roads would generally follow the anticipated layout of the permanent facility roads and would be paved with asphalt, shell, or gravel depending on anticipated traffic loads. Texas LNG would also install any electrical, communications, and water systems needed during construction at this time.

2.5.2 Liquefaction Plant

The Liquefaction Plant foundation construction would begin with the installation of piles to provide a firm base for the structures supporting the liquefaction trains. Piles would be designed, installed, and load tested to satisfy load bearing requirements of liquefaction train equipment. After the piles have been positioned, using pre-drilled holes and/or pile driving, Texas LNG would install caps and pour the concrete pad. The piles would be delivered to the site by the MOF and/or truck.

Buried and aboveground piping on steel-framed support racks would interconnect the liquefaction systems connected with the gas gate station and LNG storage tanks. Pipe spools would be primarily fabricated off-site and delivered to the site by truck or barge. Texas Gas would paint, coat, or insulate pipe sections, as necessary. Coatings and insulation, if required, would be applied after welds have been tested in accordance with applicable codes.

Larger modular units would be transported to the MOF, offloaded, and transported to their respective foundations. Texas Gas would assemble certain larger equipment units, such as pretreatment systems and liquefaction and refrigerant compressors, as modules in prefabrication yards. Other equipment would be shipped to the site by truck or barge.

Once foundations have been set, work on the liquefaction trains, piping interconnects, and associated utility systems can occur within the same general timeframe, but would be coordinated such that various inter-dependent systems (e.g., electrical and instrumentation) can be installed and tested according to an appropriately sequenced schedule. After the equipment and piping has been set in place, cable systems would be installed. Ultimately, road paving, final site grading, seeding, and clean-up would be completed. Texas Gas would leave temporary construction facilities left in place for Phase 2 construction. After Phase 2, the temporary facilities would be disassembled and removed.

Following installation, pipe sections would be either hydrostatically or pneumatically tested depending on the type and intended function of the pipe. Hydrostatic testing is discussed in greater detail in section 4.3.2.3.

2.5.3 LNG Storage Tanks

The LNG storage tanks would be constructed in accordance with the applicable requirements of the NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas*; API Standard 620, *Design and Construction of Large, Welded, Low-pressure Storage Tanks*; and API Standard 625, *Tank Systems for Refrigerated Liquefied Gas Storage*. Construction of the LNG storage tanks would begin shortly after the start of overall Project construction. The storage tank foundations would be elevated slabs with piles. Nonreinforced concrete leveling slabs would be placed above the outer tank bottom and below the inner tank bottom. Once construction of the tanks is complete, they would be hydrostatically tested to ensure the integrity of the tank. Hydrostatic testing of the tanks is further discussed in section 4.3.2.3.

2.5.4 Marine Facilities

The marine facilities associated with the Project consist of the LNG carrier berthing dock, MOF, and the maneuvering basin.

2.5.4.1 LNG Carrier Berthing Dock and Material Offloading Facility

To create a stable work surface to construct the LNG carrier berthing dock and MOF, Texas LNG would create temporary causeways in the tidal flat to support the pile-driving crane and supporting equipment. The temporary causeway would not impede the limited existing tidal exchange, as discussed further in section 4.3.2.3. Earth-moving equipment (e.g., excavator, dozer, dump truck) would begin working from the upland areas and lay clean fill on geotextile fabric. When the surface is stable and raised to 3 feet NAVD 88, Texas LNG would armor the sidewall slopes with gravel to prevent tidal erosion. Equipment would advance across the temporary causeway operating on previously installed portions of the temporary causeway. When the temporary causeway is complete, the pile-driving crane would advance and install the dolphins and supporting piles for the trestle and loading platform. When a row of piles are stationed, the fill would be excavated and removed, shortening the temporary causeway enough to install the next row of piles. This process would be repeated until all piles are installed and the temporary causeway has been completely removed.

To provide access to the MOF, a permanent heavy haul road would be constructed from the uplands into the tidal flat. The temporary causeway would then be built to the same specifications described above for the LNG carrier berthing dock. Most of the LNG carrier berthing dock and all of the MOF piles would be installed prior to dredging the maneuvering basin, in order to minimize potential acoustic impacts on marine life (see section 4.6.2.2). Installation of piles associated with the marine facilities would generally occur six days a week and 10 hours per day and is anticipated to last approximately 13 months.

Texas LNG would locate the three channel-side mooring dolphins associated with the LNG carrier berthing dock near the edge of the Brownsville Ship Channel. Because this area is usually inundated by high tides creating saturated substrates, Texas LNG would dredge a temporary construction basin to allow for installation of these three mooring dolphins from a barge. A portion of the temporary construction basin would overlap with the maneuvering basin and would not be restored. For the areas impacted by the temporary construction basin outside of the permanent footprint within what is currently tidal flat (not within the slope of the Brownsville Ship Channel), Texas LNG would restore contours to the greatest extent practicable. However, the portion of the temporary construction basin that is outside the maneuvering basin and is within the slope of the Brownsville Ship Channel would be allowed to naturally fill in over time. The onshore, tidal flat area would be restored by backfilling dredge material or clean fill to preconstruction contours. Potential impacts associated with the temporary construction basin are further discussed in section 4 of this EIS.

2.5.4.2 Maneuvering Basin

Pipeline Removal

Approximately 1,400 feet of an abandoned, underground, 4.5-inch-diameter natural gas gathering pipeline (Cowboy Pipeline) is parallel and adjacent to the Brownsville Ship Channel, crossing the proposed maneuvering basin (see figure 2.5.4-1). The pipeline is within the proposed dredge footprint and would need to be removed prior to commencing dredging activities. The method of removal of the pipeline would depend on the integrity of the pipe; however, the following steps are anticipated and would be verified after the pipeline is exposed. Regardless of the integrity of the pipeline, Texas LNG would confirm that no organic liquids (e.g., hydrocarbons) are present within the pipeline. If organic liquids are present, the liquids would be collected in drums and disposed of by a licensed contractor. The pipeline crossing the proposed maneuvering basin would then be cut into sections, lifted on slings by a small tracked vehicle, placed the pipe sections in upland areas with other scrap materials, and disposed of at an approved facility. If the pipeline has not corroded through, the remaining cut ends of the pipeline that are not removed would be plugged to prevent any future discharge of organic material to the environment.

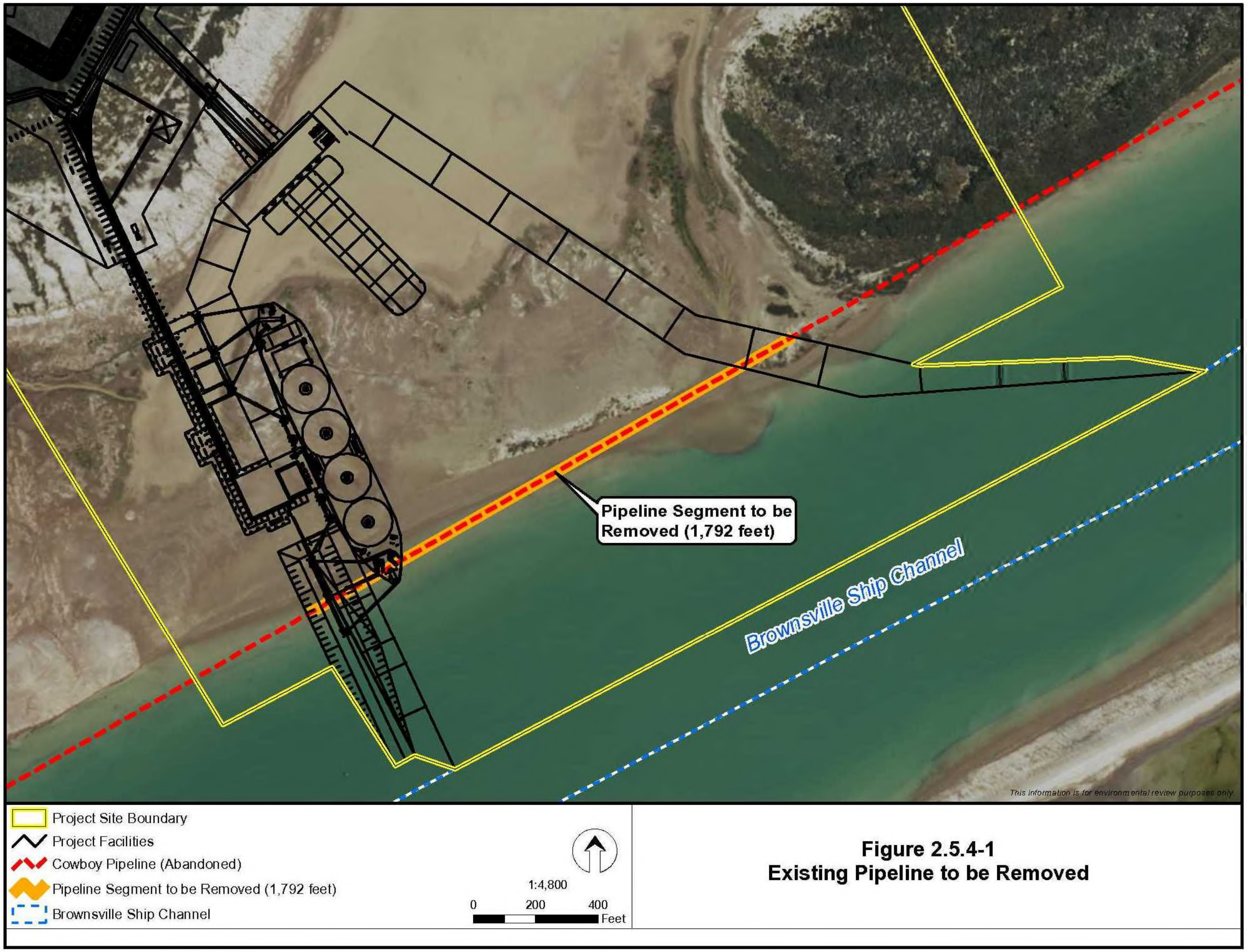

FIGURE 2.5.4-1 Existing Pipeline to be Removed

Dredging

The maneuvering basin would be recessed into the shoreline, requiring dredging of tidal mudflats, shallow water habitat, and deep water habitat. Dredging of the maneuvering basin would be completed in two phases. The first phase would involve dredging the temporary construction basin to the LNG carrier berthing dock to allow a shallow draft barge to install the three outermost mooring dolphins as described in section 2.5.4.1. A path for the barge would be dredged to approximately -20 feet MLLW to provide the necessary draft to float a barge mounted pile driver into position.

The second phase would involve dredging the maneuvering basin to -43 feet MLLW with a 2-foot allowable over dredge and sidewalls sloped to a 3 to 1 ratio in order to match the sidewall slope of the Brownsville Ship Channel. Texas LNG estimates that approximately 3.9 million cubic yards of dredge material would be removed from the site to reach the required depth of the maneuvering basin. The second phase would occur immediately following the first phase to prevent remobilization of dredging vessels. Dredging would begin from the east limit of the planned maneuvering basin to allow the piles for the LNG carrier berthing dock and MOF to be installed into the tidal flat to minimize potential acoustic impacts on marine organisms, as described in section 2.5.4.1. The area immediately surrounding the LNG carrier berthing dock and MOF would be dredged last, after pile driving has been completed.

Texas LNG would use a barge-mounted hydraulic cutterhead dredge (suction dredge) for the Project dredging activities. A hydraulic cutterhead dredge uses a rotating cutting apparatus around the intake of a suction pipe (called a cutterhead), to break up or loosen sediment. A large centrifugal pump removes the material from the seafloor and pumps the sediment-water slurry through a discharge pipeline. A typical 30-inch-diameter dredge has a production rate of up to 20,000 to 30,000 cubic yards per day, depending on sediment characteristics and placement methods. The hydraulic cutterhead dredge would swing back and forth to slowly cut away the nearshore sediments and shoreline to establish the specific dimensions and depths of the maneuvering basin. Material dredged by a hydraulic cutterhead dredge is placed directly in an upland confined placement area (further discussed below) by the discharge pipeline that would be placed on the ground and channel floor. Texas LNG would place the discharge pipeline in coordination with the Coast Guard and the COE.

Texas LNG has indicated that if disposal of dredge material in an existing upland confined placement area is not feasible, based on capacity and COE project schedules at the time Project dredging is proposed to occur, an offshore placement area may be utilized to dispose of dredge material (see section 4.3.2 for a detailed discussion of alternative dredge material placement areas that were considered for the Project). In the event that an upland confined placement area is not available and use of an offshore placement area is required, Texas LNG would not utilize a hydraulic cutterhead dredge. Discharge associated with a hydraulic cutterhead dredge in an upland confined placement area allows for suspended sediments to settle prior to discharging the water back into the Brownsville Ship Channel. If the same method were to be used with an offshore placement area, the suspended sediment would be discharged directly to the Gulf of Mexico, resulting in a large sediment plume. Therefore, if Texas LNG were to utilize an offshore placement area for disposal of dredge material, dredging would be conducted via a mechanical dredge, which excavates sediment with a grab or bucket. The sediment would then be placed on a barge and transported to the offshore placement area.

Texas LNG has indicated that use of a hydraulic cutterhead dredge for dredging activities and a confined placement area for dredge material disposal is preferred and would be possible, depending on several factors, such as COE project schedules. As a result, we have evaluated potential Project impacts throughout this EIS based on the assumption that Texas LNG would use the hydraulic cutterhead dredge method for dredging activities and an upland confined placement area for dredge material disposal. Use of a mechanical dredge and offshore placement area would result in potentially greater impacts on the environment, as described in section 4.3.2.

Once the maneuvering basin is dredged, portions of the sidewall slopes would be armored with riprap to prevent erosion or slumping during vessel operation. Riprap would consist of a 1-foot layer of bedding stone that has a median stone weight of 25 pounds placed on top of geotextile fabric covered with a 4-foot layer of median stone weight on the order of 1,500 pounds. The riprap would extend from the toe of the slope to approximately the elevation of MLLW. Rip rap would be placed within the maneuvering basin using a barge mounted crane. Texas LNG anticipates that at least a portion of the slope protection would need to be repaired every 5 years by placing new rock and/or relocating rock that may have moved. No riprap would be placed within the Brownsville Ship Channel.

Dredge Material Placement

Texas LNG plans to utilize the existing PA 5A located approximately 4 miles southwest of the Project site on the south side of the Brownsville Ship Channel for disposal of dredge material (see figure 2.5.4-2). The dredge material discharge pipe would place material directly into PA 5A. Additionally, Texas LNG anticipates using up to 10 percent of the estimated 3.9 million cubic yards of dredge material as general site fill, accounting for about a third of the estimated 1.22 million cubic yards of imported fill required for the site (see section 2.5.1). PA 5A is an existing confined dredge material disposal facility owned by the BND and operated under an easement agreement by the COE. Texas LNG evaluated various potential placement options, as further discussed in section 3.3.3.

The berms surrounding PA 5A are currently 9 feet NAVD 88. Texas LNG estimates that in order to contain the dredge material from the Project, the berms would need to be raised by 5 feet to a total of 14 feet NAVD 88. Texas LNG would raise the berms by excavating existing materials from within the disposal site for placement on top of the existing berms; therefore, the overall footprint of PA 5A would remain unchanged (see figure 2.5.4-2).

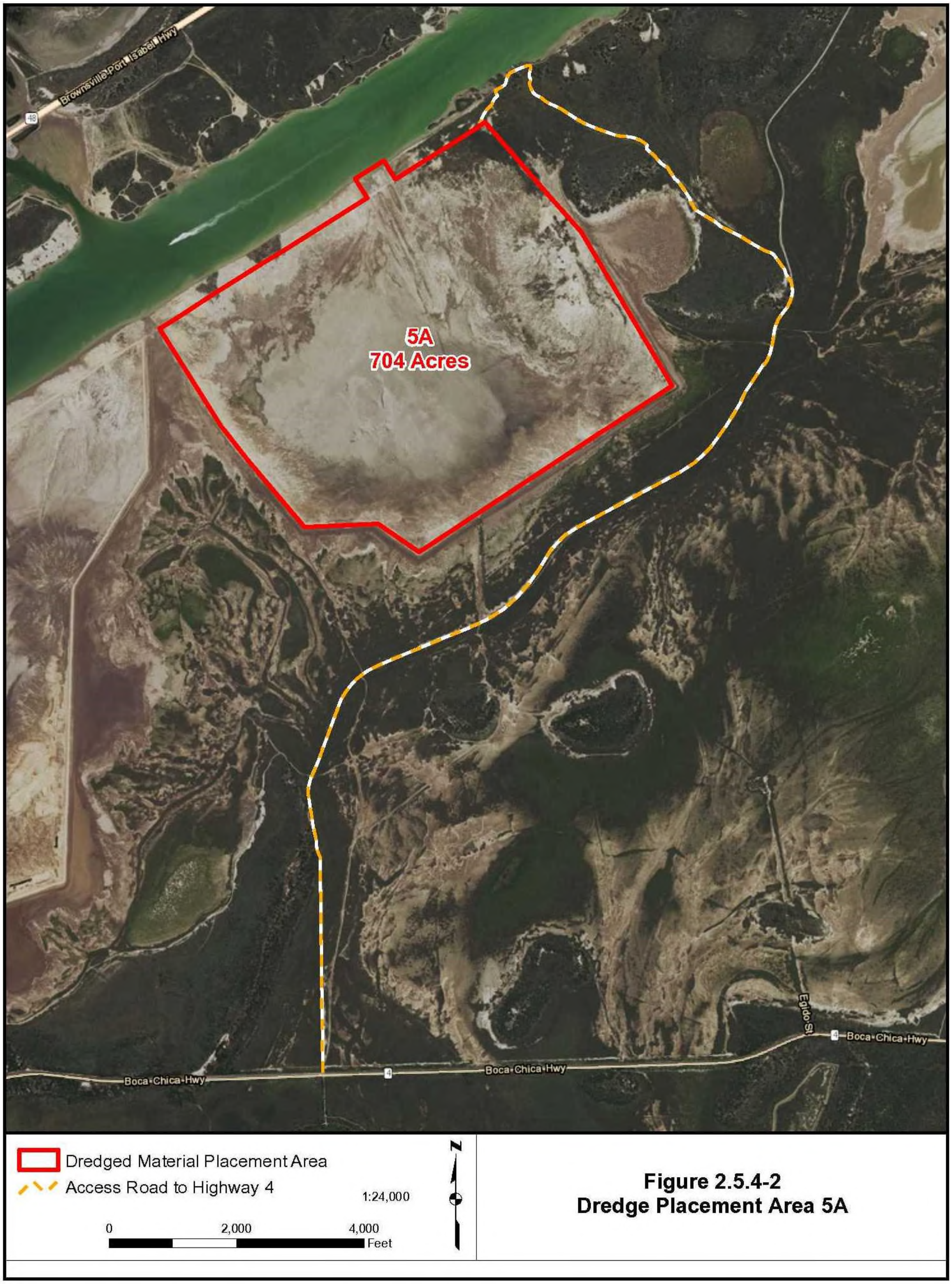

FIGURE 2.5.4-2 Dredge Material Placement Area 5A

Maintenance Dredging

Over time, the dredged maneuvering basin would be subject to accretion of material from the natural movement of sediments within the Brownsville Ship Channel and the surrounding area. Texas LNG estimates that the rate of accretion would be up to 100,000 cubic yards annually or 2.5 million cubic yards over 25 years. This volume equates to approximately 1 foot per year of average deposition; however, the distribution of the deposition could reduce the available underkeel clearance and would determine the frequency of maintenance dredging. Maintenance dredging would be conducted via hydraulic cutterhead dredge and dredge material would be placed in an approved placement area in accordance with all applicable authorizations from the BND and COE, as necessary. Texas LNG anticipates that maintenance dredging would be necessary every 3 to 5 years. Texas LNG would seek authorizations to conduct maintenance dredging, as needed.

2.5.5 Site Access

Texas LNG would access the LNG terminal site from SH 48 during construction and operation of the facility via two proposed access roads as shown on figure 2.1.2-1 and discussed in section 2.1.5. Permanent access roads would be constructed to an elevation of 7 feet NAVD 88 and width of 26 feet. Texas LNG would install culverts under the roads, where necessary, to maintain drainage and hydrologic connection between wetlands and tidal flats. Temporary access roads would be used during construction to provide additional access to the main flare and temporary workspace areas, including the temporary concrete batch plant (see figure 2.2-1).

2.5.6 Vapor Wall

To meet safety requirements, the eastern and southern boundary of the LNG terminal would be surrounded by a 20-foot-tall vapor wall designed to limit the spread of hydrocarbon vapor in the unlikely event of a spill (see figure 2.1.2-1). The vapor wall would be 4,945 feet long and made from prefabricated concrete supported by 990, 40-foot-long concrete piles. Construction would commence in incremental sections from uplands in order to drive the piles into position. Crane assemblies would then lower the wall panels, which would be attached to the concrete piles.

2.6 OPERATION AND MAINTENANCE PROCEDURES

2.6.1 LNG Carrier Traffic

Although LNG carriers and their operation are directly related to the use of the proposed LNG terminal, they are not subject to the Section 3 authorization sought in Texas LNG's application. The LNG carriers arriving at the LNG terminal must comply with all federal and international standards regarding LNG shipping.

LNG carriers would access the LNG terminal from the Gulf of Mexico through the Brownsville Ship Channel for approximately 5 miles. The Brownsville Ship Channel is currently maintained to a depth of 42 feet MLLW and width of 250 feet. The channel is essentially a straight waterway with no bridges or other air-draft obstructions for its entire

19-mile length. Due to its width, the channel is operated for single-lane, one-way traffic, with vessel traffic managed by the BND.

The Coast Guard evaluated the waterway and traffic impacts as part of the WSA (see section 1.2.3). Federal and state statutes require that all large commercial vessels be directed and controlled by a licensed marine pilot while underway in the navigable waters of the U.S. The LNG carriers would navigate from their point of origin to the pilot station near the sea buoy just outside the jetties protecting the entrance to the Brownsville Ship Channel. A pilot from the Brazos Santiago Pilots Association would navigate the LNG carrier from the sea buoy, through the Brazos Santiago Pass, into the Brownsville Ship Channel. Based on simulations conducted by the Brazos Santiago Pilots Association, Texas LNG anticipates that the passage from the sea buoy to the LNG terminal would take about 1 to 1.5 hours. Figure 2.6.1-1 identifies the LNG carrier route between the Gulf of Mexico and the LNG terminal.

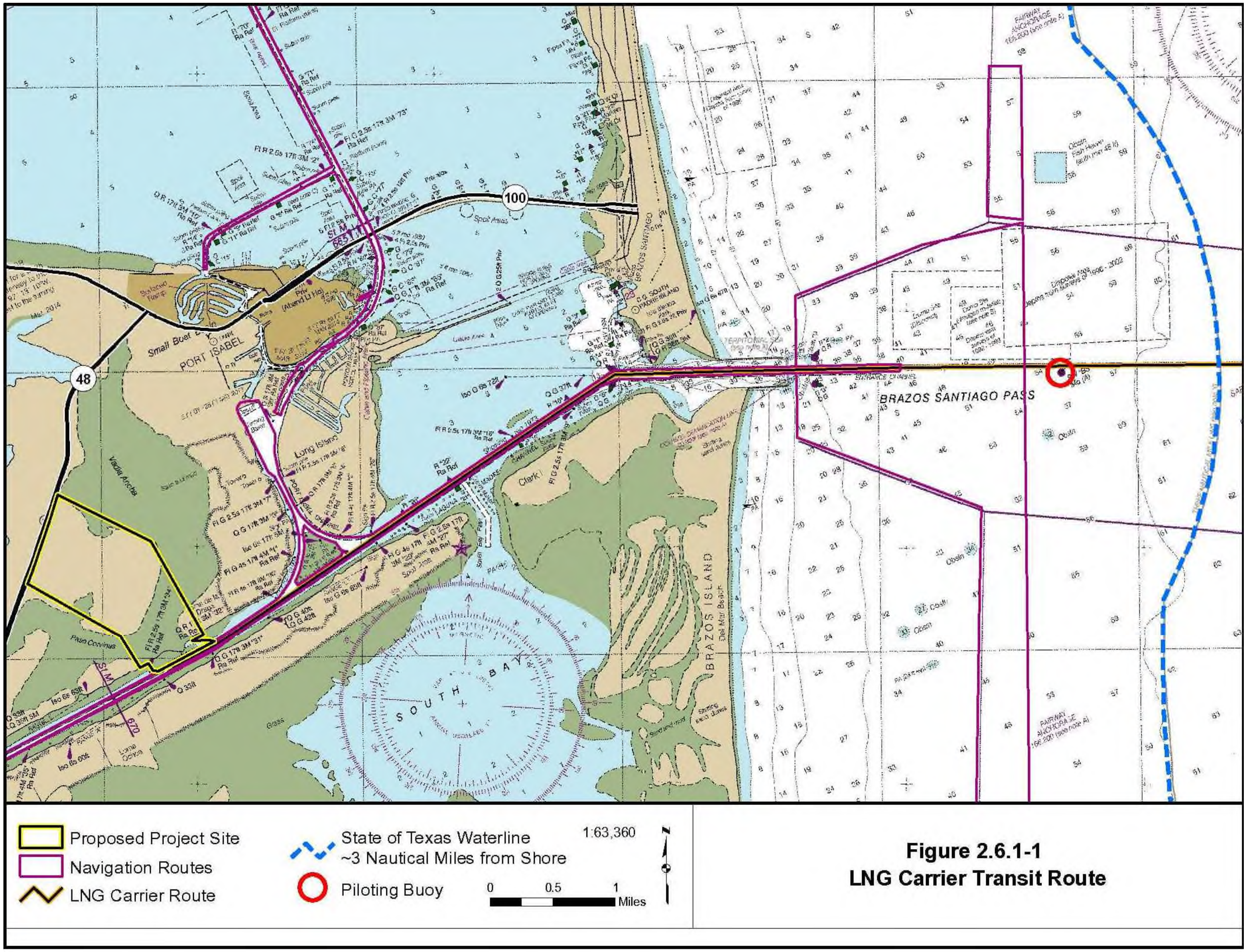

FIGURE 2.6.1-1 LNG Carrier Transit Route

When an LNG carrier enters the Brownsville Ship Channel, the Coast Guard would establish a safety zone around the vessel. As a safety and security precaution, no vessels are allowed to meet, cross, or overtake LNG carriers in transit or otherwise enter the security zone without the express permission of the Coast Guard. At its discretion, the Coast Guard may elect to provide escort to boats during LNG carrier transits to enforce the moving security zone.

LNG carriers calling on the LNG terminal would utilize the maneuvering basin so that while moored at the LNG carrier berthing dock, the LNG carrier bow would be facing toward the channel. The Project would be designed to accommodate LNG carriers with capacities of up to 180,000 m^3. These design vessels have a draft of approximately 39 feet when loaded with LNG, maximum beam of 165 feet, and length of approximately 1,000 feet. Three tractor tugs would be required to turn the LNG carrier and maneuver it to berth. After the LNG carrier is berthed, at least one of the tugs would remain nearby at the MOF.

2.6.2 LNG Terminal

All facilities would be operated and maintained in accordance with government safety standards and regulations that are intended to ensure adequate protection for the public and to prevent facility accidents and failures including 49 CFR 193, 33 CFR 127, NFPA 59A, and the RRC Chapter 14, *Regulations for Liquefied Natural Gas*. Operating procedures for the facility would be prepared after the final design is completed.

Comprehensive training would be provided to ensure that all facility personnel are familiar with the fundamental science, safety procedures, operating procedures, and maintenance procedures utilized at the LNG terminal. The training program would be conducted by professional instructors with expertise in their particular area of responsibility. A written training curriculum would be developed that includes both classroom and field training exercises. The training program would include testing to demonstrate that the personnel are competent to perform their assigned duties. These procedures would address safe start-up, shutdown, cool down, purging, upset response, and routine operation and monitoring. A process training simulator would be developed to train operators. During emergency response training, coordination with and involvement of appropriate local emergency responders would be undertaken to ensure effective integration with local communication and emergency response systems.

Texas LNG estimates that the Project would require approximately 80 full-time personnel for operation of Phase 1 and an additional 30 full-time personnel for operation of Phase 2. Maintenance of the Project facilities would be conducted in accordance with procedures and programs developed by Texas LNG. Full-time personnel would conduct routine maintenance and minor overhauls; whereas, major overhauls and non-routine maintenance would be conducted by qualified contractors. Scheduled preventative and predictive routine maintenance would also include inspection and maintenance of safety equipment, environmental systems, and instrumentation.

3.0 ALTERNATIVES

As required by NEPA and FERC policy, we evaluated alternatives to the Texas LNG Project to determine whether any such alternatives would be reasonable and have significant environmental advantages compared with the proposed action. The range of alternatives analyzed includes the No-Action Alternative, system alternatives, site alternatives, and process alternatives for the Texas LNG Project.

As part of the No-Action Alternative, we considered the effects and actions that could conceivably result if the proposed Project was not constructed. Under the analysis of system alternatives, we evaluated the ability of other existing, planned, or proposed (new or expanded) LNG export terminals to meet the proposed Project's objectives. Our evaluation of alternative sites for the Project focused on several locations for the LNG terminal and several options for dredge material placement.

The principal criteria for considering and weighing the alternatives for the Project were whether they:

- reasonably meet Texas LNG's primary objective of constructing and operating an LNG terminal to serve export markets consistent with its DOE authorization for FTA nations, and pending application for non-FTA nations;
- are technically and economically feasible and practical; and
- offer a significant environmental advantage over the proposed Project.

Texas LNG participated in our pre-filing process during the preliminary design stage of the proposed Project (see section 1.3.1). This process emphasized identification of stakeholder issues, as well as identification and evaluation of alternatives that could reduce environmental impacts. We analyzed each alternative based on public comments and guidance received from federal, state, and local regulatory agencies. Additional sources of information included Texas LNG's field surveys, aerial photography, U.S. Geological Survey (USGS) topographic maps, the FWS National Wetland Inventory (NWI) maps, pipeline system maps, agency consultations, and publicly accessible databases. To ensure equitable results, consistent data sources were used when comparing a feature across alternatives (e.g., NWI data were used for wetlands comparisons, rather than a combination of NWI and field survey data).

Through environmental comparison and application of our professional judgment, each alternative is considered to a point where it becomes clear if the alternative could or could not meet the three evaluation criteria. Our environmental analysis and this evaluation consider quantitative data (e.g., acreage) and uses common comparative factors such as dredging volume, wetland impacts, and nearest residences. In recognition of the competing interests and the different nature of impacts resulting from an alternative that sometimes exist (i.e., impacts on the natural environment versus impacts on the human environment), we also consider other factors that are relevant to a particular alternative and discount or eliminate factors that are not relevant or may have less weight or significance.

The alternatives were reviewed against the evaluation criteria in the sequence presented above. The first consideration for including an alternative in our analysis is whether or not it could satisfy the stated purpose of the project. An alternative that cannot achieve the purpose for the project cannot be considered as an acceptable replacement for the project.

Many alternatives are technically and economically feasible. Technically practical alternatives, with exceptions, would generally require the use of common construction methods. An alternative that would require the use of a new, unique or experimental construction methods may not be technically practical because the required technology is not available or is unproven. Economically practical alternatives would result in an action that generally maintains the price competitive nature of the proposed action. Generally, we do not consider the cost of an alternative as a critical factor unless the added cost to design, permit, and construct the alternative would render the project economically impractical.

Alternatives that would not meet the Project's objective or were not feasible were not brought forward to the next level of review (i.e., the third evaluation criterion). Determining if an alternative provides a significant environmental advantage requires a comparison of the impacts on each resource as well as an analysis of impacts on resources that are not common to the alternatives being considered. The determination must then balance the overall impacts and all other relevant considerations. In comparing the impact between resources, we also considered the degree of impact anticipated on each resource. Ultimately, an alternative that results in equal or minor advantages in terms of environmental impact would not compel us to shift the impacts from the current set of landowners to a new set of landowners.

One of the goals of an alternatives analysis is to identify alternatives that avoid significant impacts. In section 4.0 of this EIS, we evaluate each environmental resource potentially affected by the Project and conclude that constructing and operating the Project would not significantly impact these resources, with the exception of visual resources. As further discussed in section 4.8.5, due to the flat and open landscape characteristic of the Project area, Project facilities such as the LNG storage tanks and main flare would be prominent within the viewshed of visually sensitive areas. Texas LNG considered ground flares as an alternative to the elevated flare to minimize impacts on the viewshed; however, the use of the ground flare would not result in a significant environmental advantage, as discussed in section 3.4.2. No alternatives that would minimize impacts on visual resources from the LNG storage tanks were identified. Consistent with our conclusions, the value gained by further reducing the impacts of the Project when considered against the cost of relocating the facility to a new set of landowners was also factored into our evaluation.

3.1 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the Texas LNG Project would not be constructed and Texas LNG's objective of providing the proposed liquefaction capacity for LNG export markets would not be realized. In addition, the potential adverse and beneficial environmental impacts discussed in section 4.0 of this EIS would not occur.

The development and production of gas supplies from conventional and unconventional gas formations has increased in recent years throughout many areas of the U.S. With or without the No-Action Alternative, other LNG export projects could be developed in the Gulf Coast region or elsewhere in the U.S., resulting in both adverse and beneficial environmental impacts. LNG terminal developments of similar scope and magnitude to the proposed Project would likely result in environmental impacts of comparable significance, especially those projects in a similar regional setting.

The No-Action Alternative could require that potential end users make different arrangements to obtain LNG from other sources. Although it is speculative and beyond the scope of this analysis to predict what actions might be taken by policymakers or end users in response to the No-Action Alternative, it is possible that the energy needs to be satisfied by the proposed Project would be met largely by other fossil fuel energy sources, such as coal and oil, resulting in more air emissions and greater environmental impacts. Renewable energy sources could also be used (e.g., solar power); however, these are not always reliable or available in sufficient quantities to support most market requirements and would not necessarily be appropriate substitutes for natural gas in all applications. But the location and use (electricity, heating, industrial feed stock, etc.) would be speculative and the judgement of whether the impacts would be better or worse would be speculative without knowing what the natural gas would or could be supplanted with. In addition alternative energy sources would not meet the Project objective of liquefying natural gas to serve export markets and are beyond the scope of this EIS.

Therefore, we have dismissed the No-Action Alternative as a reasonable alternative to meet the objectives of the Project. Because the purpose of the Project is to construct and operate a terminal to export LNG to foreign markets, the development or use of renewable energy technology would not be a reasonable alternative to the proposed action.

3.2 SYSTEM ALTERNATIVES

We reviewed system alternatives to evaluate the ability of other existing, planned, or proposed facilities to meet the stated objectives of the proposed Project and to determine if a system alternative exists that would be environmentally preferable to the Project. Our analyses of system alternatives for the Project are summarized in table 3.2-1. By definition, implementation of a system alternative would make construction of all or some of the proposed facilities unnecessary; conversely, infrastructure additions or other modifications to the system alternative may be required to increase capacity or provide receipt and delivery capability consistent with that of the proposed facilities. Such modifications may result in environmental impacts that are less than, comparable to, or greater than those associated with construction and operation of the proposed facility.

For a system alternative to be preferable, it must be technically and economically feasible, as well as offer a significant environmental advantage over the proposed Project. Each of the liquefaction projects is authorized or has applied to DOE for export to FTA countries. The NGA, as amended, has deemed FTA exports to be in the public interest; therefore, we will not speculate or conclude that excess capacity is available to accommodate this Project's purpose and need. Consequently, the export capacity at any other existing or proposed LNG facility would likely require an expansion to accommodate the additional liquefaction and export facilities similar to the proposed facilities. Texas LNG did not identify specific geographic markets that would require the proposed Project to be constructed within Texas; therefore, we evaluated system alternatives that would utilize existing, proposed, or planned LNG export terminals along the Texas and Louisiana Gulf Coast.

TABLE 3.2-1

System Alternatives – Summary of Approved, Proposed, and Planned LNG Export Projects

Project Name (FERC Docket No.)[a]	Owner Location	Total Capacity (MTPA)	Project Status	Status of FTA/Non-FTA Approvals
Approved LNG Export Terminals				
Cheniere/Sabine Pass LNG Terminal (CP11-72 and CP14-12)	Sabine Pass Liquefaction, LLC/ Sabine Pass Liquefaction Expansion, LLC/ Sabine Pass LNG, L.P. Sabine, Louisiana	20.0	Plants 1-3: Operating Plant 4: Under construction	FTA: Authorized Non-FTA: Authorized
Sabine Pass Expansion (CP13-552 and CP13-553)		10.0	Plant 5: Under construction Plant 6: Approved	
Cameron LNG Terminal (CP13-25)	Cameron LNG, LLC	15.0	Under construction	FTA: Authorized Non-FTA: Authorized
Cameron LNG Expansion (CP15-560)	Hackberry, Louisiana	10.0	Approved	
Freeport LNG Dev/Freeport LNG Expansion/ FLNG Liquefaction Terminal (CP12-29, CP12-509, and CP15-518)	Freeport Development, L.P./ FLNG Liquefaction, LLC/ FLNG Liquefaction 2, LLC/ FLNG Liquefaction 3, LLC/FLNG Liquefaction 4, LLC	15.3	Under construction	FTA: Authorized Non-FTA: Authorized
Freeport LNG Expansion (CP17-470)	Freeport, Texas	5.1	Application filed 06/29/2017	FTA: Authorized Non-FTA: Pending
Corpus Christi Liquefaction Project (CP12-507 and CP12-508)	Corpus Christi Liquefaction, LLC Corpus Christi, Texas	15.0	Under construction	FTA: Authorized Non-FTA: Authorized
Stage 3 Project (CP18-512 and CP18-513)	Corpus Christi Liquefaction Stage III, LLC Corpus Christi, Texas	11.45	Application filed 06/28/2018	FTA: Authorized Non-FTA: Pending
Lake Charles LNG Terminal (CP14-120)	Lake Charles LNG Company, LLC/ Lake Charles LNG Export Company, LLC/ Trunkline Gas Company, LLC Lake Charles, Louisiana	16.45	Under construction	FTA: Authorized Non-FTA: Authorized
Magnolia LNG Terminal (CP14-347)	Magnolia Pipeline Company, LLC/ Magnolia LNG, LLC Lake Charles, Louisiana	8.0	Approved	FTA: Authorized Non-FTA: Authorized
Golden Pass LNG Terminal (CP14-517 and CP14-518)	Golden Pass Products, LLC/ Golden Pass Pipeline, LLC Sabine Pass, Texas	15.6	Approved	FTA: Authorized Non-FTA: Authorized
Proposed LNG Export Terminals				
Gulf LNG Terminal (CP15-521)	Gulf LNG Liquefaction Company, LLC/ Gulf LNG Energy, LLC Pascagoula, Mississippi	10.0	Application filed on 06/19/2015	FTA: Authorized Non-FTA: Pending

TABLE 3.2-1

System Alternatives – Summary of Approved, Proposed, and Planned LNG Export Projects

Project Name (FERC Docket No.)[a]	Owner Location	Total Capacity (MTPA)	Project Status	Status of FTA/Non-FTA Approvals
Calcasieu Pass Project (CP15-550 and CP15-551)	Venture Global Calcasieu Pass, LLC Cameron Parish, Louisiana	10.0	Application filed 09/04/2015	FTA: Authorized Non-FTA: Pending
Driftwood LNG Project (CP17-118 and CP17-119)	Driftwood LNG, LLC and Driftwood Pipeline, LLC Lake Charles, Louisiana	26.0	Application filed 03/31/2017	FTA: Authorized Non-FTA: Pending
Rio Grande LNG Project (CP16-454 and CP16-455)	Rio Grande LNG, LLC/ Rio Bravo Pipeline Company, LLC Brownsville, Texas	27.0	Application filed on 05/05/2016	FTA: Authorized Non-FTA: Pending
Annova LNG Project (CP16-480)	Annova LNG Common Infrastructure, LLC/ Annova LNG Brownsville A, LLC/ Annova LNG Brownsville B, LLC/ Annova LNG Brownsville C, LLC Brownsville, Texas	7.0	Application filed on 07/13/2018	FTA: Authorized Non-FTA: Not requested
Port Arthur LNG Project (CP17-20 and CP17-21)	Port Arthur LNG, LLC/ Port Arthur Pipeline, LLC	13.5	Application filed on 11/29/2016	FTA: Authorized Non-FTA: Pending
Venture Global Plaquemines LNG (CP17-66)	Venture Global Plaquemines LNG, LLC Plaquemines Parish, Louisiana	20.0	Application filed on 02/28/2017	FTA: Authorized Non-FTA: Pending
Planned LNG Export Terminals				
Commonwealth LNG Project (PF17-8)	Commonwealth LNG, LLC/ Commonwealth Projects, LLC Cameron Parish, Louisiana	9.0	Pre-filing approved on 08/15/2017	FTA: Authorized Non-FTA: Pending
Fourchon LNG Export Facility (PF17-9)	Fourchon LNG, LLC Lafourche Parish, Louisiana	5.0	Pre-filing approved on 08/21/2017	FTA: Authorized Non-FTA: Pending

[a] To access the public record for this proceeding, go to FERC's website (http://www.ferc.gov), click on "Documents and Filings" and select the eLibrary feature. Click on "General Search" from the eLibrary menu and enter the docket number.

All of the Projects presented in table 3.4-1 have already been approved to export to FTA countries. To accommodate the additional volume approved by the DOE for Texas LNG to export to FTA countries, additional facilities similar to those of the proposed Project would be required. Any such project would require review and authorization of the additional facilities and would likely result in similar impacts to the proposed Project, and would not result in a significant environmental advantage. Therefore, system alternatives were not evaluated further.

3.3 SITE ALTERNATIVES

3.3.1 LNG Terminal Site Alternatives

Based in part on the information provided by Texas LNG, we evaluated site alternatives in the general area of the proposed Project site. In order to meet the stated objectives of the Texas LNG Project, we applied screening criteria to identify sites that would be reasonable and most likely to provide some environmental advantage over the proposed Project site. The screening criteria included two tiers of site alternatives, Tier 1, were those sites located within port areas including: Calhoun Port, Port of Port Arthur, Port of Brownsville, and Port of Corpus Christi in Texas, and six various sites identified by the COE as potential alternatives that should be assessed: Port Aransas (Harbor Island and Brown and Root), Berry Island, Navy Electromagnetic Roll Facility, Naval Station Ingleside, and the Navy Unused Site in Port of Corpus Christi (see figures 3.3.1-1 and 3.3.1-2). In addition to location, alternative onshore sites were evaluated based on the safety requirements of the Coast Guard and DOT. In addition to safety requirements, we also considered the LNG facility size and configuration requirements. The screening included the following criteria:

- <u>Land Availability</u> – Siting an LNG facility requires a suitable amount of land for all project components, be available to lease or purchase, and to meet safety requirements (a minimum of 300 acres for the proposed Project). The proximity to a deepwater channel was also analyzed, as water depths greater than 40 feet below mean sea level are required to allow access for LNG carriers.
- <u>Natural Gas Pipelines and Transmission Lines</u> – When compared to other sites evaluated, sites closer to natural gas sources capable of supplying natural gas for up to 25 years were considered preferable.
- <u>Population Centers/Residences</u> – Sites that are not in proximity to population centers or residences were considered preferable in order to meet the regulatory requirement for LNG vapor dispersion and thermal radiation exclusion zones. In general, a distance of at least 2,000 feet was determined to be preferable.

Using the Tier 1 screening criteria described above, we evaluated ten potential development areas to determine if alternative ports would provide a significant environmental advantage over the proposed Project (four port sites and six additional COE-identified sites depicted in figures 3.3.1-1 and 3.3.1-2, respectively were evaluated). Based on the screening criteria, all of the sites meet the land lease/purchase availability criteria, were near deepwater channels, and near natural gas pipelines. However, only five of the ten identified areas were located at least 2,000 feet from residential areas, which removed the Bean Tract - Calhoun Port Authority, Port of Corpus Christi, Port of Port Arthur, Naval Station Ingleside, and Berry Island from further consideration. Of the ten sites, only three meet the land size requirements, Port of Brownsville, Naval Station Ingleside, and Navy Unused Sites; however, the Naval Station Ingleside and Navy Unused Sites were removed from consideration as one is adjacent to a residential area, and the other does not have adequate water frontage. Therefore, it was determined that the Port of Brownsville was the only area evaluated that had available land that met all of the Tier 1 siting criteria outlined above. We then used the following Tier 2, criteria to identify sites in the Port of Brownsville area that would be reasonable and most likely to provide an environmental advantage over the proposed Project site. The screening included the following criteria:

- <u>Land Availability</u> – Siting an LNG facility requires a suitable amount of land for all project components. Based on the information provided by Texas LNG it was determined that approximately 300 acres would be required for the Project. This site size would also ensure that all safety requirements are met. There would also need to be a 2,400 foot minimum length of shoreline at the site to allow construction of a recessed marine berth.

- Population Centers/Residences – Sites that are not in proximity to population centers or residences (at least 2,000 feet away) were considered preferable in order to meet the regulatory requirement for LNG vapor dispersion and thermal radiation exclusion zones without creating technical challenges (distances for dispersion and thermal radiation exclusion zones differ based on topography).
- Waterfront Access – In addition to the required shoreline, proximity to the Gulf of Mexico was considered preferable to allow for deepwater access for LNG carriers.
- Elevation – Areas that are naturally elevated were preferred to minimize the required fill that would be needed to meet DFE. Due to the limited amount of dredge material that can be used as structural fill, smaller volumes of fill are considered preferable as it would limit the amount of imported fill that would be needed. The desired elevation for the LNG terminal is 16 feet NAVD 88.
- Wetlands – Sites that do not contain wetlands (all sites were evaluated based on the FWS NWI database) were considered preferable.
- Endangered Species Habitat – Potential habitat for the threatened and endangered ocelot and jaguarundi is in the area (see section 4.7 and appendix D). Sites that would result in minimal disturbance of suitable habitat and/or are at a greater distance from the existing FWS wildlife corridor (see figure 3.3.1-3) were considered preferable.

Using the screening criteria described above, we evaluated three alternative sites for the LNG terminal (Sites 1, 2, and 3), in addition to the proposed site (Site 4). The general locations of the three alternatives and the proposed site are shown in figure 3.3.1-3. While Texas LNG identified Sites 1 and 3 as potential alternative sites, they do not contain the minimum acreage necessary to be considered a feasible alternative site. Therefore, Sites 1 and 3 were removed from consideration and are not further discussed. A comparison of each alternative site to the proposed site is presented in table 3.3.1-1 and discussed below.

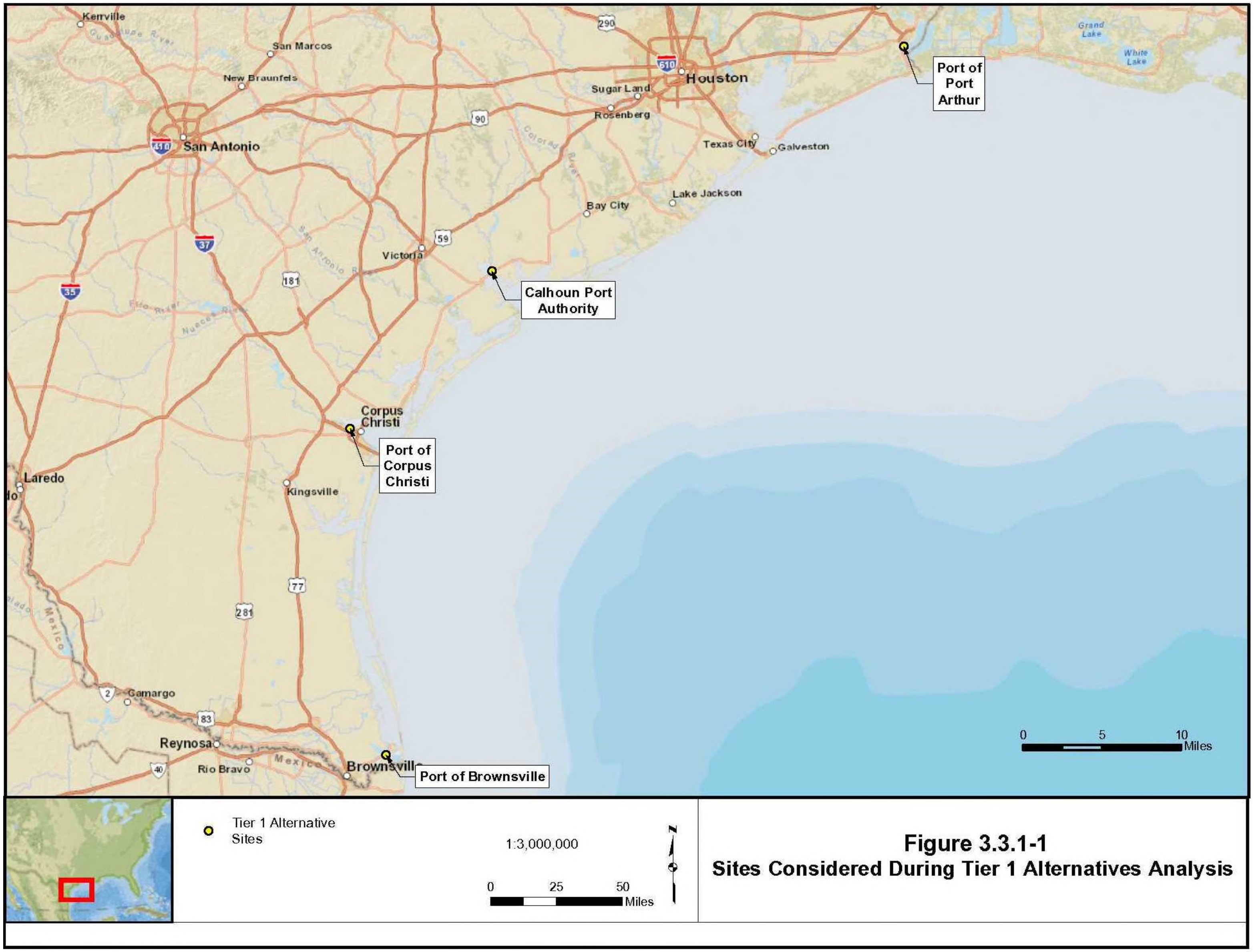

FIGURE 3.3.1-1 Sites Considered During the Tier 1 Alternatives Analysis

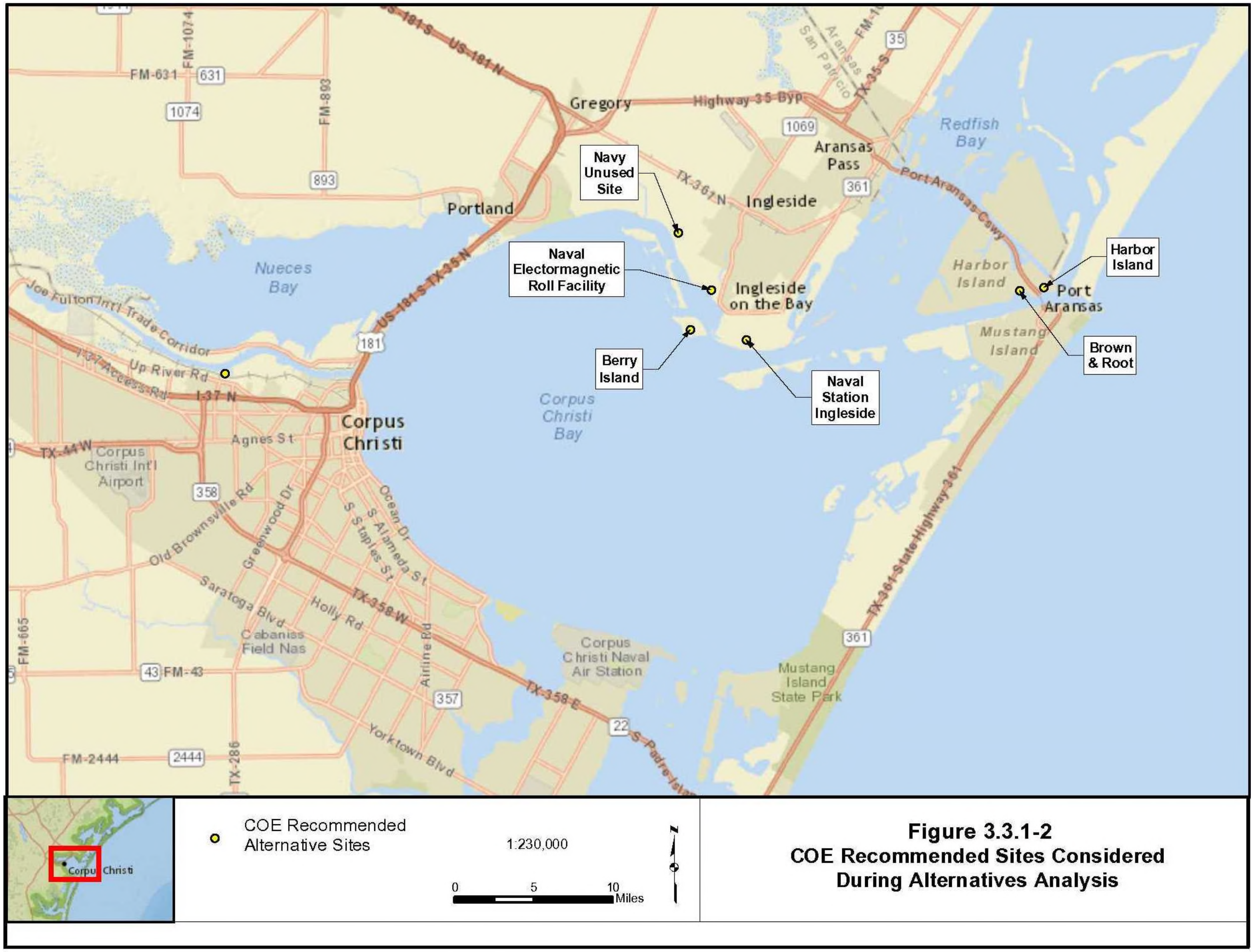

FIGURE 3.3.1-2 COE Recommended Alternative Sites Considered

FIGURE 3.3.1-3 Alternative Sites Considered

TABLE 3.3-1 Comparison of Alternative Sites for the LNG Terminal				
Site	**1**	**2**	**3**	**4 (Proposed)**
Screening Criteria				
Available Acreage (acres)	111.5	500.0	205.0	625.0
Approximate channel frontage (feet)	2,200	6,000	5,500	3,000
Dredging volumes (cubic feet)	13,591,620	9,028,719	14,950,782	3,900,000
Distance to nearest residential area (miles)	5.0	2.3	5.4	1.7
Distance from Gulf of Mexico (miles)	8.7	5.8	9.6	4.8
Natural average elevation above sea level (feet)	+2.1	+8.0	+5.5	+13.2
Wetlands and tidal areas (acres)	17.1	270.8	80.0	248.1
Potential Ocelot and Jaguarundi habitat present	Yes	Yes	Yes	Yes

Proposed Site (Alternative 4)

The proposed site is approximately 625 acres and is along the Brownsville Ship Channel, approximately 5.0 miles from the Gulf of Mexico. This site has 3,000 feet of water frontage on the Brownsville Ship Channel. This location has the greatest natural average elevation above sea level and would require the least amount of fill of the alternatives considered. The proposed site would also accommodate a recessed maneuvering basin that would allow for the desired diameter for turning and a berthing dock.

The proposed site is within wetland habitat and potential ocelot and jaguarundi habitat; however, the site is proposed 3.5 miles east of the FWS and BND established wildlife corridor which connects suitable ocelot and jaguarundi habitat. This wildlife corridor is designed to allow threatened and endangered species to move between large tracts of suitable habitat (FWS, 2015a). This location would provide the recommended land area for safety of the maneuvering basin, LNG facilities, and the shortest distance to the Gulf of Mexico. While this site includes a large number of wetlands, the overall impacts from dredging and fill that would be needed for constructing the Project components (see section 4.4.2) are less than the other alternative sites.

Alternative Site 2

Alternative Site 2 is adjacent to the southwestern portion of the proposed site and consists of 500 acres, with 6,000 feet of waterfront access along the Brownsville Ship Channel. The northern border of the site is SH 48, and the southern border is the Brownsville Ship Channel. Based off of FWS NWI data, over half of the site is considered tidal wetlands (approximately 270.8 acres). The location of this alternative provides adequate water frontage to accommodate LNG carriers, and provides sufficient land for development of both phases of the Project. The location would also provide enough area to accommodate the maneuvering basin and berth.

Alternative Site 2 is approximately 8.0 feet above sea level and would require more dredge material and/or imported fill to raise the site elevation than the proposed site. In addition, Alternative Site 2 would result in significantly more dredge material than the proposed site. This alternative site is approximately 2.3 miles southwest of the nearest population area. Alternative Site 2 is approximately 2.5 miles northeast of the existing FWS wildlife corridor for ocelot and jaguarundi habitat. While Alternative Site 2 would have an adequate amount of land available for construction of the LNG terminal, it would require a greater amount of fill to raise the site elevation, would require a greater amount of dredging for the turning basin, and would result in greater impacts on wetlands. In addition, Alternative Site 2 makes up part of the Rio Grande LNG Project site. Due to the reasons listed above, we do not consider Alternative Site 2 to provide a significant environmental advantage to the proposed Project.

Conclusion

We conclude that the alternative sites considered do not provide a significant environmental advantage when compared to the proposed site. The proposed site, while having the most land, would require the least amount of fill material to increase the site elevation. The proposed site is located away from residences, with the closest residence located approximately 1.7 miles away. While the proposed site contains a greater amount of NWI-mapped wetlands than two of the other alternative sites considered, Texas LNG has sited its proposed facilities to minimize these impacts to less than the alternative sites (see section 3.3.1 and 4.4). The ability to configure facilities to avoid or minimize impacts would be more limited on the smaller sites considered, thus the impacts on wetlands would likely be greater than the proposed site.

3.4 PROCESS ALTERNATIVES

3.4.1 Power Generation Alternatives

Texas LNG considered using gas turbines and electric motors as drivers for the refrigeration compressors. While the use of gas turbines results in greater air impacts, additional electric transmission facilities are typically required to power electric motors. The non-jurisdictional electric transmission line that would be constructed for the Project (see section 1.4) would be necessary to deliver power to the LNG terminal regardless of the type of refrigeration compressors that are used. However, the use of gas turbines would result in greater operation emissions. Texas LNG ultimately decided to use electric motors because they would provide the required power and significantly reduce air emissions compared to gas turbines at the facility. Therefore, the use of the electric motors as drivers for the refrigeration compressors provides a significant environmental advantage over gas turbines.

3.4.2 Flaring System

The use of ground flares as an alternative to the proposed elevated flares was also examined for the Project. Due to the location of the site, Texas LNG considered the prevailing winds, which for two thirds of the year, travel south to north and come off the Gulf of Mexico to travel further landward. Use of a ground flare would require a continuous open flame compared to the use of an elevated flare at the facility. Additionally, for a ground flare to have the proper distance from potential vapor sources, a larger area would be required. Alternatively, an elevated flare would minimize the potential for ignition of released vapor and would require less land. However, elevated flares result in greater impacts on visual resources and birds. Both the ground flare and the elevated flare would adversely impact environmental resources; therefore, there would not be a significant environmental advantage to either flare system.

4.0 ENVIRONMENTAL ANALYSIS

The environmental consequences of constructing and operating the proposed Project would vary in duration and significance. Four levels of impact were considered: temporary, short-term, long-term, and permanent. Temporary impacts generally occur during construction with the resource returning to preconstruction conditions almost immediately afterward. Short-term impacts could continue for up to 3 years following construction. Impacts were considered long-term if the resource would require more than 3 years to recover. A permanent impact could occur as a result of any activity that modified a resource to the extent that it would not return to preconstruction conditions during the life of the Project, such as construction of an aboveground facility. We considered an impact to be significant if it would result in a substantial adverse change in the physical environment.

In this section, we discuss the affected environment, general construction and operational impact, and proposed mitigation for each resource. Texas LNG, as part of its proposal, agreed to implement certain measures to reduce impacts. We evaluated the proposed mitigation measures to determine whether additional measures are necessary to reduce impacts. These additional measures appear as bulleted, bold-faced paragraphs in the text. We will recommend that these measures be included as specific conditions to any authorization that the Commission may issue.

Conclusions in this EIS are based on our analysis of the environmental impacts and the following assumptions:

- Texas LNG would comply with all laws and regulations;
- the proposed facilities would be constructed as described in section 2.0 of this document; and
- Texas LNG would implement the mitigation measures included in its application and supplemental filings to FERC.

4.1 GEOLOGIC RESOURCES

4.1.1 Geologic Setting

The Project is proposed in the Coastal Prairie region of the Gulf Coastal Plains physiographic province (Bureau of Economic Geology, 1996). The topography of the region is nearly flat with subsurface sediments that dip gently toward the Gulf of Mexico and are dissected by highly sinuous streams. Recent Holocene deposits along the Texas gulf coast generally consist of alluvial, deltaic, beach, bay-estuary, and marsh deposits and are underlain by Pleistocene deltaic and alluvial deposits to a few thousand feet below ground level (USGS, 2017). The geology of the Gulf Coast is complex due to cyclic deposition of sedimentary faces. Sediments of the Gulf Coast were mainly deposited in the coastal plains of the Gulf of Mexico Basin during the Tertiary and Quaternary periods. Repeated sea-level changes and natural basin subsidence produced discontinuous beds of sand, silt, clay, and gravel. The Project site is proposed within the formations of active dunes and dune complexes, floodplain deposits dominated by silts and sands, and alluvium deposits, as further discussed below (Bureau of Economic Geology, 1976).

Three geologic units, as defined by Barnes (1992), occur within the Project site, including fill and spoil, clay dune, and alluvium in Rio Grande, subdivided into areas predominately of sand. Fill and spoil occurs primarily within the southeast portion of the site near the Brownsville Ship Channel and consists of dredged material, as a result of raising the land surface above alluvium and from barrier island deposits (Barnes, 1992). The clay dune formation consists of dune clay and silt deposits deflated from saline flats and formed from windblown deposits (USGS, 1993; Bureau of Economic Geology, 1976). The formation known as alluvium in Rio Grande, subdivided into areas predominantly of sand, consists of silt and sand floodplain deposits formed by distributary channels on the Rio Grande delta (USGS, 1993). The geology of the dredge material placement area PA 5A is similar to that of the Project site, with the addition of the alluvium in Rio Grande, subdivided into areas predominantly of clay formation. This formation consists of floodplain and backswamp silt and clay deposits resulting from floods accompanying large, tropical storms (USGS, 1993).

Topography at the Project site is characterized by elevations ranging from 0 to 25 feet NAVD 88. Clay dune formations on the Project site provide the greatest topographic relief in an otherwise flat region. The Project site includes two prominent clay dunes known as Loma del Mesquite and Loma del Draga. Texas LNG proposes to site the primary components of the Project facilities on the Loma del Mesquite to use the higher ground and reduce the need for imported fill.

Based on Texas LNG's geotechnical investigation,[14] below the existing grades are very soft to very stiff cohesive soils consisting of lean clay, lean clay with sand, sandy lean clay, fat clay,[15] silt with sand, and sandy silts with intermittent layers of silty sand to depths of approximately 30 feet. Beneath the cohesive soils, medium dense to dense silty sand and clayey sand were identified and extend to a depth of about 90 feet. The bottommost formation consists of dense to very dense silty sand, poorly graded sand with silt, and clayey sand with occasional layers of fat clay.

4.1.2 Mineral Resources

The primary non-fuel mineral resources mined in Texas include construction sand and gravel, portland cement, and crushed stone. These three commodities, in addition to salt, industrial sand and gravel, lime, and masonry cement, account for more than 95 percent of non-fuel mineral value in Texas (Texas Almanac, 2015). Within the Project region, sand and gravel and crushed stone are the most prolific non-fuel mineral resources. Other minerals mined in the Project region include uranium and barite (USGS, 2015). The nearest mine to the proposed Project site is a crushed stone mine over 60 miles northwest in Hidalgo County (USGS, 2014a).

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[14] Geotechnical Report is publicly available on eLibrary under accession number 20160331-5064.

[15] Fat clays are those with high plasticity and a high proportion of minerals. Conversely, lean clays have low to moderate plasticity and are often interbedded with sand and silt layers.

Oil and gas production is prevalent throughout Texas, including the Project region. There are no active oil and gas wells within 0.25 mile of the proposed Project. The nearest recorded active well is a gas well located approximately 2.5 miles west of the proposed Project. There are several dry holes within 0.25 mile of the proposed Project, including five within the proposed site; however, these dry holes did not produce oil and/or gas or in economically recoverable quantities (RRC, 2016). Because there are no mineral resources that are extracted in the Project area, we conclude that the Project would have no impact on this resource.

4.1.3 Blasting

Based on available soils and geological data for the Project site and geotechnical investigations conducted by Texas LNG, we do not anticipate that blasting would be required for construction of the Project. Therefore, we conclude there would be no Project impacts from blasting.

4.1.4 Paleontology

The Project site is underlain by Quaternary alluvium deposits that are the products of relatively recent erosion and deposition. Within South Texas, fossils from the Pleistocene are common throughout river channel and floodplain deposits of the Beaumont Formation. The Project site is not underlain by the Beaumont formation; therefore, we conclude that construction and operation of the Project would not expected to impact paleontological resources (Baskin, 2009).

4.1.5 General Impacts and Mitigation

The primary impacts on geology and topography in the Project area would result from the site preparation stage, in which Texas LNG would grade the site to the design elevations by utilizing cut and fill techniques as well as the import of fill. Other impacts would occur as a result of the dredging of the maneuvering basin. As a result, construction of the Project would permanently alter the existing topography and geologic conditions at the site. The import of fill would also likely alter the topography of the area from which the fill material is sourced. Texas LNG has indicated that the imported fill would be from a local supplier but has not identified the source. Final grade surfacing and landscaping would consist of gravel, asphalt, concrete, topsoil, and grass.

The potential for geologic hazards such as seismicity, shoreline erosion, and flooding to impact the proposed Project facilities and measures that would be implemented to minimize those impacts are discussed in section 4.12. Based on the above discussion, and in consideration of Texas LNG's proposed mitigation and design criteria, we conclude that the Project would not markedly affect or be affected by geological conditions or hazards in the area.

4.2 SOILS

4.2.1 Existing Soil Resources

The characteristics of soils present within the proposed Project site were identified and assessed using the Soil Survey Geographic (SSURGO) database (NRCS, 2013). This database is a digital version of the original county soil surveys developed by the NRCS for use with geographic information systems. It provides the most detailed level of soils information available for the Project area for natural resource planning and management. The SSURGO system is linked to an attribute database that gives the proportionate extent of the component soils and their properties for each soil map unit. Additional information about soils was obtained from the Official Soil Series Descriptions (NRCS, 2016).

There are five soil map units within the proposed Project site including Barrada clay, 0 to 1 percent slopes, very frequently flooded, occasionally ponded; Point Isabel clay loam; Sejita silty clay loam; Lomalta clay, and Twinpalms-Yarborough complex, 0 to 3 percent slopes, frequently flooded.

Barrada clay, 0 to 1 percent slopes, very frequently flooded, occasionally ponded soils are very poorly drained, hydric soils formed from clay alluvium on wind-tidal flats. Within the proposed Project site, these soils are primarily found along the shoreline of the proposed Project site and along the edge of the Brownsville Ship Channel. Point Isabel clay loam soils consist of very deep, well drained soils found on clay dunes and low coastal plains. Within the Project site, these soils are associated with the areas of higher elevation, including the Loma del Mesquite and Loma del Draga. Sejita silty clay loam soils consist of very deep, poorly drained saline soils on flats within coastal plains. These soils comprise the majority of the inland areas of the proposed Project site. Lomalta clay soils consist of very poorly drained, hydric soils found on closed depressions on low coastal plains. Two of the emergent wetlands on the proposed Project site occur within these soils (see section 4.4 for additional information regarding wetlands). The Twinpalms-Yarborough complex, 0 to 3 percent slopes, frequently flooded consists of 55 percent Twinpalms soils and 40 percent Yarborough soils. The Twinpalms-Yarborough complex, 0 to 3 percent slopes, frequently flooded soils are somewhat poorly drained to poorly drained soils that formed from sandy or loamy dredge spoil. These soils account for a very small portion of the southwest edge of the Project site, along the Brownsville Ship Channel and are not within the proposed Project footprint. PA 5A consists mostly of the Twinpalms-Yarborough complex, 0 to 3 percent slopes, frequently flooded map unit, with small portions of the area characterized by Sejita silty clay loam.

We evaluated soils within the Project site to identify prime farmland and major soil characteristics that could affect construction or increase the potential for adverse construction-related soil impacts. The soil characteristics evaluated include erosion potential, compaction potential, and revegetation. All of the soils within the proposed Project site are deep soils with no restrictive layers within 80 inches of the surface; therefore, we conclude that no limitations due to restrictive layers such as bedrock are anticipated for the Project and are not discussed. table 4.2.1-1 summarizes the amount of prime farmland and the soil characteristics within the proposed Project site and PA 5A that would be affected by construction and operation of the Project.

TABLE 4.2.1-1

Characteristics of Soils Associated with the Texas LNG Project (acres)

Project Component	Prime Farmland	Highly Erodible		Compaction Prone [c]	Revegetation Concerns [d]
		Water [a]	Wind [b]		
Project Site					
Permanent Operational Footprint	0.0	80.1	0.0	198.7	198.7
Permanent Graded [e]	0.0	17.8	0.0	31.8	31.8
Existing Contours Restored [f]	0.0	8.8	0.0	27.7	27.7
Project Site Subtotal	**0.0**	**106.7**	**0.0**	**258.2**	**258.2**
Placement Area 5A	0.0	0.0	675.7	28.3	704.0

a Includes land in capability subclasses IVe through VIIe, which have severe to extreme erosion limitations

b Includes soils in wind erodibility groups 1 and 2, which includes soils with poor aggregation that are particularly susceptible to wind erosion.

c Includes soils in somewhat poor, poor, and very poor drainage classes with surface textures of sandy clay loam or finer.

d Includes saline soils and/or soils in somewhat poor, poor, and very poor drainage classes

e Following construction in these areas, all temporary buildings and equipment would be removed and the area would be revegetated; however, contours would not be restored, resulting in a permanent impact.

f These areas would be temporarily impacted by construction of the Project and would be fully restored following the completion of construction activities.

Source: NRCS, 2013.

4.2.1.1 Prime Farmland

The U.S. Department of Agriculture defines prime farmland as "land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, and oilseed crops" (NRCS, 1993). This designation includes cultivated land, pasture, woodland, or other lands that are either used for food or fiber crops, or are available for these uses. Urbanized land, built-up land, and open water cannot be designated prime farmland. None of the soils at the Project site are considered prime farmland. Therefore, we conclude that the Project would have no impact on prime farmland.

4.2.1.2 Erosion

Erosion is a continuing natural process that can be accelerated by human disturbance. Factors such as soil texture, structure, slope, vegetation cover, rainfall intensity, and wind intensity can influence the degree of erosion. Soils most susceptible to erosion by water are typified by bare or sparse vegetation cover, non-cohesive soil particles with low infiltration rates and moderate to steep slopes. Soils typically more resistant to erosion by water include those that occupy low relief areas, are well vegetated, and have high infiltration capacity and internal permeability. Wind erosion processes are less affected by slopes than water erosion processes. Wind-induced erosion often occurs on dry soil where vegetation cover is sparse and strong winds are prevalent. Of the soils that would be impacted by the Project, only Twinpalms-Yarborough complex, 0 to 3 percent slopes frequently flooded soils (present within PA 5A) are highly susceptible to wind erosion. One soil that would be impacted by the Project (Point Isabel clay loam) is considered highly susceptible to erosion by water (NRCS, 2016).

4.2.1.3 Compaction Potential

Soil compaction modifies the structure and reduces the porosity and moisture-holding capacity of soils. Construction equipment traveling over wet soils could disrupt soil structure, reduce pore space, increase runoff potential, and cause rutting. The degree of compaction depends on moisture content and soil texture. Fine-textured soils with poor internal drainage that are moist or saturated are the most susceptible to compaction and rutting. With the exception of the Point Isabel clay loam, all soils in the Project area are considered to be compaction prone.

4.2.1.4 Revegetation Potential

Successful restoration and revegetation are important for maintaining soil productivity and protecting the underlying soil from potential damage, such as erosion. The revegetation potential of soils was evaluated based on soil surface texture, slope, drainage class, and salinity. Coarser textured soils have a lower water holding capacity following precipitation, which could result in moisture deficiencies in the root zone and unfavorable growing conditions for many plants. Conversely, soils with very poor drainage can also inhibit revegetation. The high salt content of saline soils also limits the ability of plant roots to absorb water, causing drought-like symptoms. Soil salinity is the primary limiting factor for revegetation at the Project site. All soils at the Project site are considered saline and likely have low revegetation potential (NRCS, 2013).

4.2.2 Soil Contamination

We reviewed EPA records via the online NEPAssist tool (EPA, 2016a) in order to identify areas of potential soil contamination near the Project site. Based on this review, there are no hazardous waste sites within 1 mile of the Project site. In addition, Texas LNG did not identify any areas of soil contamination during surveys at the site.

4.2.3 General Impacts and Mitigation

Construction activities such as clearing, grading, excavation, backfilling, and the movement of construction equipment may affect soils on the Project site. Clearing removes protective vegetative cover and exposes the soil to the effects of wind and rain, which increases the potential for erosion and subsequent sedimentation into sensitive areas. In addition, grading, spoil storage, and use of heavy equipment can result in compaction of soils, reducing porosity and increasing runoff potential.

Clearing, grading, and equipment movement could accelerate erosion processes on site by exposing soils to wind and water. Immediately following clearing and before disturbance of the soil occurs, Texas LNG would install erosion control devices (ECDs) such as sediment barriers (e.g., silt fence, straw bales, biologs), stormwater diversions, and mulch. Sediment barriers are intended to prevent the flow and deposition of sediment beyond the approved workspaces or into sensitive resources. Texas LNG would only remove temporary ECDs when permanent ECDs have been installed or revegetation/stabilization is complete. EIs would inspect ECDs daily during construction. Any ECDs in need of repair or replacement would be addressed within 24 hours of discovery, or as soon as conditions allow. Other measures that Texas LNG would implement to minimize erosion and sedimentation during construction include:

- installation of temporary sediment barriers (e.g., silt fence, straw bales, biologs);
- temporary seeding or mulching of areas of bare soils and/or topsoil stockpiles, that would be left undisturbed for long periods of time (more than 14 days), to protect the surface from wind and water erosion;
- periodically wetting exposed soil to reduce impacts associated with wind erosion and minimize fugitive dust; and
- discharge trench water into a sediment filter and/or straw bale enclosure in a well vegetated upland area.

All of the soils on site, with the exception of Point Isabel clay loam, are considered prone to compaction due to the low-lying topography and prevalence of hydric soils resulting in high potential for soil saturation. Rutting and compaction are most likely to occur when soils are saturated. Texas LNG would minimize impacts on soils from rutting and compaction by using crushed lime stone/gravel in conjunction with geogrid on temporary access roads to support heavy vehicular traffic. In addition, Texas LNG would install timber mats to displace the weight of equipment and minimize soil disturbance and rutting in areas with saturated soils, as needed.

As discussed in section 2.5.1, Texas LNG would cut and fill the site as needed, and would import fill to reach the final design grade for the Project facilities (up to 16 feet NAVD 88). The source of the imported fill has not been identified; however, Texas LNG indicated that it would be from local suppliers and would be free of contaminants and invasive species. Once the rough grade is achieved, Texas LNG would apply soil amendments such as portland cement and hydrated lime to increase the load bearing capacity of the soils where it would construct permanent structures. Soil consolidation may also be achieved through the use of other methods, such as installation of wick drains and stone columns. Texas LNG would also use aggregate materials (e.g., gravel, oyster shells, and/or crushed stone) and geotextile layers to level and finish temporary workspaces and operational areas, as necessary.

Texas LNG consulted with the local NRCS office regarding seed mixes and revegetation measures it would use to restore the Project site. The NRCS recommended that Texas LNG consult with the Kika de la Garza Plant Materials Center (PMC) in order to develop individualized restoration guidance for the Project site. Texas LNG conducted a site visit with the PMC Manager on December 8, 2015 to assess the Project site's ecological composition. Based on this assessment, the PMC Manager indicated that many of the soil types within the Project site would be difficult for revegetation with seed or transplants due to various soil conditions related to high salinity and electrical conductivity. The area of the Project site containing Point Isabel clay loam was identified as the only area having potential for revegetation by seed; however, the PMC Manager cautioned that heavy textured clay soil, salinity, and the frequency of dry periods may present challenges for restoration efforts. Based on the PMC Manager's recommendations, Texas LNG developed a native seed mix which contains species best adapted to the soils present on the Project site and available from commercial sources.

Due to the low revegetation potential of the Project site, Texas LNG proposes to strip topsoil prior to conducting grading activities in areas within the Project workspace with the greatest potential for use during restoration. It is likely that not all stripped topsoil would be used on site during restoration; therefore, any unused topsoil remaining following restoration would be disposed of offsite in accordance with applicable regulations. Texas LNG proposes to grade the side slopes of the elevated areas on site to a 1 to 2 percent slope. Side slopes would be stabilized using either revegetation or riprap, depending on the location within the facility and the potential for erosion.

Texas LNG would maintain temporary workspaces, access roads, and erosion controls prepared for use during Phase 1 until the completion of Phase 2. Texas LNG has indicated that these areas would be restored either after construction of Phase 2 is complete or on or about five years after FERC issues the Notice to Proceed for Phase 2, if construction has not started and there is no imminent prospect of starting Phase 2. Upon completion of Phase 2, Texas LNG would revegetate temporary workspaces; however, graded areas would remain at the elevation achieved during grading and contours would not be restored. The surface of the temporary workspace areas would be conditioned so normal drainage is restored. The surface conditioning would include a combination of the removal of surface treatment (such as gravel) to the extent necessary and decompaction of soils. Topsoil would be replaced to a depth necessary to create a suitable seed bed and facilitate revegetation.

Dredging for the creation of the maneuvering basin would require removal of approximately 3.9 million cubic yards of dredge material. Texas LNG anticipates that approximately 10 percent of the dredge material would be reused on site as structural fill. As described in section 2.5.4.2, the remaining dredge material would be transported via temporary pipeline to PA 5A for disposal.

During construction, potential exists for spills of hazardous materials, such as hydraulic fluid and diesel fuel used for vehicles and equipment. To prevent contamination of soils and nearby wetlands, waterbodies, or other sensitive resources during construction, Texas LNG would implement its SPAR Plan[16] during construction and its SPCC Plan during operation of the LNG terminal. These plans would identify potential sources of releases at the site, measures to prevent a release to the environment, and initial responses in the event of a spill. We have reviewed Texas LNG's SPAR Plan, and find it acceptable. However, as of this writing, Texas LNG has not yet submitted its SPCC Plan; therefore, **we recommend that:**

- **<u>Prior to construction</u>, Texas LNG should file with the Secretary of the Commission (Secretary) for review and written approval by the Director of the OEP, its SPCC Plan for operation of the Project.**

Given the impact minimization and mitigation measures described above, we conclude that impacts on soils due to construction and operation of the Project would be permanent but minor.

16 The Spill Prevention and Response Plan is publicly available on the FERC's website under Docket No. CP16-116-000 (Accession Number 20160331-5064).

4.2.4 Dredge Material Disposal Sites

Texas LNG is proposing to utilize PA 5A for placement of dredge material; however, all three proposed LNG export projects in the Brownsville area including Texas LNG, Rio Grande LNG, and Annova LNG have proposed to utilize PA 5A for dredge material disposal. The COE has indicated that there is likely insufficient capacity at PA 5A to accommodate the dredge material generated by all three projects, as well as the proposed Brazos Island Harbor Channel Improvement Project (see section 4.13.1.9). In the event that PA 5A does not have available capacity at the time of Project dredging activities, Texas LNG would be required to modify its permit with the COE and identify an alternative location for dredge material placement. Based on preliminary conversations between Texas LNG and the COE, ocean disposal of dredge material would be the most likely second choice for dredge material placement. Ocean dredge disposal areas are further discussed below. Therefore, Texas LNG evaluated several potential sites in addition to the proposed site (PA 5A) for dredge material placement, of which the majority are located onshore and two are offshore (see figure 4.2.4-1). Texas LNG anticipates dredging about 3.9 million cubic yards of material to create the marine berth and maneuvering basin.

Texas LNG considered the beneficial uses of dredge material in addition to the placement of the material in a disposal area. However, based on Texas LNG's discussions with the COE and other federal and state agencies, no beneficial use opportunities were identified. Further, the dredge material is anticipated to have high clay content, making it generally less suitable for beneficial use (see section 4.3.2.3). In addition, the dredged material has limited potential for use on site as structural fill, with up to 10 percent being used for fill in areas of non-critical Project components.

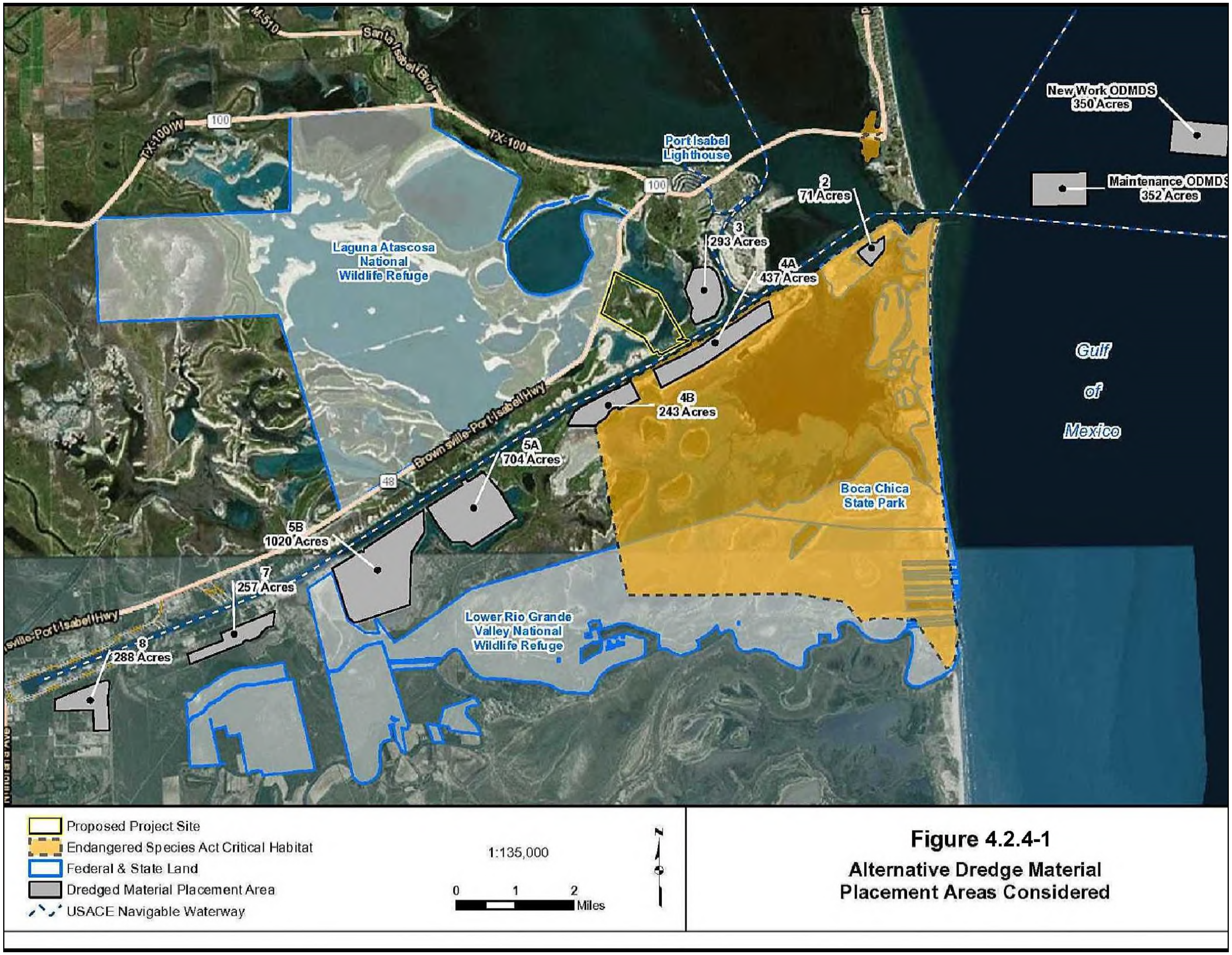

FIGURE 4.2.4-1 Alternative Dredge Placement Areas Considered

4.2.4.1 Upland Placement Areas

PA 5A is adjacent to the Brownsville Ship Channel approximately 4 miles west of the Project site and is the proposed site for dredge material placement. PA 5A is managed by the BND but is operated by the COE under an easement agreement. This area is approximately 704 acres in size and has an overall existing levee elevation of 9 feet NAVD 88, due to the levees being recently raised. In addition to the levees being recently raised, the drop-outlet structure was recently rebuilt.

As stated above, PA 5A is approximately 4 miles west of the proposed Project site and would allow for disposal of dredge material generated via hydraulic cutterhead dredge (the preferred dredge method; see section 2.5.4.2) by placement of a temporary dredge disposal pipeline. In addition, there is currently sufficient capacity to allow for placement of the estimated 3.9 million cubic yards of dredge material that would be generated during construction of the Project; although the existing containment berms would need to be raised by 5 feet. However, the ultimate use and availability of PA 5A would be determined by the COE and be dependent on COE project schedules.

PA 4A is located directly across from the Project site on the Brownsville Ship Channel and is a 437-acre confined placement area; therefore, this site would allow for disposal of dredge material generated via hydraulic cutterhead dredge by placement of a temporary dredge disposal pipeline. The berms surrounding PA 4A are currently 27 feet tall and would need to be raised higher than at PA 5A in order to accommodate the dredge material from construction of the proposed Project. While PA 4A would be located onshore and be directly across from the proposed Project site, the alterations required to raise the already high berms would be greater than PA 5A in order to meet the dredge material disposal requirements of the Project.

In addition to PA 5A and PA 4A, Texas LNG considered six other upland placement areas in the Project area (PA 2, 3, 4B, 5B, 7, and 8). These six placement areas range in size from 71 acres to 1,020 acres and all would allow Texas LNG to utilize a hydraulic cutterhead dredge, which is the preferred dredge method. PA 3, which is located approximately 0.3 mile east of the Project site, is operated by the Port Isabel/San Benito Navigation District, which is independent of the BND. Based on consultations between the Port Isabel/San Benito Navigation District and Texas LNG, a third party entity currently has exclusive rights to use PA 3 through 2019.

While some of the other upland placement areas provide the necessary capacity for placement of dredge material generated during construction of the Project, others were determined to be of insufficient capacity. With the exception of PA 3, the other upland placement areas are located further from the Project site than, PA 5A, which would reduce the efficiency gained by transporting the dredge material to a closer PA.

4.2.4.2 Ocean Dredge Material Disposal Site – New Work

There are two Ocean dredge material disposal site (ODMDS) available for offshore disposal of dredged material and is managed by the EPA and COE. The ODMDS– New Work site was previous designated by the EPA as a one-time disposal area for material removed during construction of the Brownsville Ship Channel. This site is offshore, approximately 4.4 miles away from the Project site, and does not have an established capacity; however, it is estimated to cover approximately 350 acres. In addition, the site is in a high-energy erosional zone generally allowing for no volumetric limit on capacity at this site. A Site Management and Monitoring Plan (SMMP) would need to be prepared if Texas LNG were to use this site to ensure that mounding does not occur.

The ODMDS – Maintenance site was designated by the EPA in order to hold material generated by maintenance dredging the Brownsville Ship Channel jetty and entrance channels. This site is located approximately 1.9 miles from the entrance of the Brownsville Ship Channel and is about 352 acres in size; although, similar to the ODMDS – New Work site, a maximum capacity has not been determined for this site. Due to the close proximity of the ODMDS to the Brownsville Ship Channel, there is a strong chance that sediments would be suspended and deposited in the Brownsville Ship Channel entrance, which would increase the need for dredging (COE, 2014). In addition, the ODMDS – Maintenance site already has an SMMP developed for maintenance dredge material. The SMMP includes bathymetric surveys, and sediment chemistry testing. Any disposal of material would need to meet those requirements and be monitored accordingly. If monitoring based off of the SMMP illustrated a significant impact, the SMMP outlines what the next steps would be to rectify the situation (EPA and COE, 2017).

4.3 WATER RESOURCES

4.3.1 Groundwater Resources

The Project site is proposed within the coastal lowlands aquifer system, which underlies the majority of the Gulf Coastal Plain extending from south Texas to the Florida panhandle (USGS, 1996). The coastal lowlands aquifer system consists mostly of Miocene and younger unconsolidated sediment deposits of sand, silt, and clay that lie above and coastward of the Vicksburg-Jackson confining unit. These coastward dipping sediments extend to the land surface and can reach a thickness of thousands of feet. The sediment deposits thicken as they dip towards the Gulf of Mexico, resulting in a wedge-shaped configuration of the hydrologic units (USGS, 1996). Salinity of the aquifer system increases naturally towards the coast and recharge occurs through infiltration of rainfall in outcrop areas on the western portion of the aquifer.

The Chicot aquifer and Evangeline aquifer are commonly used hydrogeologic unit designations for subdivisions of the upper, mostly sandy part of the aquifer deposits, while the underlying Jasper aquifer is the most deep-seated aquifer of the system (USGS, 1996; Texas Water Development Board [TWDB], 1990). The Chicot aquifer includes stratigraphic units from the Pleistocene and Holocene of Willis Sand, Bentley Formation, Montgomery Formation, Beaumont Clay, and surficial alluvial deposits. The Holocene alluvial deposits present at the Project site are considered part of the Chicot aquifer system (Baker, 1979). The Chicot aquifer has been delineated in southeast Texas based on the presence of a higher sand-clay ratio as compared to the underlying Evangeline aquifer. The Chicot and Evangeline aquifers can also be differentiated by differences in hydraulic conductivity or water levels in some areas.

4.3.1.1 Sole Source Aquifers

The EPA defines a sole or principal source aquifer as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. To be defined as a sole-source aquifer, there cannot be an alternative drinking water source that could physically, legally, and economically supply all those who depend on the aquifer with drinking water (EPA, 2015). The EPA has not designated any sole source aquifers within the Project area. The nearest EPA designated sole source aquifer is the Edwards Aquifer, over 250 miles northwest of the proposed Project site in south central Texas (EPA, 2016b).

4.3.1.2 Water Supply Wells

Groundwater accounted for approximately 14 percent of municipal water supplies in Cameron County in 2014 (TWDB, 2016a). The majority of groundwater used for public water supply is withdrawn from 20 wells operated by the Southmost Regional Water Authority located west of Brownsville and more than 20 miles from the Project site. Groundwater withdrawn from these wells is brackish and is treated at a desalination plant prior to distribution. The Southmost Regional Water Authority is a conservation and recreation district consisting of six entities in southern Cameron County, including the Brownsville Public Utilities Board (BPUB), which would supply municipal water used for the Project, as further discussed in sections 4.3.1.4 and 4.3.2.3.

There are no drinking water wells within 150 feet of the proposed Project site. The nearest private water well is on South Padre Island, more than 4 miles from the Project site (TWDB, 2016b).

4.3.1.3 Groundwater Quality

Groundwater quality in the Lower Rio Grande Valley varies widely in composition from freshwater to brine (0 parts per thousand [ppt] to >25 ppt) (Chowdhury and Mace, 2007). Water quality within the southern portion of the Chicot aquifer changes both laterally and vertically due to the thick deltaic deposits, deteriorating in quality with distance from the Rio Grande River (Baker and Dale, 1961). Dissolved solids in groundwater in the Lower Rio Grande Valley are high and generally range from 1,000 to 5,000 milligrams per liter (mg/l), primarily consisting of sodium, chloride, sulfate, boron, and nitrate (TWDB, 1990). Groundwater quality in eastern Cameron County is generally poor and unsuitable for stock and domestic uses due to high salinity (Baker and Dale, 1961).

In addition to the generally marginal to poor groundwater quality throughout the Lower Rio Grande Valley, there are also localized areas of groundwater contamination (TWDB, 1990). High nitrate levels have been reported in wells, particularly those less than 100 feet deep, in all counties in the Lower Rio Grande Valley. The extent of the high nitrate concentrations are localized and widely scattered, suggesting the groundwater is subject to organic contamination, likely caused by fertilizer use (TWDB, 1990).

4.3.1.4 Groundwater Impacts and Mitigation

Clearing, Grading, and Excavation

The Project would require trenching and excavating in upland areas and dredging in the tidal flats. Trenching and excavation during construction activities would generally be 5 to 10 feet below ground surface; however, some footings for the storage tanks and other structures would require deeper excavation or driven piles (at least 60 feet deep). Texas LNG conducted geotechnical investigations at the Project site, which encountered groundwater at depths of 11 to 18 feet below the surface (Professional Service Industries, 2015). Texas LNG may need to dewater areas if shallow groundwater is encountered during construction. Dewatering may temporarily lower the groundwater level in the immediate vicinity of the construction activity; however, this impact would be short-term and minor.

Clearing and grading could result in minor impacts on groundwater by increasing sheet flow and decreasing aquifer recharge rates. Soil compaction caused by heavy construction equipment could further reduce the ability of soils to absorb water in isolated areas. Following construction, the portion of the ground surface that is not paved or otherwise occupied by aboveground facilities would be decompacted, as necessary, and revegetated to eliminate exposed soils and to ensure restoration of overland flow and recharge patterns. Impacts on groundwater recharge would be permanent where there are impervious surfaces such as at the aboveground facilities and other paved areas such as access roads. However, due to the relatively small area of development when compared to the undeveloped nature of the surrounding areas, we conclude that impacts on groundwater recharge would be minor and not significant.

Contamination

Shallow groundwater areas could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials used during construction and operation of the Project. Accidental spills and leaks of hazardous materials associated with equipment trailers; the refueling or maintenance of vehicles; and the storage of fuel, oil, and other fluids pose the greatest risk to groundwater resources. In addition, deep pilings may create pathways for surface spills to reach groundwater resources. If not properly contained and cleaned-up, contaminated soil could continue to leach pollutants into the groundwater long after a spill has occurred. During construction, Texas LNG would adhere to its SPAR Plan to minimize the potential for spills to occur as well as potential impacts in the event of a spill. During operation, Texas LNG would implement measures outlined in the SPCC Plan. We are recommending in section 4.2.3 that Texas LNG's SPCC Plan be filed with the Secretary for review and approval prior to construction. Therefore, we conclude that the potential for the Project to contaminate groundwater would be minimal.

Groundwater Withdrawals

Texas LNG would not directly withdraw groundwater for construction or operation of the proposed Project; however, water necessary for both construction and operation of the Project would be obtained from municipal and surface water (Brownsville Ship Channel) sources. As discussed in section 4.3.1.2, approximately 20 percent of the drinking water supplied by the BPUB is sourced from groundwater; therefore, it is likely that at least some portion of the municipal water used by Texas LNG would consist of groundwater. The exact volume of groundwater-sourced municipal supplies that would be used by Texas LNG during construction and operation is unknown; however, it is likely that use of municipal water supplies could have at least incremental impacts on groundwater levels. Texas LNG would utilize a total of 2.5 million gallons of municipal water during construction and 16 million gallons during operation, as detailed in section 4.3.2.3. Due to the relatively minor volumes of groundwater that would likely be associated with the Project as compared to the up to 10 million gallons per day of groundwater treated at the Southmost Regional Water Authority plant, we conclude any impact on groundwater levels attributed to Texas LNG water use would be negligible.

4.3.2 Surface Water

4.3.2.1 Surface Water Quality Standards and Designated Uses

Water quality standards are developed by states to enhance or maintain water quality, protect the public health or welfare, and provide for designated uses of the waters of the state. In Texas, the surface water quality standards are codified in Texas Administrative Code (TAC) 30:307. The TCEQ oversees the state's water quality management programs with the purpose of assessing, protecting, and improving the quality of surface water in Texas. Major surface waters of the state are classified as segments for the purposes of water quality management and designation of site-specific standards. Classified segments are aggregated by basin, which are categorized as river basin waters, coastal basin waters, bay waters, and gulf waters.

There are three designated uses established for surface waters in Texas: recreation, domestic water supply, and aquatic life. Each of these designated uses is further broken down into categories. Recreational use consists of five categories: primary contact recreation 1, primary contact recreation 2, secondary contact recreation 1, secondary contact recreation 2, and noncontact recreation. The Brownsville Ship Channel is designated as noncontact recreation as primary or secondary contact recreation is considered unsafe for other reasons such as ship and barge traffic (TCEQ, 2010).

Domestic water supply use consists of three categories including public water supply, sole-source surface drinking water supply, and aquifer protection. Segments designated for public water supply are actively used as the supply source for public water systems or have characteristics that would allow them to be used. Sole-source surface drinking water supplies and associated protection zones are bodies of surface water that are the sole source of a public water supply system, exclusive of emergency water connections (TCEQ, 2010). Classified segments designated for aquifer protection are capable of recharging the Edwards Aquifer (an EPA designated sole-source aquifer, as identified in section 4.3.1.1).

Aquatic life use designations are highly dependent on several factors including the desired use, sensitivities of aquatic communities, and local physical and chemical properties. Six categories of aquatic life use have been established and include minimal, limited, intermediate, high, and exceptional aquatic life and oyster waters. Criteria used to classify segments according to these six categories include dissolved oxygen criteria and aquatic life attributes, such as habitat characteristics, species assemblage, sensitive species, diversity, species richness, and trophic structure (TCEQ, 2010).

4.3.2.2 Existing Surface Water Resources

The Project is proposed in the South Laguna Madre watershed (hydrologic unit code [HUC] 8), which extends from the coast into Kenedy, Hidalgo, Willacy, and Cameron Counties, Texas. The Laguna Madre is a long, narrow, shallow lagoon separated from the Gulf of Mexico by a barrier island (North and South Padre islands). The Laguna Madre is rich in seagrasses at least in part due to its hypersaline environment in which salinities often exceed that of seawater. Low precipitation, flat terrain, and relatively few large fresh waterbodies all contribute to the hypersaline environment in which evaporation exceeds freshwater inflows (Handley et al., 2007). The Lower Laguna Madre is connected to the Gulf of Mexico through the Brazos Santiago Pass, which also serves as the entrance to the Brownsville Ship Channel.

The Brownsville Ship Channel is an artificial, man-made ship channel that was completed in 1936 and connects the Port of Brownsville to the Brazos Santiago Pass and is considered a navigable waterbody under Section 10 of the RHA. It was subsequently dredged several more times becoming progressively deeper to accommodate larger vessels. In the vicinity of the Project site, the channel was last deepened and widened in 1986. Since then, it has been maintained by dredging as a federal navigation channel with a depth of -42 feet MLLW (COE, 2014).

The Brownsville Ship Channel is essentially straight and free of bridges or other obstructions for its entire 19-mile length and the proposed Project site is 5 miles from the Brazos Santiago Pass and the Gulf of Mexico. Dredge material from past activities has been placed along either side of the channel, effectively isolating many of its previous connections to the Laguna Madre, Bahia Grande, and South Bay. As such, precipitation is the main source of freshwater input in the channel. As a result of the limited freshwater input and small tidal exchange from the Gulf of Mexico, the Brownsville Ship Channel has high salinity levels. Salinity is highest during the summer months when evaporation is maximized and lowest following large tropical storms or hurricanes (COE, 2014).

Texas LNG conducted field surveys of the Project site in 2015. During these surveys, no waterbodies were identified, with the exception of the Brownsville Ship Channel. Estuarine tidal flats (as further discussed in section 4.4) surround the terrestrial portion of the site. These tidal flats historically served as a connection between the Vadia Ancha north of the Project site and the South Bay, but the connection has since been cut off by dredge material placement from the Brownsville Ship Channel, as well as construction of SH 48.

TCEQ has established two designated uses for the Brownsville Ship Channel. The designated uses include noncontact recreation and exceptional aquatic life use. The TCEQ *2014 Texas Integrated Report* indicates that the low tidal exchange and periodic low water velocities result in low dissolved oxygen in some areas. Further, the water quality standard for recreational use in the Brownsville Ship Channel is not supported due to periodically elevated levels of *Enterococcus* bacteria (TCEQ, 2014). As a result of the elevated levels of *Enterococcus*, the

Brownsville Ship Channel is listed as an impaired waterbody in accordance with Section 303(d) of the CWA. No other 303(d) listed waterbodies are present on the Project site (TCEQ, 2014).

The COE has collected and archived water and sediment chemistry data from the Brownsville Ship Channel that was performed in conjunction with maintenance dredging and chemical, physical, and bioaccumulation assessments that were conducted in 2012 (COE, 2014). The results of these samples indicated that there were no concerns regarding the physical and chemical properties of sediments in the Brownsville Ship Channel and the sediments do not contain contaminated material. Further, the COE requires that dredge material is tested for contaminants prior to disposal. Texas LNG filed with FERC and the COE in April 2017 test results from samples it too where it proposes to dredge stating that contaminated sediments in the Project area are not a concern. The COE concurred with this determination on June 9, 2017.[17]

4.3.2.3 Surface Water Impacts and Mitigation

Section 4.3.2.2 above describes the surface waters that would be affected as a result of construction and operation of the Project. Potential impacts on surface waters would be associated with dredging and dredge material placement, construction of the LNG carrier berthing dock and MOF, vessel traffic, site modification and stormwater runoff, hydrostatic testing, fire water system, and spills or leaks of hazardous materials. The following sections describe these potential impacts as well as measures that Texas LNG would implement to minimize impacts on surface waters.

Site Modification and Construction Stormwater Discharge

During construction of the Project, disturbed soils would be exposed to potential erosion. To minimize erosion and sedimentation impacts on surface waters and wetlands both onsite and offsite, Texas LNG would conduct land disturbing activities in accordance with its ECP, including restoring and revegetating all temporary workspaces as soon as possible after construction is complete. In addition, Texas LNG would obtain a NPDES Construction General Permit for stormwater discharges from the EPA and prepare a Project-specific Stormwater Pollution Prevention Plan (SWPPP). Texas LNG's SWPPP would take into consideration site drainage requirements and selection of the most appropriate erosion and sediment controls, management strategies, and waste disposal measures.

Excavations in low areas or areas with shallow groundwater during construction may require dewatering. Dewatering could increase the potential for runoff or sedimentation into adjacent waterbodies, increasing sedimentation and turbidity. Texas LNG would implement erosion and sediment controls in accordance with its ECP to minimize the potential for dewatering activities to adversely impact adjacent surface waterbodies. Texas LNG would remove dewatering structures as soon as possible after the completion of dewatering activities.

During construction, Texas LNG would implement dust control measures consisting primarily of application of municipal water obtained from the BPUB. Additives, including calcium chloride may be utilized in conjunction with the application of water to reduce the

[17] Documentation of this correspondence is available on eLibrary under Accession No. 20170622-5032.

volume of water necessary for dust suppression. Use of chemicals or additives would only be utilized in upland areas at least 100 feet from wetlands or waterbodies and would be applied in accordance with the manufacturer-recommended application methods.

Dredging and Dredge Material Placement

Dredging of the Maneuvering Basin and Temporary Construction Basin

To create the recessed maneuvering basin and accommodate a fully loaded LNG carrier, Texas LNG would dredge an approximately 72-acre area (composed of 39.4 acres of tidal mud flat, 32.7 acres open water[18]) to a depth of -43 feet MLLW plus an additional 2 feet allowable over depth (impacts on tidal flats as result of dredging are further discussed in section 4.4.2). The maneuvering basin would be dredged with a 3 to 1 side slope ratio to match the side slopes of the Brownsville Ship Channel. As described in greater detail in section 2.5.4.2, a combination of onshore excavation and dredging would be used to construct the maneuvering basin, which would be recessed in the southeast portion of the site adjacent to the ship channel. Texas LNG estimates that approximately 3.9 million cubic yards of material would be dredged for construction of the maneuvering basin. Texas LNG estimates that dredging activities would last approximately 11 months, the majority of which would be within the recessed maneuvering basin adjacent to the Brownsville Ship Channel.

Texas LNG would also dredge a 20-foot deep MLLW temporary construction basin necessary to install the three southernmost mooring dolphins from a barge. The majority of this temporary construction basin would overlap with the maneuvering basin; however, 1.5 acres would occur outside the maneuvering basin. After the installation of the three southernmost mooring dolphins, Texas LNG would restore the contours of the portion of the temporary construction basin within the tidal flats (see figures 2.1.2-1 and 2.2-1). The portion of the temporary construction basin proposed within the Brownsville Ship Channel (note, the temporary construction basin would not be within the actual navigation channel, but within the side slopes of the channel) would be allowed to naturally fill in following the completion of construction.

The material to be dredged within the maneuvering basin is expected to consist primarily of stiff clays with interbedded sand and silt layers (Texas General Land Office, 2015). Potential impacts on water quality from dredging include temporary increases in turbidity levels. Increased turbidity levels could cause a reduction in light penetration through the water column, which would lower the rate of photosynthesis; introduce organic material and/or nutrients that could lead to an increased biological oxygen demand and reduce dissolved oxygen; and alter water circulation and flow patterns.

Texas LNG would dredge the maneuvering basin via a barge mounted hydraulic cutterhead dredge, as discussed in section 2.5.4.2. Hydraulic cutterhead dredges minimize turbidity as compared to other dredge methods (e.g., hopper or mechanical bucket dredges). As the cutterhead cuts into the sediment, the hydraulic cutterhead suction dredge removes the

[18] For the purposes of this EIS, open water is considered to be areas that are continuously inundated and do not meet the COE definition of a wetland (see section 4.4).

sediment into the dredge hopper. The material and water within the dredge hopper is then moved by suction through the dredge piping to the piping outfall location (i.e., dredge material placement area). Turbidity is reduced because much of the turbid water is siphoned along with the substrate. In addition, cutterhead dredge speeds can be adjusted to accommodate different sediment types to further minimize turbidity. Although the majority of sediment suspended during dredging is captured, some sediment would remain suspended. Studies of cutterhead dredges indicate that elevated turbidity is typically limited to the lower portion of the water column and turbidity reaches background levels within several hundred feet of the cutterhead (McLellan et al., 1989).

Texas LNG assessed potential changes to water levels and current speed within the Brownsville Ship Channel as a result of the dredging of the Project maneuvering basin through modification of an existing hydrodynamic model. Based on this model, there would be no meaningful change in current speeds within the Brownsville Ship Channel as a result of dredging the Project maneuvering basin. The model also indicated that removal of a berm along the shoreline of the Project site from past dredging activities within the Brownsville Ship Channel has restricted tidal exchange with the adjacent tidal flats. Following dredging of the maneuvering basin, Texas LNG would remove this berm and tidal flow would be restored, increasing current speeds north and east of the Project site by 11 to 20 percent (as these areas currently have minimal tidal flows). Overall, this increase is moderate, but would improve water quality and habitat in the undisturbed tidal flats adjacent to the Project site. Due to the relatively moderate change in current speeds, no increase in shoreline erosion is anticipated to occur as a result of the Project. In addition, changes in water level would be negligible.

Texas LNG also conducted a dredge plume propagation analysis to assess potential turbidity levels and the extent that suspended sediments would travel during Project dredging (Moffatt and Nichol, 2017).[19] While this model assessed potential impacts from dredging via a hydraulic cutterhead dredge as well as a mechanical dredge, Texas LNG only proposed use of a hydraulic cutterhead dredge; therefore, only impacts associated with use of a hydraulic cutterhead dredge are discussed in this EIS (see our recommendation in section 2.5.4.2). Sediment characteristics play an important role in turbidity generation. Coarse sands settle quickly following disturbance and generating relatively low turbidity. Loose silts are more easily suspended and do not settle as quickly, creating higher turbidity levels than sands. Clays consist of even finer particles than silts and can stay suspended for long periods of time; however, due to the cohesive properties of clays, stiff clays can be cut out with relatively low suspension of particles.

Based on geotechnical studies conducted within the proposed maneuvering basin, sediments present within the dredge area consist of interbedded layers of clay, sand, and sandy clay. Based on TCEQ water quality standards for total suspended solids (TSS), the target maximum suspended sediment concentrations was determined to be 300 mg/l. Based on the dredge plume modeling results, the area immediately surrounding the hydraulic cutterhead dredge would be expected to generate TSS levels of 425.67mg/l for clays and 16.35 mg/l for sandy clays. TSS levels for clays are anticipated to reach the TCEQ level of 300 mg/l

[19] Dredging Plume Propagation report can be viewed on eLibrary under Accession No. 20170112-5179.

approximately 460 feet from the dredging activity. Based on the results of the dredge plume propagation study conducted for the Project, turbidity is anticipated to be greatest during dredging of clays with moderate impacts in the immediate vicinity of dredge activities; however, TSS levels are anticipated to dissipate to acceptable levels within a relatively short distance (460 feet).

Once dredging of the maneuvering basin is complete, portions of the side slopes would be armored with rock slope protection to prevent erosion or slumping. Riprap would consist of a 1-foot thick layer of bedding stone placed on geotextile fabric covered with a 3-foot layer of Class 1 shore protection stone. The riprap would extend from the toe of the slope to approximately the same elevation as the existing grade at the MLLW level. Slope protection would be placed within the maneuvering basin using a barge mounted crane. Texas LNG anticipates repairing at least some of the slope protection every 5 years. No rip rap would be placed within the Brownsville Ship Channel.

Texas LNG would dredge 3.9 million cubic yards of material from the Brownsville Ship Channel during initial construction and 300,000 to 500,000 cubic yards of material during maintenance dredging every 3-5 years (as described below), which would result in elevated turbidity levels 460 feet downstream during this activity. However, this is a manmade ship channel that routinely undergoes dredging operations by the COE approximately every 2 years (EPA and COE, 2017). Additionally, Texas LNG's removal of the berms to allow freshwater inflows could help increase the overall water quality in the Brownsville Ship Channel. Therefore, we conclude that dredging would result in temporary and not significant impacts on surface water resources. In addition, in March 2016, Texas LNG applied for authorization from the COE to dredge and/or fill waters of the United States under Section 404 of the CWA and Section 10 of the RHA (see discussion in section 4.4). Texas LNG would be required to implement the measures incorporated into the COE permit, including any special requirements or procedures that may further minimize of impacts on water quality as a result of dredging.

Dredge Material Placement

Texas LNG proposes to dispose of dredge material associated with construction of the Project in the existing BND-owned PA 5A. PA 5A is 704 acres in size and is located approximately 4 miles southwest of the Project site (see figure 2.5.4-2). While PA 5A is owned by the BND, the COE operates the PA under an easement agreement; therefore, use of PA 5A for the Project would be authorized by the COE. Texas LNG must also obtain any other necessary permits including Section 401 Water Quality Certification from the RRC prior to placement of dredge material in PA 5A.

Texas LNG estimates that up to 3.9 million cubic yards would be dredged and placed in PA 5A (excluding up to 10 percent that Texas LNG may be able to use onsite). In order to contain this volume, the existing berms surrounding PA 5A would need to be raised from 9 feet to 14 feet. This would be accomplished by using the existing material in PA 5A and would not result in an expansion of the overall footprint.

Dredge material associated with the Project would be transported to PA 5A via a temporary discharge pipeline. The temporary discharge pipeline would be placed on the channel floor across the Brownsville Ship Channel, so as to not impede vessel traffic. Placement of the temporary discharge pipeline up to 30 inches in diameter on the channel floor during dredging activities could increase turbidity during placement and removal of the pipeline. In addition, benthic habitats directly beneath the pipeline would be impacted for the duration of the dredging activities, until the pipeline is removed. Therefore, impacts associated with the temporary discharge pipeline would be short-term and minor.

Use of the confined PA minimizes impacts on water quality by containing the dredge material and associated water collected by the cutterhead suction dredge. Water is managed within the PA by use of berms which direct water so as to increase evaporation and settling of solids. Some water would drain off-site and into the Brownsville Ship Channel via an existing drop-outlet structure on the north side of PA 5A. Texas LNG indicated that it would sample any return water effluent associated with the dredge material placement in accordance with applicable permits, to ensure that discharges are consistent with TCEQ Water Quality Standards, which allow for up to 300 mg/l TSS concentration for discharge of return water from confined upland disposal areas. Further, Texas LNG conducted preliminary tests on samples of sediment from the proposed dredge area that indicated all levels of contaminants were within acceptable levels in accordance with COE guidelines. Therefore, effluent discharges into the Brownsville Ship Channel after the sediment is placed in PA 5A are anticipated to be within acceptable limits as identified by the COE and TCEQ (RPS Austin, 2017).

Impacts associated with dredge material placement would be limited to the discharge of return water, as Texas LNG would utilize the existing PA 5A. We conclude that Texas LNG's proposed dredge disposal methods would sufficiently minimize Project-related turbidity and sedimentation within the Brownsville Ship Channel.. In addition, Texas LNG would adhere to all applicable permit requirements regarding placement of the dredge material, including compliance with Texas Water Quality Standards and any conditions outlined in the COE permit.

Maintenance Dredging

Texas LNG would conduct maintenance dredging of the maneuvering basin every 3 to 5 years during operation and would remove an estimated 300,000 to 500,000 cubic yards of dredge material via hydraulic cutterhead dredge during each cycle. Texas LNG anticipates that sedimentation rates within the maneuvering basin would be comparable to sedimentation rates of the adjacent Brownsville Ship Channel at 0.98 inch per year. Maintenance dredge material would be placed in an approved PA in accordance with all applicable authorizations from the BND and COE, as necessary. Potential impacts on surface water from maintenance dredging would be similar to that described for initial dredging of the maneuvering basin; however, these impacts would be shorter in duration due to the reduced amount of material being removed from the maneuvering basin. Therefore, we conclude that maintenance dredging would have temporary and minor impacts on surface water.

Construction of the LNG Carrier Berthing Dock and Materials Offloading Facility

The entirety of the MOF and the majority of the LNG carrier berthing dock would be constructed within tidal flats. Texas LNG would construct the three southernmost mooring dolphins in open water associated with the Brownsville Ship Channel (but located outside of the maintained channel). Piles associated with both the LNG carrier berthing dock and the MOF would be installed prior to dredging the maneuvering basin. As discussed in detail in section 2.5.4.1, Texas LNG would install these facilities via temporary construction causeways. The causeways would be placed in areas that would be dredged following the installation of piles. The surface of the causeways would be 3 feet above MLLW and the side slopes would be armored with rock to minimize erosion. In addition, placement of the causeways is not anticipated to impede tidal flows in the area. Once the causeways are installed, the pile-driving crane would install the waterward piles first and work landward. As pile driving is completed, the causeways would be incrementally removed until all piles are in place and the causeways have been completely removed. Texas LNG estimates that use of the causeway would last approximately 180 days.

Fill materials associated with construction of the temporary causeways would be placed on geotextile fabric to facilitate removal during restoration. Impacts associated with the causeway outside of the permanent dredge area for the maneuvering basin would consist of compaction of underlying sediments. Texas LNG would restore the temporarily impacted onshore areas to preconstruction contours. Impacts from compaction are anticipated to be minor, as the area currently supports limited vegetation.

Overall, construction of the LNG carrier berthing dock and MOF would result in localized temporary increases in turbidity (increased TSS levels), especially associated with the installation of the three southernmost mooring dolphins which would be in open water, rather than tidal flats. However, we conclude that these impacts would be temporary, localized, and not significant, confined primarily to the area within and immediately adjacent to the LNG carrier berthing dock and MOF. No permanent or long-term water quality impacts are anticipated.

Hydrostatic Testing

Prior to being placed in service, Texas LNG would test piping, equipment, and storage tanks to ensure structural integrity. The cryogenic piping would be pneumatically tested and the non-cryogenic piping would be hydrostatically tested. Hydrostatic testing of the LNG storage tanks would involve filling each tank with water meeting the requirements of the API 620, Q.8.3. Prior to hydrostatic testing, Texas LNG would prepare the equipment to be tested by removing accumulated construction debris, dirt, and dust, as appropriate.

Texas LNG would withdraw water from the Brownsville Ship Channel for hydrostatic testing of the LNG storage tanks and municipal water from the BND would be used for hydrostatic testing of piping and other storage tanks. Texas LNG estimates that it would use approximately 71 million gallons of water from the Brownsville Ship Channel for hydrostatic testing. Table 4.3.2-1 summarizes the source and volume of water anticipated to be used for hydrostatic testing of each Project phase and component.

TABLE 4.3.2-1

Estimated Water Usage for Hydrostatic Testing

Phase/Project Component	Water Source	Volume of Discharge (gallons)
Phase 1		
LNG Storage Tank	Seawater [a]	35,405,174

TABLE 4.3.2-1 Estimated Water Usage for Hydrostatic Testing		
Phase/Project Component	**Water Source**	**Volume of Discharge (gallons)**
Other Storage Tanks	Potable water [b]	1,231,723
Plant Piping	Potable water [b]	1,017,583
Phase 1 Subtotal		**37,654,480**
Phase 2 Temporary Workspace		
LNG Storage Tank	Seawater [a]	35,405,174
Other Storage Tanks	Potable water [b]	73,169
Plant Piping	Potable water [b]	194,831
Phase 2 Subtotal		**35,673,174**
PROJECT TOTAL		**73,327,654**

[a] Seawater would be withdrawn from the Brownsville Ship Channel.
[b] Potable water would be appropriated from the BND or other municipal source.

Seawater used for hydrostatic testing would be sourced from permanent water intake structures on the MOF or by using temporary pumps appropriated directly from the channel. The permanent intake structures would be screened and are intended to be used as part of the back-up fire suppression system (see section 2.1.6); however, they would be installed during construction of the MOF and available for use for hydrostatic testing water withdrawals. Texas LNG anticipates a maximum rate of 3,000 gallons per pump per minute to be utilized for withdrawals. Multiple pumps may be utilized at once to minimize the duration of withdrawal activities. Texas LNG anticipates that the total combined water withdrawal rates for hydrostatic testing would be between 6,000 and 12,000 gallons per minute.

To limit bacteria and other components that can be corrosive, chemical additives may be required during the hydrostatic test process where seawater is used. Before returning the water to the Brownsville Ship Channel, Texas LNG would filter the water to remove suspended solids and neutralize or biodegrade the chemical additives into non-hazardous materials. Texas LNG has indicated that it would seek authorization from the EPA to use additives and would provide specific additives and the intended concentrations prior to construction.

Potable water would be used to test piping and other storage tanks (i.e., not the LNG storage tanks). Texas LNG has committed to discharging small quantities of potable water (quantities that are not anticipated to reach a surface waterbody or wetland) used for hydrostatic testing directly to the ground at a rate not to exceed 1,000 gallons per minute to minimize erosion and scour. Larger quantities of potable water used for hydrostatic testing would be discharged directly to the Brownsville Ship Channel or onsite, in accordance with EPA and RRC hydrostatic test discharge permits (see section 1.5) at a rate of up to 10,300 gallons per minute. To minimize the potential for erosion and scour at the discharge locations, Texas LNG would use energy dissipation devices (e.g., filter bags and straw bale structures), sediment barriers, and other erosion and sediment control methods, as applicable. Through implementation of these measures, we conclude that impacts on surface water quality associated with hydrostatic testing would be temporary and not significant.

Vessel Traffic

Shoreline Erosion and Resuspension of Sediments

During construction, Texas LNG anticipates that it would receive most modular units, major material supplies, and equipment via barge or other ocean-going vessel at the MOF. Texas LNG anticipates 109 total barge trips during construction. During operation of Phase 1 and Phase 2, Texas LNG estimates that 74 LNG carriers would call on the LNG Terminal annually (or approximately 6 carriers per month). Each LNG carrier calling on the terminal would be accompanied by three to four tugs.

During construction and operation, vessel traffic within the maneuvering basin and along vessel transit routes has the potential to increase shoreline erosion and suspended sediment concentrations due to increased wave activity. Shoreline erosion is a concern when hard structures are placed along the shoreline that could cause changes in wave dynamics and increase erosion of adjacent areas. Texas LNG does not anticipate that the LNG carriers would contribute more than negligible impacts on the shoreline, as they would move relatively slowly within the maneuvering basin with tug boat assistance. The tugs, however, would be high powered and have the potential to contribute to shoreline erosion. As described above, Texas LNG would install rock armoring along the side slopes of the maneuvering basin to provide scour protection from propeller wash. In addition, the tugs would be moored at the MOF while the LNG carriers are at the LNG terminal, thereby eliminating the need for the tugs to rest against unprotected shoreline in the Brownsville Ship Channel.

The Brownsville Ship Channel was specifically created to provide deepwater access for maritime commerce. It is governed by the BND and maintained by regular dredging. Similarly, LNG carriers transiting the Gulf of Mexico would use established shipping channels. As such, use of the waterways by LNG carriers, barges, and support vessels during construction and operation of the Project would be consistent with the planned purpose and existing use of active shipping channels, and we conclude that associated impacts on shoreline erosion and water quality from resuspension of sediments due to vessel traffic would not be significant.

Ballast Water Discharge

LNG carriers calling on the LNG terminal would likely arrive with empty cargo tanks because they would be loaded at the LNG terminal with LNG destined for export. Vessels with empty cargo tanks ride higher in the water and can experience challenges associated with navigation including being more susceptible to wind influences and less efficient as a result of reduced performance of the propulsion system. To reduce or eliminate the challenges of navigating the ship without cargo aboard, water is often taken in from surrounding waters and placed in ballast tanks to provide additional draft. A constant draft is necessary to maintain alignment with the LNG loading arms during the transfer of LNG. To maintain a constant draft, ballast water would be discharged below the water surface as the LNG cargo is loaded. The amount of ballast water discharged would vary depending on the size of the LNG carrier and would be less than the weight of the loaded LNG.

The Coast Guard's ballast water management regulations (33 CFR 151.2025 and 46 CFR 162) established a standard for the allowable concentration of living organisms in ships' ballast water discharged into waters of the U.S. The Coast Guard also established engineering requirements and an approval process for ballast water treatment systems installed on ships. All ships calling on U.S. ports must either carry out open sea exchange of ballast water or ballast water treatment, in addition to fouling and sediment management and document these activities in the ship's log book. In addition, the International Maritime Organization has adopted this regulation and requires each vessel to install and operate a ballast water management system (as defined in 33 CFR 151.2026).

Ballast water discharged in the maneuvering basin would either be treated by a ballast water management system or be composed of open ocean water in accordance with regulations, as discussed above. Ballast water discharges at the LNG terminal could impact water quality by changing the salinity, temperature, pH, and dissolved oxygen level of water present within the maneuvering basin. The physiochemical composition of ballast water in comparison to the water present within the maneuvering basin would vary depending on tidal and hydrologic conditions at the time of discharge. The primary potential impact on water quality due to ballast water would be a temporary change in salinity. As discussed in section 4.3.2.2, the Lower Laguna Madre is a hypersaline environment with relatively high salinity levels; however, salinity in the region can vary widely depending on rainfall and freshwater inflows. The LNG carrier would discharge approximately 15 million gallons of ballast water while at the LNG terminal. As such, ballast water discharged into the maneuvering basin during each LNG carrier visit would represent a very minor influence on the overall system (Handley et al., 2007).

Another physiochemical water quality parameter that may be influenced by ballast water discharges is dissolved oxygen levels. Ballast water typically has a lower dissolved oxygen level than sea water. Ballast water would be discharged near the bottom of the maneuvering basin where dissolved oxygen levels are generally lower. Further, the Brownsville Ship Channel tends to experience episodes of low dissolved oxygen due to its being a dead-end channel with little freshwater inflow, low velocities, and low tidal exchange (COE, 2014). If ballast water has lower dissolved oxygen levels than the maneuvering basin, the impacts following discharge would be temporary and localized, having a relatively minor influence on the overall system.

Water temperature and pH could also be affected in the maneuvering basin during ballast water discharge; however, temperatures are not expected to deviate markedly from ambient temperatures. In addition, the pH of ballast water (reflective of seawater in open ocean conditions) is maintained in a fairly narrow range (8.1 to 8.5), which is relatively consistent with the pH of the Brownsville Ship Channel (8.0 on average) (Knezovich, 1994; Breuer, 1972). Therefore, ballast water discharge is anticipated to have a negligible effect on water temperature and pH in the maneuvering basin.

To minimize impacts on water quality and ensure compliance with U.S. laws and regulations governing ballast water discharges, Texas LNG would include these laws and regulations in all agreements for LNG carriers offloading LNG at the terminal. Therefore, we conclude that impacts on surface waters as a result of ballast water discharge would be intermittent and minor.

Cooling Water Discharge

During operation, LNG carriers require water for cooling of the main engine/condenser, diesel generators, and fire main auxiliary and hotel services. To do this, LNG carriers take on water from the surrounding area, transfer heat from the equipment to the water, and discharge the water back to the surrounding area. LNG carriers calling on the LNG terminal are anticipated to conduct cooling water uptakes and discharges while in the maneuvering basin. Based on annual average water temperatures in the region (NOAA, 2017a), the ambient water temperature in the maneuvering basin is anticipated to average 72.8 degrees Fahrenheit (°F). Because the water is withdrawn and discharged from the same location while at the LNG terminal, no changes in water quality would occur; however, the discharged water would be approximately 5 to 6 °F warmer than the ambient water. Texas LNG estimates that a 174,000 m^3 LNG carrier would discharge an estimated 972,500 gallons of cooling water per hour, approximately 0.1 percent of the total volume of the maneuvering basin. Due to the small volumes of cooling water discharge, relative to the maneuvering basin as a whole, it is anticipated that temperatures would quickly return to ambient levels. Ballast water discharges as well as tidal exchange would further dilute the cooling water discharge. Therefore, we conclude that cooling water would have a negligible, intermittent effect on surface water quality.

Industrial Stormwater Discharge

Following construction, a portion of the Project site would include impervious surfaces resulting in increases in stormwater runoff. To accommodate this increase, as well as the topographic changes that would occur as a result of site development, a system of catchment basins and drainage conduits would be incorporated into the final site design. To prevent uncontrolled industrial stormwater runoff, the stormwater drainage system would be curbed with water collected and treated before discharge. Energy dissipaters would be placed as necessary at outfalls to prevent scour and erosion. Texas LNG has identified one outfall that would be used to discharge processed water from the operation of the LNG terminal into the Brownsville Ship Channel. The outfall would consist of a 2-inch-diameter pipe attached to pilings on the LNG carrier loading dock.

Stormwater that does not have potential for contamination would be carried directly to the outfall; however, stormwater from areas with potential for contamination would be directed to the oily water treatment system. Areas with the potential for oil-contaminated stormwater include oil storage tanks, areas containing compressors using lubricating oil, the warm flare knock out drum, and the plant air compressor. Stormwater from the oil storage tanks would drain to an impoundment basin. Stormwater falling into this impoundment would not be released until an operator confirms that there is no oil contamination. In the event that there is oil in the water, the water would be removed for disposal at a licensed off-site facility. Areas containing compressors using lubricating oil would be curbed and covered to limit rain falling inside the curb. Any stormwater falling inside the curbed area would flow to the oily water treatment system and water from the warm flare knock-out drum would be piped to the oily water treatment system. In addition, water from the plant air compressor would be sent to the oily water treatment system if it is determined to have potential to contain contaminated water.

In addition to the potential for oil-contaminated stormwater, there is potential for amine contamination. To prevent amine contaminated stormwater from leaving the site, the amine pumps and filters would be curbed. The curbed area would have two sets of valves that are both normally closed. If the stormwater is uncontaminated with amine, an operator would open the drain valve to the environment. If the stormwater is contaminated with amine, the water would drain to the amine contaminated stormwater tank and the source of the amine leak would be repaired. The amine contaminated water would be trucked off-site by a licensed contractor, as needed.

With the implementation of the measures identified above, we conclude that impacts on water quality as a result of industrial stormwater discharge would be minor and not significant. In addition, Operation of the facility would be regulated by an NPDES Industrial General Permit for stormwater discharges with regulated outfalls.

Industrial Process Water

Texas LNG would primarily use water obtained from the BND during operation of the Project. As discussed in section 1.4.3, a new water pipeline would be installed by the BND as an extension of its existing system, to transport potable water to the Project site for use during facility operation. Texas LNG estimates that a total of approximately 16 million gallons of water would be used annually during operation of the Project. The BND purchases treated water from the BPUB. The BND has purchased an average of approximately 161 million gallons of potable water annually from the BPUB between 2013 and 2015. During consultations with Texas LNG regarding water use, the BND indicated that it has reduced water loss and increased water conservation in recent years. This has resulted in the BND purchasing less water in recent years than in previous years. Therefore, the BND anticipates that sufficient water would be available for operation of the Project.

Table 4.3.2-2 provides an estimate of the volume of water that Texas LNG anticipates using during operation, as well as the associated discharges. The majority of water necessary for operation of the Project would be used at utility stations to wash down the equipment of dust, pollen, and debris, or to ready equipment for maintenance by warming it with continuous water flow. Other operation processes requiring freshwater include potable water for use by facility personnel, safety showers, acid gas removal systems, demineralization plant, and firewater.

As identified in table 4.3.2-2, Project facilities associated with acid gas removal require demineralized water. Texas LNG would construct a demineralization plant within the LNG terminal. During the demineralization process, minerals are transferred from the potable water provided by the BND to a discharge stream into the Brownsville Ship Channel. The resulting discharge stream would have more mineral hardness, be slightly warmer, and have a lower pH than the potable water received from the BND. It is anticipated that due to the relatively small volume of water being discharged as result of the demineralization process (approximately 2.8 gallons per minute), adverse effects on the Brownsville Ship Channel would be minor and localized, with the discharged water quickly diffusing into the surrounding water column.

As discussed in section 2.1.6, a freshwater firewater tank would be the primary water source in the event of a fire during operation of the Project (the seawater firewater back-up system is further discussed below). While the use of the firewater tank is not anticipated, Texas LNG would regularly test the system to ensure it is operating correctly in the case of an emergency. Texas LNG would conduct weekly tests of the freshwater firewater system which would replace the full volume of the firewater tank. Testing of the freshwater firewater system would result in an annual average water use of 1.3 gallons per minute during operation (monthly tests result in 1,500 gallons per minute for 5 minutes, with an additional 1 gallon per minute assumed leakage rate) as detailed in table 4.3.2-2 below. In addition, Texas LNG would conduct monthly tests of different hydrants and monitors within the LNG terminal resulting in estimated discharges of 1,500 gallons per minute for five minutes. All water discharged during testing of the freshwater firewater system would be conveyed to outfalls onsite via stormwater paths as discussed above. Texas LNG also estimates a leakage rate of 1 gallon per minute.

Sanitary waste water at the administration building would be treated in an onsite septic system provided with a dedicated leaching field connected to the administration building. Sanitary waste from the control rooms and satellite restrooms would be treated at a septic system near the control room, also with a dedicated leaching field.

TABLE 4.3.2-2

Estimated Water Usage for Operation of Phases 1 and 2 of the Texas LNG Project

Facility/Project Component	Average Gallons per Minute
Sanitary waste water	1.3
Safety showers	0.4
Utility stations	20.0
Demineralization system (wastewater)	2.8 [a]
Acid gas removal system	4.3 [b]
Firewater system (test water)	1.3
PROJECT TOTAL	**30.1**

[a] This volume accounts for the waste water generated as result of demineralization. The demineralized water consumption is accounted for in the water requirements of the acid gas removal system.

[b] Demineralized water would be used for the acid gas removal system.

As a backup system to the freshwater firewater system, a seawater firewater system would automatically activate on detection of low water in the freshwater firewater tank. Use of the seawater firewater system would only occur in the event of an emergency and after the freshwater firewater tank is depleted. The water for the seawater firewater system would be appropriated from two permanent pumps on the MOF, which would each withdraw water at a rate of 4,500 gallons per minute.

The TWDB projects that total water usage in Cameron County in 2020 will be approximately 144.7 billion gallons of water annually with the City of Brownsville using an estimated 11.8 billion gallons per year (TWDB, 2016c). Texas LNG’s use of 16 million gallons of water per year represents an overall increase of 0.1 percent on the projected 2020 City of Brownsville water demand. Based on current projections for the City of Brownsville, there is sufficient water supply to meet the projected demands until 2040. Between 2040 and 2070, demand is anticipated to exceed supply; however, water management strategies, including desalination and conservation, would be sufficient to address any potential shortages (TWDB, 2016c). Therefore, we conclude that annual water usage during operation of the Project would have minor and not significant impacts on water use in the Project area.

Spills

During construction and operation of the Project, hazardous materials resulting from spills or leaks flushed into the Brownsville Ship Channel could have an adverse impact on water quality. To prevent impacts from spills and leaks, Texas LNG would implement its Project-specific SPAR Plan during construction and its SPCC Plan during operation of the Project. These plans outline potential sources of releases at the site, measures to prevent a release, and initial responses in the event of a spill (see our recommendation and additional discussion in section 4.2.3). Measures that Texas LNG would implement during construction to minimize potential spills of hazardous materials include:

- storing hazardous materials at least 100 feet from wetlands and waterbodies, unless special provisions outlined in the SPAR Plan are implemented and prior approval from the Environmental Inspector is obtained;
- using secondary containment measures for all tanks or containers greater than 5 gallons;
- keeping sufficient spill control materials on site; and
- regularly inspecting locations where hazardous materials are stored, handled, and dispensed.

In addition, the abandoned 4.5-inch-diameter natural gas pipeline that Texas LNG would remove from the tidal flats prior to dredging the maneuvering basin could contain contaminated materials. If the pipeline is still intact, Texas LNG would flush the line and collect any contaminated materials prior to removal to ensure that contaminated media is not released into the tidal flats or adjacent Brownsville Ship Channel. Given the impact minimization and mitigation measures described above that Texas LNG would implement during construction and our recommendation regarding the SPCC Plan during operation (see section 4.2.3), we conclude that impacts on surface waters due to spills or leaks during construction and operation of the Project would be temporary and not significant.

4.4 WETLANDS

Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal environmental conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known and hydrophytic vegetation (Environmental Laboratory, 1987). Wetlands can be a source of substantial biodiversity and serve a variety of functions that include providing wildlife habitat, recreational opportunities, flood control, and naturally improving water quality.

Wetlands are protected under Section 404 of the CWA, which is implemented by the COE, Galveston District in the Project area. Section 404 establishes standards to evaluate and reduce the total and net impacts on wetlands under the jurisdiction of the COE. These standards require avoidance of wetlands where possible and minimization of disturbance where impacts are unavoidable, to the degree practicable. Texas LNG must also demonstrate that appropriate steps have been taken to minimize wetland impacts, in compliance with the COE's Section 404(b)(1) guidelines that restrict discharges of dredged or fill material where less environmentally damaging alternatives exist. Further, Section 404 requires compensatory mitigation of impacts that are deemed unavoidable.

Wetland impacts authorized under Section 404 of the CWA also require state water quality certification under Section 401 of the CWA. Water quality certification has been delegated to the state agencies, with review by the EPA. In Texas, the RRC has sole authority for the prevention and abatement of pollution of surface waters associated with oil and gas exploration, development, and production operations and is the certifying agency for issuance of COE permits associated with such operations (Texas Natural Resource Code Section 91.101; Texas Water Code Section 26.131).

4.4.1 Existing Wetland Resources

Texas LNG conducted wetland delineations within the entire Project site (651.5 acres) in January 2015. Wetland delineations were conducted in accordance with the COE *Wetland Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coast Plain Region* (Version 2.0), which require the investigation of wetlands based on the presence of three parameters: hydrophytic vegetation, hydric soils, and wetland hydrology (Environmental Laboratory, 1987; COE, 2010).

Four palustrine emergent (PEM) wetlands and one contiguous tidal flat, totaling 60.0 acres and 178.0 acres respectively, were delineated within the Project site (see figure 4.4.2-1). Palustrine wetlands are defined as non-tidal wetlands dominated by trees, shrubs, emergent vegetation, emergent mosses, or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per trillion. The tidal flats present within the Project site are considered estuarine wetlands according to the Cowardin et al. (1979) classification system. Estuarine wetlands consist of deepwater tidal habitats and adjacent tidal wetlands that are usually partially enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from land. The salinity in estuarine wetlands may be periodically increased above that of the open ocean as a result of evaporation. Open ocean, estuaries, and lagoons are all considered estuarine systems (Cowardin et al., 1979).

The PEM wetlands within the Project site are closed-system depression wetlands within the interior of the site (see figure 4.4.2-1). The primary functions include water retention from rain events, water quality improvement by trapping and metabolizing nutrients from runoff, and wildlife habitat. The dominant wetland vegetation species found in the PEM wetlands within the Project site include Gulf cordgrass, bushy seaside tansy, and screwbean mesquite.

The tidal flats within the Project site (estuarine wetlands) are often exposed and not inundated; however, based on NOAA data, tides in the area are slightly higher during the fall months. Although USGS topographic maps indicate that the area is subject to inundation, it is often barren and dry. Historic maps show the area as open water. It is likely that construction of the Brownsville Ship Channel along with the continued maintenance dredging has resulted in the deposition of displaced dredge material along the channel in what was historically shallow open water. The continued accretion of sediment from dredging as well as other sources, such as ship traffic, has effectively cut off natural tidal exchange in the area except during extreme high tides and storm surges. The tidal flats within the Project site provide habitat for shorebirds and benthic (bottom-dwelling) invertebrates and still supports water quality improvement by trapping and metabolizing nutrients from runoff. The tidal flats are sparsely vegetated with species such as turtleweed, dwarf glasswort, shoreline seapurslane, chickenclaws, and annual seepweed.

4.4.2 Wetland Impacts and Mitigation

Construction of the Project would result in the permanent loss of 42.9 acres of wetlands, including 1.1 acres of PEM wetlands and 41.8 acres of tidal flats, and an additional 2.3 acres in temporary impacts, including 0.5 acre of PEM wetlands and 1.8 acres of tidal flats (see table 4.4.2-1).

TABLE 4.4.2-1

Wetlands Impacted by the Project Facilities (in acres)

Facility [a, b]	Wetland ID	Wetland Classification	Construction Impact (acres) [c]	Operation Impact (acres)
PERMANENT FACILITIES				
Liquefaction Process Area and LNG Storage Tanks	MA001	E2US3P	<0.1	<0.1
	MA003	E2US3P	<0.1	<0.1
	MB001	E2US3P	0.4	0.4
	MB002	E2US3P	0.2	0.2
	MB003	E2US3P	0.3	0.3
	WA002	PEM	<0.1	<0.1
	WB002	PEM	0.1	0.1
Maneuvering Basin	MA003	E2US3P	38.7	38.7
	MB003	E2US3P	0.3	0.3
	MB004	E2US3P	0.4	0.4
LNG Carrier Berthing Dock	MA003	E2US3P	1.3	1.3
	MB003	E2US3P	0.2	0.2
Permanent Access Road	N/A	N/A	N/A	N/A
Non-jurisdictional Facilities within the Project Site	MB001	E2US3P	<0.1	<0.1
	WB002	PEM	0.6	0.6
	WA001 [d]	PEM	0.3	0.3
	WB001 [d]	PEM	<0.1	<0.1
Permanent Facilities Subtotal	**--**	**--**	**42.9**	**42.9**
TEMPORARY WORKSPACE AND LAYDOWN AREAS				
Phase 1 Temporary Workspace				
Temporary Construction Basin	MA003	E2US3P	0.4	0.0
Jetty and Flarestack Laydown Areas	N/A	N/A	N/A	N/A
LNG Carrier Berthing Dock	MA003	E2US3P	0.8	0.0
	MB003	E2US3P	0.1	0.0

TABLE 4.4.2-1 Wetlands Impacted by the Project Facilities (in acres)				
Facility [a, b]	**Wetland ID**	**Wetland Classification**	**Construction Impact (acres) [c]**	**Operation Impact (acres)**
Site Preparation Temporary Workspace	MA001	E2US3P	0.1	0.0
	MB001	E2US3P	0.2	0.0
	MB003	E2US3P	0.1	0.0
	WA002	PEM	0.1	0.0
	WB002	PEM	0.3	0.0
Borrow Areas	N/A	N/A	N/A	N/A
Phase 1 Subtotal	**--**	**--**	**2.3**	**0.0**
Phase 1 and 2 Temporary Workspaces [e]	N/A	N/A	N/A	N/A
PROJECT SITE TOTAL [f]	**--**	**--**	**45.2**	**42.9**

N/A = Not Applicable, Project component would not impact wetlands.

[a] PEM = palustrine emergent; E2US3P = estuarine intertidal unconsolidated shore irregularly flooded (tidal flat)

[b] No wetlands would be impacted by the disposal of dredge material at PA 5A.

[c] Construction impacts are inclusive of operation impacts.

[d] Wetlands WA001 and WB001 would be crossed by the permanent rights-of-way associated with the non-jurisdictional facilities within the Project site. Impacts during construction would be temporary; however, the permanent rights-of-way would be subject to periodic vegetation maintenance; therefore, these impacts are considered permanent for the purposes of this table.

[e] None of the Phase 1 and 2 Temporary Workspaces, as identified in table 2.2-1, including the concrete batch plant, warehouse and workshops, laydown areas, contractor offices, contractor parking lot, crane pad, topsoil storage area, and temporary access road would impact wetlands.

[f] Numbers in this table have been rounded for presentation purposes; as a result the total may not equal the sum of the addends.

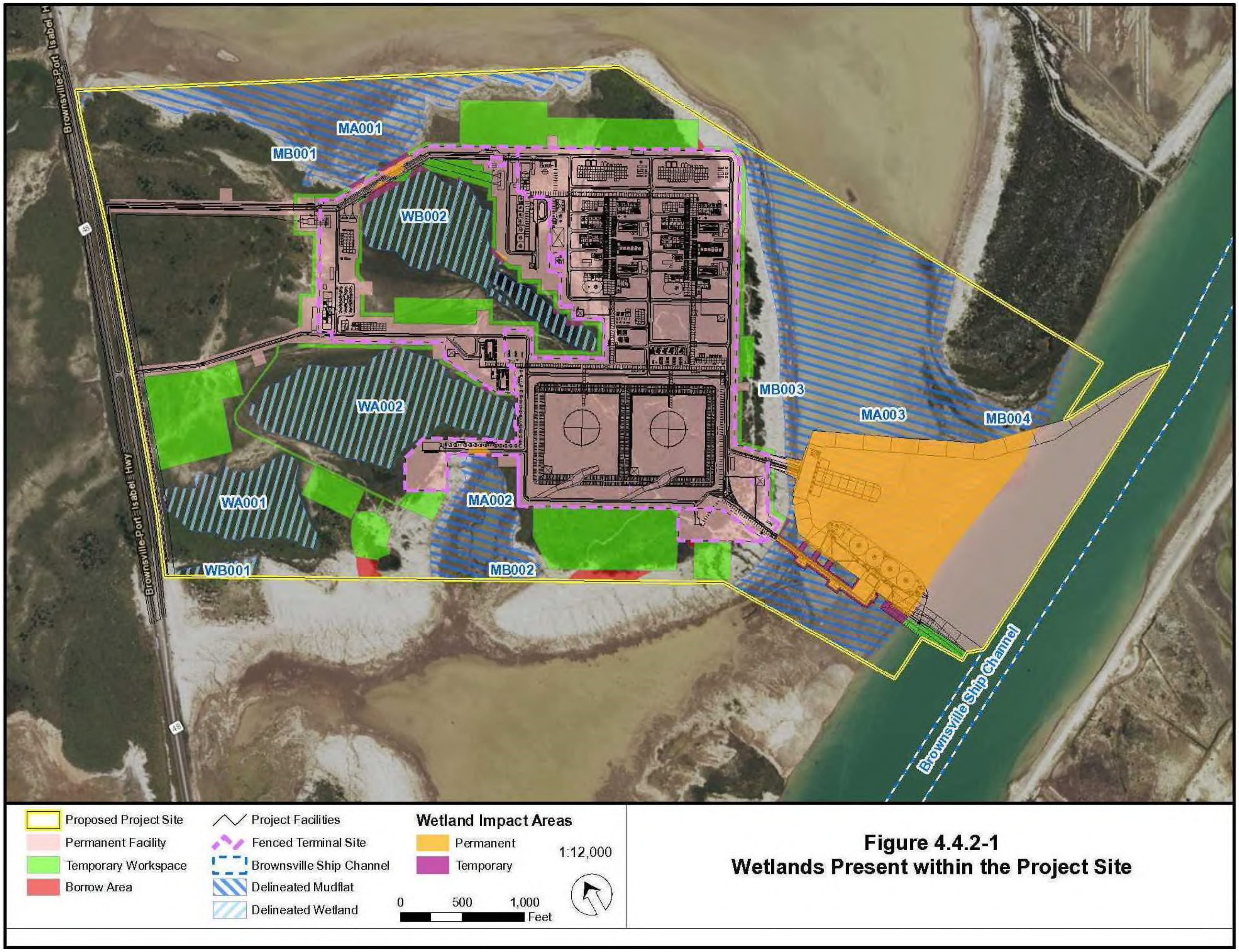

FIGURE 4.4.2-1 Wetlands Present within the Project Site

Permanent wetland impacts would occur as a result of pile driving, site preparation and fill, and dredging of the maneuvering basin. As discussed in section 2.5.4.1, pile driving would primarily be conducted from temporary causeways constructed within the tidal flats. The area that would be impacted by the temporary causeways for both the MOF and the LNG carrier berthing dock overlaps the area that would be permanently dredged; therefore, no additional impacts on wetlands associated with the installation of piles are anticipated. Construction of the LNG carrier berthing dock would permanently impact a total of 1.4 acres of tidal flats, outside of the maneuvering basin (see figure 4.4.2-1). All impacts associated with the MOF would occur within the dredge area for the maneuvering basin. Removal of the abandoned 4.5-inch-diameter gathering line would also impact the tidal flats; however, all activities associated with the removal would occur within the area that would be dredged for the maneuvering basin.

The marine structures, including the MOF and LNG carrier berthing dock, could have secondary impacts on tidal flats by shading the substrate. However, the majority of the areas that would be subject to the effects of shading are unvegetated. Although only found in scattered patches, the dominant plant species are annual seepweed and dwarf glasswort. No submerged aquatic vegetation is present on the Project site. After dredging is completed, the MOF and LNG carrier berthing dock would be positioned over the dredged maneuvering basin, which would be maintained as deepwater habitat. The access trestles, however, would extend up to 20 feet across the existing tidal mud flat. The COE recommends that structures be placed a minimum of 5 feet above special aquatic sites in order to minimize the impacts associated with shading (COE, 2015a). Texas LNG would construct these trestles to be a minimum of 10 feet above the flat, thus minimizing potential secondary impacts resulting from shading. Impacts on aquatic resources as a result of shading are further discussed in section 4.6.2.2.

Construction of the liquefaction process area and LNG storage tanks would permanently impact 1.0 acre of tidal flats and 0.1 acre of PEM wetlands. In addition, the non-jurisdictional facilities that would be installed within the Project site (i.e., natural gas pipeline, water line, and electric transmission line) would permanently impact 1.0 acre of PEM wetlands. Workspace for site preparation of the Project facilities would temporarily impact 0.5 acre of PEM wetlands and 0.4 acre of tidal flats.

Dredging would be conducted in two phases. The first phase would involve dredging of a temporary construction basin, as discussed in section 4.3.2.3 to allow a shallow draft barge to install the three outermost mooring dolphins associated with the LNG carrier berthing dock. A path would be dredged to a depth of -20 feet MLLW to provide the necessary draft to float a barge with a mounted pile driver into position. Although the temporary construction basin overlaps with the maneuvering basin resulting in only 38,000 cubic yards of additional dredging.

Dredging of the temporary construction basin would impact 2.6 acres consisting of tidal flats and deep water habitat within the Brownsville Ship Channel; however, 1.1 acres of this would overlap with the maneuvering basin and be permanently impacted. The remaining 1.5 acres would occur outside the maneuvering basin and result in only temporary impacts. Texas LNG would restore the portion of the construction basin that is within the tidal flats and does not overlap with the maneuvering basin (0.4 acre) to preconstruction contours. The portion of the construction basin that is within the side slope of the Brownsville Ship Channel and does not overlap with the maneuvering basin (1.1 acres) would be allowed to naturally fill in following the completion of construction.[20]

The second phase would consist of dredging of the maneuvering basin to -43 MLLW with a 2-foot allowable over depth. To construct the maneuvering basin, Texas LNG would dredge a total of approximately 3.9 million cubic yards. The maneuvering basin would be recessed into the shoreline on the Brownsville Ship Channel. The dredged area would have sidewalls sloped to a 3 to 1 ratio in order to match the sidewall slope of the Brownsville Ship Channel, as described in section 2.1.4. A total of 72.0 acres would be dredged, including 39.4 acres of tidal flats and 32.7 acres located in the deep water habitat between the property boundary and the northern edge of the Brownsville Ship Channel.

Dredging of the maneuvering basin would require permanent deepening of the tidal flats resulting in the conversion of shallow water habitat to deep water habitat. However, as discussed in section 4.4.1 above, the existing tidal flats in the Project area have been cut off from natural tidal exchanges. During a site visit with Texas LNG in October 2015, FWS observed that through the dredging of the maneuvering basin, a conduit for tidal exchange could be created, improving the surrounding tidal flat habitat into a higher functioning estuarine shallow water habitat.

In response to comments from the FWS, Texas LNG designed the Project facilities to minimize wetland impacts to the extent practicable. Of the 60.0 acres of PEM wetlands delineated within the Project site, only 1.1 acres would be permanently impacted. Similarly, 178.0 acres of tidal flats were delineated within the Project site; however, only 41.8 acres of tidal flats would be permanently impacted by the Project. Texas LNG would minimize impacts on surrounding wetlands and wetlands temporarily impacted during construction by adhering to measures outlined in its Project-specific ECP. Texas LNG's Project-specific ECP was developed in accordance with the FERC Procedures except where Texas LNG has requested deviations, as identified in section 4.4.3. In addition, Texas LNG has indicated that the hydrology of wetlands not directly impacted by the Project would be maintained through the use of culverts.

4.4.2.1 Mitigation Plan

As required by the CWA and in accordance with the COE Final Mitigation Rule (33 CFR 332), Texas LNG is proposing compensatory mitigation to offset unavoidable impacts on wetlands that would occur as a result of the proposed Project. As of the writing of this EIS, Texas LNG's Mitigation Plan is still under review by the COE; therefore, this section describes Texas LNG's preliminary Conceptual Mitigation Plan (provided in appendix C).

Texas LNG proposes to mitigate for the 42.9 acres of permanent wetland impacts that would occur as a result of the Project through preservation of 405 acres of tidal flats located within the Loma Ecological Preserve, approximately 0.8 mile south of the Project site (see figure 4.4.2-2). The Loma Ecological Preserve consists of 4,600 acres of tidal flat and upland

[20] The Brownsville Ship Channel is considered open water and is not classified as a wetland; impacts on the Brownsville Ship Channel are not captured in table 4.4.2-1

lomas that was leased by the BND to the FWS in 1983 to fulfill the BND’s compensatory mitigation requirement for a previous channel deepening project. The COE did not ultimately require compensatory mitigation for that project and as such, the lease expires in 2023, at which time the BND could choose to return the area to its developable land holdings for future development and maintenance of the Port of Brownsville (e.g., industrial development, expansion of dredge material placement areas, oil and gas exploration).

Texas LNG’s proposed 405 acres of preservation within the Loma Ecological Preserve would abut and extend the existing mitigation area that was used for compensatory mitigation required for the SpaceX Project. According to the COE, Texas LNG’s proposed mitigation area consists of a unique assemblage of high-quality wetlands. The natural tidal hydrology flows from South Bay and includes a network of tidal creeks and submerged aquatic vegetation and mangroves. The mitigation area also includes designated critical habitat (wintering) for the federally listed piping plover as well as EFH.

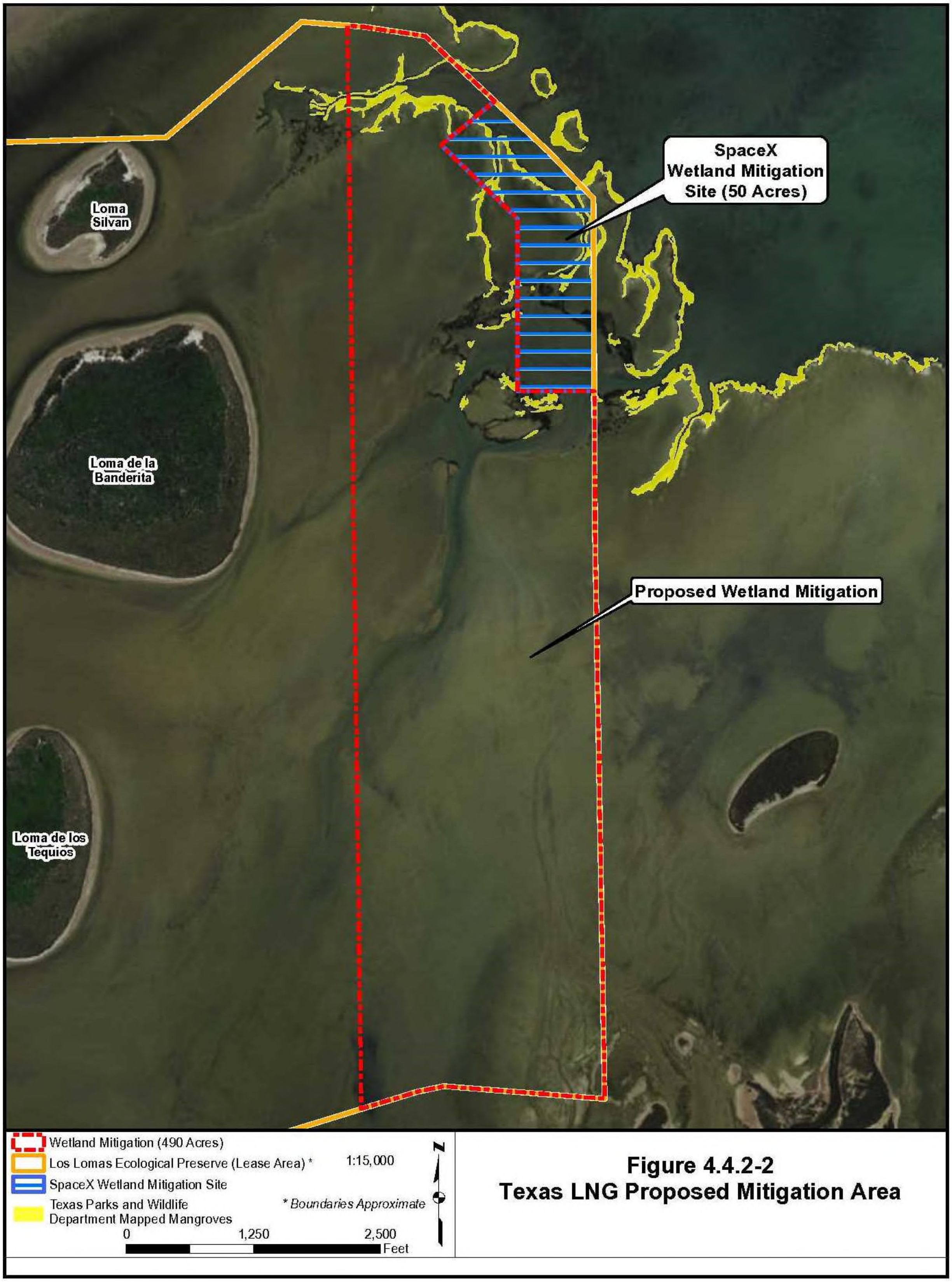

FIGURE 4.4.2-2 Texas LNG Proposed Mitigation Area

Texas LNG is developing its Mitigation Plan in coordination with COE (appendix C). In accordance with our recommendation 9 in section 5, Texas LNG is required to obtain all federal authorizations, or waver thereof, prior to construction. Further, because Texas LNG has minimized wetland impacts to the extent practicable, would maintain hydrologic connectivity for all wetlands not impacted, and would restore temporarily impacted wetlands in accordance with its ECP (which includes our Procedures), we conclude that impacts on wetlands would not be significant.

4.4.3 Alternative Measures to the FERC Procedures

Section VI.A.6 of the FERC Procedures states that aboveground facilities should be located outside of wetlands, except where such siting would prohibit compliance with DOT regulations. The Project would permanently convert 1.1 acres of PEM wetlands and 2.4 acres of tidal flats (excluding dredging impacts) to industrial land (see table 4.4.2-1); however, Texas LNG has sited the majority of Project facilities outside of the PEM wetlands present on the site. Due to the water dependency of the Project (access to a navigation channel for export) and the presence of tidal flats surrounding the Project site, impacts on tidal flats were determined to be unavoidable. Section 3.3 of this EIS provides an analysis of alternative Project sites and concludes that, when multiple factors are considered, alternative sites would not provide a significant environmental advantage. In addition, Texas LNG configured the proposed Project facilities within the Project site to impact the least amount of wetlands possible. Because the proposed alternative measures to Section VI.A.6 of the FERC Procedures are necessary due to land use requirements and limitations at the Project site, we have determined that the proposed deviation from the FERC Procedures is reasonably and adequately justified.

Section VI.B.1.a of our Procedures requires that all extra workspaces (e.g., staging areas and additional spoil storage areas) be at least 50 feet away from wetland boundaries, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. Portions of the temporary workspace associated with the Project are within 50 feet of wetlands or located within wetlands, as further identified in table 4.4.3-1 below. Table 4.4.3-1 also provides justification for siting of the temporary workspaces in proximity to wetlands as well as compliance measures that would be implemented to ensure minimization of impacts on wetlands.

TABLE 4.4.3-1

Wetlands Within 50 feet of Temporary Workspace at the Project Site

Facility [a]	Wetland ID	Wetland Classification	Distance from Temporary Workspace (feet)	Justification	Equal Compliance Measures
Phase 1 Temporary Workspace					
Temporary Construction Basin	MA003	E2US3P	0	Necessary for installation of three channel-side mooring dolphins.	
Jetty and Flarestack Laydown Areas	MB003	E2US3P	40		Sediment barriers, such as silt fence, to prevent

TABLE 4.4.3-1 Wetlands Within 50 feet of Temporary Workspace at the Project Site					
Facility [a]	Wetland ID	Wetland Classification	Distance from Temporary Workspace (feet)	Justification	Equal Compliance Measures
	MB002	E2US3P	40		offsite sedimentation and restoration of contours following construction.
LNG Carrier Berthing Dock	MA003	E2US3P	0	Necessary to ensure that equipment needed to construct the permanent facilities does not leave the approved workspace.	
	MB003	E2US3P	0		
Site Preparation Temporary Workspace	MA001	E2US3P	0	Necessary to ensure that equipment necessary to construct the permanent facilities does not leave the approved workspace.	
	MB001	E2US3P	0		
	MB003	E2US3P	0		
	WA002	PEM	0		
	WB002	PEM	0		
Phase 1 and 2 Temporary Workspaces					
Concrete Batch Plant	WA001	PEM	10	Unable to position these temporary facilities further from the wetland within the Project site.	Sediment barriers, such as silt fence, to prevent offsite sedimentation and restoration of contours following construction.
Warehouse and Workshops	MB001	E2US3P	25		Sediment barriers, such as silt fence, to prevent offsite sedimentation.
Contractor Offices	WB002	PEM	20		Sediment barriers, such as silt fence, to prevent offsite sedimentation.

[a] PEM = palustrine emergent; E2US3P = estuarine intertidal unconsolidated shore irregularly flooded (tidal flat)

As stated above, Texas LNG configured the Project facilities to minimize wetland impacts to the extent practicable. Further, Texas LNG would implement other best management practices outlined in our Procedures and as required to maintain compliance with the CWA to prevent materials from the extra workspace needed for laydown and topsoil storage from leaving the approved workspace and entering wetlands. Overall, through the implementation of mitigation measures outlined above, we have concluded that Project impacts on wetlands would not be significant.

4.5 VEGETATION

As part of the natural heritage classification program, the TPWD identified the broad natural regions of the state. Based on the natural heritage classification, the Project is proposed in Natural Region 4- Gulf Coast Prairies and Marshes, which is made up of 21,000 square miles of dunes and barrier islands, marshes and estuaries, and upland prairies and woods. Uniformly distributed rain patterns of the region, along with warm and humid temperatures allow the growing season to extend more than 300 days per year (Lyndon B. Johnson School of Public Affairs, 1978).

4.5.1 Existing Vegetation Resources

The TPWD, in cooperation with private, state, and federal partners, has developed a detailed land classification map known as the Ecological Systems Classification Project, which includes detailed descriptions of the ecological systems or vegetative communities present within Texas. Mapping of the ecological systems is based upon a combination of satellite imagery, SSURGO soils data, other parameters, and field verification (TPWD, 2010; TPWD, 2013). Texas LNG conducted a habitat assessment survey of the Project site to characterize and map vegetative communities using the TPWD defined Ecological Systems. Vegetation communities within PA 5A were determined based on aerial interpretation. Table 4.5.1-1 identifies the vegetative communities present within the Project site that would be affected by construction and operation of the Project.

Eight vegetative communities or habitat types were identified within the Project site (see figure 4.5.1-1) and PA 5A including tidal flat, salt and brackish high tidal marsh, sea ox-eye daisy flat, loma evergreen shrubland, salty prairie, barren, loma deciduous shrubland, and loma grassland Descriptions of each of these vegetation communities are provided in the following sections[21].

4.5.1.1 Loma Evergreen Shrubland

Loma evergreen shrublands consist of clay dunes (lomas) dominated by evergreen shrub species. On the proposed Project site, loma evergreen shrubland occurs in two areas on the eastern portion of the site that are separated by tidal flats and barren habitats. The larger of the two areas is known as Loma del Mesquite and is interspersed with loma deciduous shrublands and loma grassland habitats, as discussed below. The smaller of the two loma evergreen shrublands on the Project site is located on the Loma de la Draga and would not be impacted by Project construction. Loma evergreen shrubland within the site are primarily composed of dense, relatively short thornscrub that are intermixed with areas of open grassland. Dominant shrub species include granjeno, lotebush, negrito, and curly mesquite. The herbaceous layer is composed of Texas snakeweed, giant cutgrass, and mangle dulce. A total of 64.4 acres of loma evergreen shrublands would be impacted by construction of the Project, including 63.6 acres that would be permanently impacted during operation or would not be restored to preconstruction contours.

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21 The TPWD Ecological Systems Classification Project uses different parameters than the COE in defining wetlands (e.g., marsh, tidal flat); therefore, portions of the habitat mapped within the Project site as salt and brackish high tidal marsh and tidal flat do not necessarily meet the COE's definition of a wetland (Environmental Laboratory, 1987). As such, acreages presented for these habitat types are not comparable to wetland acreages presented elsewhere in this EIS.

4.5.1.1 Sea Ox-Eye Daisy Flat

Sea ox-eye daisy flats are irregularly flooded sites dominated by sea ox-eye daisies. Within the Project site, these areas consist of large areas of sea ox-eye daisies with glasswort and annual seepweed throughout. The majority of the sea ox-eye daisy flats within the proposed Project site are in the central portion of the site between salty prairie and salt and brackish high tidal marsh habitats. A total of 63.6 acres of sea ox-eye daisy flats would be impacted by construction of the Project, including 54.0 acres that would be permanently impacted during operation or would not be restored to preconstruction contours.

4.5.1.2 Tidal Flat

Tidal flats are composed of unvegetated to sparsely vegetated mud flats that are periodically inundated with water. Within the proposed Project site, tidal flats are in three areas along the north, south, and east boundaries. The tidal flat along the eastern portion of the Project site serves as the boundary between the Brownsville Ship Channel and the upland portion of the Project site. Inundation by tides within the Project site is limited, as further discussed in section 4.4; however, the tidal flats within the Project site are frequently inundated from storm surges and rain events. A total of 43.8 acres of tidal flats (as mapped and defined by TPWD) would be impacted by construction of the Project, including 42.0 acres that would be permanently impacted during operation or would not be restored to preconstruction contours.

4.5.1.3 Salt and Brackish High Tidal Marsh

Salt and brackish high tidal marsh consists of large areas dominated almost exclusively by cordgrasses that are irregularly flooded during high tide. The majority of this habitat type occurs within relatively large areas in the central portion of the proposed Project site, between loma and salty prairie habitats. It is not currently tidally influenced; although it may be occasionally flooded during storm events. A total of 35.7 acres of salt and brackish high tidal marsh would be impacted by construction of the Project, including 31.9 acres that would be permanently impacted during operation or would not be restored to preconstruction contours.

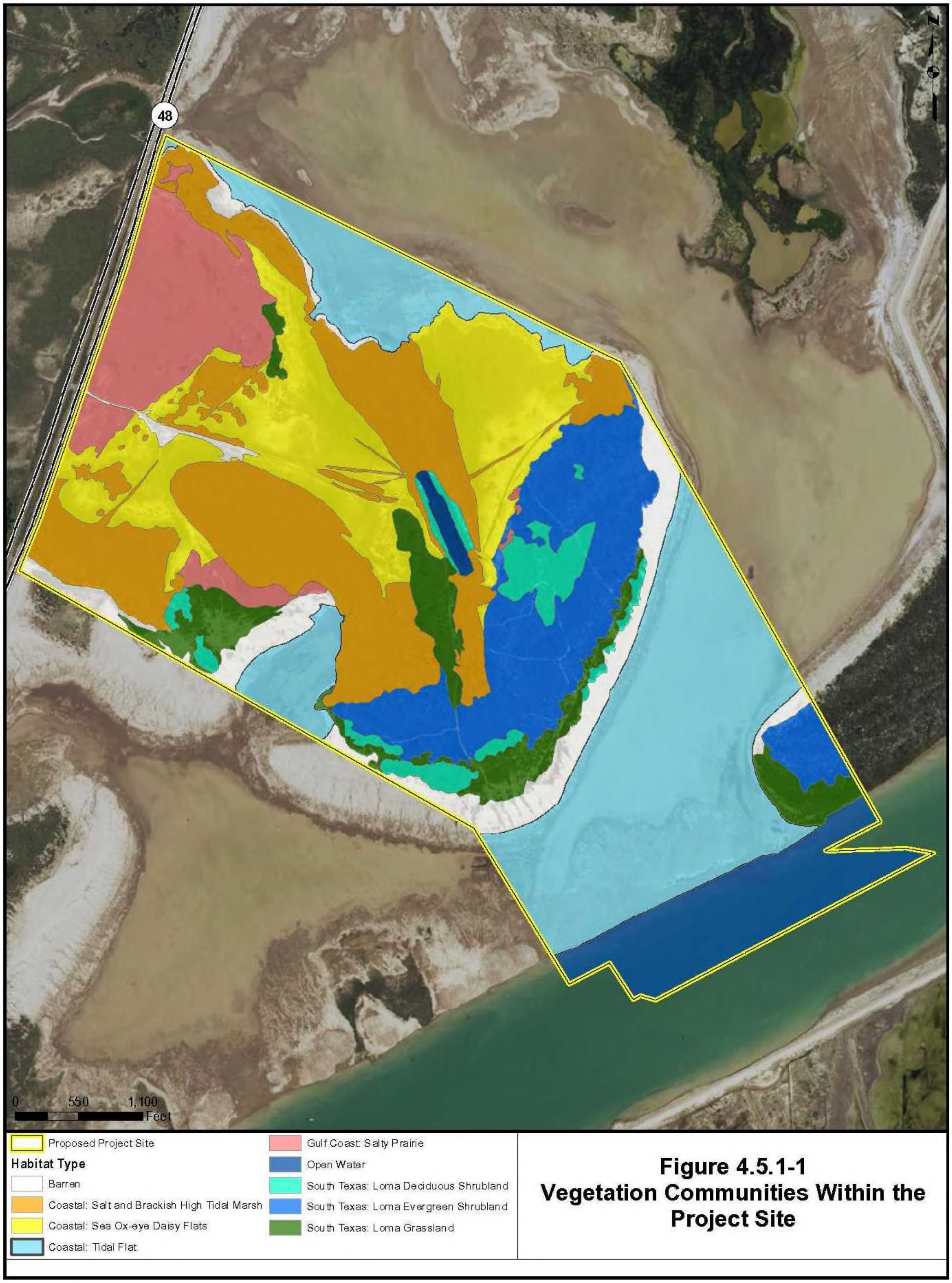

FIGURE 4.5.1-1 Vegetation Communities Within the Project Site

4.5.1.1 Loma Grassland

Loma grassland consists of clay dunes (lomas) dominated by grasses, often at the edges of shrublands. Within the proposed Project site, loma grassland habitat occurs in relatively small areas adjacent to the loma shrublands on the eastern third of the site, a small loma deciduous shrubland near the southwestern boundary of the site, and a small area of higher elevation in the northwestern portion of the site. Dominant grass species present include, shoregrass and giant cutgrass; although, Lindheimer pricklypear (also occurs throughout this vegetation community within the Project site. A total of 23.6 acres of loma grasslands would be impacted by construction of the Project, including 20.2 acres that would be permanently impacted during operation or would not be restored to preconstruction contours.

4.5.1.1 Loma Deciduous Shrubland

Loma deciduous shrublands consist of clay dunes (lomas) dominated by deciduous shrub species. On the proposed Project site, loma deciduous shrublands are located within and adjacent to loma evergreen shrublands in the eastern third of the site and within the loma grasslands near the southwestern boundary of the site. These areas are composed of a dense thicket of honey mesquite, Texas ebony, brasil, and colima with very little understory. A total of 15.4 acres of loma deciduous shrublands would be impacted by construction of the Project, including 14.7 acres that would be permanently impacted during operation or would not be restored to preconstruction contours.

4.5.1.2 Salty Prairie

Salty prairie habitat consists of nearly monotypic stands of cordgrass in coastal areas where soils are high in salinity. Within the proposed Project site salty prairie habitats are characterized primarily by cordgrass with areas of other grasses including switchgrass, shoregrass, and bushy bluestem in areas with higher elevation. Shrub encroachment is common throughout the salty prairie with honey mesquite and Spanish dagger dominating the shrub layer. The westernmost portion of the site is characterized by salty prairie habitat. A total of 16.7 acres of salty prairie would be impacted by construction of the Project, including 13.0 acres that would be permanently impacted during operation or would not be restored to preconstruction contours.

4.5.1.3 Barren Land

Barren land consists of unvegetated to sparsely vegetated sandy shorelines. Within the proposed Project site, barren land includes the windblown unvegetated slopes adjacent to the lomas on the eastern third of the Project site, as well as areas near the western entrance to the site that was previously cleared and not revegetated. A total of 14.5 acres of barren land would be impacted by the Project, including 9.9 acres of permanent impacts. In addition, all 704 acres of PA 5A are characterized as barren land.

4.5.1.4 Open Water

Open water is mapped by TPWD; however, it is unvegetated and thus not presented in table 4.5.1-1.

TABLE 4.5.1-1

Vegetation Communities Affected by Construction and Operation of the Texas LNG Project (in acres) [a, b]

Facility	Loma Evergreen Shrubland		Sea Ox-eye Daisy Flat		Tidal Flat		Salt and Brackish High Tidal Marsh		Loma Grassland		Loma Deciduous Shrubland		Salty Prairie		Barren		Total	
	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.
PERMANENT FACILITIES																		
Liquefaction Process Area and LNG Storage Tanks	53.9	53.9	40.9	40.9	1.2	1.2	26.1	26.1	15.4	15.4	10.9	10.9	1.6	1.6	6.6	6.6	156.6	156.6
Maneuvering Basin [c]	0.0	0.0	0.0	0.0	39.4	39.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.4	39.4
LNG Carrier Berthing Dock	0.0	0.0	0.0	0.0	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	1.5	1.5
Permanent Access Road	0.0	0.0	1.3	1.3	0.0	0.0	0.6	0.6	0.5	0.5	0.0	0.0	3.9	3.9	0.4	0.4	6.7	6.7
Non-jurisdictional Facilities within the Project Site [d]	0.0	0.0	1.2	1.2	0.0	0.0	2.1	2.1	0.1	0.1	0.0	0.0	7.5	7.5	0.4	0.4	11.4	11.4
Subtotal	**53.9**	**53.9**	**43.4**	**43.4**	**42.0**	**42.0**	**28.8**	**28.8**	**16.0**	**16.0**	**10.9**	**10.9**	**13.0**	**13.0**	**7.6**	**7.6**	**215.5**	**215.5**
TEMPORARY WORKSPACE AND LAYDOWN AREAS [e]																		
Phase 1 Only																		
Temporary Construction Basin	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
Jetty and Flarestack Laydown Areas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.2	<0.1	<0.1	0.0	0.0	2.5	<0.1	3.4	0.2
LNG Carrier Berthing Dock	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
Site Preparation Temporary Workspace	0.6	0.0	3.2	0.0	0.4	0.0	1.8	0.0	0.9	0.0	0.6	0.0	0.0	0.0	1.4	0.0	9.0	0.0
Borrow Areas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.3	0.3	0.0	0.0	1.1	1.1	2.0	2.0
Subtotal	**0.6**	**0.0**	**3.2**	**0.0**	**1.8**	**0.0**	**1.8**	**0.0**	**2.3**	**0.7**	**0.9**	**0.3**	**0.0**	**0.0**	**5.0**	**1.1**	**15.8**	**2.2**
Phases 1 and 2																		
Concrete Batch Plant	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.0	0.8	0.0	0.0	0.0	1.3	0.0	0.0	0.0	2.7	0.0
Warehouse and Workshops	2.7	2.7	8.3	8.3	0.0	0.0	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	12.8	12.8
Laydown Areas	7.0	7.0	0.0	0.0	0.0	0.0	0.8	0.8	1.4	1.4	3.2	3.2	0.0	0.0	0.6	0.6	12.9	12.9

TABLE 4.5.1-1

Vegetation Communities Affected by Construction and Operation of the Texas LNG Project (in acres) [a, b]

Facility	Loma Evergreen Shrubland Cons.	Loma Evergreen Shrubland Oper.	Sea Ox-eye Daisy Flat Cons.	Sea Ox-eye Daisy Flat Oper.	Tidal Flat Cons.	Tidal Flat Oper.	Salt and Brackish High Tidal Marsh Cons.	Salt and Brackish High Tidal Marsh Oper.	Loma Grassland Cons.	Loma Grassland Oper.	Loma Deciduous Shrubland Cons.	Loma Deciduous Shrubland Oper.	Salty Prairie Cons.	Salty Prairie Oper.	Barren Cons.	Barren Oper.	Total Cons.	Total Oper.
Contractor Offices	0.0	0.0	2.3	2.3	0.0	0.0	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5
Contractor Parking Lot	0.0	0.0	5.3	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.6	0.0	10.0	0.0
Crane Pad	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.0	0.0
Topsoil Storage Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	2.1	0.3	0.3	0.0	0.0	0.0	0.0	2.4	2.4
Temporary Access Road	0.0	0.0	0.6	0.0	0.0	0.0	<0.1	0.0	0.3	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.1	0.0
Subtotal	**9.9**	**9.7**	**17.0**	**10.6**	**0.0**	**0.0**	**5.1**	**3.1**	**5.3**	**3.5**	**3.6**	**3.5**	**3.7**	**0.0**	**1.9**	**1.3**	**46.4**	**31.6**
PROJECT SITE TOTAL	**64.4**	**63.6**	**63.6**	**54.0**	**43.8**	**42.0**	**35.7**	**31.9**	**23.6**	**20.2**	**15.4**	**14.7**	**16.7**	**13.0**	**14.5**	**9.9**	**263.2**	**249.3**
DREDGE MATERIAL PLACEMENT AREA																		
Placement Area 5A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	704.0	704.0	704.4	704.0

[a] Total construction impacts include both temporary and permanent work areas. Acreages have been rounded for presentation purposes; therefore, the totals may not equal the sum of the addends in all cases.

[b] Open water is not included due to lack of vegetation present (see section 4.5.1.9).

[c] Includes the acreage associated with the MOF.

[d] Includes the portions of the non-jurisdictional natural gas pipeline, electric transmission line, and potable water line located within the Project site.

[e] Impacts presented in the “Operation” column under “Temporary Workspace and Laydown Areas” represent areas used for construction in which contours would not be restored. Following construction in these areas, all temporary buildings and equipment would be removed and the area would be revegetated; however, contours would not be restored, resulting in a permanent impact.

4.5.2 Vegetation Impacts and Mitigation

As summarized in table 4.5.1-1, a total of 263.2 acres of vegetation would be cleared during construction of the Project. Following construction, approximately 249.3 acres would be converted to developed land or would not be restored to preconstruction contours, resulting in a permanent loss of 63.6 acres of loma evergreen shrublands, 54.0 acres of sea ox-eye daisy flats, 42.0 acres of tidal flats, 31.9 acres of salt and brackish high tidal marsh, 20.2 acres of loma grasslands, 14.7 acres of loma deciduous shrublands, 13.0 acres of salty prairie, and 9.9 acres of barren land. None of the vegetated open water areas (i.e., open water area within the center of the site, not including the Brownsville Ship Channel) would be impacted by the Project. Temporary workspace areas in which contours would not be restored may be revegetated; however, for the purposes of this EIS, impacts in these areas have not been distinguished and are thus, characterized as permanent. Overall, the Project would have the greatest impact on loma evergreen shrublands (64.4 acres) and sea ox-eye daisy flats (63.6 acres).

As discussed in section 4.2.3, revegetation of the Project area is anticipated to be difficult. Texas LNG would utilize topsoil stripped from areas with the highest potential for revegetation prior to grading activities, for use during restoration. Texas LNG developed a native seed mix best suited to the Project site conditions based on consultations with the NRCS and PMC. Native species that would be used for seeding include several grasses such as slender grama, whiplash pappusgrass, and pink pappusgrass; and a single forb species, creeping bundleflower.

Texas LNG's implementation of its ECP, which requires the use of temporary and permanent erosion control measures, revegetation procedures, and post-construction monitoring, would further minimize impacts on vegetation communities within and adjacent to the Project. Revegetation would be considered successful if upon visual survey, the density and cover of vegetation is similar to adjacent undisturbed lands. If revegetation is not immediately successful, Texas LNG would continue to monitor revegetation and may implement additional revegetation measures such as reseeding or over-seeding during optimal time periods, or performing soil testing to determine if additional soil amendments may be necessary. Due to the relatively undisturbed nature of the Project site, similarity of vegetation types in areas surrounding the Project site, and the low revegetation potential, we have determined that impacts on vegetation associated with the Project would be permanent and moderate, but not significant.

4.5.3 Exotic or Invasive Plant Communities and Noxious Weeds

Exotic plant communities, invasive species, and noxious weeds can out-compete and displace native plant species, thereby negatively altering the appearance, composition, and habitat value of affected areas. In accordance with the Plant Protection Act of 2000 (7 USC 7701), 19 plants have been federally designated as noxious weeds that could occur in Texas (United States Department of Agriculture, 2017), and 31 plants have been designated as a noxious weed by the State of Texas (TAC Title 4 Part 1 Chapter 19).

Field surveys of the Project site did not identify any state or federally designated noxious weeds; however, during a site visit the FWS noted that non-native buffelgrass and guineagrass is present on the Project site. Although not considered a noxious weed by the Texas Department of

Agriculture, buffelgrass and guineagrass can be invasive in areas where ground disturbing activities occur. Texas LNG would implement its Noxious Weed and Invasive Plant Plan to minimize the spread of these non-native species, which includes both methods to prevent introduction and spread of noxious weeds and invasive plants, as well as treatment for those plants already present on the Project site.[22]

To prevent the introduction of weeds and invasive plants to the Project site, Texas LNG would require that all construction equipment, including timber mats, be cleaned prior to arriving on site. In addition, as required by Texas Parks and Wildlife Code (Section 66 Part 71), any prohibited aquatic exotic plant that is attached to construction-related vessels, watercraft, or the equipment used to transport such vehicles would be removed prior to launching in the Brownsville Ship Channel or connected waters. Texas LNG would also implement best management practices in construction areas to minimize the time that bare soil is exposed, minimizing the opportunity for weeds or invasive plants to become established. In areas to be revegetated, Texas LNG would utilize certified invasive plant and weed-free, native seed mix developed through consultation with the local NRCS (see section 4.5.2). In addition, all imported fill and topsoil used in areas to be revegetated would be obtained from commercial sources and be free of weeds and invasive plants. Mulch or straw bales used for erosion control, would be similarly free of weeds and invasive plants.

Prior to clearing and grading operations, Texas LNG would pre-treat invasive plant communities within the Project site as necessary to aid in minimizing the spread of weeds and invasive plants during construction. The weed and invasive plant control measures implemented at these locations would include application of herbicide or mechanical measures, such as removal by hand or equipment and mowing to prevent seed maturity. Texas LNG may also utilize herbicides to reduce the size of weed and invasive plant populations. Texas LNG would acquire all necessary permits and authorization prior to use of herbicides and would adhere to the manufacturer's recommendations regarding herbicide application. In accordance with our Procedures and Texas LNG's Project-specific ECP, herbicides would not be used within 100 feet of wetlands or waterbodies. Based on these measures, we conclude that the Project would not contribute to the introduction or spread of exotic or invasive plant species.

4.5.4 Vegetation Communities of Special Concern

The Texas Conservation Action Plan, developed by TPWD identifies Species of Greatest Conservation Need as well as important habitats. Five rare plant communities identified in the Texas Conservation Action Plan are present on the Project site. Table 4.5.4-1 summarizes each of these plant communities.

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[22] The Noxious Weed and Invasive Plant Plan is publicly available on the FERC's website under Docket No. CP16-116-000 (Accession Number 20160331-5064).

TABLE 4.5.4-1 Rare Plant Communities Present on the Project Site		
Community	**Scientific Name**	**Description [a]**
Gutta-percha Mayten – Creeping Mesquite/Salt Meadow Cordgrass Herbaceous Vegetation	*Maytenus phyllanthoides – Prosopis reptans / Spartina patens*	Level upland community dominated by salt meadow cordgrass. Found a few feet above sea level along lomas on saline clay or loam soils.
Tamaulipan Maritime Shrubland	*Citharexylum berlandieri – Yucca treculeana – Ebenopsis ebano – Phaulothamnus spinescens*	Dry, subtropical shrubland found on clay dunes (lomas). Dominated by thorny evergreen shrubs. Plant composition is variable with no dominant species.
Tamaulipan Mesquite Brushland	*Prosopis glandulosa* var. *glandulosa / (Celtis pallida, Phaulothamnus spinescens, Ziziphus obtusifolia* var. *obtusifolia)*	Deciduous woodland found on non-saline soils in the Lower Rio Grande Valley. Open to closed canopy above a diverse shrub layer. Dominant canopy species include honey mesquite.
Texas Ebony – Snake Eyes Shrubland	*Ebenopsis ebano – Phaulothamnus spinescens*	Tall, thorny shrubs dominate this subtropical evergreen shrubland. Occurs on clay oils on river levees and resaca banks.
Texas Ebony Resaca Forest	*Ebenopsis ebano – Ehretia anacua / Condalia hookeri*	Evergreen, subtropical community occurring on well-drained soils of the Rio Grande River delta. Found on old river channels. May be periodically inundated.

[a] Source: Ecological Society of America, 2017

Each of the five rare plant communities identified in table 4.5.4-1 are associated with the loma habitats on the Project site. As indicated in table 4.5.1-1, the majority of Project impacts on the loma habitats present on the Project site would be permanent. Although, some areas that would be temporarily impacted during construction would be revegetated, as discussed in section 4.5.2, the rare plant communities documented on the site are unlikely to reestablish.

In addition to the rare plant communities identified above, Texas LNG also identified a lichen species (*Roccella gracilis*), never before documented along the Gulf Coast of Texas (Tehler, 2011) and lily of the loma (*Echeandia chandleri*), a flowering forb considered rare in Texas (Poole et al., 2010). Both species were found on the Loma del Mesquite, which would be permanently impacted by the Project. The lichen species was found growing on Texas goatbush (*Castella erecta*) in the dense thornscrub on the eastern side of Loma del Mesquite.

In a letter dated June 22, 2017, TPWD recommended that due to the rarity of the lily of the loma and TPWD's interest in preserving populations, TPWD would like to discuss the potential to coordinate seed/fruit collection from plants observed on the Project site. As of the writing of this EIS, these consultations have not occurred. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Texas LNG should file with the Secretary a plan for the collection of seed/fruit from rare plant species within the proposed Project site, developed in consultation with TPWD.**

While individuals of these species would be permanently removed, with implementation of Texas LNG's proposed ECS, the impacts would be limited to the Project site. Further, our recommendation to work with TPWD could help the continuation of these species. Therefore, we conclude that impacts would be permanent, but not significant.

4.6 WILDLIFE AND AQUATIC RESOURCES

4.6.1 Wildlife Resources

Wildlife species occurring in the vicinity of the Project site are characteristic of the habitats provided by the plant communities that occur in the area. Section 4.5.1 provides detailed information on the vegetation communities present in the vicinity of the Project. Habitat types were identified based on the Texas Ecological Systems Classifications and verified through Texas LNG's field surveys and aerial interpretation. Aquatic resources and protected wildlife species are discussed in sections 4.6.2 and 4.7, respectively.

4.6.1.1 Existing Wildlife Habitats

Wildlife habitat is more generally defined than the detailed vegetation communities presented in section 4.5.1 by cover type, and is based on field surveys conducted by Texas LNG. Wildlife habitat types presented in this section are synonymous with the land use types presented in section 4.8.1 and include open land, scrub shrub, wetlands/tidal flats, and open water. Due to the diversity of habitats present on the Project site, wildlife diversity is high. Typical wildlife species occurring within these habitat types that have been observed within the Project site are described below.

Open land (defined in this section as wildlife habitat consisting of uplands dominated by grasses and unvegetated barren land) comprises the majority (47 percent) of the wildlife habitat that would be impacted on the proposed Project site. Vegetation communities typical of open land on the Project site include loma grasslands and portions of the salty prairie that are not subject to shrub encroachment. Wildlife species typical of this habitat include Cassin's sparrow, crested caracara, turkey vulture, lesser nighthawk, northern bobwhite, horned lark, peregrine falcon, white-tailed hawk, northern aplomado falcon, barn swallow, loggerhead shrike, eastern meadowlark, mourning dove, coyote, eastern cottontail, nine-banded armadillo, Coastal Plain toad, six-lined racerunner, Texas indigo snake, and Texas horned lizard (NatureServe, 2016; Audubon Society, 2016; TPWD, 2018).

Scrub shrub within the proposed Project site comprises 28 percent of wildlife habitat impacts and is primarily associated with the lomas as well as portions of the salty prairie where shrub encroachment has occurred. Scrub shrub habitats within the Project site range in composition from the more open scrub shrub on the western part of the site associated with the salty prairie to the very dense scrub shrub characteristic of the loma evergreen shrublands and loma deciduous shrublands in the eastern part of the site. Wildlife species typical of scrub shrub habitat include olive sparrow, northern cardinal, common ground-dove, groove-billed ani, blue jay, golden-fronted woodpecker, northern mockingbird, common pauraque, clay-colored sparrow, long-billed thrasher, white-eyed vireo, bobcat, gray fox, ocelot, nilgai, nine-banded armadillo, Virginia opossum, Dekay's brown snake, eastern patch-nosed snake, eastern fence lizard, Texas spiny lizard, and Texas tortoise.

Tidal flats surround the upland areas of the proposed Project site out to the Brownsville Ship Channel and comprise 14 percent of Project impacts on wildlife habitat. Vegetation communities associated with tidal flats include sea ox-eye daisy flats, as well as the tidal flats described in section 4.5.1. Wildlife species typical of this area consist primarily of bird species including snowy plover, black-necked stilt, long-billed curlew, brown pelican, reddish egret, and western sandpiper.

Wetlands, as defined by the COE (see section 4.4) comprise less than 1 percent of the proposed Project impacts on wildlife habitat. Vegetation communities presented in section 4.5.1 that are at least partially within wetlands within the Project site include brackish and high tidal marsh. Wildlife species typical of wetlands in the Project area include great egret, mottled duck, sora, least grebe, raccoon, Rio Grande leopard frog, and western ribbon snake.

Open water habitat within the proposed Project site consists entirely of the Brownsville Ship Channel (11 percent of Project impacts on habitat). Open water habitats are those that are consistently submerged, unlike wetlands or tidal flats in which inundation may be variable and determined by such factors as tide and rainfall. Typical wildlife associated with open water habitat include several bird species, such as osprey, herring gull, laughing gull, and brown pelican, marine mammals, marine reptiles, and fish species (see additional discussion in sections 4.6.2 and 4.6.3).

4.6.1.2 Impacts and Mitigation

A total of 311.5 acres of wildlife habitat (including open water) would be affected by construction of the Project. Overall, the greatest impacts would be on open land (145.8 acres) and scrub shrub (86.7 acres) habitats (see table 4.8.1-1). Following construction, 282.0 acres of habitat would be permanently converted to industrial land, of which 39.4 acres would be permanently converted to open water habitat for the maneuvering basin. A total of 29.5 acres would be restored to preconstruction contours and revegetated. Open water habitat within the Brownsville Ship Channel would be retained; however, the Project would dredge the side slopes of the ship channel to the depth of the maneuvering basin (-43 feet MLLW).

In addition to the areas directly impacted by Project workspace, approximately 36 acres, including 7 acres of temporary workspace, would be indirectly impacted by exclusion fencing. This area, depicted on figure 2.1.2-1, primarily consists of emergent wetlands (hydrology would be maintained through culverts) and scrub shrub habitats. This area would continue to serve as habitat for aerial species and some smaller species; however, the fencing would prevent the continued use by most larger terrestrial wildlife species.

Impacts on wildlife from construction of the Project would include displacement, stress, and direct mortality of some less mobile species. Vegetation clearing would reduce suitable cover, nesting, and foraging habitat for some wildlife species. More mobile wildlife, such as birds and mammals may relocate to similar nearby habitats when construction activities commence. Smaller, less mobile wildlife, such as small mammals, reptiles, and amphibians, could be inadvertently injured or killed by construction equipment. Increased vehicle traffic along SH 48 may also result in the direct mortality of wildlife crossing the road. The permanent reduction in available habitat within the Project site as well as the influx of individuals to other nearby areas may increase population densities for certain species, resulting in increased intra- and inter-specific competition and reduced reproductive success of individuals.

The greatest impacts on terrestrial wildlife would result from the permanent loss of open land and scrub shrub habitats, which exhibit rich biodiversity within the Project site. The high biodiversity and complexity of vegetation communities make for valuable wildlife habitat. Construction and operation of the Project would also result in the permanent loss of 42.9 acres of PEM wetlands and tidal flats. As discussed in section 4.4, the tidal flats within the Project site are currently cut off from natural tidal exchange due to past dredging of the Brownsville Ship Channel. While construction and operation of the Project would result in the permanent conversion of tidal flats to industrial use or open water habitat, the dredging would likely allow tidal exchange within a larger area, restoring its natural function and improving wildlife habitat. Development within the Project site may also serve as a barrier for wildlife movement between habitats south of the Brownsville Ship Channel and habitat north of SH 48 within the Laguna Atascosa National Wildlife Refuge (NWR) (see section 4.6.1.3).

Operation of the Project would result in increased noise, lighting, and human activity that could disturb wildlife in the area. The Project site and surrounding area is primarily undeveloped (see discussion in section 4.8.1) with the nearest development over 1 mile from the proposed Project site in Port Isabel; therefore, wildlife in the area are likely not acclimated to human activity. However, due to the undeveloped nature of the surrounding area, there is abundant habitat available for wildlife displaced temporarily and permanently by construction and operation of the proposed Project.

To minimize Project-related impacts on wildlife, Texas LNG would implement its ECP as well as its SPAR Plan during construction and SPCC Plan during operation (see our recommendation and additional discussion in section 4.2.3). Texas LNG would also implement its Facility Lighting Plan, which would minimize impacts on nocturnal wildlife by utilizing down-facing lights with shielding to reduce the horizontal emission of light away from the intended areas, as well as timers and motion detection sensors, where feasible.[23] During construction and operation, Texas LNG would implement a training and awareness program for all personnel, which would include information regarding species life history and endangerment factors to wildlife, as well as the responsibility of personnel in preventing vehicular impacts (e.g., driving the speed limit, proper vehicle lighting). In addition, Texas LNG would inspect open trenches left overnight prior to commencing work to ensure no wildlife is trapped.

Based on the high diversity of wildlife species and habitat present at the Project site, the generally undeveloped nature of the surrounding area, and implementation of Texas LNG's proposed mitigation measures, we have determined that the Project would have minor impacts on wildlife in the area; however, these impacts would not be significant.

4.6.1.3 Unique and Sensitive Wildlife

Unique or sensitive wildlife resources, such as migratory birds and national wildlife refuges are present in the vicinity of the Project and are discussed below. Species protected under the ESA and state-listed endangered and threatened species regulations are discussed in section 4.7.

[23] Texas LNG's Facility Lighting Plan is available on eLibrary under Accession No. 20160511-5281.

Migratory Birds

Migratory birds follow broad routes called flyways between breeding grounds in the north and wintering grounds in the tropical regions of Mexico, Central and South America, and the Caribbean for the non-breeding season. Some species migrate from breeding areas in the north to the Gulf Coast for the non-breeding season. South Texas and the Gulf of Mexico are part of the Central Flyway, an important pathway for migratory birds, with many coastal and marine species using the coastlines of Louisiana and Texas during migration (FWS, 2018a; Central Flyway Council, 2018). The vegetation communities within the Project area provide potential habitat for a wide variety of migratory bird species including songbirds, waterbirds, and raptors. Additionally, Cameron County is an important recreational bird watching area. Migratory birds are federally protected under the MBTA. The MBTA (16 USC 703-711) as amended, implements protections for many native migratory game and non-game birds, with exceptions for the control of species that cause damage to agricultural or other interests. The MBTA prohibits the take of any migratory bird or their parts, nest, and eggs, where "take" means to "pursue, hunt, shoot, wound, kill, trap, capture, or collect." In addition to the MBTA, the BGEPA provides additional protection to bald and golden eagles. Non-breeding or wintering bald eagles could occur in the Project area because it provides suitable foraging habitat with abundant food sources of fish and waterfowl.

Executive Order 13186 (January 2001) requires all federal agencies undertaking activities that may negatively affect migratory birds to take a prescribed set of actions to further implement the MBTA, and directs federal agencies to develop a memorandum of understanding (MOU) with the FWS that promotes the conservation of migratory birds. FERC entered into a MOU with the FWS in March 2011. The focus of the MOU is on avoiding or minimizing adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between the two agencies.

Although all migratory birds are afforded protection under the MBTA, both Executive Order 13186 and the MOU require that Birds of Conservation Concern (BCC) and federally listed species be given priority when considering effects on migratory birds. BCCs are a subset of MBTA-protected species identified by FWS as those in the greatest need of additional conservation action to avoid future listing under the ESA. Executive Order 13186 states that emphasis should be placed on species of concern, priority habitats, key risk factors, and that particular focus should be given to addressing population-level impacts.

Bird Conservation Regions (BCR) are regions that encompass landscapes with similar bird communities, habitats, and resource management issues (FWS, 2008). BCRs were established to facilitate a regional approach to bird conservation and to identify overlapping or conflicting conservation priorities. The Project is proposed within BCR 37 – Gulf Coastal Prairie (FWS, 2008). Based on the FWS (2008) list for BCC in BCR 37, as well as review of the FWS Information for Planning and Consultation system, 43 BCC have potential to occur in the Project region. Table 4.6.1-1 identifies the BCC for the Project area and if each species breeds in the Project region (species that are listed in in the FWS [2008] BCC list for BCR 37 that do not occur within the Project region are not presented). For each of the species in table 4.6.1-1, the nesting habitat requirements and potential for these nesting habitats to occur on the Project site were examined. Of the 43 species with potential to occur in the Project area, 19 of those species have the potential to nest within the Project site from approximately February to September (Cornell Lab of Ornithology 2015; Audubon, 2016; FWS, 2008; 2018b).

Colonial waterbirds, a subset of migratory birds, include a large variety of bird species that share two common characteristics: 1) they tend to gather in large assemblies, called colonies or rookeries, during the nesting season; and 2) they obtain all or most of their food from the water (FWS, 2002).[24] However, no colonial waterbird rookeries have been identified at the Project site.

TABLE 4.6.1-1

Birds of Conservation Concern in the Vicinity of the Texas LNG Project Area

Common Name	Scientific Name	Colonial Water Bird	Breeds in Project Region	Nesting Habitat [a]		
				Ground	Shrub	Tree
American Oystercatcher	*Haematopus palliates*	-	X	X	o	o
American Bittern	*Botaurus lentiginosus*	-	-	-	-	-
Bald Eagle	*Haliaeetus leucocephalus*	-	X	o	o	X
Black Rail	*Laterallus jamaicensis*	-	-	-	-	-
Black Skimmer	*Rynchops niger*	X	X	X	o	o
Botteri's Sparrow	*Peucaea botteri*	-	X	X	o	o
Buff-breasted Sandpiper	*Calidris subruficollis*	-	-	-	-	-
Clapper Rail	*Rallus crepitans*	-	X	X	o	o
Dickcissel	*Spiza americana*	-	X	o	X	o
Dunlin	*Calidris alpine*	-	-	-	-	-
Grasshopper Sparrow	*Ammodramus savannarum*	-	-	-	-	-
Gull-billed Tern	*Gelochelidon nilotica*	X	X	X	o	o
Hudsonian Godwit	*Limosa haemastica*	-	-	-	-	-
LeConte's Sparrow	*Ammospiza leconteii*	-	-	-	-	-
Least Bittern	*Ixobrychus exilis*	-	X	X	o	o
Least Tern	*Sternella antillarum*	X	X	X	o	o
Lesser Yellowlegs	*Tringa flavipes*	-	-	-	-	-
Loggerhead Shrike	*Lanius ludovicianus*	-	X	o	o	X
Long-billed Curlew	*Numenius americanus*	-	-	-	-	-
Magnificent Frigatebird	*Fregata magnificens*	X	X	o	X	o
Marbled Godwit	*Limosa fedoa*	X	-	-	-	-
Mountain Plover	*Charadrius montanus*	-	-	-	-	-
Painted Bunting	*Passerina ciris*	-	X	o	X	o
Peregrine Falcon	*Falco peregrinus*	-	-	-	-	-
Prothonotary Warbler	*Protonotaria citrea*	-	-	-	-	-
Red Knot [b]	*Calidris canutus*	-	-	-	-	-
Reddish Egret	*Egretta rufescens*	X	X	-	-	X
Ruddy Turnstone	*Arenaria interpres*	-	-	-	-	-

[24] Colonial waterbirds demonstrate nest fidelity, meaning that they return to the same rookery year after year. Rookeries are typically established in marshes or near the shores of ponds or streams. Although some colonial waterbirds (e.g., least terns) will nest in developed areas, many waterbirds (e.g., great blue heron and great egrets) are wary of human activity.

TABLE 4.6.1-1						
Birds of Conservation Concern in the Vicinity of the Texas LNG Project Area						
Common Name	**Scientific Name**	**Colonial Water Bird**	**Breeds in Project Region**	**Nesting Habitat [a]**		
				Ground	**Shrub**	**Tree**
Sandwich Tern	*Thalasseus sandvicensis*	X	X	X	o	o
Seaside Sparrow	*Ammospiza maritima*	-	X	o	X	o
Sedge Wren	*Cistothorus platensis*	-	-	-	-	-
Semipalmated Sandpiper	*Calidris pusilla*	-	-	-	-	-
Short-billed Dowitcher	*Limnodromus griseus*	-	-	-	-	-
Short-eared Owl	*Asio flammeus*	-	-	-	-	-
Snowy Plover	*Charadrius nivosus*	X	X	X	o	o
Solitary Sandpiper	*Tringa solitaria*	-	-	-	-	-
Sprague's Pipit	*Anthus spragueii*	-	-	-	-	-
Swallow-tailed Kite	*Elanoides forficatus*	-	-	-	-	-
Upland Sandpiper	*Bartramia longicauda*	X	-	-	-	-
Whimbrel	*Numenius phaeopus*	-	-	-	-	-
White-tailed Hawk	*Geranoaetus albicaudatus*	-	X	o	o	X
Willet	*Tringa semipalmata*	X	X	X	o	o
Wilson's Plover	*Charadrius wilsonia*	X	X	X	o	o

Sources: FWS, 2008; 2018b; Cornell Lab of Ornithology, 2017; Audubon, 2016
Notes: "-" = not applicable; "o" = does not nest in habitat type
[a] Nesting habitat is only provided for those species that breed in the Project area.
[b] Species listed as threatened or endangered under the ESA are discussed further in section 4.7.

Impacts and Mitigation

The increased presence of humans, noise, lighting, and vibrations associated with Project activities would likely cause sensory disturbances of migratory birds. The resulting negative effects are expected to be primarily during construction of the LNG terminal facilities. Displacement and avoidance of the area are direct responses to sensory disturbances. Birds may be injured or suffer mortality as an indirect effect of fleeing an area of disturbance. Sensory disturbances to adults could also result in nest abandonment, affecting egg-laying and potentially causing the mortality of young. As such, sensory disturbance effects associated with these activities may affect individuals but would not likely have notable effects on any local populations of migratory birds. Permanent aboveground structures would create potential localized sensory disturbances for the operational life of the Project, and thus would have more permanent effects.

Impacts on migratory birds and their habitat due to construction and operation of the Project would typically be similar to impacts on general wildlife resources (see section 4.6.1.2). In addition, potential impacts specific to migratory birds include loss of habitat, impacts with structures, and injury or disorientation due to flaring and other artificial illumination. Alternatively, the FWS indicated during an October 2015 site visit with Texas LNG, that dredging of the maneuvering basin could open up the adjacent tidal flats to tidal exchange resulting in a beneficial impact on migratory bird habitat.

Construction of the Project would impact 311.5 acres of habitat, with operation resulting in the permanent loss of 282.0 acres, as further described in section 4.6.1.1. Project construction is a one-time, direct impact on the available nesting, foraging, and wintering habitat for migratory birds at the LNG terminal site. Texas LNG participated in a site visit with the FWS on September 16, 2015 in which impacts on migratory birds were discussed. During the site visit, the FWS indicated that ground-nesting birds such as snowy plover, killdeer, least tern, and American oystercatcher could be adversely affected during dredging activities and recommended that preconstruction surveys for nesting birds be conducted if dredging occurs during the breeding season.

Texas LNG completed a winter bird survey in March 2016, as requested by FWS. Several BCC and state-listed species (see section 4.7.2), including white-tailed hawk and reddish egret, were observed during these surveys.

Texas LNG developed a Migratory Bird Plan to assess potential impacts on migratory birds and describe mitigation measures it would implement to minimize these impacts.[25] To minimize impacts on nesting birds, Texas LNG would conduct all clearing, grading, and dredging activities outside of the primary nesting season of April 1 through July 15, as recommended by TPWD. If clearing, grading, and dredging is proposed during the primary nesting season, Texas LNG would conduct nesting surveys prior to commencing these activities. In accordance with the Migratory Bird Plan, bird nest surveys would be coordinated to allow completion of a survey for a portion of the Project site as close to the date construction crews are scheduled to begin clearing or grading of the area as feasible, and these surveys would be valid for seven days. If construction crews do not begin clearing within seven days of survey completion, resurvey would be required prior to construction activities.

If an active nest is discovered during surveys, clearing, or construction, work would stop in the immediate area around that location until the young have fledged or nests are abandoned. Migratory birds that are BCC would receive a nest buffer with a radius of 30 feet. Active nests identified during surveys would be monitored once per week until the young have fledged (anticipated to be mid-July or earlier in most instances) or the nest has failed, at which time the buffer would be lifted. Texas LNG has not provided documentation of review and comment of the Migratory Bird Plan by the FWS as of the writing of this EIS; however, in a June 22, 2017 letter, the TPWD recommended that a 30-foot buffer from active nests was not sufficient to ensure that nest abandonment would not occur and recommended that a 150-foot buffer be implemented. Further, the FWS recommends that vegetation removal and disturbance should be avoided during the primary nesting season of March 1 through August 31. Because Texas LNG has not yet addressed the FWS comment regarding the buffers and time of year to avoid construction, **we recommend that:**

- **<u>Prior to construction</u>, Texas LNG should consult with the FWS to develop a revised Migratory Bird Plan that addresses TPWD and FWS recommendations. Texas LNG should file with the Secretary the final Migratory Bird Plan and evidence of consultation with the FWS.**

[25] Texas LNG's Migratory Bird Plan is available on eLibrary under Accession No. 20160331-5064.

If wintering birds are present in the Project area during construction, they would be forced to relocate to nearby suitable habitat.

While no rookeries were identified within the Project site, the closest documented colonial wading bird rookery identified by the Texas Natural Diversity Database (TXNDD) (2015) is approximately 0.8 mile east of the proposed Project site on a tidal marsh/flat at the confluence of the Brownsville Ship Channel and the Port Isabel Channel. Due to the distance from the Project site and the location along an active ship channel, the Project is not anticipated to impact this rookery.

Bald eagles nest in large trees near coastlines, rivers, and lakes; however, there are no known nesting bald eagles in Cameron County. Nesting bald eagles in Texas occur primarily in the eastern half of the state and along counties from Rockport to Houston. Any bald eagles present in the Project area would likely be transient and acclimated to the widespread disturbance and human activity. Therefore, we conclude that construction and operation of the Project would have a minor impact on bald eagles.

During operation, permanent facility lighting necessary for safe operations would be installed. Glare from artificial lighting can affect foraging, migration, reproduction, communication, and other critical bird behaviors. Sometimes, artificial lighting may disorient birds used to navigating in dark environments. For example, songbirds can confuse lights on buildings and communication towers for stars that provide navigational cues during migration. This disorientation can lead to birds striking buildings and towers or colliding with one another, especially under foggy or overcast weather conditions (Evans and Ogden, 1996; Evans and Rosenberg, 1999). Conversely, increased illumination may extend diurnal or crepuscular behaviors into the nighttime by improving a bird's ability to orient itself (Longcore and Rich, 2004).

Potential impacts on migratory birds caused by facility lighting would be minimized through implementation of Texas LNG's Facility Lighting Plan. Texas LNG would utilize down-facing lights with shielding needed to meet regulatory standards and minimize illumination specifications. Facility lighting would be chosen and positioned to minimize the horizontal emission of light from intended areas, and shielding would help minimize impacts on birds and other wildlife while providing illumination needed to ensure safe operation of the facility. In addition, Texas LNG would utilize timers and motion detection sensors, where feasible.

In addition, bird collisions with Project infrastructure such as the communication tower, flares, LNG tanks, and powerlines may cause individual bird mortality during operation. The FWS (2016) developed *Guidelines for Recommendations on Communication Tower Siting, Construction, Operation, and Decommissioning*, which outlines recommended measures that project proponents may take to minimize potential impacts on migratory birds resulting from collisions with communication towers. In accordance with FWS recommendations, Texas LNG would construct a communication tower within the Project site using a lattice structure without guy wires. Further the communication tower would be less than 200 feet in height and would not require aviation safety lights.

For structures that are greater than 200 feet and require aviation safety lights in accordance with FAA regulations, Texas LNG would minimize potential impacts on migratory birds from collisions with structures at night by utilizing flashing lights rather than non-flashing lights. The FAA conducted a study which evaluated obstruction lighting arrangements in an effort to reduce avian fatalities due to tower strikes (Patterson, 2012). The conclusions of this study indicate that structures with non-flashing lights or a combination of flashing and non-flashing lights represent a greater risk of bird tower strikes than towers with only flashing lights installed. The study also concluded that towers with only flashing lights provided sufficient warning to passing aircraft of the obstruction.

The Project would include the installation of a 315-foot-high main flare and a 180-foot-high marine flare. The flares are used during start-up, shut-down, and non-routine venting of excess pressure. Operation of the flares is anticipated to be intermittent and limited to approximately one occasion per year (annual flaring events are anticipated to occur for 372 hours for the main flare and 264 hours for the marine flare), as further discussed in section 2.1.7. Further, start-up and maintenance events would be planned by Texas LNG to avoid inclement weather when the risk of bird mortalities from attraction to the flares would be highest. In addition, planned maintenance events would be primarily scheduled during the summer months, outside of the spring and fall migration periods, further minimizing potential impacts on migrating birds.

Texas LNG conducted visual simulations depicting anticipated nighttime lighting conditions at the Project site during operation (see detailed discussion in section 4.8.5). Based on our review of the visual simulations as well as the measures outlined in the Facility Lighting Plan, we have determined that the increase in nighttime lighting during construction and operation of the Project would not have a significant impact on migratory bird populations.

Based on the potential impacts on migratory bird habitat and the measures that Texas LNG would implement during construction and operation to minimize impacts on migratory birds in the area, including our recommendation, we have determined that construction of the Project would not have a significant impact on migratory bird populations.

National Wildlife Refuges and Preserves

One NWR and two wildlife preserves are within 1.0 mile of the proposed Project site. Impacts on wildlife within these areas are further discussed below.

<u>Laguna Atascosa National Wildlife Refuge</u>

The Bahia Grande Unit of the Laguna Atascosa NWR is across SH 48, approximately 200 feet from the Project site. Acquired by the FWS in 2000, the Bahia Grande Unit is considered one of the largest and most successful coastal wetland restoration projects in the U.S. Restoration activities are ongoing, but once complete the Bahia Grande Unit will consist of 10,000 acres of wetlands enhancing habitat for wildlife and fisheries. Several sensitive wildlife species are known to inhabit the Bahia Grande Unit including the federally listed ocelot and northern Aplomado falcon (see section 4.7.1).

Due to the proximity of the Project site to the NWR, wildlife within the NWR would likely be impacted by increased noise and light during both construction and operation. Further, wildlife displaced from the Project site during construction and operation could relocate to the NWR, increasing competition for resources. Further, development of the Project site could serve as a partial barrier and deterrent for wildlife movement between the Laguna Atascosa NWR and other protected habitats south of the Brownsville Ship Channel, such as the Lower Rio Grande Valley NWR, Loma Ecological Preserve, and South Bay Coastal Preserve (see section 4.8.4), potentially affecting gene flow by reducing mating opportunities for highly mobile species, such as the ocelot (see section 4.7.1).

Texas LNG modeled noise impacts at Laguna Atascosa NWR, the results of which are presented in section 4.11.2.3. The modeling concludes that noise impacts during construction of Phase 1 and construction of Phase 2 with operation of Phase 1 at the NWR boundary would increase ambient noise up to 6.0 decibels. During operation of both Phase 1 and Phase 2 there would be an increase of 1.0 decibel above ambient levels. Overall, noise levels would diminish as distance from the Project site increases. Elevated noise levels can have varying degrees of impact on wildlife, depending on the time of year, species present, and intensity and duration of the noise. The primary impact that noise would have on wildlife is displacement. While elevated noise levels associated with construction would be temporary, it would also be long-term (approximately five years, assuming overlapping construction of Phase 1 and Phase 2). Further, the increased noise levels associated with operation of both Phase 1 and Phase 2 would be permanent, although much lower than during construction, potentially resulting in the permanent relocation of some wildlife species. In addition, some species would become acclimated to the increased noise levels over time. Elevated noise levels during times of the year when some species are particularly vulnerable to noise, such as reproductive stages could cause individuals to alter their behavior in a way that interferes with these activities. Elevated noise levels may also result in physiological changes from stress or increased susceptibility to predation.

Impacts on wildlife in the NWR as a result of facility lighting would be similar to that discussed for migratory birds. Implementation of Texas LNG's Facility Lighting Plan, including the use of down-facing, shielded lights as well as timers and motion detection sensors, where feasible, would minimize potential impacts on wildlife within the NWR.

Based on the long-term, increased noise levels and traffic on SH 48 during construction, permanent increased noise levels during operation, and effects of facility lighting we have determined that the Project would have moderate impacts during construction and minor impacts during operation on wildlife within the Laguna Atascosa NWR; however, impacts would not be significant. Additional information regarding Project impacts on the Laguna Atascosa NWR is provided in section 4.8.4.1.

Loma Ecological Preserve

The Loma Ecological Preserve is on the western end of South Bay approximately 0.4 mile south of the proposed Project site. The Loma Ecological Preserve consists of 4,600 acres of tidal flats, lomas, and vegetated island ridges that are situated above tidal inundation areas. The Loma Ecological Preserve is owned by the BND and held under lease by the FWS until 2023 when the lease expires. The primary purpose of the Loma Ecological Preserve is wildlife habitat preservation. Due to proximity to the Project site, impacts on the Loma Ecological Preserve would be similar to those described above for the Laguna Atascosa NWR, but less pronounced. While Texas LNG did not model noise impacts within the Loma Ecological Preserve, it can be reasonably assumed that increased noise levels would be slightly reduced as compared to those reported for the Laguna Atascosa NWR due to the increased distance of the Loma Ecological Preserve from the primary noise generating equipment (approximately 0.2 mile further than the NWR); therefore, we have determined that impacts on wildlife within the Loma Ecological Preserve would be moderate, but not significant during construction and permanent, but minor during operation of the Project.

South Bay Coastal Preserve

The South Bay Coastal Preserve (SBCP), managed by TPWD and established in 1984, consists of approximately 3,500 acres bounded to the south by the Rio Grande riparian edge, to the north by the Brownsville Ship Channel and associated spoil banks, to the west by Loma Ecological Preserve, and to the east by Brazos Island. The SBCP is approximately 1.0 mile southeast of the Project site. Impacts on wildlife within the SBCP would be similar to those discussed for the Loma Ecological Preserve and Laguna Atascosa NWR, but less pronounced. The SBCP is used more frequently for recreation activities such as hunting and fishing than the Loma Ecological Preserve or Laguna Atascosa NWR and is the location of extensive commercial oyster landings. Due to the increased distance from the Project site and current human activities within the area, we have determined that the Project would not have a significant impact on the SBCP.

Pollinator Habitat

Pollinator species, including various birds, bats, bees, butterflies, moths, wasps, flies, and beetles carry pollen from one plant to another as they collect nectar. This process, known as pollination, is important in facilitating plant reproduction, including 75 percent of the most common human food crops. Pollinator populations appear to be declining, with a total of 30 native pollinators species (bees, butterflies, and moths) designated by TPWD as Species of Greatest Conservation Need in Texas. TPWD has developed the *Texas Monarch and Native Pollinator Conservation Plan* (2016a) to conserve habitat, educate the public and continue research and monitoring of native pollinator populations.

In addition, the June 20, 2014 Presidential Memorandum, *Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators*, states that "given the breadth, severity, and persistence of pollinator losses, it is critical to expand Federal efforts and take new steps to reverse pollinator losses and help restore populations to healthy levels." In response to the Presidential Memorandum, the federal Pollinator Health Task Force published a *National Strategy to Promote the Health of Honey Bees and Other Pollinators* in May 2015. This strategy outlines a process to increase and improve pollinator habitat.

The proposed Project would result in removal of 263.2 acres of potential pollinator habitat (vegetation), of which 249.3 acres would be permanently converted to industrial uses during operation. As discussed in sections 4.2.3 and 4.5.2, revegetation of the Project area is anticipated to be difficult due to the saline soils and arid conditions. Consistent with the federal guidance outlined above as well as the TPWD *Management Recommendations for Native Insect Pollinators in Texas* (2016b), Texas LNG stated that it would further consult with the NRCS and PMC to identify potential native species to add to the proposed seed mix (see section 4.5.2) that would benefit pollinator species. Therefore, we conclude that impacts on pollinator species would be minimized within the temporary workspace; however, the Project would result in the permanent loss of pollinator habitat during operation of the Project. Due to the amount of potential pollinator habitat that would be permanently impacted by the Project (249.3 acres; however, much of that habitat has limited vegetative growth) in relation to the abundant habitat adjacent to the Project site, we have determined that impacts on pollinator habitat would not be significant.

4.6.2 Aquatic Resources

4.6.2.1 Existing Aquatic Resources

Habitat for aquatic resources present within the Project site includes the tidal flats present on site as well as the Brownsville Ship Channel. As discussed in greater detail in section 4.3.2, the Brownsville Ship Channel is affected by saltwater inflow from the Gulf of Mexico tides and limited freshwater inflows. In general, freshwater inflows to the Lower Laguna Madre are concentrated primarily at the Brownsville Ship Channel via channelized floodways that carry overflow from the Rio Grande basin, Nueces-Rio Grande coastal basin, and Arroyo Colorado. Because evaporation exceeds the sum of freshwater inflows and precipitation on the Lower Laguna Madre, at times salinities in some areas exceed that of seawater (Texas Department of Water Resources, 1983). In addition, low tidal exchange and periodic low water velocities result in low dissolved oxygen in some areas. The tidal flats surrounding the upland portion of the Project site have been effectively cut off from natural tidal exchange except during extreme high tides and storm surges, as a result of the deposition of displaced dredge material along the channel in what was historically shallow open water. Therefore, the Project area consists of tidal estuarine, often hypersaline, environments providing habitat to support warmwater and coolwater species (depending on seasonal temperatures in the Gulf of Mexico), as well as estuarine and saltwater species.

The Brownsville Ship Channel is considered a saltwater fishery by the TPWD (2014) and has been designated for exceptional aquatic life use by TCEQ. This designated use indicates that there is outstanding natural variability in habitats, the species assemblage is exceptional or unusual, there are abundant sensitive species, diversity and species richness are exceptionally high, and the trophic structure is balanced (TAC 30:307). Water depth within the Project area ranges from 0 feet at the shoreline to approximately -42 feet within the navigation channel and substrates are composed mainly of clay and silt. Unconsolidated sediments within the Brownsville Ship Channel provide foraging habitat for benthic organisms and fish and are designated as EFH for red drum, shrimp, reef fish, highly migratory species, and coastal migratory pelagic species (see discussion in section 4.6.3).

Open water areas less than 6 feet deep typically have sufficient light penetration to support a diverse assemblage of organisms, nursery areas, and seagrass beds. Small areas of seagrass habitat are present approximately 2.0 miles northeast of the Project site along the northern shoreline of the Brownsville Ship Channel with larger areas of seagrass present adjacent to the Intracoastal Waterway in the Laguna Madre and near the South Bay (see figure 4.6.2-1 for the location of seagrass beds relative to the Project site) (TPWD, 2017a). However, no seagrass occurs at the proposed Project site. Due to the lack of tidal exchange and high evaporation rates, the tidal flats within the Project area do not provide functioning habitat for many aquatic species that may otherwise be found in higher quality habitats in the area, including fish species managed under the MSA (see discussion in section 4.6.3).

FIGURE 4.6.2-1 Seagrass Mapped within the Project Area

Table 4.6.2-1 lists representative fish species found in the vicinity of the Project including the Brownsville Ship Channel and the South Bay. The South Bay is a very shallow bay connected to the Brownsville Ship Channel via the South Bay Pass, approximately 1 mile southeast of the proposed Project site. The South Bay supports extensive seagrass beds and stands of black mangroves, as well as the only significant population of eastern oysters south of Corpus Christi Bay (TPWD, 2015a).

There are extensive commercial and recreational fisheries within the Project area. Commercial fisheries in the area include eastern oysters, as described above, as well as penaeid shrimp. The penaeid shrimp fishery is comprised of three shrimp species: brown shrimp, pink shrimp, and white shrimp (TPWD, 2002). For commercial shrimping purposes, the lower Laguna Madre, including the Brownsville Ship Channel, is considered a Bait Bay, where a boat licensed as a commercial bait shrimp boat is used inside waters of the state for taking bait shrimp for pay, barter, sale, or exchange. Specifically identified Bait Bays, including the Brownsville Ship Channel are not considered nursery areas that serve as significant growth and development environments for post larval and juvenile shrimp, and commercial shrimping is permitted year-round (TPWD, 2017b). Other recreationally and commercially harvested fish species are identified in table 4.6.2-1. Recreational fishing is further discussed in section 4.8.4.

TABLE 4.6.2-1

Representative Fish Species Potentially Occurring in the Vicinity of the Project

Common Name	Scientific Name
Common snook	*Centropomus undecimalis*
Fat snook	*Centropomus parallelus*
Mangrove snapper	*Lutjanus griseus*
Tarpon	*Megalops atlanticus*
Jack crevalle	*Caranx hippos*
Ladyfish	*Elops saurus*
Spanish mackerel	*Scomberomorus maculatus*
Kingfish	*Menticirrhus* spp.
Speckled trout [a]	*Cynoscion nebulosus*
Red drum [a]	*Sciaenops ocellatu*
Southern flounder [a]	*Paralichthys lethostigma*
Barracuda	*Sphyraena* spp.
Atlantic croaker [a]	*Micropogonias undulatus*
Black drum [a]	*Pogonias cromis*
Blacktip shark [a]	*Carcharhinus limbatus*
Bull shark [a]	*Carcharhinus leucas*
Sheepshead [a]	*Archosargus probatocephalus*
Sand trout [a]	*Cynoscion arenarius*

[a] Commercial and/or recreational species.

Exotic and invasive fish species pose a threat to Texas waterways. Non-indigenous species may be introduced through numerous pathways of dispersal (e.g., aquaculture, aquarium trade, ballast water discharges, fish stocking), with intentional stocking of freshwater species for sport being a major pathway for fish introductions (Commission for Environmental Cooperation, 2011). Currently, one of the largest marine threats in Texas is the lionfish, which reached Texas waters in 2011; although to date, they are rare in the western Gulf of Mexico (Texas Invasive Plant and Pest Council, 2011). Additional invasive fish species that may be present in the Project area include European eel and salt tolerant tilapia. Invasive species associated with ballast water discharges are discussed in section 4.6.2.2.

4.6.2.2 Impacts and Mitigation

Potential impacts on aquatic resources during construction and operation of the Project include those associated with dredging, pile driving, hydrostatic testing, vessel traffic, stormwater runoff, lighting, industrial process water, firewater systems, and inadvertent spills.

Dredging

The LNG carrier berthing dock and maneuvering basin would be recessed into the Project site shoreline on the Brownsville Ship Channel. To construct the maneuvering basin, tidal flats and deepwater habitat consisting of 72.0 acres would be dredged. An additional 1.5 acres would be dredged for construction of the LNG carrier berthing dock (see section 4.3.2.3). As described in section 2.5.4.21, dredging would remove approximately 3.9 million cubic yards of sediments over 11 months using a hydraulic cutterhead dredge. Dredge material would be transported by a temporary pipeline to PA 5A for disposal. Potential impacts on aquatic resources resulting from dredging activities include direct take and habitat modification, as well as temporary increases in noise, turbidity, and sedimentation, which are described below.

Dredging of the maneuvering basin would result in the permanent conversion of 39.4 acres of tidal flats to open water habitat. As discussed in sections 4.4.1 and 4.6.1, tidal flats within the Project area have been cut off from the influences of natural tidal exchange, reducing the overall habitat quality for aquatic resources. The tidal flats within the Project site are part of a larger complex of tidal flats that extend south, east, and north of the Project site and are similarly cut off from natural tidal exchange. During an October 2015 site visit with Texas LNG, the FWS indicated that dredging of the maneuvering basin could open up tidal exchange to the surrounding areas, effectively enhancing the existing tidal flat habitat and restoring function, provided that the slope protection that Texas LNG installs within the maneuvering basin is below tide levels and does not create a barrier for tidal exchange. As suggested by the FWS, Texas LNG designed its slope protection to allow tidal exchange in the surrounding tidal flats following the completion of dredging activities by not extending above MLLW. While dredging of the maneuvering basin would result in the permanent conversion of tidal flats to open water habitat, it would result in beneficial impacts on surrounding tidal flats by restoring natural tidal exchange.

In addition, the Project would result in the permanent conversion of shallow-water habitat (open water less than 6 feet deep) to deep water habitat. Approximately 17.3 acres of open water habitat less than 6 feet deep will be permanently deepened by dredging of the maneuvering basin. An additional 0.8 acre of open water habitat less than 6 feet deep would be temporarily impacted by dredging of the temporary construction basin. Texas LNG estimates that approximately 2.2 acres of open water habitat less than 6 feet deep would be created along the top edge of the maneuvering basin side-walls on a 3 to 1 slope. Of these 2.2 acres, approximately 0.3 acres would consist of existing substrate within the Brownsville Ship Channel, with the remaining 1.9 acres consisting of rock rip-rap.

Most fish species are highly mobile and would be expected to leave the area during dredging activities. Dredging would, however, result in direct mortality of benthic species such as aquatic macroinvertebrates, mollusks, and crustaceans, which are an important food source for many fish species. Slower, less mobile benthic organisms would likely be directly affected, while larger, more mobile species (e.g., blue crab) would experience temporary displacement. Following dredging activities, aquatic resources would be expected to return to the maneuvering basin, which would provide habitat similar to the adjacent Brownsville Ship Channel. However, shallow-water species utilizing the Project area prior to construction would be permanently displaced from the deepwater habitats created by dredging the maneuvering basin.

Dredging activities would also temporarily increase noise, turbidity, and sedimentation within the water column, which could reduce light penetration and the corresponding primary production of aquatic algae and phytoplankton. Increased turbidity and sedimentation could also adversely affect fish eggs and juvenile fish survival, benthic community diversity and health, foraging success, and suitability of spawning habitat. Further, sediments in the water column could be deposited on nearby substrates, burying aquatic macroinvertebrates. Impacts on aquatic resources due to increased turbidity and sedimentation would vary by species. Texas LNG performed acoustical modeling and analysis of potential underwater sound levels due to hydraulic dredging. The underwater noise thresholds for injury and behavioral disturbance for fish are the same as those described for pile driving in the following section. Based on the estimates of underwater sound that would occur during dredging, behavioral disturbance of fish would occur within 96 feet of the dredge and injury would occur within 89 feet (see table 4.6.2-3).

To minimize impacts on aquatic resources due to increased turbidity and sedimentation, Texas LNG would use a hydraulic cutterhead suction dredge (see discussion in section 4.3.2.3). Because excavated material would be suctioned into a pipeline, resuspension of sediments and the associated increase in turbidity and sedimentation would be minimized. Therefore we have determined that impacts on aquatic resources due to temporary increases in noise, turbidity, and sedimentation levels would be localized and not significant.

Texas LNG would conduct maintenance dredging of the maneuvering basin every 3 to 5 years during operation and would remove an estimated 300,000 to 500,000 cubic yards of dredge material during each cycle. Maintenance material would be placed in an approved placement area in accordance with all applicable authorizations from the BND and COE, as necessary. Potential impacts on aquatic resources from maintenance dredging would be similar to those described for initial dredging of the maneuvering basin; however, these impacts would be shorter in duration due to the reduced amount of material being removed from the maneuvering basin. Therefore, we conclude that maintenance dredging would have temporary and minor impacts on aquatic resources.

Pile Driving

Construction of the Project would require the installation of piles to support the proposed structures. As discussed in section 2.5.4.1, pile driving activities would take place 10 hours per day, six days per week. Onshore pile driving would be conducted over approximately 13 months. Driving piles in aquatic environments creates sound waves that can adversely impact marine life. Most piles associated with construction of the LNG carrier dock and all of the MOF would be installed prior to dredging the maneuvering basin to reduce potential acoustic impacts on aquatic resources; however, 12, 48-inch-diameter steel piles associated with the three southernmost mooring dolphins located closest to the Brownsville Ship Channel would be installed in-water over an anticipated total of 12 days. Marine piles would be driven by vibratory pile drivers and finished with impact pile drivers, which may include both land-based and floating rigs.

Studies have shown that the sound waves from pile driving may result in injury or trauma to fish, sea turtles, and other animals with gas-filled cavities such as swim bladders, lungs, sinuses, and hearing structures (Abbott and Bing-Sawyer, 2002; Popper et al., 2009). Underwater sound pressure levels generated by pile driving could affect sea turtles, fish, and marine mammals by causing decreased auditory sensitivity, loss of hearing, behavioral changes (primarily avoidance which can increase energy expenditure and thus reduce fitness), or by masking acoustic cues that are important for evading predators or anthropogenic hazards (e.g., vessels, fishing equipment).

Potential impact thresholds for fish were determined using a spreadsheet that was developed by NMFS as a tool for assessing the potential effect on fish exposed to elevated levels of underwater sound produced during pile driving (Stadlar and Woodbury, 2009), as well as the California Department of Transportation's *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* (ICF Jones and Stokes, 2012). Together, these guidance documents establish pressure thresholds for injury and behavioral disturbance for fish during pile driving activities. The principles of underwater sound are further described in section 4.11.2.3. NMFS uses 150 decibels (dB) referenced to 1 micro Pascal (re 1 μPa) as the threshold for behavioral effects on fish species citing that noise levels in excess of 150 dB re 1 μPa can cause temporary behavior changes (startle and stress) that could decrease a fish's ability to avoid predators (NMFS, 2018). Table 4.6.2-2 identifies the underwater sound thresholds for the onset of injury in fish.

TABLE 4.6.2-2

Underwater Sound Thresholds for Fish

Functional Hearing Group	Underwater Sound Thresholds [b]	
	Behavior Disturbance Threshold	Injury Threshold
Fish ≥ 2 grams [a]	150 dB RMS	187 dB SEL_{cum}
Fish < 2 grams [a]	150 dB RMS	183 dB SEL_{cum}
Fish All sizes [a]	150 dB RMS	206 dB Peak

TABLE 4.6.2-2 Underwater Sound Thresholds for Fish		
Functional Hearing Group	Underwater Sound Thresholds [b]	
	Behavior Disturbance Threshold	Injury Threshold

[a] From California Department of Transportation's *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* (ICF Jones and Stokes, 2012).
[b] dB = decibel
Peak = peak sound pressure
RMS = root mean-square sound pressure
SEL_{cum} = cumulative sound exposure level

The intensity of the sound pressure levels produced during pile driving depends on a variety of factors such as the type and size of the pile, the substrate into which the pile is being driven, the depth of water, and the type of pile driving equipment that is being used. In discussing the impacts of sound on aquatic resources, it is important to note the difference in sound intensity in air versus water. Sound in water and sound in air are both waves that move similarly and can be characterized the same way; however, the differences in density and sound speed (the speed at which the sound wave travels through the medium, in this case air or water) result in a different reference pressure in air than in water.

The thresholds presented in table 4.6.2-2 would be exceeded unless mitigation measures are implemented. Therefore, Texas LNG would implement the following measures to minimize impacts on aquatic resources during pile driving:

- conducting the majority of pile driving for the LNG carrier berthing dock in the tidal flats prior to dredging the maneuvering basin;
- use of soft starts, gradually increasing the intensity of pile driving activities, to allow marine life to leave the area;
- use of vibratory piles for the majority of in-water pile driving with impact drivers used to complete pile installation;
- pile drivers would minimize impact energy to the extent feasible in order to lower underwater sound pressure levels; and
- use of cushion blocks, consisting of wood, nylon, conbest, or mircata between the pile and the hammer or bubble curtains, to minimize the noise generated while driving the pile.

Texas LNG estimated the sound pressures for in-water pile driving of the proposed 48-inch-diameter steel piles by averaging the known values for 36-inch-diameter and 60-inch-diameter piles. The maximum anticipated distances to the behavior and injury thresholds for fish during in-water pile driving are presented in table 4.6.2-3 and were calculated based on the implementation of the mitigation measures identified above, including use of cushion blocks or bubble curtains. In addition to pile driving, dredging activities would also result in increased underwater noise, as indicated in section 4.6.2.2, *Dredging*. Hydraulic cutterhead dredges typically have a sound pressure level at 1 meter ranging from 172 dB to 185 dB re 1 μPa (Central

Dredging Association, 2011). For the purposes of this analysis, we assumed that a cutterhead dredge operating in the soft substrates characteristic of the Project site, would have a sound pressure level of 172 dB re 1 µPa at 1 meter. Figures 4.6.2-2 and 4.6.2-3 depicts the distances to behavioral disturbance thresholds for fish, marine mammals (cetaceans), and sea turtles as a result of pile driving and dredging, respectively.

TABLE 4.6.2-3

Calculated Distances to Underwater Noise Thresholds from Dredging and Mitigated In-water Pile Driving for the Texas LNG Project

Activity	Marine Fauna	Distance from Source in which Threshold would be Exceeded [a]		
		Injury due to Peak Pressure	Injury due to Accumulated Sound Exposure (SEL_{cum})	Behavioral Disturbance (RMS)
Impact pile driving	Fish ≥ 2 grams	13 feet	1,221 feet	7,065 feet
	Fish < 2 grams		1,522 feet	
Vibratory pile driving	Fish ≥ 2 grams	< 1 foot	127 feet	328 feet
	Fish < 2 grams		772 feet	
Dredging	Fish ≥ 2 grams	N/A	48 feet	96 feet
	Fish < 2 grams		89 feet	

[a] Peak = peak sound pressure
RMS = root mean-square sound pressure
SEL_{cum} = cumulative sound exposure level

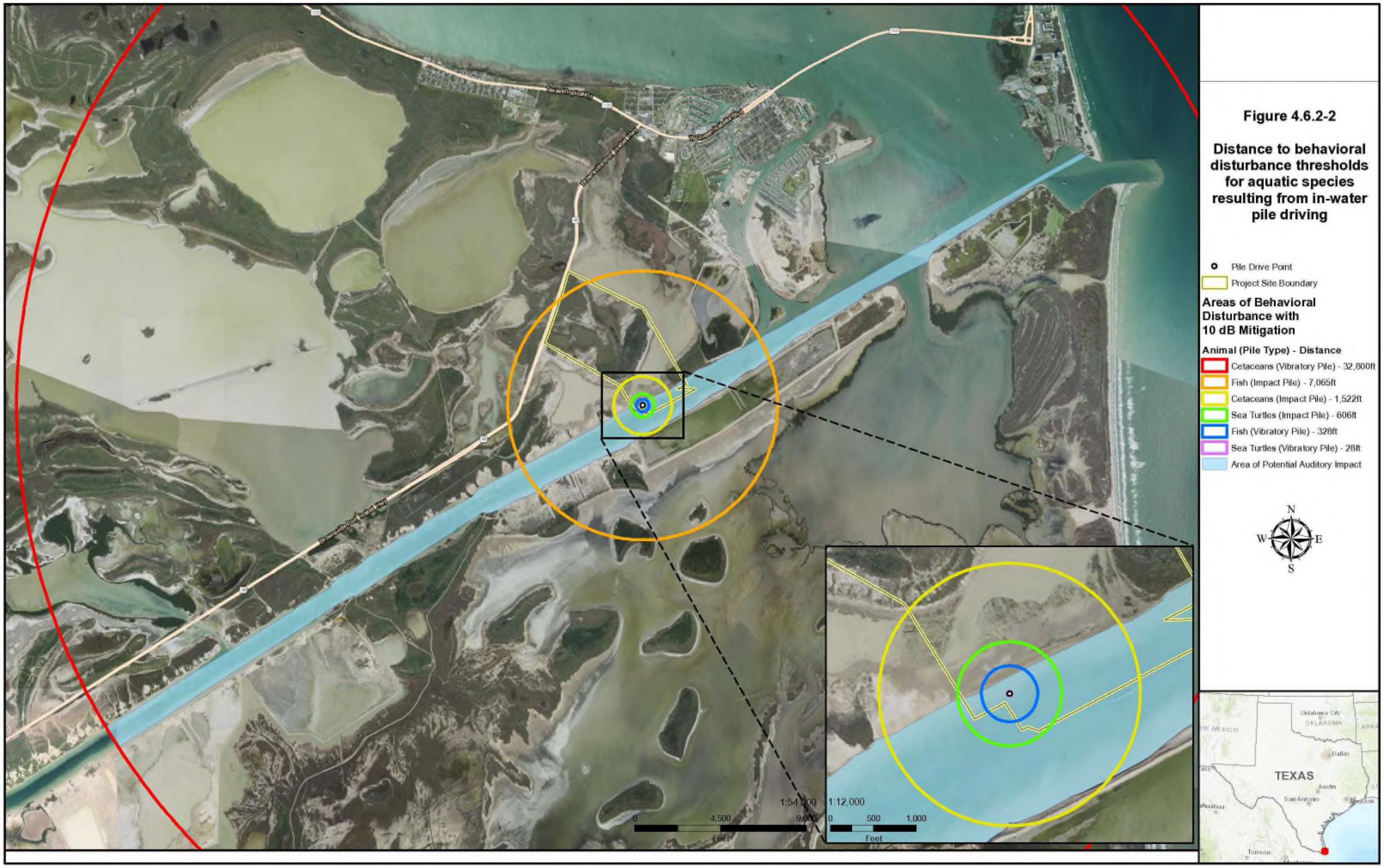

FIGURE 4.6.2-2 **Distance to behavioral disturbance thresholds for aquatic species resulting from in-water pile driving.**

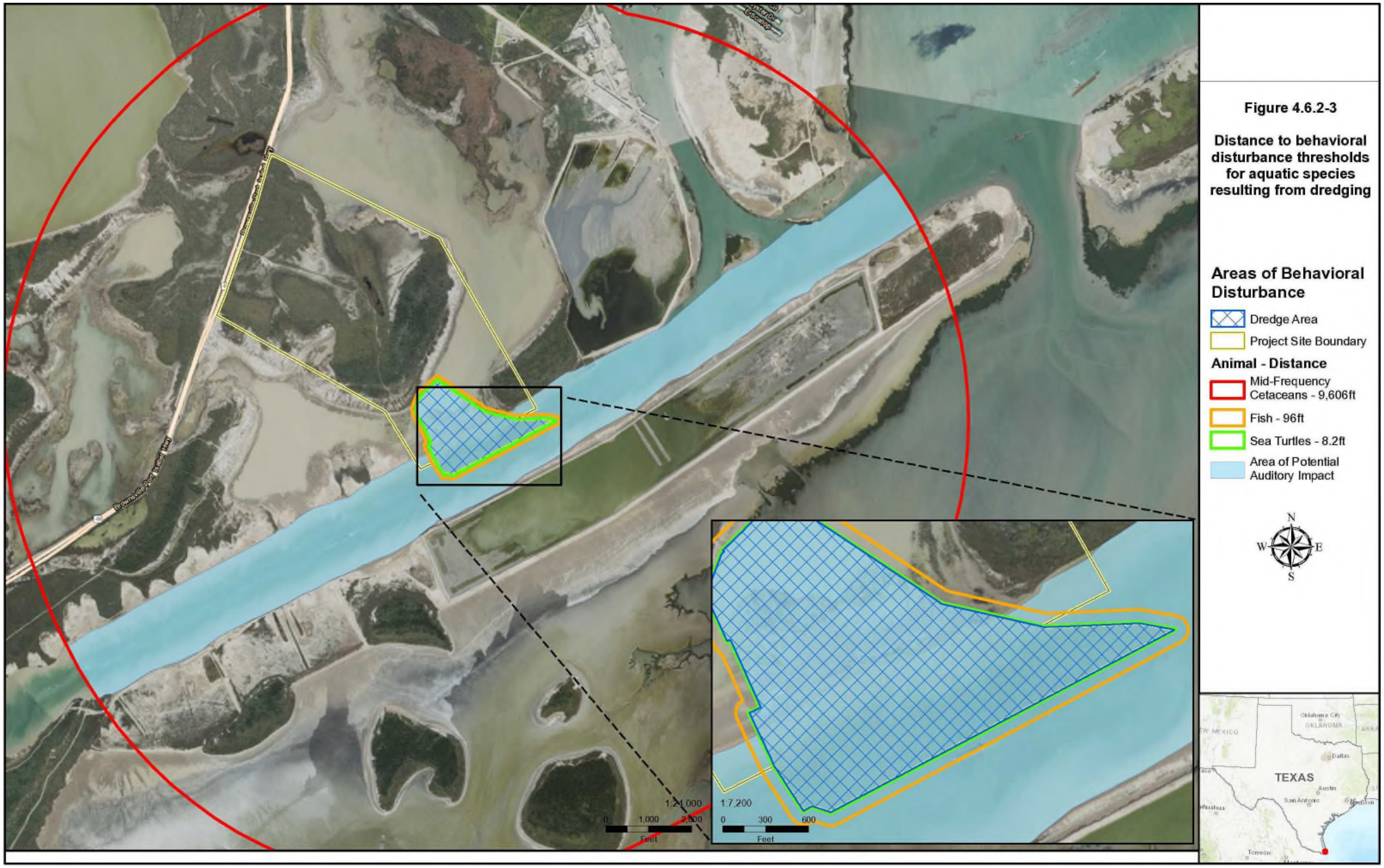

FIGURE 4.6.2-3 Distance to behavioral disturbance thresholds for aquatic species resulting from dredging.

Based on the distances presented in table 4.6.2-3, the in-water pile driving and dredging could result in injury and behavior disturbance to fish species that remain the Project area after the soft-starts, especially if the mitigation measures are not implemented. To ensure that actual underwater noise from pile driving is not significantly greater than predicted noise, **we recommend that:**

- **<u>Prior to initiating pile driving activities</u>, Texas LNG should perform initial test drives to measure the actual underwater noise generated during in-water pile driving. Following the completion of the initial test drives, Texas LNG should file with the Secretary and NMFS the acoustic monitoring methods and results, including any additional mitigation measures that it would implement to reduce noise to acceptable levels. Texas LNG should not initiate in-water pile driving for the Project until approved by the Director of OEP.**

Hydrostatic Testing

Prior to being placed into service, the LNG storage tanks would be hydrostatically tested with surface water to ensure their integrity. About 71 million gallons of water being used for testing of the LNG storage tanks would be withdrawn from the Brownsville Ship Channel, as described in section 4.3.2.3.

The water withdrawal process could entrain fish eggs and juvenile fish near the intake structures within the Brownsville Ship Channel. In accordance with its Project-specific ECP, Texas LNG would screen intake hoses to limit the entrainment of aquatic organisms during water withdrawal. Multiple screen sizes would be used to incrementally step the screen size down so that the initial screen would filter larger-sized debris resulting in less mass blockage to the downstream finer screen mesh. Under this scenario an initial 1.0-inch screen would be used with intervening 0.75- to 0.25-inch screens. In addition, Texas LNG would withdraw water at a rate of 3,000 gallons per minute per pump, although up to four pumps may be used at a time.

As discussed in section 4.3.2.3, Texas LNG has indicated that it may use chemical additives to limit bacteria and other components that can be corrosive during the hydrostatic test process where seawater is used. Before returning the water to the Brownsville Ship Channel, Texas LNG would filter the water to remove suspended solids and neutralize or biodegrade the chemical additives into non-hazardous materials. Texas LNG would seek authorization from the EPA to use additives and discharge the water in accordance with its permits. Therefore, we have determined that impacts on aquatic resources due to the discharge and withdrawal of hydrostatic test water would be temporary and not significant.

Vessel Traffic

During construction and operation of the Project, barges, support vessels, and LNG carriers would call on the LNG terminal, increasing ship traffic within the Brownsville Ship Channel. Potential impacts on marine mammals resulting from vessel strikes are discussed in section 4.7.2.2. Potential impacts on aquatic resources resulting from increased vessel traffic include shoreline erosion and resuspension of sediments, ballast water discharges, cooling water discharges, and increased noise levels. The following sections describe these potential impacts as well as measures proposed by Texas LNG to minimize impacts on aquatic resources.

Shoreline Erosion and Resuspension of Sediments

During construction, barges and support vessels would deliver large equipment and materials to the Project site. Texas LNG anticipates 109 barge and/or support vessel trips to the Project site during construction. During operation, Texas LNG anticipates that up to 74 LNG carriers (with up to four tugs per carrier) per year would call on the LNG terminal. Vessel traffic within and adjacent to the maneuvering basin has the potential to increase shoreline erosion and suspended solid concentrations due to increased wave activity. Texas LNG would install rock armoring along the 3 to 1 side slopes of the maneuvering basin to minimize shoreline erosion and prevent scour from propeller wash associated with the tugs used to assist the LNG carriers (see section 4.3.2.3). In addition, the tugs would be moored at the MOF while the LNG carriers are at the terminal, thereby eliminating the need for the tugs to rest against unprotected shoreline in the Brownsville Ship Channel.

The Brownsville Ship Channel was specifically created to provide deepwater access for maritime commerce. It is governed by the BND and maintained by regular dredging. Similarly, LNG carriers transiting the Gulf of Mexico would use established shipping channels. As such, use of the waterways by LNG carriers, barges, and support vessels during construction and operation of the Project would be consistent with the planned purpose and existing use of active shipping channels, and associated impacts on aquatic resources due to increased shoreline erosion and resuspension of sediments would be negligible.

Ballast Water Discharge

The effects of ballast water discharges on ambient water quality parameters including temperature, pH, dissolved oxygen, and salinity are described in section 4.3.2.3. Ballast water is stored below the ship's hull; as a result, the temperature of the discharged water is not expected to deviate substantially from ambient water temperature. In addition the pH of ballast water (reflective of seawater in open ocean conditions) is maintained in a fairly narrow range (8.1 to 8.5), which is relatively consistent with the pH of the Brownsville Ship Channel (8.0 on average) (Knezovich, 1994; Breuer, 1972).

Ballast water may have different salinity levels than the ambient levels at the Project site during discharge. As discussed in section 4.3.2.2, the Lower Laguna Madre is a hypersaline environment with relatively high salinity levels; however, salinity in the region can vary widely depending on rainfall and freshwater inflows. The amount of ballast water discharged into the maneuvering basin during each LNG carrier visit would represent a very minor influence on the overall system (Handley et al., 2007). Further, due to the variation in salinity levels throughout the Laguna Madre and associated waterbodies such as the Brownsville Ship Channel, most fish species are euryhaline (able to live in waters with a wide range of salinity) (Tunnel and Judd, 2002). Therefore, we have determined that increases in salinity from ballast water discharge would be temporary and are not anticipated to adversely affect aquatic resources.

Ballast water generally contains low dissolved oxygen levels and could decrease existing dissolved oxygen levels within the immediate vicinity of the discharge point. Ballast water would be discharged near the bottom of the maneuvering basin where dissolved oxygen levels are generally lower. Further, the Brownsville Ship Channel tends to experience episodes of low dissolved oxygen due to its being a dead-end channel with little freshwater inflow, low velocities, and low tidal exchange (COE, 2014). However, depending on the oxygen levels present in both the ballast and ambient water at the time of discharge, aquatic resources present in the vicinity of the discharge point could be exposed to dissolved oxygen levels considered unhealthy for aquatic life. More mobile species such as fish would likely temporarily relocate from the area; whereas, less mobile species such as mollusks may experience increased stress or death if dissolved oxygen levels were to remain low. However; due to the variation in dissolved oxygen levels typical of the Brownsville Ship Channel, less mobile species in the area would likely be adaptable to temporary changes. Due to the quantity of ballast water that would be discharged and the ability of most species to move over short distances to more suitable conditions, we have determined that the impact of ballast water on aquatic resources resulting from changes in dissolved oxygen levels would be localized, temporary, and not significant.

A primary environmental concern regarding ballast water discharge is the potential for the introduction of non-native species in the ecosystem. Ballast water may contain a diverse assemblage of marine organisms that may be non-native to a vessel's destination port. Non-native species may threaten to outcompete and exclude native species, which may affect the overall health of an ecosystem, cause algal blooms and hypoxic conditions, and/or affect all trophic levels resulting in a decline in biodiversity.

In 2012, the Coast Guard amended its ballast water management regulations by establishing a standard for the allowable concentration of living organisms in ballast water discharged in U.S. waters, as further discussed in section 4.3.2.3. The Coast Guard also established engineering equipment requirements and an approval process for ballast water treatment systems installed on ships. All ships calling at U.S. ports and intending to discharge ballast water must either carry out open sea exchange of ballast water or ballast water treatment, in addition to fouling and sediment management. Ships are required to keep logs documenting their open water ballast exchanges or ballast water treatment to comply with the Coast Guard's regulations. With the implementation of these mandatory practices required by the Coast Guard, we conclude that impacts on aquatic resources as a result of the potential introduction of non-native species through ballast water discharge would be negligible.

<u>Cooling Water</u>

As discussed in section 4.3.2.3, cooling water would be used by LNG carriers to cool engines and other equipment while at the LNG terminal during operation. Approximately 972,500 gallons of cooling water would be withdrawn and discharged hourly while at the LNG terminal, accounting for approximately 0.1 percent of the overall volume of the maneuvering basin. Intakes on LNG carriers are screened; however, the mesh size of the screens varies. Cooling water withdrawals would entrain small aquatic organisms, such as fish larvae and eggs. During operation LNG carriers would call on the LNG terminal approximately six times per month; therefore, we conclude that impacts on aquatic resources from cooling water intake would not be significant.

Discharged cooling water is anticipated to be 5 to 6 F greater than the ambient water; however, it is anticipated to quickly return to ambient levels. Fish and invertebrates within the immediate vicinity of the LNG carrier could be temporarily affected by the increase in temperature associated with cooling water discharge; however, many of these species are mobile and would be expected to relocate to more suitable conditions during discharges. Given the volume of cooling water discharged relative to the total volume of water within the maneuvering basin and the mobility of aquatic life, we have determined that impacts on aquatic resources resulting from cooling water discharges would be intermittent and not significant.

Increased Noise Levels

Engine-noise produced by LNG carriers would result in temporary increases in underwater noise levels near the transiting ships. Noise generated by LNG carriers is generally omni-directional, emitting from all sides of the vessel (Whale and Dolphin Conservation Society, 2004), but are greatest on the sides of the ship and weakest on the front and rear of the ship. Impacts on aquatic resources due to increased noise levels would vary by species; however, the aquatic resources present within the LNG carrier routes are likely accustomed to regular fluctuations in noise levels from ongoing industrial and commercial shipping activities. Additionally, as described above, many of the species present within the LNG carrier routes are mobile and would be able to move out of areas of noise that would startle or stress aquatic resources present. Due to the existing industrial and shipping activities within the LNG carrier transit routes and the mobility of resident species, we have determined that impacts on aquatic resources associated engine-noise produced by LNG carriers during operation of the Project would be intermittent and minor.

Stormwater Runoff

Construction of the Project would remove vegetation cover at the site and expose the underlying soils to the effects of wind and rain, which increases the potential for soil erosion and sedimentation of aquatic habitat. Similarly, during operation of the Project, areas within the Project site would be converted to impervious or semi-pervious surfaces to support structures and roads throughout the site. This development of currently undeveloped surfaces would increase stormwater runoff into adjacent vegetation and open water habitats. Potential impacts from stormwater runoff on aquatic resources include increased turbidity and sedimentation, which are discussed above (see section 4.6.2.2, *Dredging*).

Texas LNG would conduct land disturbing activities in accordance with its ECS, which includes installing erosion controls to minimize any turbidity or sedimentation as a result of on-land construction. Further, Texas LNG's SWPPP would take into consideration site drainage requirements and selection of the most appropriate erosion and sediment controls, management strategies, and waste disposal measures (see detailed discussion in section 4.3.2.3). In addition, the design and operation of all stormwater discharge and treatment facilities would be in accordance with applicable regulations and permits, including NPDES regulations under the CWA. Therefore, we conclude that the impacts from stormwater runoff would not be significant.

Lighting

Lighting fixtures would provide lighting on the LNG carrier loading dock and MOF during facility operation to meet safety requirements. Lighting at the LNG carrier loading dock and MOF would be located or shielded in a manner as to minimize interference with navigation on the adjacent Brownsville Ship Channel; therefore, most lighting effects would be localized to the immediate area surrounding the docks. The lighting system would be designed to provide an average illumination up to 54 lux at 1 meter above the deck of the LNG carrier loading dock.

Artificial lighting of surface waters in the vicinity of the Project could adversely affect aquatic resources. Artificial lighting in a marine environment was found to alter the recruitment of some sessile (immobile) invertebrates, which could alter the species composition of shallow benthic environments (Davies et al., 2015). Fish behavior and abundance may also be affected. Another study documented an increase in predatory fish in an area receiving artificial light (Becker et al., 2012). There are also concerns regarding the potential effects of artificial lighting on the vertical migration of zooplankton (Peters, 2015). While these or similar effects may occur in the maneuvering basin, the extent to which lighting would influence aquatic resources likely varies due to the effects of other environmental factors such as turbidity (Benfield and Minello, 1996).

The deck of the LNG carrier loading dock would be positioned 23 feet above the water surface (mean sea level). Due to the height of the dock over the water surface, the shielding of lights, and relatively low illumination, the impacts of facility lighting on aquatic species would be negligible.

In addition to facility lighting, shading from over-water structures, such as the LNG carrier berthing dock, and MOF can also affect aquatic resources. Benthic invertebrates, algae, and aquatic plants may be affected by shading. Algae and plants may not receive adequate sunlight to complete photosynthesis. Benthic invertebrates and other species that eat those plants and/or algae may also be affected. To minimize impacts resulting from shading, the COE recommends that structures be placed a minimum of 5 feet above special aquatic sites in order to minimize the impacts associated with shading (COE, 2015a). Texas LNG would construct trestles associated with the LNG carrier berthing dock and MOF to be a minimum of 10 feet above the tidal flats, thus minimizing potential secondary impacts resulting from shading. Further, no submerged aquatic vegetation or other special aquatic sites are present within the Project footprint. Therefore, we conclude that impacts resulting from shading would be permanent, but not significant.

Industrial Process Water

As described in section 4.3.2.3, Project facilities associated with acid gas removal require demineralized water. A demineralization plant would be within the LNG terminal. During the demineralization process, minerals are transferred from the potable water provided by the BND to a discharge stream into the Brownsville Ship Channel. The resulting discharge stream would have more mineral hardness, be slightly warmer, and have a lower pH than the potable water received from the BND. Texas LNG anticipates that discharges would be approximately 2.8 gallons per minute. In addition, the discharge stream would mix with seawater through a diffuser. It is anticipated that due to the relatively small volume of water being discharged as result of the demineralization process, adverse effects on aquatic resources would be minor and localized, with the discharged water quickly diffusing into the surrounding water column.

Seawater Firewater System

As a backup system to the freshwater firewater system, a seawater firewater system would automatically activate on detection of low water in the freshwater firewater tank. Use of the seawater firewater system would only occur in the event of an emergency and after the freshwater firewater tank is depleted. The water for the seawater firewater system would be appropriated from five permanent pumps located on the MOF (see section 2.1.4 for additional information on the firewater system). During operation, use of each pump would be limited to periodic tests of short duration to ensure firewater system readiness. Intake structures would be screened with 0.25-inch to 1.0-inch mesh to minimize entrainment of aquatic resources and prevent debris from entering the system; however, smaller organisms could still be removed with the withdrawn water. Texas LNG indicated that use of the larger screen size is necessary to minimize the likelihood of blockages in the event the pumps are needed during an emergency. Because of the infrequent operation of the system and the use of screening to minimize entrainment of aquatic resources, we conclude that the seawater firewater system would have intermittent and minor impacts on aquatic resources.

Inadvertent Spills

During construction and operation, hazardous materials resulting from spills or leaks entering the Brownsville Ship Channel could have adverse impacts on aquatic resources. The impacts would be caused by either the physical nature of the material (e.g., physical contamination and smothering) or by its chemical components (e.g., toxic effects and bioaccumulation). These impacts would depend on the depth and volume of the spill, as well as the properties of the material spilled. To prevent spills and leaks, Texas LNG would implement its Project-specific SPAR Plan during construction and its SPCC Plan during operation, which outline potential sources of releases at the site, measures to prevent a release, and initial responses in the event of a spill (see discussion in section 4.3.2.3). Increased vessel traffic during construction and operation of the Project would also result in an increased potential for spills of hazardous materials; however, all ships are required to maintain a Shipboard Oil Pollution Emergency Plan to minimize impacts on aquatic resources. Given the impact minimization and mitigation measures described above, we conclude that the probability of a spill of hazardous materials is small and any resulting impacts on aquatic resources would be temporary and not significant.

4.6.3 Essential Fish Habitat

4.6.3.1 Regulatory Background

The MSA (Public Law 94-265, as amended through October 11, 1996) was established, along with other goals, to promote the protection of EFH during the review of projects to be conducted under federal permits and licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. Federal agencies that authorize, fund, or undertake activities that may adversely affect EFH must consult with NMFS. Although absolute criteria have not been established for conducting EFH consultations, NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the Fish and Wildlife Coordination Act, and the ESA, to reduce duplication and improve efficiency (50 CFR 600.920(e)). Generally, the EFH consultation process includes the following steps:

1. Notification – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into an EIS).

2. EFH Assessment – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH Assessment should include:

   - a description of the proposed action;

   - an analysis of the effects (including cumulative effects) of the proposed action on EFH, managed fish species, and major prey species;

   - the federal agency's views regarding the effects of the action on EFH; and

   - proposed mitigation, if applicable.

3. EFH Conservation Recommendations – After reviewing the EFH Assessment, NMFS should provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.

4. Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to NMFS. The action agency may notify NMFS that a full response to the conservation recommendations would be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH. For any conservation recommendation that is not adopted, the action agency must explain its reason to NMFS for not following the recommendation.

The FERC proposes to incorporate EFH consultation for the Project with the interagency coordination procedures required under NEPA. As such, we request that NMFS consider this draft EIS initiation of EFH consultation.

4.6.3.2 Essential Fish Habitat within the Project Site

Between 1979 and 1987, the Gulf of Mexico Fishery Management Council (GMFMC) prepared fishery management plans for seven marine groups within the Gulf of Mexico: reef fish, migratory pelagic fish, red drum, shrimp, spiny lobster (*Panulirus argus*), stone crab (*Menippe adina* and *Menippe mercenaria*), and corals. Each fishery management plan has been amended several times since then. One important amendment that applied to all seven fishery management plans was implemented in 1998 and involved the identification of EFH for each group. All estuarine systems of the Gulf (e.g., Laguna Madre, South Bay, Brownsville Ship Channel) are considered EFH, which is managed by the GMFMC (GMFMC, 2010). In addition, NMFS manages a number of fish species in the U.S. Atlantic and Gulf of Mexico waters known as highly migratory species. Highly migratory species include tuna, sharks, swordfish, and billfish that live throughout the Gulf of Mexico and Atlantic Ocean and often migrate long distances. Because these species cross domestic and international boundaries, NMFS' Highly Migratory Species Management Division is responsible for managing them under the MSA.

The GMFMC (2005) designated the majority of the Brownsville Ship Channel and surrounding waters as EFH for four groups of finfish and shellfish, including red drum, shrimp, reef fish, and coastal migratory pelagics (NMFS, 2016a). Life stage occurrences for several species within these groups that are found within the vicinity of the Project are presented in table 4.6.3-1. The only areas classified as EFH within the Project site are the Brownsville Ship Channel and the tidal flats. The GMFMC has mapped seven general habitat types as EFH in the vicinity of the Project site including coral reefs, estuarine emergent wetlands, estuarine water columns, hard bottoms (sand, shell, and rock substrates), mangroves, non-vegetated soft bottoms (mud, clay, and silt), and submerged aquatic vegetation. Of these, estuarine water columns and non-vegetated soft bottoms are present within the Project site. While the dredge plume propagation study indicates that suspended sediments would travel approximately 460 feet before reaching acceptable TSS levels (see section 4.3.2.3), some clays would likely extend further potentially settling at greater distances from the dredging activities. However, due to the anticipated TSS concentrations, we anticipate that this sediment deposition would be minimal and would not affect EFH.

Designating EFH for highly migratory species is more difficult, as these species occupy a wide range of habitats including estuarine, coastal, and offshore pelagic. Highly migratory species are typically associated with oceanographic features such as fronts, current boundaries, temperature discontinuities, or water boundaries with particular physical characteristics. These oceanographic features are ephemeral and often change overtime. Therefore, EFH for highly migratory species is based on geographic or bathymetric features that coincide with areas of highly migratory species known occurrences (NMFS, 2006). Within the Project area, EFH for highly migratory species includes the Brownsville Ship Channel (NMFS, 2009).

TABLE 4.6.3-1

Life Stage Occurrence for Species with Essential Fish Habitat in the Project Area

Managed Species	Life Stage			
	Eggs	Larvae/Neonate	Juvenile	Adult
Shrimp				
White shrimp *Penaeus setiferus*	-	X	X	-
Brown shrimp *Penaeus aztecus*	-	X	X	-
Reef Fish				
Gray snapper *Lutjanus griseus*	-	-	-	X

TABLE 4.6.3-1 Life Stage Occurrence for Species with Essential Fish Habitat in the Project Area				
Managed Species	**Life Stage**			
	Eggs	**Larvae/Neonate**	**Juvenile**	**Adult**
Lane snapper *Lutjanus synagris*	-	-	X	-
Yellowtail snapper *Ocyurus chrysurus*	-	-	X	-
Red drum				
Red drum *Sciaenops ocellatus*	-	X	X	X
Coastal Migratory Pelagic				
Spanish mackerel *Scomberomorus maculatus*	-	-	X	X
Bluefish *Pomatomus saltatrix*	-	-	X	-
Atlantic Highly Migratory Species				
Blue marlin *Makaira nigricans*	-	-	X	-
Atlantic sharpnose shark *Rhizoprionodon terraenovae*	-	X	X	X
Blacktip shark *Carcharhinus limbatus*	-	X	X	X
Bonnethead shark *Sphyrna tiburo*	-	X	X	X
Bull shark *Carcharhinus leucas*	-	X	X	-
Lemon shark *Negaprion brevirostris*	-	-	X	-
Scalloped hammerhead shark *Sphyrna lewini*	-	X	X	-
Silky shark *Carcharhinus falciformis*	-	X	X	X
Spinner shark *Carcharhinus brevipinna*	-	-	X	-

Source: NMFS, 2009; GMFMC, 2004

X EFH for this life stage is present in the Project area
\- EFH for this life stage is not present in the Project area

As discussed in section 4.4.2, the continued accretion of sediment from dredging as well as other sources, such as ship traffic, has effectively cut off natural tidal exchange to the tidal flats within the Project site except during extreme high tides and storm surges. Due to the limited tidal exchange and high evaporation rates, the tidal flats within the Project site likely do not function as EFH. However, the portion of the Project within the Brownsville Ship Channel is designated EFH and functions as such. The mud substrates within and adjacent to the Brownsville Ship Channel provide soft bottom habitat that serves as important nursery, growth, and feeding habitat for several species and their invertebrates prey species (e.g., worms and mollusks living on and in the sediments). In addition, the estuarine water column serves as EFH for several species and their prey at various life stages by providing suitable habitat for breeding and foraging.

4.6.3.3 Impacts and Mitigation

As described in section 4.6.2.2, construction of the Project (in particular, construction of the maneuvering basin and LNG carrier berthing dock) would result in temporary increases in noise, artificial lighting, turbidity, and sedimentation within the estuarine water column. Impacts on managed species during construction and operation of the Project would be similar to those described above for aquatic resources (see section 4.6.2.2). Entrainment of managed species larvae and eggs could occur as a result of intake associated with the cooling water and firewater systems; however, due to the limited frequency of LNG carriers calling on the LNG terminal (74 per year) and the infrequent use of the seawater firewater system, we conclude that impacts on managed species from entrainment would not be significant. Potential impacts on soft bottoms and estuarine water column habitat in the Project area are described below.

Construction of the maneuvering basin, LNG carrier dock, and MOF would require deepening the existing tidal flats and a portion of the Brownsville Ship Channel to a depth of -43 feet MLLW. A total of 73.5 acres of unvegetated soft bottom habitat would be impacted by these activities. Of which, 39.4 acres of unvegetated soft bottom habitat associated with the tidal flats within the Project site would be permanently converted to unvegetated soft bottom habitat within open water. Dredging within this area would also create 39.4 acres of additional estuarine water column habitat. An additional 0.4 acre of unvegetated soft bottom habitat in tidal flats would be impacted by the temporary construction basin; however, this area would be allowed to revert to preconstruction conditions following the completion of construction activities (see section 2.5.4.1). Construction activities would also impact 33.8 acres of unvegetated soft bottom habitat and estuarine water column habitat between the existing shoreline and the northern edge of the Brownsville Ship Channel. Although dredging would permanently increase the water depth to -43 feet MLLW within a 72.0-acre area, habitat would continue to consist of estuarine water column and unvegetated soft bottoms. The remaining 1.5 acres would be temporarily impacted by the temporary construction basin, but would be allowed to return to preconstruction conditions following the completion of construction activities.

In addition to the impacts presented above associated with deepening existing unvegetated soft bottom habitat, the Project would also permanently impact 2.4 acres of unvegetated soft bottom habitat associated with tidal flats for the liquefaction process area and the LNG carrier berthing dock. Temporary impacts associated with construction of these Project components would total 1.4 acres within unvegetated soft bottom habitat associated with tidal flats.

Dredging activities would result in the removal of the existing mud substrates, in turn removing the existing benthic community. In addition, sediments resuspended in the water column during dredging and other construction activities would be redeposited on nearby substrates, potentially smothering immobile fish eggs and larvae as well as benthic invertebrates. Based on the turbidity modeling analysis that Texas LNG conducted for the Project (see section 4.3.2.3), it is anticipated that turbidity associated with the use of the hydraulic cutterhead dredge could extend 460 feet from the dredge area before reaching acceptable TSS concentrations (300 mg/l per TCEQ guidelines). Dredging activities could also cause mortality of larval and juvenile shrimp as well as fish species in the immediate vicinity of the cutterhead of the dredge. Impacts on soft bottom habitat would be greatest if dredging occurs during a period of peak larval abundance in early spring or summer. Increased turbidity associated with dredging would also impact the estuarine water column, temporarily reducing habitat quality through localized increases in suspended sediment and nutrient levels and decreases in dissolved oxygen. These impacts are anticipated to be short-term, but could have localized effects on movement and foraging of managed fish species within the estuarine water column habitat. In addition, the dredge material would be placed in an existing confined upland placement area in accordance with Texas LNG's COE permit; therefore, we conclude that impacts on EFH as a result of dredge material placement would not occur.

Traffic associated with construction and operation of the Project could affect the estuarine water column within the Brownsville Ship Channel and the maneuvering basin. Impacts on water quality may occur due to resuspension of suspended solids, discharge of ballast water, and intake and discharge of cooling water. However, the Brownsville Ship Channel was specifically created to provide deepwater access for maritime commerce and support high levels of deep draft ship traffic. Therefore, impacts on the estuarine water column as a result of increased ship traffic would be minor.

As stated above, dredging of the maneuvering basin would remove the existing benthic community from the Project area; however, these communities would be expected to recolonize as tidal flows are restored. While construction of the Project would permanently convert tidal flats within the Project site to open water habitat, it would also restore tidal flows to the larger tidal flat complex to the north of the Project site, restoring functionality to previously designated EFH (FWS, 2015c). We are still coordinating with the NMFS as part of the essential fish habitat consultation under the Magnuson-Stevens Fishery Conservation and Management Act.

In addition to the initial dredging within the Project site, Texas LNG would also conduct periodic maintenance dredging of the maneuvering basin. Texas LNG anticipates that maintenance dredging would be necessary every three to five years. Impacts on EFH as a result of maintenance dredging would be similar to that discussed above for the initial dredging activities associated with the Project and would not result in a change in EFH type. Therefore, impacts on EFH as a result of maintenance dredging would be temporary and minor.

4.6.3.4 Conclusions

The majority of impacts on EFH associated with the Project would be short-term, as estuarine water column habitat and unvegetated soft bottom habitat would remain following the completion of construction activities. While unvegetated soft bottom habitats associated with tidal flats would be converted to open water habitats, the deepening of the tidal flats would create estuarine water column habitat and restore tidal flows to tidal flats beyond the Project site. Further, Texas LNG is proposing to mitigate for unavoidable impacts on tidal flats as part of its Section 404 permit (see section 4.4.2) through preservation of 405 acres of estuarine habitats within the Loma Ecological Preserve, which is designated as EFH and hosts a variety of habitat types. Based on the short-term and temporary nature of the majority of EFH impacts, with the exception of converting shallow water habitat to deep water habitat, and the resulting secondary restoration of EFH in the adjacent tidal flats, we have determined that the Project would have short-term, minor impacts on EFH.

4.7 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed species and species that are protected under the ESA, as amended; species that are currently candidates or proposed for federal listing under the ESA; state-listed threatened or endangered species; and species otherwise granted special status at the state or federal level (e.g., protected under the MMPA).

Federal agencies are required under Section 7 of the ESA, as amended, to ensure that any actions authorized, funded, or carried out by the agency would not jeopardize the continued existence of a federally listed threatened or endangered species, or result in the destruction or adverse modification of designated critical habitat of a federally listed species. As the lead federal agency, the FERC is required to coordinate with the FWS and NMFS to determine whether federally listed threatened or endangered species or designated critical habitat are found in the vicinity of projects, and to determine potential effects on those species or critical habitats.

For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the lead federal agency must prepare a BA and submit its BA to the FWS and/or NMFS. If the action would adversely affect a listed species, the federal agency must also submit a request for formal consultation. In response, the FWS and/or NMFS would issue a Biological Opinion as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat.

As required by Section 7 of the ESA, we prepared a BA for the Project, which is provided in appendix D. Furthermore, we are requesting concurrence from NMFS and the FWS with our determinations of effect for the federally listed species in table 4.7-1.

To assist in compliance with Section 7 of the ESA, Texas LNG, acting as the FERC's non-federal representative for the Project, coordinated with the FWS Coastal Ecological Services Field Office and NMFS Protected Resources Division for technical assistance in evaluating potential impacts on federally listed threatened and endangered species and designated critical habitat. In March 2015, Texas LNG initiated informal coordination with the FWS by submitting a technical assistance request letter. Also in March, Texas LNG participated in a meeting with the FWS to discuss the Project. Texas LNG has participated in several follow-up meetings and site visits with the FWS and continues to coordinate with them regarding impacts on threatened and endangered species. Texas LNG has also consulted with NMFS regarding impacts on federally threatened and endangered species. On October 29, 2015 Texas LNG received recommendations from NMFS regarding information that should be included in the BA. Texas LNG participated in a follow-up call on November 19, 2015 with NMFS to further discuss potential Project impacts on federally listed threatened and endangered species.

Based upon our review of publicly available information, agency correspondence, and field surveys, a total of 20 federally listed species and 43 state-listed species (not including those that are also federally listed) may occur in in the vicinity of the Project. Within the Project vicinity, critical habitat has been designated for two species, piping plover and loggerhead sea turtle. Federally and state-listed species potentially occurring in the Project area are identified in table 4.7-1 and appendix E, respectively. We have determined that the Project would have no effect on 29 state-listed species based on the species' range and/or a lack of suitable habitat present at the Project site (see appendix E). Because we have determined that the Project would not affect these species, they are not discussed further. Additional discussion of the federally listed species and 14 remaining state-listed species is provided in appendix D and section 4.7.2, respectively.

TABLE 4.7-1

Federally Listed Species Potentially Occurring in the Project Area

Common Name *Scientific Name*	**Federal Status**	**Project Component** [a]	**Determination of Effect and Habitat Assessment**
Birds			
Northern aplomado falcon [b] *Falco femoralis septentrionalis*	Endangered	LNG terminal	*May affect, not likely to adversely affect* Inhabits open grasslands with scattered islands of shrubs or trees. Nest in yucca covered sand ridges in coastal prairies, riparian woodlands in grasslands, and desert grasslands with sporadic mesquite and yucca. Suitable habitat is present within the Project site; however, no nests were observed.
Piping plover [b] *Charadrius melodus*	Threatened Designated Critical Habitat	LNG terminal	*May affect, not likely to adversely affect* Preferred wintering habitat includes beaches, mudflats, algal flats, and washover passes with adjacent sparsely vegetated areas above the high tide line. Suitable habitat is present within the Project site; however, Texas LNG would conduct species specific surveys prior to construction. *No destruction or adverse modification of critical habitat* Designated critical habitat is present within PA 5A; however, consultations with the FWS indicate that it no longer contains the primary constituent elements necessary to be considered critical habitat.
Red knot *Calidris canutus rufa*	Threatened	LNG terminal	*May affect, not likely to adversely affect* Forages on beaches, oyster reefs and exposed bay bottoms. Roosts on high sand flats, reefs, and other sites protected from high tides. Suitable habitat is present within the Project site; however, Texas LNG would conduct species specific surveys prior to construction.
Whooping crane *Grus Americana*	Endangered	LNG terminal	*May affect, not likely to adversely affect* Migrates from nesting habitat in Wood Buffalo National Park in Canada to wintering habitat along the Texas coast primarily in the Aransas NWR located approximately 145 miles north of the Project site; however, whooping cranes have been documented in Cameron County. Suitable wintering habitat is present on the Project site; however, if present in the Project area during construction, individuals would likely relocate to nearby suitable habitat.
Red-crowned parrot *Amazon viridigenalis*	Candidate	LNG terminal	*Project would not contribute to a trend toward federal listing* Inhabits tropical lowlands and foothills with tropical deciduous forest, gallery forest, evergreen floodplain forest, Tamaulipan thornscrub, or semi-open areas. Suitable habitat may be present within the Project site; however, this species has only been documented in urban areas in south Texas.

TABLE 4.7-1 Federally Listed Species Potentially Occurring in the Project Area			
Common Name ***Scientific Name***	**Federal Status**	**Project Component [a]**	**Determination of Effect and Habitat Assessment**
Mammals			
Gulf Coast jaguarundi [b] *Herpailurus (=felis) yagouaroundi cacomitli*	Endangered	LNG terminal	*May affect, not likely to adversely affect* Prefers dense brush and thorny shrublands near water. Suitable habitat is present within the Project site; however, the site would likely only be used by transient individuals.
Ocelot [b] *Leopardus (=felis) pardalis*	Endangered	LNG terminal	*May affect, not likely to adversely affect* Prefers dense vegetation including canopy cover of at least 75 percent and 95 percent cover in the shrub layer. Suitable habitat is present within the Project site; however, the site would likely only be used by transient individuals.
Sperm whale *Physeter macrophalus*	Endangered	LNG transit routes	*May affect, not likely to adversely affect* Inhabits deep waters in open ocean. Although rare, this species could utilize offshore areas along LNG transit routes.
Fin whale *Balaenoptera physalus*	Endangered	LNG transit routes	*May affect, not likely to adversely affect* Inhabits deep, offshore waters. Although rare in the Gulf of Mexico, this species could utilize offshore areas along LNG transit routes during migration.
Sei whale *Balaenoptera borealis*	Endangered	LNG transit routes	*May affect, not likely to adversely affect* Inhabits deep waters in open ocean. Although rare in the Gulf of Mexico, this species could utilize offshore areas along LNG transit routes during migration.
Blue whale *Balaenoptera musculus*	Endangered	LNG transit routes	*May affect, not likely to adversely affect* Inhabits open ocean. Although rare in the Gulf of Mexico, this species could utilize offshore areas along LNG transit routes.
Gulf of Mexico Bryde's whale *Balaenoptera edeni (Gulf of Mexico subspecies)*	Proposed	LNG transit routes	*May affect, not likely to jeopardize* Inhabits waters less than 1,000 feet deep in the Gulf of Mexico. Primarily occurs in the eastern Gulf of Mexico and could utilize offshore areas along LNG transit routes.
West Indian manatee [b] *Trichechus manatus*	Threatened	LNG terminal, LNG transit routes	*May affect, not likely to adversely affect* Inhabits shallow, slow moving estuaries, bays, rivers, and lakes with water at least 3 feet deep. Although extremely rare in south Texas, this species could occur along LNG transit routes or within the Brownsville Ship Channel, although suitable foraging habitat is not present within the Project site.
Reptiles			

TABLE 4.7-1 Federally Listed Species Potentially Occurring in the Project Area			
Common Name ***Scientific Name***	**Federal Status**	**Project Component** [a]	**Determination of Effect and Habitat Assessment**
Green sea turtle [b] *Chelonia mydas*	Threatened	LNG terminal, LNG transit routes	*May affect, not likely to adversely affect in marine habitat* *No effect on nesting habitat* Occurs offshore and within shallow estuarine and marine waters including reefs, bays and inlets where they feed on seagrass and algae. This species could occur in the Brownsville Ship Channel or along LNG transit routes.
Hawksbill sea turtle [b] *Eretmochelys imbricata*	Endangered	LNG terminal, LNG transit routes	*May affect, not likely to adversely affect in marine habitat* *No effect on nesting habitat* Prefers shallow coastal waters with rocky bottoms, coral reefs, seagrass or algae beds, mangrove-bordered bays and estuaries, and mud flats. This species could occur in the Brownsville Ship Channel or along LNG transit routes.
Kemp's ridley sea turtle [b] *Lepidochelys kempii*	Endangered	LNG terminal, LNG transit routes	*May affect, not likely to adversely affect in marine habitat* *No effect on nesting habitat* Occurs in open ocean as well as shallow coastal waters and estuarine habitats. This species could occur in the Brownsville Ship Channel or along LNG transit routes.
Leatherback sea turtle [b] *Dermochelys coriacea*	Endangered	LNG terminal, LNG transit routes	*May affect, not likely to adversely affect in marine habitat* *No effect on nesting habitat* Primarily inhabits open ocean, only utilizing coastal waters during the reproductive season. Although extremely rare, this species could occur in the Brownsville Ship Channel or along LNG transit routes.
Loggerhead sea turtle [b] *Caretta caretta*	Threatened Designated Critical Habitat	LNG terminal, LNG transit routes	*May affect, not likely to adversely affect in marine habitat* *No effect on nesting habitat* Occur in open water habitats as well as estuarine waters of coastal lagoons, mouths of large rivers, inshore bays, and ship channels within tropical and temperate waters. This species could occur in the Brownsville Ship Channel or along LNG transit routes. *No destruction or adverse modification of critical habitat* Designated critical habitat (floating *Sargassum*) may occur along LNG transit routes.
Plants			
South Texas ambrosia [b] *Ambrosia cheiranthifolia*	Endangered	LNG terminal	*No effect* Occurs on grasslands and mesquite shrublands in coastal prairies and savannas. Suitable habitat is present within the Project site; however, no individuals were documented during species-specific surveys.

TABLE 4.7-1 Federally Listed Species Potentially Occurring in the Project Area			
Common Name ***Scientific Name***	**Federal Status**	**Project Component** [a]	**Determination of Effect and Habitat Assessment**
Texas ayenia [b] *Ayenia limitaris*	Endangered	LNG terminal	*No effect* Occurs in association with other shrub species and native grasses and forbs on open ground, along edges of thickets, or within thickets. Suitable habitat is present within the Project site; however, no individuals were documented during species-specific surveys.

[a] LNG terminal refers to all construction and operation activities associated with the Project site, including dredging of the maneuvering basin (i.e., not vessel transit).
[b] Species is also state-listed.

4.7.1 Federally Listed Threatened and Endangered Species

Texas LNG proposes several measures to minimize impacts on federal species and their habitats, which are discussed throughout our BA. For federally listed marine species, including whales, sea turtles, and West Indian manatee, we determined additional avoidance or conservation measures are necessary to reduce adverse effects that would occur if the Project is constructed, and in part, are basing our determinations of effects on implementation of these measures. **We recommend that:**

- **<u>During in-water construction activities</u>, Texas LNG should utilize biological monitors to ensure that federally listed or other special status species are not present within the Project area. In the event that federally listed or other special status species are observed, Texas LNG should stop all in-water construction activities until the individual(s) leave the area on their own and Texas LNG should notify FWS or NMFS.**

A variety of measures have been proposed by Texas LNG that would minimize impacts on federally listed and other special status species, including but not limited to, species-specific surveys, environmental monitors during construction, environmental training programs, and providing LNG carrier captains with NMFS-issued guidance that outlines collision avoidance measures to be implemented in order to minimize impacts on marine mammals and sea turtles. However, because consultations with the FWS and NMFS are ongoing, **we recommend that:**

- **Texas LNG should <u>not begin</u> construction activities <u>until</u>:**

  a. the FERC staff receives comments from the FWS and the NMFS regarding the proposed action;

  b. the FERC staff completes Section 7 ESA consultation with the FWS and NMFS; and

  c. Texas LNG has received written notification from the Director of OEP that construction or use of mitigation may begin.

4.7.2 State-Listed and Special Status Species

4.7.2.1 State-Listed Species

There are 55 state-listed threatened or endangered species identified by the TPWD as potentially occurring in Cameron County, including 9 species (see table 4.7-1) that are also federally listed (TPWD, 2015b). In January 2015, Texas LNG conducted a background review of the TXNDD followed by an onsite assessment performed in conjunction with the wetland delineation. TPWD participated in a visit to the Project site in September 2015, during which TPWD determined that potentially suitable habitat for several state-listed species is present within the Project site. Species-specific surveys for federally and state-listed species were conducted in October 2015. At the request of the FWS, a winter bird survey was also conducted by Texas LNG at the Project site in March 2016. All state-listed species with potential to occur within Cameron County along with a description of habitat requirements are included in appendix E. Federally listed species that are also state-listed are only discussed in section 4.7.1 and are not presented in appendix E.

Specific TPWD vegetation communities, as described in section 4.5.1 and shown on figure 4.5.1-1, were used along with field survey data collected by Texas LNG, as described above to determine if suitable habitat is present within the Project site for each state-listed species. Based on our review of this information, as well as agency correspondence, and other publicly available resources (as cited), we have determined that 14 state-listed species may or are known to occur within the Project site. These 14 state-listed species are identified in appendix E and further discussed below.

Impacts on state special status species may be greater than impacts on other vegetation and wildlife because these species may be more sensitive to disturbance, more specific to a habitat, and less able to move to unaffected suitable habitat which may not be available (or currently exists only in small tracts). For one state-listed species, we received comments from the TPWD that additional avoidance or conservation measures are necessary to reduce adverse effects that would occur if the Project is constructed.

Birds

Peregrine Falcon and American Peregrine Falcon

The American peregrine falcon has been state-listed as endangered since 1974. This subspecies nests in the western U.S., Canada, and Mexico. Due to the similarity in appearance the peregrine falcon is also state-listed as endangered. Historically within Texas, the American peregrine falcon would nest within suitable habitat in the Trans-Pecos region and on the Edwards Plateau. Currently, this species' nesting habitat is limited to the Trans-Pecos region of Texas, which is part of Chihuahuan Desert on the western side of the state. American peregrine falcons are residents of the Big Bend and Guadalupe Mountains National Parks and the Chisos, Davis, and Guadalupe mountain ranges. Breeding habitat within this region consists of tall sheer cliff faces near water with a prey base. The nest site is generally not made up of sticks, but a hollowed out depression or "scrape on a cliff face." Typically, this species spends the nonbreeding season near breeding areas or generally south of breeding habitat, although they can be seen throughout the state (Campbell, 2003; Texas A&M Agrilife Extension, 2017a).

An adult individual was observed flying over the Project site during the October 2015 field surveys. While the Project site potentially contains suitable foraging habitat for the American peregrine falcon, there is no suitable nesting habitat located within the Project site.

Reddish Egret

The reddish egret is state-listed as threatened. Reddish egrets are wading birds that inhabit Gulf of Mexico and Southern Atlantic coastal habitats within protected estuaries and bays, including shorelines, salt marsh, and tidal flats. This species breeds in colonies with other wading bird species in Texas and Florida. There are approximately 1,500 to 2,000 nesting pairs of reddish egret within the U.S., with the majority of these pairs occurring within Texas (TPWD, 2017c).

Within Texas, the reddish egret is a permanent resident within salt and brackish habitat along the coast. This species typically nests on the ground near a bush or prickly pear cactus or on an oyster shell beach. During the January 2015 field surveys, Texas LNG observed one individual feeding near the tidal flat located on the north side of the Project site. During the March 2016 winter bird survey, 11 reddish egrets were observed in the salt and brackish high tidal marsh, tidal flat, and open water areas within the Project site. Breeding bird surveys were not conducted within the Project site; however, the closest documented colonial wading bird rookery identified by the TXNDD (2015) is located approximately 0.8 mile east of the Project site on a tidal marsh/flat at the confluence of the Brownsville Ship Channel and the Port Isabel Channel. Suitable foraging and breeding habitat is present within the sea ox-eye daisy flat, tidal flat, salt and brackish high tidal marsh, open water, and loma deciduous shrublands (nesting) within the Project site.

White-faced Ibis

The white-faced ibis is a state-listed threatened species with a wide distribution from western North America to South America (The Cornell Lab of Ornithology, 2015). The white-faced ibis is a resident along the Gulf Coast of Texas and primarily inhabits freshwater wetlands, especially cattail and bulrush marshes. Suitable foraging habitat primarily includes flooded hay meadows, agricultural fields, and estuarine wetlands (Texas A&M Agrilife Extension, 2017b).

During the breeding season from early April to late July, the white-faced ibis nests in small colonies on islands along the central and upper coast of Texas. Occasionally, the species will migrate inland and as far north as the Texas Panhandle to breed. Coastal nests are commonly located in emergent vegetation or shrubs and low trees over shallow water. Inland nests are commonly found in shallow marshes and swamps with "islands" of emergent vegetation (Texas A&M Agrilife Extension, 2017b).

Potentially suitable foraging and nesting habitat for the white-faced ibis is present within the salt and brackish high tidal marsh and emergent wetlands within the Project site. The closest documented colonial wading bird rookery identified by the TXNDD is located approximately 0.8 mile east of the Project site on a tidal marsh/flat at the confluence of the Brownsville Ship Channel and the Port Isabel Channel.

White-tailed Hawk

The white-tailed hawk is a state-listed threatened species with ranges extending from south Texas, Mexico, and Central and South America. The white-tailed hawk is considered an "all seasons" resident in Texas and is commonly found in the Coastal Sand Plain, Coastal Prairies, and South Texas Brush Country regions (Texas A&M Agrilife Extension, 2017c). The white-tailed hawk forages by soaring flight or by hovering; therefore, preferred foraging habitats generally possess very little canopy cover, such as dry grassland and coastal prairies with scattered shrubs consisting of mesquite, hackberry, and oak (The Cornell Lab of Ornithology, 2015; Audubon, 2016).

Breeding season begins in late January and extends through late July or, occasionally, late August. Nesting habitat is similar to foraging habitat; nests are generally placed on the tops of short trees and shrubs approximately 10 feet above ground (Audubon, 2016).

Potentially suitable foraging and nesting habitat for the white-tailed hawk is present within the salt and brackish high tidal marsh, sea-oxeye daisy flat, salty prairie, loma grassland, and loma shrubland vegetation communities within the Project site; however, no raptor nests were observed during surveys. One white-tailed hawk was observed within the salty prairie habitat on the Project site during the October 2015 field surveys. During the March 2016 winter bird survey, a white-tailed hawk was seen near SH 48 in the western portion of the Project site.

Bird Impacts and Mitigation

Suitable foraging habitat is present within the Project site for all four bird species discussed above; however, suitable nesting habitat is only present for the reddish egret, white-faced ibis, and white-tailed hawk. If present on the Project site, all of these species are highly mobile and would likely move to nearby suitable habitat. If species were nesting on the Project site, Project construction could temporarily disrupt nesting through clearing of vegetation, operation of heavy equipment, increased human activity in the area, lighting, and noise. Construction machinery and vehicles could cause harassment, injury, or mortality, particularly of nesting birds and young. Increased human activity, noise, and lighting could also cause nesting birds to abandon their nests. In order to minimize potential impacts on nesting state-listed threatened and endangered birds, Texas LNG would implement the measures outlined in its Migratory Bird Plan, as further discussed in section 4.6.1.3 (see our recommendation). These measures include, but are not limited to, conducting all clearing, grading, and dredging activities outside of the primary nesting season of April 1 through July 15, as recommended by TPWD. If clearing, grading, and dredging is proposed during the primary nesting season, Texas LNG would conduct nesting surveys prior to commencing these activities (see our recommendation in section 4.7.1 regarding nesting surveys).

Operation of the Project could also impact state-listed bird species due to permanent lighting that would be installed at the LNG terminal. Glare from LNG terminal lighting could affect foraging, migration, reproduction, and other critical bird behaviors. In addition, bird collisions could occur with Project infrastructure such as the communications tower, flares, LNG storage tanks, and powerlines which could result in individual bird mortalities during operation. However, Texas LNG has developed a Facility Lighting Plan to demonstrate consistency with various regulation standards that would minimize potential impacts on migratory birds from facility lighting. The Facility Lighting Plan includes down-facing lights with shielding lighting that would minimize the horizontal emission of light away from intended areas, as well as the use of timers and motion detection sensors, where feasible. In addition, Texas LNG would adhere to the FWS (2016) *Guidelines for Recommendations on Communication Tower Siting, Construction, Operation, and Decommissioning*, as well as FAA lighting recommendations to minimize impacts on birds, as further discussed in section 4.6.1.3.

Through implementation of the measures outlined above, we have determined that impacts on state-listed threatened and endangered bird species would be minor.

Reptiles and Amphibians

Black-striped Snake

The black-striped snake is state-listed as threatened and has a current distribution that ranges from southern Texas to Mexico. The preferred habitat for this species consists of relatively loose, sandy soils with scattered debris such as rotting cacti. Soil cracks that form in dry soil may also be utilized by the black-striped snake. This nocturnal species forages at night and burrows beneath soil or seeks shelter under debris during the day (Herps of Texas, 2017).

Potentially suitable habitat within the Project site consists of barren land, salt and brackish high tidal marsh, salty prairie, sea ox-eye daisy flat, loma evergreen shrubland, loma deciduous shrubland, and loma grassland.

Northern Cat-eyed Snake

The northern cat-eyed snake is state-listed as threatened and has a distribution that ranges south along the Gulf Coast from south Texas into South America. In Texas, this species prefers subtropical thornscrub habitats. The northern cat-eyed snake hunts at night or in dense foliage along waterbodies and searches for prey on the ground and in trees (Herps of Texas, 2017).

Potentially suitable habitat within the Project site consists of loma evergreen shrubland, loma deciduous shrubland, and emergent wetlands. According to the TXNDD, the closest recorded sighting to the Project was documented in 1927 and located approximately 16.5 miles southwest of the Project.

Texas Horned Lizard

The Texas horned lizard was state-listed as threatened in 1977. The range of this species extends from northern Mexico, through much of Texas, Oklahoma, Kansas, and New Mexico. This species prefers semiarid, open areas with sparse vegetative cover and nests and hibernates in loose sand to loamy soils, which serve as an important habitat indicator (TPWD, 2017d).

Suitable habitat for the Texas horned lizard within the Project site consists of loma grassland and barren land. During the January 2015 field surveys, a Texas horned lizard was observed in the loma habitat located within the south-central portion of the Project site.

Texas Indigo Snake

The Texas indigo snake is state-listed as threatened. This snake species occurs within the southern third of Texas and is generally found south of San Antonio and Del Rio. The Texas Indigo snake inhabits mesquite savanna and bush woodlands but typically prefers riparian areas and frequently uses burrows created by other animals (Herps of Texas, 2017; Lee et al., 2007).

Suitable habitat within the Project site includes salty prairie, loma evergreen shrubland, loma deciduous shrubland, and loma grassland. During the October 2015 species-specific survey, one Texas indigo snake and a shed skin were observed within the Project site.

Texas Tortoise

The Texas tortoise was state-listed as threatened in 1977, and the distribution ranges from south-central Texas to Mexico (TPWD, 2017e). Habitat for the Texas tortoise includes brush and scrub lands and lomas, with a preference for sandy, well-drained soils, which allow the tortoise to excavate a “pallet” to escape the heat of the day and also to create shallow nesting chambers to lay eggs (Arkive.org, 2018). During the cold winter months, Texas tortoises are inactive. Texas tortoises are herbivores, primarily feeding on prickly pear cactus, small plants, and grasses (Herps of Texas, 2017).

Vegetation communities that contain suitable habitat for the Texas tortoise present within the Project site include salty prairie, loma evergreen shrubland, loma deciduous shrubland, and loma grassland. During the October 2015 species-specific survey, a total of 48 Texas tortoises were found within the Project site, all of which were observed in the loma habitats and areas of higher elevation within the salty prairie habitat.

Black-Spotted Newt

The black-spotted newt is state-listed as threatened. This species inhabits south Texas and Mexico and prefers shallow, warm water habitats such as ditches, ponds, and swamps that contain vegetative cover. Breeding for this species can occur all year, but generally peaks in the spring when females will lay up to 300 eggs within submerged vegetation in shallow water habitats (Herps of Texas, 2017). The emergent wetlands located within the central portion of the Project site potentially serves as suitable habitat for the black-spotted newt.

Sheep Frog

The sheep frog is state-listed as threatened and is found from south Texas down to Costa Rica. This species spends the majority of the year burrowed underground or under fallen tree limbs but occasionally emerges at night or in the late summer with heavy rains (Herps of Texas, 2017). The emergent wetlands located within the central portion of the Project site potentially serves as suitable habitat for the sheep frog.

South Texas Siren (Large Form)

The South Texas siren was state-listed as threatened in 2003. This aquatic species is endemic to the southern Texas; however, its current range is unknown. The preferred habitat consists of shallow waterbodies and wetlands (Kline and Carreon, 2013). This nocturnal species burrows into the soft substrates during the day (Herps of Texas, 2017). At dry times, this species will aestivate inside a mucus layer beneath substrate until optimal conditions return.

The emergent wetlands located within the central portion of the Project site potentially serves as suitable habitat for the south Texas siren. According to the TXNDD, the closest recorded sighting to the Project was documented in 1960 and located approximately 13.5 miles southwest of the Project.

White-lipped Frog

The white-lipped frog is state-listed as threatened. The current distribution of this species extends from southern Texas into South America and preferred habitat consists of wet to moist areas such as roadside ditches, irrigated fields, ponds, or wetlands. White-lipped frogs are nocturnal and burrow into moist soils during the day. Breeding of this species occurs during heavy rains in the spring, and eggs are laid in vegetated areas near waterbodies (Herps of Texas, 2017).

The emergent wetlands located within the central portion of the Project site potentially serves as suitable habitat for the white-lipped frog. The closest known occurrence to the Project site, according to the TXNDD was located approximately 10 miles away.

Reptile and Amphibian Impacts and Mitigation

All of the state-listed amphibians and reptiles discussed above have potentially suitable habitat present within the Project site and could be impacted by clearing and grading activities associated with construction of the Project. Project construction could disrupt normal reptile and amphibian activities, including foraging and breeding, through human activity, lighting, and noise. In addition, open trenches could create a risk of inadvertent entrapment, resulting in injury or mortality, and construction machinery and vehicles could cause harassment, injury, or mortality. Texas tortoises would be more at risk of harm from construction machinery and vehicles given their lesser mobility. Generally, reptiles and amphibians would be more susceptible to direct physical harm during the spring mating season when they are more active, and when eggs would be at risk of being crushed by construction equipment. Reptiles would also be at risk of injury or mortality during the hibernation period through late fall and winter when they are most inactive (October through March) and would not be able to move away from construction equipment (TPWD, 2015c).

Texas LNG would implement conservation measures to minimize impacts and avoid take of state-listed reptiles and amphibians, as detailed in the Terrestrial Reptile and Amphibian Conservation Plan[26]. Conservation measures are based in part on best management practices for Texas tortoise published by the TPWD (2012) and recommendations provided by the TPWD in a letter dated May 5, 2015, and include the following:

- Texas LNG would install exclusion fencing around suitable habitats within construction areas to isolate suitable habitats and allow state-listed reptiles and amphibians to be captured and relocated prior to construction activities.
- Biological monitors with a Scientific Collecting Permit from the TPWD Wildlife Permits Program for handling state-listed species would be on site prior to and after the installation of exclusion fencing and during clearing and grading activities to:
    - relocate state-listed reptiles and amphibians from construction areas;

[26] Texas LNG's Amphibian and Reptile Conservation Plan is available on eLibrary under accession number 20170622-5032.

- o inspect exclusion fencing at least twice weekly and after any significant weather-related impact or human and/or machine encounter; and
- o inspect any trenches left overnight prior to work commencing.

- Texas LNG would follow the specific guidelines in its Terrestrial Reptile and Amphibian Conservation Plan for the safe capture and relocation of Texas tortoises and the safe recovery and relocation of Texas tortoise eggs.
- Biological monitors would release any captured Texas horned lizards adjacent to harvester ant mounds in an effort to increase survival success.
- Texas LNG would conduct environmental training for company and contract personnel, including training on the conservation measures described in the Terrestrial Reptile and Amphibian Conservation Plan.
- Texas LNG would implement a “no kill” policy regarding potential wildlife encounters within the construction site.
- Erosion and spill control measures would be implemented to minimize and/or avoid impacts from erosion, sedimentation, and incidental spills of hazardous substances, as detailed in the Project-specific ECP, SPAR Plan, and SWPPP.

Based on the relatively limited extent of the proposed disturbance within the broader landscape, available adjacent habitats, Texas LNG’s plan to revegetate areas used as temporary workspace, and the implementation of the Terrestrial Reptile and Amphibian Conservation Plan to avoid and minimize potential impacts, impacts on state-listed reptiles and amphibians are anticipated to be minor. In a letter dated June 22, 2017, the TPWD made additional recommendations and provided comments on Texas LNG’s Terrestrial Reptile and Amphibian Conservation Plan. The TPWD is particularly concerned with relocation of Texas tortoises, as reduced survival rates of relocated tortoises or resident tortoises at the relocation site could occur. The TPWD recommends that Texas LNG conduct “soft releases” in which relocated tortoises are placed in an enclosed habitat within the relocation site and supplemented with food to ease the transition to the new habitat. The TPWD requested additional consultations with Texas LNG regarding relocation options and methods, which have not occurred as of the writing of this EIS. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Texas LNG should file with the Secretary a plan for the capture and relocation of Texas tortoises developed in consultation with TPWD.**

4.7.2.2 Marine Mammals

Marine mammals are federally protected under the MMPA. The MMPA established, with limited exceptions, a moratorium on the “take” of marine mammals in waters or on lands under U.S. jurisdiction. The MMPA further regulates, with certain exceptions, the “take” of marine mammals on the high seas by person, vessels, or other conveyances subject to the jurisdiction of the U.S. A total of 26 mammals protected under the MMPA may occur along the LNG carrier transit routes in the Gulf of Mexico and/or within the Brownsville Ship Channel (NMFS, 2012). Five of these species are also listed under the ESA (four whales and the West Indian manatee) and are included in section 4.7.1. Table 4.7.2-1 identifies all marine mammals known to occur with the Gulf of Mexico that are not otherwise federally listed as threatened or endangered.

TABLE 4.7.2-1

Non-Federally Listed Marine Mammals Potentially Occurring Along LNG Carrier Transit Routes

Common Name	Scientific Name	Area Where Mammal May Occur
Dolphins		
Atlantic spotted dolphin	*Stenella frontalis*	Gulf of Mexico
Bottlenose dolphin	*Tursiops truncates*	Brownsville Ship Channel, Gulf of Mexico
Clymene dolphin	*Stenella clymene*	Gulf of Mexico
False killer whale	*Pseudorca crassidens*	Gulf of Mexico
Fraser's dolphin	*Lagenodelphis hosei*	Gulf of Mexico
Killer whale	*Orcinus orca*	Gulf of Mexico
Melon-headed whale	*Peponocephala electra*	Gulf of Mexico
Pantropical spotted dolphin	*Stenella attenuate*	Gulf of Mexico
Pygmy killer whale	*Feresa attenuate*	Gulf of Mexico
Risso's dolphin	*Grampus griseus*	Gulf of Mexico
Rough-toothed dolphin	*Steno bredanensis*	Gulf of Mexico
Short-finned pilot whale	*Globicephala macrorhynchus*	Gulf of Mexico
Spinner dolphin	*Stenella longirostris*	Gulf of Mexico
Striped dolphin	*Stenella coeruleoalba*	Gulf of Mexico
Whales		
Blainville's beaked whale	*Mesoplodon densirostris*	Gulf of Mexico
Gulf of Mexico Bryde's whale	*Balaenoptera edeni*	Gulf of Mexico
Cuvier's beaked whale	*Ziphius cavirostris*	Gulf of Mexico
Dwarf sperm whale	*Kogia sima*	Gulf of Mexico
Gervais' beaked whale	*Mesoplodon europaeus*	Gulf of Mexico
Minke whale	*Balaenoptera acutorostrata*	Gulf of Mexico
Pygmy sperm whale	*Kogia breviceps*	Gulf of Mexico
Sowerby's beaked whale	*Mesoplodon bidens*	Gulf of Mexico

Source: NMFS, 2012

Bottlenose dolphins are the most common marine mammal that occurs throughout the inshore and nearshore waters of the Texas Gulf Coast. Bottlenose dolphins are the only marine mammal species anticipated to occur within the Brownsville Ship Channel; however the remaining marine mammal species listed in table 4.7.2-1 may occur along the LNG carrier transit routes within the Gulf of Mexico. In addition, the West Indian manatee is considered a marine mammal; however, it is also protected by the ESA, as further discussed in section 4.7.1.2. Due to their presence within the Brownsville Ship Channel, bottlenose dolphins could be affected by dredging and pile driving activities at the Project site.

NMFS recently developed the *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (2016b). The bottlenose dolphin is classified by NMFS as a mid-frequency cetacean. Although the West Indian manatee is not a cetacean, NMFS guidance states that manatees are most similar to mid-frequency cetaceans; therefore, underwater noise thresholds for mid-frequency cetaceans were used to assess potential impacts on manatees resulting from Project activities (NMFS, 2016c). The underwater noise thresholds developed by NMFS for mid-frequency cetaceans are presented in table 4.7.2-2.

TABLE 4.7.2-2

Underwater Sound Thresholds for Marine Mammals

Functional Hearing Group	Underwater Sound Thresholds [b]			
	Vibratory Pile Driving – Behavioral Disturbance [a]	Vibratory Pile Driving – Injury [b, c]	Impact Pile Driving – Behavioral Disturbance [a]	Impact Pile Driving – Injury
Marine Mammals (mid-frequency cetaceans) Temporary Threshold Shift [d]	120 dB RMS	178 dB SEL_{cum} 224 dB Peak	160 dB RMS	170 dB SEL_{cum} 224 dB Peak
Marine Mammals (mid-frequency cetaceans) Permanent Threshold Shift [d]	120 dB RMS	198 dB SEL_{cum} 230 dB Peak	160 dB RMS	185 dB SEL_{cum} 230 dB Peak

a The root mean square exposure level is the square root of the average sound pressures over the duration of a pulse and represents the effective pressure and intensity produced by a sound source.
b The cumulative sound exposure level is the energy accumulated over multiple strikes or continuous vibration over a period of time.
c Peak sound pressure level is the largest absolute value of instantaneous sound pressure.
d The injury threshold is the general level for temporary or permanent threshold shift onset for mid-frequency cetaceans as identified by NMFS (2016a). Threshold shifts are influenced by the frequency of noise received and a cumulative sound exposure exceeding this level may not cause a threshold shift if outside the range of hearing.

A detailed discussion of the anticipated underwater sound levels that would occur during construction of the Project is provided in section 4.6.2.2 and appendix D. The anticipated distances at which the thresholds presented in table 4.7.2-2 would be expected to occur are presented in table 4.7.2-3. As detailed in table 4.7.2-3, the thresholds presented in table 4.7.2-2 would be exceeded, even with the implementation of noise mitigation measures such as bubble curtains or cushion blocks.

TABLE 4.7.2-3

Calculated Distances to Underwater Noise Thresholds for Marine Mammals from Dredging and Mitigated In-water Pile Driving for the Texas LNG Project

Activity	Distance from Source in which Threshold would be Exceeded		
	Permanent Injury	Temporary Injury	Behavioral Disturbance
Impact pile driving	80 feet	800 feet	1,522 feet
Vibratory pile driving	6 feet	127 feet	32,800 feet
Dredging	<0.1 foot	2 feet	9,606 feet

Based on the thresholds developed by NMFS, thresholds for permanent and temporary injury to marine mammals are anticipated to be exceeded within 80 feet and 800 feet of the in-water pile driving activities, respectively. Behavioral thresholds would be exceeded up to 6.2 miles from pile driving activities; therefore, an incidental take authorization from NMFS may be required. During dredging activities, threshold for permanent and temporary injury to marine mammals are anticipated to be exceeded within 0.1 foot and 2 feet, respectively, and behavioral thresholds would be exceeded within 1.8 miles. Although bottlenose dolphins would be expected to largely avoid the Project area during pile driving activities, the potential exists for bottlenose dolphins to be injured during the first several strikes of the pile driving hammer. Texas LNG would reduce impacts on marine mammals from pile driving, as well as all marine species by implementing the measures outlined in section 4.6.2.2. However, the potential exists for marine mammals to be injured during pile driving activities. Texas LNG has not completed consultations with NMFS regarding pile driving activities (see our recommendation in section 4.6.2.2).

Impacts on marine mammals occurring along the LNG carrier transit routes would be similar to those discussed in the BA (appendix D) regarding the West Indian manatee, federally listed whales, and sea turtles. The primary threat to marine mammals resulting from LNG carrier transits would be an increased risk of vessel strikes during operation. LNG carriers operating within the Exclusive Economic Zone in the Gulf of Mexico are generally slower and generate more noise than typical large vessels, which would make them likely to be avoided by marine mammals. As described in the BA, Texas LNG would provide ship captains with the NMFS Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) and would advocate compliance with the measures identified in the document to minimize the likelihood of vessel strikes. Based on the implementation of the measures discussed above and our recommendation in section 4.6.2.2, we have determined that the proposed Project impacts on marine mammals would be minor.

4.8 LAND USE, RECREATION, AND VISUAL RESOURCES

4.8.1 Land Use

The Project site consists of four land use types including wetlands, scrub shrub, open land, and open water. Table 4.8.1-1 summarizes the acreage of each land use type that would be affected by construction and operation of the Project. Land use was primarily determined based on the dominant vegetation type and function of the land. Each land use type present within the Project site is characterized as follows:

- Wetlands – Areas including both PEM wetlands and tidal flats delineated within the Project site. PEM wetlands are dominated by vascular emergent plants and are not tidally influenced. Tidal flats on the Project site are generally unvegetated and receive periodic inundation as a result of tides (although tidal exchange is limited due to historic dredging along the Brownsville Ship Channel).

- Scrub shrub - Areas dominated by shrubs that are less than 15 feet tall with shrub canopy typically greater than 20 percent of total vegetation. This land use type includes true shrubs as well as young trees or stunted trees. Scrub shrub land within the Project site is primarily present on the lomas and is dominated by mesquite (see section 4.5 for additional information regarding vegetation within the Project site).

- Open land - Areas dominated by grasses within the Project site that are not otherwise classified as wetlands. It also includes dirt access roads and sparsely vegetated upland areas bordering the tidal flats.

- Open water – Areas that are consistently inundated regardless of tide or precipitation and generally lack emergent vegetation. Within the Project site, open water consists entirely of the Brownsville Ship Channel.

4.8.1.1 Environmental Setting

The Project site consists of a 625-acre parcel, as well as an additional 26.5-acre area necessary to connect the parcel to the Brownsville Ship Channel. The Project site is owned by the BND and is zoned for industrial uses; however, it has never been developed. The site is closed to the public, and although it was historically used to graze cattle, the current use is limited to storage by the BND. Of the 651.5-acre Project site, 311.5 acres would be impacted during construction, of which 282.0 acres would be retained for operation or be permanently impacted by grading activities.

Impacts on land use at the Project site are considered to be permanent where permanent facilities would be constructed, dredging would occur, and areas in which contours would not be restored to preconstruction conditions. Texas LNG would grade the Project site, as shown on figure 2.5.1-1. Several temporary workspaces necessary for construction of the Project would be within the graded areas. Following construction, Texas LNG does not intend to restore contours in all of these areas; however, these areas would not be used for operation of the Project facilities or maintained. Impacts on areas where preconstruction contours would not be restored following construction are considered permanent; therefore, for the purposes of presenting impacts associated with the Project, these areas are included under "Operation" impacts in table 4.8.1-1.

Several temporary workspace areas, totaling 16.9 acres, would be utilized during Phase 1 of the Project, but would not be required for Phase 2. These areas include the temporary construction basin, jetty and flarestack laydown areas, borrow areas, temporary workspace for the LNG carrier berthing dock, and temporary workspace necessary for site preparation. Following construction of Phase 1, these areas would be restored and revegetated. Texas LNG would not restore contours within the borrow areas[27] or within a portion (0.2 acre) of the jetty and flarestack laydown areas; however, these areas would be revegetated. Restoration activities would consist of removing temporary structures, temporary fill such as gravel, and soil amendments, where necessary. Additionally, topsoil stored at the Project site, would be used during restoration to help facilitate revegetation (see sections 4.2.3 and 4.5.2 for additional information regarding revegetation).

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[27] Borrow areas are areas where Texas LNG would use soil from the site Project site as fill during site preparation and grading activities.

The remaining temporary workspace and laydown areas (46.4 acres) would be used during construction of both Project phases. Texas LNG has indicated that these areas would be restored either after construction of Phase 2 is complete or on or about five years after FERC issues the Notice to Proceed for Phase 2, if construction has not started and there is no imminent prospect of starting Phase 2. Temporary workspace and laydown areas necessary for construction of both phases of the Project include the concrete batch plant, construction warehouse and workshops, laydown areas, contractor offices, contractor parking lot, crane pad, topsoil storage area, and temporary access road. Contours would not be restored in areas used for the construction warehouse and workshops, laydown areas, contractor offices, and topsoil storage area; however, all temporary workspace areas used during construction of both Project phases would be revegetated and would not be maintained by Texas LNG during operation of the Project. Restoration and revegetation would be the same as described above for temporary workspace used during construction of Phase 1.

Texas LNG also plans on using the 704-acre PA 5A for placement of dredge material during construction. PA 5A is an actively used confined PA for dredge material. Impacts within PA 5A would consist of raising the existing berms and placement of dredge material from dredging of the maneuvering basin, which is consistent with its current land use.

The Project site is crossed by a 5-foot-wide right-of-way easement that contains an abandoned, underground 4.5-inch-diameter natural gas gathering line (see section 2.5.4.2). The pipeline formerly serviced two gas wells on Long Island about 1.5 miles east of the Project site near Port Isabel. Both ends of the pipeline have been disconnected from gas supplies or sale sources. The pipeline is parallel and immediately adjacent to the shoreline of the Brownsville Ship Channel crossing the area proposed for the maneuvering basin. The depth and current condition of the pipeline is unknown; however, due to continuous exposure to saltwater without cathodic protection, it is anticipated that the pipeline is likely in poor condition. Additional information regarding the procedures that would be followed during construction to remove the pipeline is provided in section 2.5.4.2.

TABLE 4.8.1-1										
Land Use Types Affected by Construction and Operation of the Texas LNG Project (in acres)										
	Open Land		**Scrub Shrub**		**Wetland/Tidal Flat**		**Open Water**		**Total**	
Facility	**Cons.**	**Oper.**	**Cons.**	**Oper.**	**Cons.**	**Oper.**	**Cons.**	**Oper.**	**Cons.** [a]	**Oper.**
PERMANENT FACILITIES										
Liquefaction Process Area and LNG Storage Tanks [b]	87.0	87.0	68.4	68.4	1.1	1.1	0.0	0.0	156.6	156.6
Maneuvering Basin [c]	0.0	0.0	0.0	0.0	39.4	39.4	32.7	32.7	72.0	72.0
LNG Carrier Berthing Dock	0.1	0.1	0.0	0.0	1.4	1.4	0.0	0.0	1.5	1.5
Permanent Access Road	6.7	6.7	0.0	0.0	0.0	0.0	0.0	0.0	6.7	6.7
Non-jurisdictional Facilities within the Project Site [d]	10.4	10.4	0.0	0.0	1.0	1.0	0.0	0.0	11.4	11.4
Subtotal	**104.2**	**104.2**	**68.4**	**68.4**	**42.9**	**42.9**	**32.7**	**32.7**	**248.2**	**248.2**
TEMPORARY WORKSPACE AND LAYDOWN AREAS [e]										
Phase 1 Only										
Temporary Construction Basin	0.0	0.0	0.0	0.0	0.4	0.0	1.1	0.0	1.5	0.0
Jetty and Flarestack Laydown Areas	3.2	0.0	0.2	0.2	0.0	0.0	0.0	0.0	3.4	0.2
LNG Carrier Berthing Dock	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0
Borrow Areas	1.8	1.8	0.2	0.2	0.0	0.0	0.0	0.0	2.0	2.0
Site Preparation Temporary Workspace	7.1	0.0	1.0	0.0	0.9	0.0	0.0	0.0	9.0	0.0
Subtotal	**12.1**	**1.8**	**1.4**	**0.4**	**2.3**	**0.0**	**1.1**	**0.0**	**16.9**	**2.2**
Phases 1 and 2										
Concrete Batch Plant	2.5	0.0	0.2	0.0	0.0	0.0	0.0	0.0	2.7	0.0
Warehouse and Workshops	8.8	8.8	4.0	4.0	0.0	0.0	0.0	0.0	12.8	12.8
Laydown Areas	1.9	1.9	11.0	11.0	0.0	0.0	0.0	0.0	12.9	12.9
Contractor Offices	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5
Contractor Parking Lot	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0
Crane Pad	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
Topsoil Storage Area	1.7	1.7	0.7	0.7	0.0	0.0	0.0	0.0	2.4	2.4
Temporary Access Road	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
Subtotal	**29.5**	**15.9**	**16.9**	**15.7**	**0.0**	**0.0**	**0.0**	**0.0**	**46.4**	**31.6**
PROJECT SITE TOTAL	**145.8**	**121.9**	**86.7**	**84.5**	**45.2**	**42.9**	**33.8**	**32.7**	**311.5**	**282.0**
DREDGE MATERIAL PLACEMENT AREA										
Placement Area 5A	704.0	704.0	0.0	0.0	0.0	0.0	0.0	0.0	704.0	704.0

TABLE 4.8.1-1										
Land Use Types Affected by Construction and Operation of the Texas LNG Project (in acres)										
	Open Land		Scrub Shrub		Wetland/Tidal Flat		Open Water		Total	
Facility	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons.	Oper.	Cons. [a]	Oper.

[a] Total construction impacts include both temporary and permanent work areas. Due to rounding the totals may not equal the sum of the addends.
[b] Includes all areas contained within the liquefaction and storage tank areas of the fenced Project site, including but not limited to the administration building, gas gate station, utility substation, and communication tower).
[c] Includes the acreage associated with the MOF.
[d] Includes the portions of the non-jurisdictional natural gas pipeline, electric transmission line, and potable water line located within the Project site.
[e] Impacts presented in the "Operation" column under "Temporary Workspace and Laydown Areas" represent areas used for construction in which contours would not be restored. Following construction in these areas, all temporary buildings and equipment would be removed and the area would be revegetated; however, contours would not be restored, resulting in a permanent impact.

4.8.1.2 Impacts and Mitigation

Construction of the Project would impact a total of 311.5 acres of land at the Project site. Of this, 282.0 acres would be permanently affected by operation of the Project and 29.5 acres would be restored to preconstruction conditions after the completion of construction activities. In addition to the land required at the Project site, Texas LNG would also utilize 704.0 acres of land associated with the existing PA 5A for dredge material placement. The land use types affected by construction at the Project site include open land (47 percent), scrub shrub (28 percent), wetland (14 percent), and open water (11 percent). Project impacts on each of these land use types are further discussed below.

Open Land

Construction of the Project would affect 145.8 acres of open land at the Project site with 121.9 acres permanently impacted during operation. The majority of permanent impacts on open land (104.2 acres) would occur as a result of the conversion of open land to industrial land necessary for installation of Project facilities, including the liquefaction process area and LNG storage tanks, permanent access roads, LNG carrier berthing dock, and the non-jurisdictional facilities located within the Project site. The remaining 17.7 acres of impacts are considered permanent because contours would not be restored to preconstruction conditions; however, the areas would be revegetated and would remain open land.

The entirety of the 704.0-acre area at PA 5A that would be impacted by placement of dredge material is characterized as open land. PA 5A is an active dredge disposal area routinely used by BND and COE during maintenance dredging of the Brownsville Ship Channel. As described in section 4.3.2.3, Texas LNG would raise the berms around PA 5A to contain the dredge material associated with the Project. The raising of the berms and placement of the dredge material would permanently raise the elevations of the site; however, the area would continue to be characterized as open land and would retain its current land use as a dredge material PA.

Scrub Shrub

Scrub shrub affected by the construction of the Project would total 86.7 acres, of which 84.5 acres would be impacted during operation. Of the 84.5 acres of scrub shrub land that would be permanently impacted by the Project, 68.4 acres would be associated with the liquefaction process area and LNG storage tanks and converted to industrial land. Texas LNG would revegetate remaining 18.3 acres following the completion of construction; however, contours would not be restored within 16.1 acres.

Wetland

Wetlands affected by the Project include tidal flats as well as PEM wetlands. In total, 45.2 acres of wetlands would be impacted during construction of the Project, with 42.8 acres permanently impacted during operation. Impacts on wetlands as a result of the Project are further discussed in section 4.4. The majority of permanent wetland impacts (39.4 acres) would result from dredging of the maneuvering basin, which would convert the existing wetlands to deep water habitat. The remaining 3.5 acres of permanent impacts on wetlands would be associated with the liquefaction process area and LNG storage tanks, LNG carrier berthing dock, and non-jurisdictional facilities within the Project site. Wetland areas temporarily impacted during construction (2.3 acres) would be utilized during construction of Phase 1. Following the completion of Phase 1, wetlands temporarily impacted would be restored to preconstruction contours and allowed to revegetate in accordance with Texas LNG's Project-specific ECP.

Open Water

Construction and operation of the Project would impact a total of 32.7 acres of open water, consisting entirely of the Brownsville Ship Channel. The Project would dredge the bank and side slopes of the Brownsville Ship Channel to create a pathway to the maneuvering basin. Following the completion of Project construction, this area would remain open water, although the depth and contours would change as a result of dredging.

Summary and Conclusions

While the majority of the 651.5-acre Project site is owned by the BND and zoned for industrial use, the site has never been developed and currently consists only of open land, scrub shrub, wetland, and open water land use types. Construction of the Project would impact 311.5 acres of the Project site and require 282.0 acres for operation. Although the Project would result in the conversion of a large portion of currently undeveloped land into industrial land, the Project site is zoned for industrial use; therefore, we conclude that Project impacts on land use in the area would not be significant.

4.8.2 Landowner and Easement Requirements

Texas LNG would lease the 625-acre parcel, secured through a lease option and subsequent amendment, from the BND. PA 5A is also owned by BND; however, the COE currently has a lease agreement for use of PA 5A. Prior to using PA 5A Texas LNG would be required to get approval from the COE for use of this site. Texas LNG would obtain federal and state permits in conjunction with its other permits for the Project including the Section 404 and Section 10 permit from the COE and the Section 401 water quality certification from the RRC.

Aside from the Brownsville Ship Channel, no federal, state, or local agency owned or managed lands occur within the Project site.

4.8.3 Planned Developments

There are no planned residential developments within 0.25 mile of the Project site. The City of Port Isabel's Comprehensive Plan Future Land Use Map (2010) identifies an area approximately 1 mile north of the Project site as a planned single family residential area; however, no plats or subdivision proposals have been submitted to the City of Port Isabel. The only planned residential development in the area is Pirates Cove subdivision on the Port Isabel Side Channel approximately 1.5 miles northeast of the Project site.

Non-residential developments planned within 0.25 mile of the Project area include the COE Brazos Island Harbor Channel Improvement Project (Channel Improvement Project) and the Rio Grande LNG Project. The Channel Improvement Project involves the deepening of the Brownsville Ship Channel from -42 feet to -52 feet, in order to improve the navigation efficiency of deep draft vessels and offshore oil rigs using the Brownsville Ship Channel. The LNG carriers calling on Texas LNG's LNG terminal would benefit from the improved navigation efficiency that is anticipated as a result of the Channel Improvement Project. Further, the Channel Improvement Project is specifically designed to improve navigation for the industrial properties located along the Brownsville Ship Channel. Therefore, the Channel Improvement Project would not be adversely affected by the proposed Project, nor would the proposed Project be adversely affected by the Channel Improvement Project.

The Rio Grande LNG Project is a proposed natural gas liquefaction and LNG export facility proposed on the parcel immediately west of the Project site. Rio Grande LNG, LLC (RG LNG) is seeking FERC approval (FERC Docket No. CP16-488-000) for six liquefaction trains, each with a nominal LNG output capacity of 4.5 MTPA. The terminal would also have natural gas pre-treatment facilities, four full containment LNG storage tanks, and truck loading facilities. Marine facilities at the terminal would be in or along a single dock and would include two marine loading berths capable of receiving and loading LNG carriers. Additional dredging would be required to create a maneuvering basin adjacent to the loading berth area. The Rio Grande LNG Project would also include various control and administration structures, a natural gas-fired power plant, and a saltwater desalination plant. In addition, the Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC (collectively, Annova) is proposing to construct an LNG facility on the south side of the Brownsville Ship Channel, approximately 1.7 miles southwest of the Project site. Annova filed an application to site and operate the Annova LNG Brownsville Project (Annova LNG Project) in July 2016 (FERC Docket No. CP16-480-000). The Rio Grande LNG and Annova LNG projects would serve similar purposes to the proposed Project; therefore, the proposed Project would not be adversely affected by, nor would it adversely affect the Rio Grande LNG and Annova LNG projects.

Each of these projects, as well as other planned or proposed development projects in the region are discussed in the cumulative impact analysis provided in section 4.13.

4.8.4 Recreation and Special Interest Areas

Publicly available information was utilized to determine the presence of recreational use areas, including public parks, conservation areas, or other public interest areas in the Project area. A total of nine recreational use areas were identified within five miles of the Project site. In addition, the Palo Alto Battlefield NHP and NHL was also assessed due to the sensitivity of the area and in response to comments received from the NPS. These ten areas are summarized in table 4.8.4-1, depicted on figure 4.8.4-1, and further discussed in the following sections.

TABLE 4.8.4-1

Summary of Recreational Use Areas within 5 miles of the Project Site

Recreational Use Area	Managing Agency	Recreational Uses	Distance from Project (miles)	Direction from Project
Laguna Atascosa National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife viewing, fishing, hunting	<0.1	West
Loma Ecological Preserve	U.S. Fish and Wildlife Service	Wildlife viewing	0.4	South

TABLE 4.8.4-1 Summary of Recreational Use Areas within 5 miles of the Project Site				
Recreational Use Area	**Managing Agency**	**Recreational Uses**	**Distance from Project (miles)**	**Direction from Project**
South Bay Coastal Preserve and South Bay Paddling Trail	Texas Parks and Wildlife Department	Beaches, fishing, wildlife viewing, kayaking	1.0	Southeast
Port Isabel State Historic Site	Texas Parks and Wildlife Department	Lighthouse, museum, picnic area, event space	2.4	Northeast
Lower Rio Grande Valley National Wildlife Refuge	U.S. Fish and Wildlife Service	Wildlife viewing, kayaking	3.0	South
Brazos Island State Scenic Park	Texas Parks and Wildlife Department	Camping, fishing, wildlife viewing, kayaking	3.7	East
Jaime J. Zapata Memorial Boat Ramp	Cameron County Parks and Recreation	Kayaking, fishing	4.4	Southwest
Isla Blanca Park	Cameron County Parks and Recreation	Camping, fishing, wildlife viewing, kayaking, surfing, boating	4.4	Northeast
Palmito Ranch Battlefield National Historic Landmark	National Park Service	Interpretive signage, informational/educational radio broadcast repeater	4.3	South
Palo Alto Battlefield National Historic Park and National Historic Landmark	National Park Service	Educational programming, visitor facilities, hiking, viewing areas	12.5	West

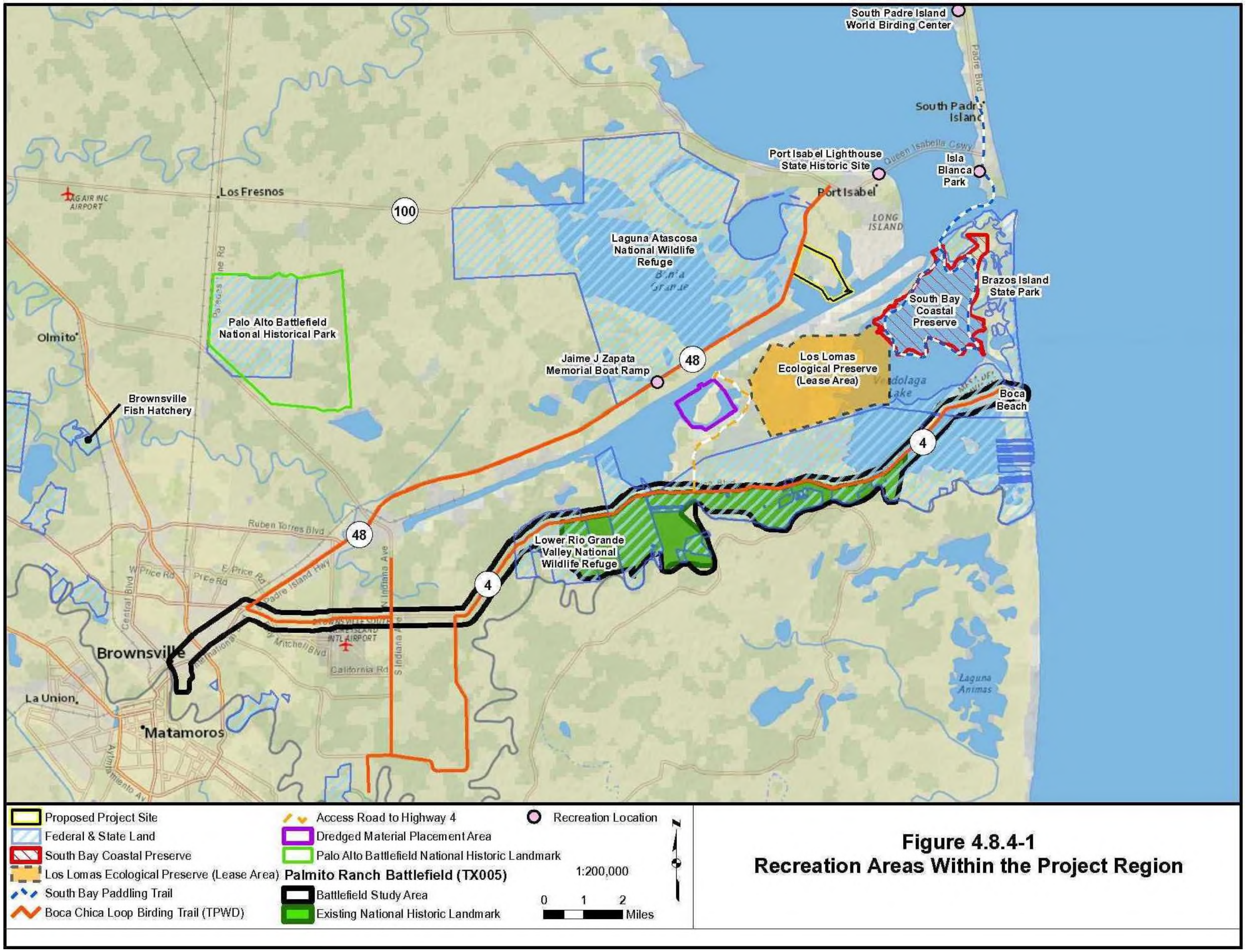

FIGURE 4.8.4-1 Recreation Areas within the Project Region

4.8.4.1 Laguna Atascosa National Wildlife Refuge

The Laguna Atascosa NWR is a 97,007-acre refuge consisting of four main units along the northeastern edge of Cameron County and the southeastern edge of Willacy County. The unit nearest to the Project site is the 21,762-acre Bahia Grande Unit located between SH 48 and SH 100 approximately 1 mile west of Port Isabel (FWS, 2010a). The Project site neighbors the Laguna Atascosa NWR along 0.8 mile of its northwest boundary and is separated by SH 48, a divided highway with a 200-foot-wide right-of-way.

Acquired by FWS in 2000, the Bahia Grande Unit is considered one of the largest and most successful coastal wetland restoration projects in the U.S. The Laguna Atascosa NWR offers a number of recreation opportunities for visitors including wildlife viewing, hunting, fishing, photography, and environmental education (FWS, 2015a). There are two wildlife viewing areas within the Bahia Grande Unit, the closest of which is approximately 2.5 miles southwest of the proposed Project site along SH 48. Non-motorized boats are also allowed within San Martin Lake, accessed from the Jaime J. Zapata Memorial Boat Ramp approximately 4.4 miles southwest of the proposed Project site (see section 4.8.4.6 for additional information regarding the Jaime J. Zapata Memorial Boat Ramp). The Laguna Atascosa NWR also frequently conducts guided birdwatching tours throughout the Bahia Grande Unit.

Recreation activities within the Laguna Atascosa NWR could be affected by construction and operation of the Project due to an increase in traffic along SH 48 and construction and operation noise. Increased noise associated with construction of the Project could deter recreational users in the area for bird watching or other wildlife viewing. In particular, pile driving and road noise from increased traffic on SH 48 could result in the avoidance of the area by recreational users.

In addition to increased noise, the increase in construction traffic during the estimated five-year construction period (assuming overlapping construction of Phase 1 and Phase 2) would also increase dust, emissions, and travel times along SH 48, including the SH 48 wildlife viewing area and along San Martin Lake. Increased traffic could deter people from stopping at the SH 48 viewing area, especially those coming from the west that would turn left to access the area. More detailed discussions of the impacts of construction traffic and emissions are discussed in sections 4.9.6 and 4.11.1, respectively.

Users of the Laguna Atascosa NWR may be further affected as a result of noise associated with operation of the Project. Anticipated increases in noise within the Laguna Atascosa NWR are further addressed in sections 4.6.1 and 4.11.2. During the construction of Phase 1 and the operation of Phase 1 with construction of Phase 2, the noise from the Project contribution at the nearest point in the Laguna Atascosa NWR could increase ambient noise by 5.9 and 6.0 decibels, respectively. This increase in background noise levels would be noticeable and greatest during concurrent dredging and pile driving activities. During operation of both Project phases, the Project contribution to the existing ambient noise would be an increase of 1.0 decibel. This increase is not likely to be perceptible by recreation users within the Project area, as perceptible noise increases for humans are estimated to be 3 decibels (Bolt, Beranek, and Newman, Inc., 1973).

All designated recreation areas within the Laguna Atascosa NWR are located more than 2 miles from the proposed Project site. The majority of impacts on these areas would likely be associated with increased traffic on SH 48 during construction and would be moderate but temporary. Other recreational uses of Bahia Grande Unit, such as guided birdwatching tours, could occur closer to the Project site. Due to the proximity of the refuge to the proposed Project site (less than 200 feet), impacts associated with increased noise during construction and operation would be moderate and minor at the refuge boundary, respectively, but not significant, with impacts diminishing as distance from the Project site increases. Impacts resulting from operational noise would be permanent, but not perceptible; whereas, impacts from construction noise would be temporary, but noticeable. Because two designated recreation areas in the Bahia Grande Unit are directly off of SH 48, increased traffic on SH 48 during construction would be moderate but temporary and not significant.

4.8.4.2 Loma Ecological Preserve

The Loma Ecological Preserve is on the western end of South Bay approximately 0.4 mile south of the proposed Project site. The Loma Ecological Preserve consists of 4,600 acres of tidal flats, lomas, and vegetated island ridges that are situated above tidal inundation areas. The Loma Ecological Preserve is owned by the BND and held under lease by the FWS until 2023 when the lease expires (BND, 1983). The primary function of the Loma Ecological Preserve is habitat preservation not recreational use; however, it contributes to the recreational opportunities on adjacent public land and water around the South Bay by providing a visual buffer from development along the Brownsville Ship Channel (FWS, 1997).

Construction and operation of the Project could affect the Loma Ecological Preserve. During construction, noise impacts, primarily associated with pile driving activities, may be perceptible within parts of the Loma Ecological Preserve; however, these impacts would be temporary and not significant. During operation, noise from the facility may also be perceptible within parts of the Loma Ecological Preserve; however, this is anticipated to be less than that described for the Laguna Atascosa NWR due to the increased distance of the Loma Ecological Preserve from the Project activities. Increased ship traffic during construction and operation, including LNG carriers, could adversely affect recreational boaters accessing the Loma Ecological Preserve by delaying or temporarily restricting access across the Brownsville Ship Channel (additional information regarding impacts from ship traffic on recreational boaters is provided in section 4.9.6). Overall, impacts on the Loma Ecological Preserve as a result of operation of the Project would be minor, but permanent.

4.8.4.3 South Bay Coastal Preserve and South Bay Paddling Trail

The SBCP, managed by TPWD and established in 1984, consists of approximately 3,500 acres bounded to the south by the Rio Grande riparian edge, to the north by the Brownsville Ship Channel and associated spoil banks, to the west by Loma Ecological Preserve, and to the east by Brazos Island. The South Bay Paddling Trail begins in Isla Blanca Park (see section 4.8.4.7), crosses the Brownsville Ship Channel, and follows the shores of South Bay in a loop of about 8 miles (TPWD, 2017f). The SBCP and South Bay Paddling Trail is characterized by areas of emergent and submergent vegetation and algal flats that provide important habitat to numerous species of fish and shellfish. Black mangroves and cordgrass provide habitat for nesting and wintering birds. In addition, the SBCP supports the largest concentration of oysters in the Lower Laguna Madre and permits commercial oyster "landing" areas where oyster cages are collected and brought to shore (TPWD, 2015a). Due to the shallow water, access to the SBCP is generally limited to non-motorized boats. Recreational uses include wildlife viewing, fishing, hunting, and paddling.

The SBCP and South Bay Paddling Trail are 1 mile southeast of the proposed Project site and would not be directly affected by Project activities. Indirect impacts would be similar to that described above for the Loma Ecological Preserve.

4.8.4.4 Port Isabel State Historic Site

The Port Isabel State Historic Site is 2.4 miles northeast of the proposed Project site in Port Isabel. The site is known for the historic lighthouse, which is open to the public and affords views of the surrounding area (TPWD, 2017g). Construction and operation of the Project would not directly impact the Port Isabel State Historic Site. The Project facilities would likely be visible from the lighthouse, in the distance, resulting in negligible permanent impacts on the viewshed, as further discussed in section 4.8.5. However, due to the distance and direction from the Project site, the LNG terminal would not block views.

4.8.4.5 Brazos Island State Scenic Park

Brazos Island State Scenic Park is on the southernmost barrier island in Texas just north of the eastern end of SH 4 and is approximately 4.0 miles southeast of the proposed Project site. The entire 217-acre park is undeveloped and is used for ocean fishing, surfing, swimming, camping, and nature study (Texas State Historical Association, 2010). Due to the distance from the Project site, as well as land and marine transit routes that would be used for the Project, the Project is not anticipated to impact the Brazos Island State Scenic Park.

4.8.4.6 Jaime J. Zapata Memorial Boat Ramp

The Jaime J. Zapata Memorial Boat Ramp is on SH 48 adjacent to the Brownsville Ship Channel and San Martin Lake approximately 4.4 miles west of the proposed Project site. In addition to boat launching facilities, the Jaime J. Zapata Memorial Boat Ramp also includes a lighted pier for fishing, kayak access to San Martin Lake and the Brownsville Ship Channel, and picnic facilities (Cameron County, 2015a). Construction and operation of the Project would not directly impact the boat ramp; however, increased traffic on SH 48 during construction and LNG carrier traffic on the Brownsville Ship Channel could adversely affect access to the boat ramp. Boaters traveling to areas around or beyond the Project site to the east could be delayed during operation by LNG carriers in transit to the LNG terminal. Kayak launch use is generally directed towards San Martin Lake and would not be affected by the Project. Vehicles accessing the boat ramp from the east may experience traffic delays during construction; however, these delays would be temporary and are anticipated to be minor. The Project facilities would be visible from the boat ramp, as further discussed in section 4.8.5.

4.8.4.7 Isla Blanca Park

Isla Blanca Park is on the southern tip of South Padre Island approximately 4.4 miles east of the proposed Project site. Isla Blanca Park is situated on the north side of the Brazos Santiago Pass, which is the entrance to the Brownsville Ship Channel from the Gulf of Mexico. The park contains 600 recreational vehicle spaces and approximately 1 mile of beach along the Gulf of Mexico, making it a popular destination for fishing, surfing, and boating (Cameron County, 2015b). The park has a public boat ramp that accesses the Laguna Madre near Brazos Santiago Pass. Isla Blanca Park is also the access point for the South Bay Paddling Trail, as described in section 4.8.4.3. The park is maintained by Cameron County and hosts amenities such as a beachfront pavilion, activity center, and bait shop.

Recreation activities at Isla Blanca Park could be affected by construction and operation of the Project as a result of increased vessel traffic. Construction-related barge traffic would likely have negligible impacts on access to the Brownsville Ship Channel, due to the relative infrequency of marine deliveries (109 deliveries during construction). In addition, the Brownsville Ship Channel is frequently used by large industrial vessels calling on the Port of Brownsville and construction-related barge traffic would be consistent with this existing use. During operation, access to the Ship Channel and Brazos Santiago Pass would be limited when LNG carriers are in transit to the LNG terminal due to the moving Coast Guard security zones that are established around LNG carriers. However, impacts on recreational boaters accessing the Brownsville Ship Channel from Isla Blanca Park would be minor, as Texas LNG would receive LNG carriers once every 5 days and the duration of transit would be short. Additional information regarding LNG carrier traffic is provided in section 4.9.6.

4.8.4.8 Palmito Ranch Battlefield National Historic Landmark

Palmito Ranch Battlefield NHL is along SH 4 and is approximately 4.3 miles south of the proposed Project site at its nearest location. The Palmito Ranch Battlefield is the location of the last land battle fought in the Civil War. There are limited recreational opportunities within the battlefield; however, a radio broadcast repeater broadcasts information about the battlefield. There is also an observation platform and several historical markers located along SH 4 (Texas Historical Commission [THC], 2017). Due to the height of the flares and LNG storage tanks, the Texas LNG terminal would have a minor to moderate, but not significant, impact on the northern viewshed of the NHL, particularly from the Camp Belknap Historical Marker to the eastern terminus of the NHL (see section 4.8.5). In addition, it is anticipated that the construction and operation of the Texas LNG terminal could negatively impact the visitor experience at Palmito Ranch Battlefield NHL by degrading the night sky at the NHL.

4.8.4.9 Palo Alto Battlefield National Historical Park and National Historic Landmark

Palo Alto Battlefield NHP and NHL was established to preserve an area of historical significance as one of the three initial battles of the U.S. - Mexican War fought on land currently within the U.S. The Palo Alto Battlefield NHL consists of about 6,600 acres, overlapping 3,434 acres of public and private lands that make up the NHP (EPA, 2013). The NHP offers recreational opportunities including educational programming, visitor facilities, viewing platforms, and hiking paths. The NHP is approximately 12.5 miles west of the proposed Project site. Due to the distance from the proposed Project activities, no direct impacts on recreation at the Palo Alto Battlefield NHP and NHL are anticipated. However, due to the height of the flares and storage tanks, there is potential to discern a change on the eastern viewshed of the NHP (see section 4.8.5 and figure 4.8.5-3).

4.8.4.10 Lower Rio Grande Valley National Wildlife Refuge

The Lower Rio Grande Valley NWR consists of numerous tracts following the last 275 river miles of the Rio Grande River. The Refuge was established to preserve isolated tracts of remnant native habitat within the Lower Rio Grande Valley in order to maintain wildlife corridors essential for protecting species biodiversity. Approximately 46,000 acres are accessible by the public for wildlife viewing, hiking, and hunting (FWS, 2015b). A large portion of the Lower Rio Grande Valley NWR is approximately 3.0 miles south of the proposed Project site at its closest point. Impacts on the refuge would be similar to those discussed for the other recreational areas south of the Brownsville Ship Channel. Impacts during construction would primarily consist of increased noise levels, particularly during pile driving activities; however, due to the distance from the Project, it is not anticipated that this noise would be significantly above ambient levels. Therefore, we conclude that impacts on recreation within the Lower Rio Grande Valley NWR would not be significant.

4.8.4.11 Other Recreation Areas

In addition to the designated recreation areas identified and discussed in the previous sections, there are several recreational tour operators based in Port Isabel and South Padre Island which utilize waterways near the Project site, including the Brownsville Ship Channel, Gulf of Mexico, and Laguna Madre, depending on the activity. These operators offer a variety of activities including fishing, dolphin watching, jet ski tours, parasailing, dinner cruises, and snorkeling. The Project facilities would result in a change in the land use, which would adversely affect recreation activities, such as dolphin watching, that may occur relatively close to the Project site. It is likely that increased noise during construction and operation could deter some of these activities in the immediate area and cause them to move to other less developed areas. In addition, increased ship traffic during construction and operation would increase the time it takes for recreational vessels to transit the Brownsville Ship Channel, as further discussed in section 4.9.6. Construction and operation could have moderate, but not significant, temporary and permanent impacts on recreation activities that may currently operate, at least partially, near the Project site within the Brownsville Ship Channel. Although the Project facilities would be visible from parts of the Laguna Madre and the Gulf of Mexico, impacts from increased ship traffic, construction and operation noise, and changes to the viewshed in these areas, would be minor and not likely to significantly deter from the recreational user experience.

4.8.5 Visual Resources

"Visual Resources" refers to the composite of basic terrain features, geologic features, hydrologic features, vegetation patterns, and anthropogenic features that influence the visual appeal of an area for residents or visitors. In general, impacts on visual resources may occur during construction when large equipment, excavation activities, spoil piles, and construction material are visible to local residents and visitors and during operation to the extent that facilities or portions of facilities and their lighting are visible to residents and visitors. The degree of visual impact resulting from proposed facilities would be highly variable among individuals, and would typically be determined by the general character of the existing landscape and the visually prominent features of the proposed facilities.

The Project site and adjoining lands along SH 48 are undeveloped and primarily comprised of open lands and tidal flats with isolated lomas (clay dunes). The topography of the Project site and surrounding area generally range from 0 to 30 feet above sea level. The immediate viewshed of the Project site includes the Brownsville Ship Channel, Laguna Atascosa NWR, dredge material PAs, and SH 48. The Project would not affect nationally or state-designated visual resources including scenic byways or scenic rivers (DOT, 2017; National Wild and Scenic Rivers System, 2017); however, portions of the Project would be visible from the visually sensitive Palo Alto NHP and NHL and Palmito Ranch NHL.

Construction of the Project would result in changes to the visual character of the Project site including increased equipment, vehicles, soil disturbance, import of fill to raise portions of the site elevation, and erection of structures. Construction activities would be visible from users of SH 48, the Brownsville Ship Channel, and other areas surrounding the Project site.

Once both phases of the Project are complete, many aboveground structures would result in permanent impacts on the viewshed near the Project site. The most prominent visual features at the Project site would be two LNG storage tanks, each of which would be 290 feet-wide and 190 feet in height, the 315-foot-high main flare stack, and the 180-foot-high marine flare stack. Other structures at the Project site would include the liquefaction trains, administration and control buildings, and LNG carrier berthing dock. The new facilities would also require lighting for operations, safety, and to comply with FAA requirements. Texas LNG would minimize visual impacts from lighting by implementing measures outlined in its Facility Lighting Plan, including shielding lights, using lights designed to minimize glare, and using timers and motion detection sensors where feasible.

Texas LNG conducted visual simulations for several scenarios at key observation points (KOP) in the vicinity of the Project, including the Palo Alto NHP and NHL, Palmito Ranch NHL, and several recreation areas. A map depicting the location of each KOP (numbered 1 through 8) assessed by Texas LNG relative to the Project site is provided as figure 4.8.5-1. The following summarizes the visual simulations conducted, as well as potential impacts on the viewshed, based on our review.

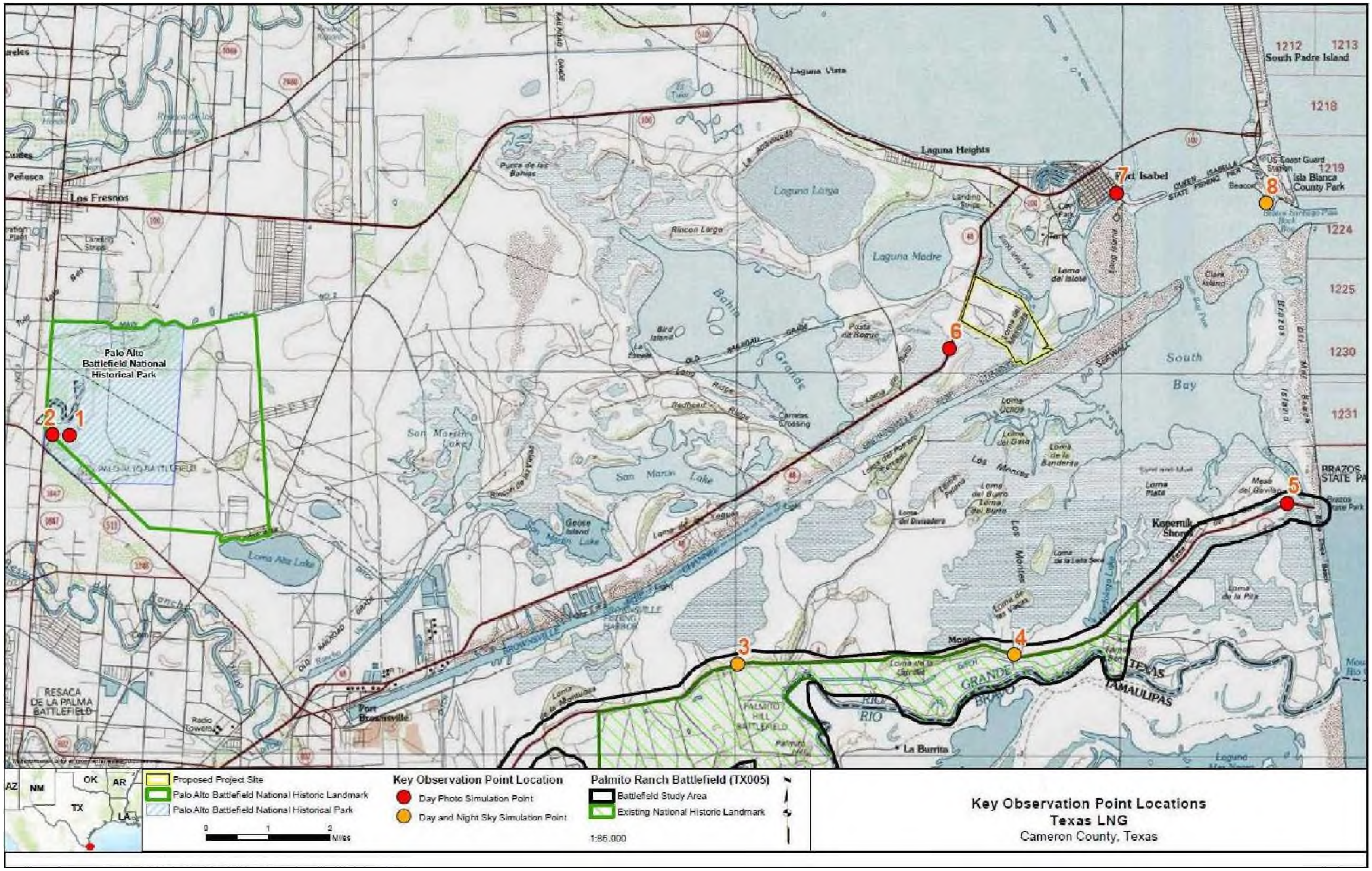

FIGURE 4.8.5-1 Key Observation Point Locations for Visual Simulations Conducted for the Texas LNG Project

- Laguna Atascosa National Wildlife Refuge (KOP 6) (200 feet west of the Project site) – Texas LNG conducted a simulation for daytime and nighttime visual impacts from the Laguna Atascosa NWR at SH 48 approximately 0.8 mile south of the Project entrance (see figures 4.8.5-29 and 4.8.5-31, respectively). While the Laguna Atascosa NWR is approximately 200 feet west of the property boundary, major and more visually prominent Project facilities would be constructed on the opposite side of the Project site, approximately 0.6 mile from the refuge boundary. Due to the proximity of the Laguna Atascosa NWR to the Project site and a lack of visual buffers, the LNG storage tanks, main flare, and liquefaction trains would be prominent when viewed from portions of the refuge. Equipment would also be visible during construction of the Project. Texas LNG also conducted daytime and nighttime visual simulations for the Laguna Atascosa NWR during flaring events. Due to the proximity of the Laguna Atascosa NWR the Project facilities and light from the flare would be prominent both during the day and at night (see figures 4.8.5-32 and 4.8.5-33, respectively). As discussed in section 3.0, we have not identified any feasible visual screening methods that could be implemented to minimize impacts on visual resources. Therefore, we conclude that the Project would have a permanent and significant impact on visual resources when viewed from the Laguna Atascosa NWR.

- Loma Ecological Preserve (0.8 mile south of the Project site) – Texas LNG did not conduct simulations of visual impacts on the Loma Ecological Preserve as a result of the Project; however, due to the relatively flat topography and minimal vegetation characteristic of the area, other visual simulations may be used to assess potential impacts. Based on distance from the Project site, visual impacts would likely be similar to those presented in figure 4.8.5-17 for the Lower Rio Grande Valley NWR. Figure 4.8.5-17 (for KOP 4) accurately depicts the direction from the Project site; however, KOP 4 is nearly 4 miles further from the Project site than the Loma Ecological Preserve at its closest point. Based on the visibility of the main flare and storage tanks in figure 4.8.5-17 and the prominence of the flare (figures 4.8.5-20 and 4.8.5-21), these facilities would be much more prominent when viewed from the Loma Ecological Preserve. Therefore, we have determined that the Project would have a permanent and moderate, but not significant, impact on visual resources when viewed from the Loma Ecological Preserve.

- South Bay Coastal Preserve and South Bay Paddling Trail (1.0 mile southeast of the Project site) – Texas LNG did not conduct simulations of visual impacts on the SBCP and the South Bay Paddling Trail. Visual impacts on the SBCP and South Bay Paddling Trail as a result of the Project would be similar to those discussed for the Loma Ecological Preserve. Figure 4.8.5-23 (for KOP 5) accurately depicts the direction from the Project site; however, KOP 5 is also nearly 4 miles further from the Project site than the SBCP. While the SBCP and South Bay Paddling Trail at its closest point is approximately 1.0 mile from the Project site and 1.7 miles from major structures such as the LNG tanks and main flare, these structures would likely be prominent within the viewshed of the SBCP and the South Bay Paddling Trail. Therefore, we have determined that the Project would have a permanent and moderate, but not significant, impact on visual resources when viewed from the SBCP and South Bay Paddling Trail.

- Port Isabel State Historic Site (2.4 miles northeast of the Project site) – Texas LNG conducted a daytime and nighttime simulation of visual impacts on Port Isabel as a result of the Project (KOP 7), including the Port Isabel State Historic Site. As shown in figures 4.8.5-35 and 4.8.5-37, the Project storage tanks and the flare stack would be visible, but partially obscured by other existing industrial facilities near Port Isabel. However, flaring events would be much more prominent, especially at night (see figures 4.8.5-38 and 4.8.5-39). Due to the anticipated infrequency of flaring, we have determined that the Project would have a minor and intermittent impact on visual resources when viewed from the Port Isabel State Historic Site.

- Brazos Island State Scenic Park (4.0 miles southeast of the Project site) – Texas LNG conducted daytime and nighttime simulations of visual impacts on Brazos Island State Scenic Park (KOP 5 for Palmito Ranch Pilings Historic Marker is adjacent to Brazos Island State Scenic Park) as a result of the Project (figures 4.8.5-23 and 4.8.5-25). The storage tanks, main flare, and liquefaction trains would be visible on the distant horizon from Brazos Island State Scenic Park at SH 4 during the day, where it is most readily accessible (figure 4.8.5-23). In addition, during flaring events the flares would be visible both during the day and at night, but would not be prominent (figures 4.8.5-26 and 4.8.5-27). Therefore, we have determined that the Project would have a permanent and minor impact on visual resources when viewed from the Brazos Island State Scenic Park.

- Jaime J. Zapata Memorial Boat Ramp (4.4 miles west of the Project site) – Texas LNG did not conduct a simulation of visual impacts on the Jaime J. Zapata Memorial Boat Ramp. Visual impacts from the Project on the boat ramp would likely be similar to those depicted in figures 4.8.5-29, 4.8.5-31, 4.8.5-32, and 4.8.5-33 for KOP 6; however, Project facilities would be less prominent due to the increased distance of the boat ramp from KOP 6. In addition, the fishing pier and kayak launch are facing west, away from the Project site. Therefore, we have determined that the Project would have a permanent and minor impact on visual resources when viewed from the Jaime J. Zapata Memorial Boat Ramp.

- Isla Blanca Park (4.4 miles east of the Project site) – Texas LNG conducted daytime and nighttime simulations of visual impacts on Isla Blanca Park (KOP 8) (see figures 4.8.5-41 and 4.8.5-43, respectively). All major structures including the liquefaction trains, main flare, and storage tanks would be clearly visible from Isla Blanca Park; however, due to the distance from the park, the Project facilities would not dominate the viewshed. Similarly, facility lighting would be visible at nighttime from Isla Blanca Park; however, it would be minimal due to the distance of the Project from the park and consistent with the light associated with Port Isabel. In addition, flaring would be visible from Isla Blanca Park during the daytime and nighttime (figures 4.8.5-44 and 4.8.5-45, respectively), but it would not be prominent. Therefore, we have determined that the Project would have a permanent and minor impact on daytime and nighttime visual resources when viewed from Isla Blanca State Park.

- Palmito Ranch Battlefield National Historic Landmark (4.3 miles south of the Project site) – Texas LNG conducted daytime and nighttime simulations of visual impacts on the Palmito Ranch Battlefield NHL at three historic markers located along SH 4 (KOP 3, 4, and 5) (figures 4.8.5-11, 4.8.5-13, 4.8.5-17, 4.8.5-19, 4.8.5-23, and 4.8.5-25). In general, some of the Project facilities, including the storage tanks and main flare, would be visible from the historic markers. Of the three historic markers, the facilities are least visible from the Palmito Ranch Battlefield NHL Historic Marker (KOP 3), which is 6.7 miles southwest of the proposed Project site. At this KOP, the Project facilities are partially obscured by scrub shrub vegetation (see figure 4.8.5-11). Project facilities are most visible from the Camp Belknap Historic Marker (KOP 4) where there is no vegetation or topography to obscure the view. At this KOP, the storage tanks and main flare are clearly visible, and prominent features in the landscape compared to other development and would result in a permanent, minor to moderate, but not significant impact on the viewshed (see figure 4.8.5-17). The third historical marker that was assessed for visual impacts is the Palmito Ranch Battlefield NHL Pilings Marker (KOP 5) located at the east end of SH 4. Visual simulations for this point are the same as those discussed for Brazos Island State Scenic Park. Visual simulations were also conducted for all three markers for daytime flaring activities (figures 4.8.5-14, 4.8.5-20, 4.8.5-26). While visible, the flares are not significantly more visible during the day than the facilities are when flaring is not occurring. Overall, we have determined that the Project would have a permanent and minor to moderate, but not significant, impact on daytime visual resources when viewed from the Palmito Ranch Battlefield NHL historic markers.

  Texas LNG also conducted nighttime simulations of visual impacts on the Palmito Ranch Battlefield NHL from the Palmito Ranch Battlefield NHL Historic Marker, Camp Belknap Historic Marker, and Palmito Ranch Battlefield NHL Pilings Marker (see figures 4.8.5-13, 4.8.5-19, and 4.8.5-25, respectively). Texas LNG also conducted nighttime simulations for each of the markers during flaring events (figures 4.8.5-15, 4.8.5-21, and 4.8.5-27). Flares would be slightly visible from the markers at night. Due to distance and direction of the Project site from the historical markers, we determined that impacts from lighting on the Palmito Ranch Battlefield NHL would be permanent and minor.

- Palo Alto Battlefield National Historic Park and National Historic Landmark (12.5 miles west of the Project site) – At the request of NPS, Texas LNG conducted daytime and nighttime simulations of visual impacts on the Palo Alto NHP and NHL as a result of the Project. Simulations were conducted for two visually sensitive locations at the NHP including an overlook and the visitor center (KOPs 1 and 2, respectively). While other parts of the NHP and NHL are situated closer to the Project site (12.5 miles), these visually sensitive areas are nearly 15 miles from the Project site. Due to distance from the Project site and vegetation present, the Project facilities would not be visible from the visitor center during the day during normal facility operation (see figure 4.8.5-9). Due to the similarity in distance and direction from the Project site, Texas LNG did not conduct nighttime or flaring simulations for the visitor center (KOP 2). Additionally, due to the distance from the Project site, the storage tanks and main flare would be barely visible on the horizon from the overlook during the day and at night (see figures 4.8.5-3 and 4.8.5-5). Further, during flaring, the flare would be barely visible during the day or at night (figures 4.8.5-6 and 4.8.5-7). Therefore, we have determined that the Project would have a minor impact on visual resources when viewed from the Palo Alto Battlefield NHP and NHL.

- Lower Rio Grande Valley National Wildlife Refuge (3.0 miles south of the Project site) – Texas LNG did not conduct simulations of visual impacts on the Lower Rio Grande Valley NWR; however, visual impacts would be similar to those discussed for the Palmito Ranch Battlefield NHL, as the majority of the NHL is within the NWR (see figure 4.8.4-1). At its closest point, the Lower Rio Grande Valley NWR would be approximately 2.3 miles closer to the Project site than the Camp Belknap Historical Marker; therefore, the LNG storage tanks and main flare would be more visible than depicted in figure 4.8.5-17. In addition, flaring would be more visible than that depicted in figures 4.8.5-20 and 4.8.5-21. As a result, we have determined that the Project would have permanent and minor impacts on visual resources when viewed from the Lower Rio Grande Valley NWR.

FIGURE 4.8.5-2 Current Day View Facing East from the Palo Alto Battlefield Overlook (KOP 1)

FIGURE 4.8.5-3 Simulation of Day View Facing East from the Palo Alto Battlefield Overlook (KOP 1)

FIGURE 4.8.5-4 Current Night View Facing East from the Palo Alto Battlefield Overlook (KOP 1)

FIGURE 4.8.5-5 Simulation of Night View Facing East from the Palo Alto Battlefield Overlook (KOP 1)

FIGURE 4.8.5-6 Simulation of Daytime Flaring Facing East from the Palo Alto Battlefield Overlook (KOP 1)

FIGURE 4.8.5-7 Simulation of Nighttime Flaring Facing East from the Palo Alto Battlefield Overlook (KOP 1)

FIGURE 4.8.5-8 Current Day View Facing East from the Palo Alto Battlefield Visitor Center (KOP 2)

FIGURE 4.8.5-9 Simulation of Day View Facing East from the Palo Alto Battlefield Visitor Center (KOP 2)

FIGURE 4.8.5-10 Current Day View Facing Northeast from the Palmito Ranch Battlefield Historic Marker (KOP 3)

FIGURE 4.8.5-11 Simulation of Day View Facing Northeast from the Palmito Ranch Battlefield Historic Marker (KOP 3)

FIGURE 4.8.5-12 Current Night View Facing Northeast from the Palmito Ranch Battlefield Historic Marker (KOP 3)

FIGURE 4.8.5-13 Simulation of Night View Facing Northeast from the Palmito Ranch Battlefield Historic Marker (KOP 3)

FIGURE 4.8.5-14 Simulation of Daytime Flaring Facing Northeast from the Palmito Ranch Battlefield Historic Marker (KOP 3)

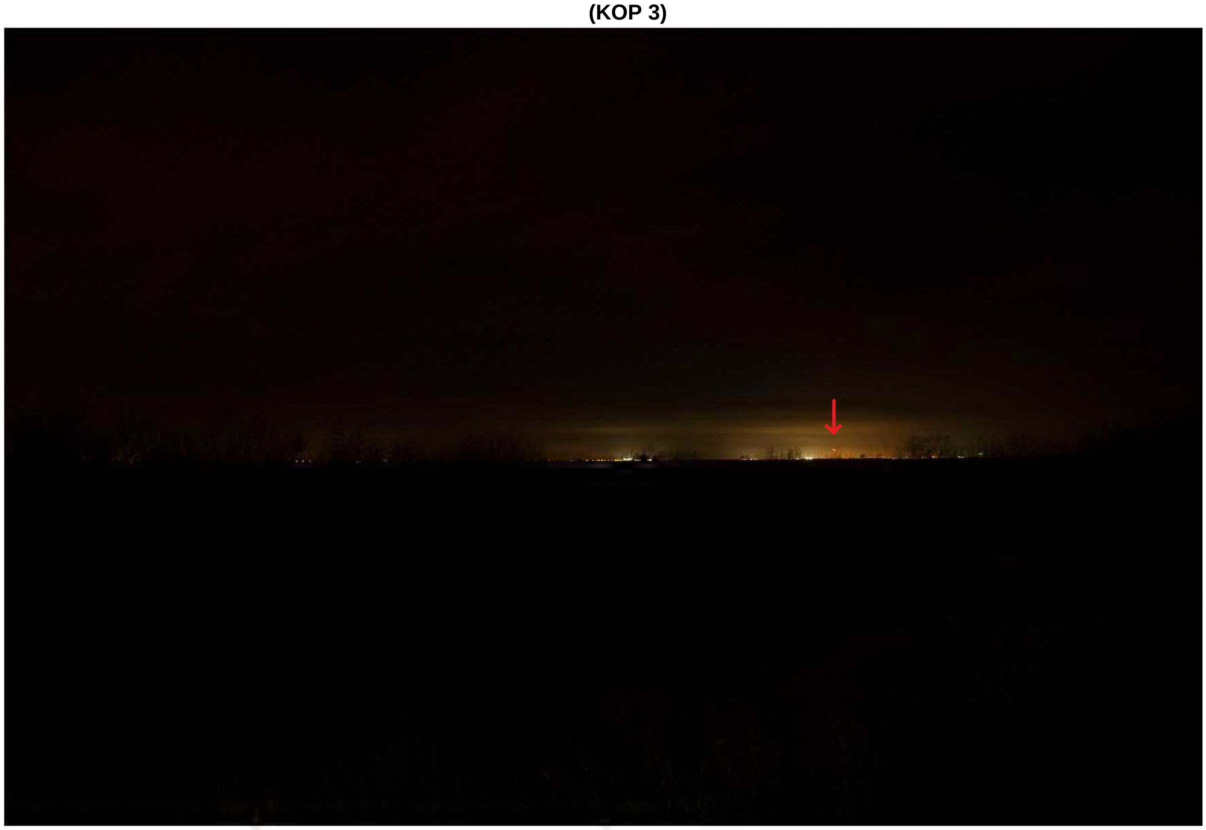

FIGURE 4.8.5-15 Simulation of Nighttime Flaring Facing Northeast from the Palmito Ranch Battlefield Historic Marker (KOP 3)

FIGURE 4.8.5-16 Current Day View Facing North from the Camp Belknap Historic Marker (KOP 4)

FIGURE 4.8.5-17 Simulation of Day View Facing North from the Camp Belknap Historic Marker (KOP 4)

FIGURE 4.8.5-18 Current Night View Facing North from the Camp Belknap Historic Marker (KOP 4)

FIGURE 4.8.5-19 Simulation of Night View Facing North from the Camp Belknap Historic Marker (KOP 4)

FIGURE 4.8.5-20 Simulation of Daytime Flaring Facing North from the Camp Belknap Historic Marker (KOP 4)

FIGURE 4.8.5-21 Simulation of Nighttime Flaring Facing North from the Camp Belknap Historic Marker (KOP 4)


FIGURE 4.8.5-22 Current Day View Facing Northwest from the Palmito Ranch Pilings Marker (KOP 5)


FIGURE 4.8.5-23 Simulation of Day View Facing Northwest from the Palmito Ranch Pilings Marker (KOP 5)

FIGURE 4.8.5-24 Current Night View Facing Northwest from the Palmito Ranch Pilings Historic Marker (KOP 5)

FIGURE 4.8.5-25 Simulation of Night View Facing Northwest from the Palmito Ranch Pilings Historic Marker (KOP 5)

FIGURE 4.8.5-26 Simulation of Daytime Flaring Facing Northwest from the Palmito Ranch Pilings Historic Marker (KOP 5)

FIGURE 4.8.5-27 Simulation of Nighttime Flaring Facing Northwest from the Palmito Ranch Pilings Historic Marker (KOP 5)

FIGURE 4.8.5-28 Current Day View Facing East from State Highway 48 (KOP 6)

FIGURE 4.8.5-29 Simulation of Day View Facing East from State Highway 48 (KOP 6)

FIGURE 4.8.5-30 Current Night View Facing East from State Highway 48 (KOP 6)

FIGURE 4.8.5-31 Simulation of Night View Facing East from State Highway 48 (KOP 6)

FIGURE 4.8.5-32 Simulation of Daytime Flaring Facing East from State Highway 48 (KOP 6)

FIGURE 4.8.5-33 Simulation of Nighttime Flaring Facing East from State Highway 48 (KOP 6)

FIGURE 4.8.5-34 Current Day View Facing Southwest from Port Isabel (KOP 7)

FIGURE 4.8.5-35 Simulation of Day View Facing Southwest from Port Isabel (KOP 7)

FIGURE 4.8.5-36 Current Night View Facing Southwest from Port Isabel (KOP 7)

FIGURE 4.8.5-37 Simulation of Night View Facing Southwest from Port Isabel (KOP 7)

FIGURE 4.8.5-38 Simulation of Daytime Flaring Facing Southwest from Port Isabel (KOP 7)

FIGURE 4.8.5-39 Simulation of Nighttime Flaring Facing Southwest from Port Isabel (KOP 7)

FIGURE 4.8.5-40 Current Day View Facing Southwest from Isla Blanca Park (KOP 8)

FIGURE 4.8.5-41 Simulation of Day View Facing Southwest from Isla Blanca Park (KOP 8)

FIGURE 4.8.5-42 Current Night View Facing Southwest from Isla Blanca Park (KOP 8)

FIGURE 4.8.5-43 Simulation of Night View Facing Southwest from Isla Blanca Park (KOP 8)

FIGURE 4.8.5-44 Simulation of Daytime Flaring Facing Southwest from Isla Blanca Park (KOP 8)

FIGURE 4.8.5-45 Simulation of Nighttime Flaring Facing Southwest from Isla Blanca Park (KOP 8)

The Project facilities would likely be visible from some residences in Port Isabel and South Padre Island. South Padre Island, in particular, has numerous high rise condominiums that would have views of the Project facilities, especially from the higher floors. In addition to residences, the Project facilities would be visible from sightseeing tours that operate within the Brownsville Ship Channel, as discussed in section 4.8.4.11. The prominence of the facilities within the viewshed of the immediate area could cause sightseeing tours to avoid the Brownsville Ship Channel and associated waterbodies and operate in other waterbodies where there is less development such as the Laguna Madre. There is minimal industrial development surrounding the Project area and we have determined that the addition of the Project facilities would result in a significant and permanent change to the viewshed when viewed from the Laguna Atascosa NWR and would have a negligible to moderate permanent impact on the other visual resources evaluated.

4.8.6 Coastal Zone Management

The entirety of the proposed Project site is within the Coastal Zone Management boundary. The Texas Coastal Management Program (TCMP) was accepted into the federal Coastal Zone Management Program by NOAA in 1997 after the Texas Legislature passed the Coastal Coordination Act of 1991. The Coastal Coordination Act called for the development of a coastal program based on the need for a comprehensive approach to the management of coastal natural resources and other coastal issues (TCMP, 2014). The mission of the TCMP is to improve the management of the state's coastal natural resource areas that are of concern to Texas and ensure the long-term ecological and economic productivity of the Texas coast. The eight-member Coastal Coordination Advisory Committee and ad-hoc Coastal Issue Teams preside over issues related to water quality, TCMP grants, TCMP long-term planning, and regulatory/permitting. The regulatory/permitting Coastal Issue Teams focus on federal consistency issues and information exchange on consistency reviews. This process, referred to as "federal consistency review," ensures that the state's interest is fairly represented and allows the state the opportunity to provide input into policies, procedures, or actions and activities that may affect the management of coastal areas.

Federal actions and activities within the Texas coastal zone must be consistent with enforceable policies of the TCMP to the maximum extent practicable. The Project would be designed and built in compliance with conditions set forth in various agency authorizations, including the FERC authorization, the COE permits, and any permits required under the Coastal Coordination Advisory Committee. As part of its COE permit application, Texas LNG requested that the Coastal Coordination Advisory Committee conduct a coastal zone consistency review for the Project. Texas LNG has not received its consistency determination from the Coastal Coordination Advisory Committee; therefore, **we recommend that:**

- **<u>Prior to construction</u>, Texas LNG should file with the Secretary a determination from the Coastal Coordination Advisory Committee that the Project is consistent with the laws and regulations of the state's Coastal Zone Management Program.**

4.9 SOCIOECONOMICS

Construction and operation of the Project could impact socioeconomic conditions, either adversely or positively, in the general Project vicinity. These potential impacts include alteration of population levels or local demographics, increased employment opportunities, increased demand for housing and public services, increased traffic on area roadways and waterways, and an increase in government revenue associated with sales, ad valorem, and payroll taxes. The socioeconomic analysis for the proposed Project examines data from Cameron County, Texas, where the majority of the Project workforce is anticipated to reside during construction and operation. In addition, Texas LNG anticipates that approximately 10 percent of construction workers (approximately 70 workers on average, based on the Peak Impact Scenario, which is further discussed below) would be sourced from the City of Matamoros, Tamaulipas, Mexico. According to the Instituto Nacional de Estadistica Y Geografia (2010), the total population of Matamoros as of the 2010 census was estimated to be 489,193. As such, the workers hired for construction of the Project would represent a small percentage (0.01 percent) of the total population and is anticipated to have insignificant impacts on the socioeconomic resources in the city. Therefore, the City of Matamoros is not further addressed in this socioeconomic analysis. For the purposes of our socioeconomic analysis, Cameron County, Texas, is referred to as the "affected area."

The Project would be constructed in two phases, and Texas LNG anticipates that Phase 1 would require about 44 months to complete and Phase 2 would require 43 months. Texas LNG plans to initiate construction of Phase 1 upon receipt of all required authorizations. Phase 2 would only be constructed if a customer for production of LNG enters into an agreement sufficient to finance the Phase 2 construction cost. While the exact timing of Phase 2 construction would be based on market demand and the availability of a customer, the greatest potential for socioeconomic impacts would be if Phase 1 and Phase 2 construction overlapped. To evaluate peak socioeconomic impacts during construction of the Project, we assumed Phase 2 would commence construction 18 months after the start of Phase 1, which is referred to as the "Peak Impact Scenario."

4.9.1 Population

Table 4.9.1-1 provides a summary of population information for the affected area.

TABLE 4.9.1-1

Existing Socioeconomic Conditions in the Affected Area

State/County/City	2010 Population [a]	2015 Population (est.) [a]	Population Density (per square mile) [a]	Per Capita Income [a]	Civilian Labor Force [b]	Unemployment Rate (percent) [b]	Top Industries [b]
Texas	25,145,561	27,469,114	96.3	$26,513	12,791,590	7.7	E, R, P
Cameron	406,220	422,156	456.0	$14,898	161,941	10.5	E, R, A

[a] U.S. Census Bureau, 2015a
[b] U.S. Census Bureau, 2015b

Industries:
A – Arts, entertainment, and recreation, and accommodation and food services
E – Educational services, and health care and social assistance
P – Professional, scientific, and management, and administrative and waste management services
R – Retail trade

Cameron County, Texas had an estimated population of 422,156 people in 2015 and a population density of 456 persons per square mile (U.S. Census Bureau, 2015a). In comparison, the 2015 population of Texas was 27,469,114 people with a population density of 96.3 persons per square mile. The closest municipalities are Port Isabel, approximately 2 miles northeast of the Project site and South Padre Island, approximately 4 miles northeast of the Project site. The two largest municipalities in Cameron County are Brownsville, approximately 19 miles southwest of the Project site and Harlingen, approximately 28 miles northwest of the Project site.

Texas LNG estimates that under the Peak Impact Scenario an average of approximately 1,312 onsite workers would be required during peak construction. Throughout construction, the number of workers is anticipated to vary greatly depending on the construction phase. Texas LNG estimates initial mobilization would require 50 to 100 workers. As site activity increases, the workforce would average approximately 700 workers for the construction period, with the number of workers increasing during installation of the liquefaction train components and decreasing as the facilities near completion and pre-commissioning, commissioning, and plant start-up.

Texas LNG states that approximately 80 percent of the construction workforce would be locally sourced, resulting in an estimated average of 560 resident and 140 non-resident workers (based on the estimated average workforce of 700 workers) and a maximum of 1,050 resident and 262 non-resident workers (based on the estimated peak workforce of 1,312 workers). If the non-resident workers are accompanied by family members, assuming an average household size of 3.36 persons in Cameron County, up to 880 non-local persons could relocate to the affected area during the construction period associated with the Peak Impact Scenario (U.S. Census Bureau, 2015b). To provide a conservative estimate of the potential non-resident persons that could relocate to the Project area, we assumed the maximum non-resident workforce would be residing in the Project area for the entire construction duration. Although it is unlikely that all 1,312 workers would relocate with families, this addition would represent a 0.1 percent increase in the total population of Cameron County.

Following construction, Texas LNG estimates that Phase 1 of the Project would require approximately 80 full-time personnel with an additional 30 full-time personnel necessary for operation of Phase 2. This workforce would represent a negligible, but permanent increase in the population in the Project vicinity.

4.9.2 Economy and Employment

Table 4.9.1-1 provides selected employment and income statistics for the affected area. The top industries in the affected area include:

- arts, entertainment, and recreation, and accommodation and food services;
- educational services, and health care and social assistance;
- professional, scientific, and management, and administrative and waste management services; and

- retail trade (U.S. Census Bureau, 2015b).

Travel and tourism also contribute to the local Cameron County economy. Travel industry employment includes the leisure and hospitality sector (arts, entertainment, and recreation, and accommodation and food services); transportation (all air and ground transportation goods and services); and retail trade. According to a report prepared for the Office of the Governor by Dean Runyan Associates in 2015, 4.5 percent of all jobs in Cameron County were related to the travel industry and total employee earnings from the travel industry accounted for an estimated $186.3 million. In addition, according to the *2014 Texas Tourism Region and MSA Visitor Profile*, 94 percent of visitors to the Brownsville-Harlingen Metropolitan Statistical Area traveled there for leisure purposes (D.K. Shifflet & Associates, Ltd., 2015).

The civilian labor force is defined as the sum of employed persons and unemployed persons who are actively seeking work or are otherwise available for work and excludes people who are institutionalized and people on active duty in the United States Armed Forces (U.S. Census Bureau, 2010). Assuming 80 percent of the workforce would be hired from within Cameron County, in 2015, the civilian labor force was 161,941 people and the average per capita income was $14,898, which is well below the per capita income for Texas as a whole ($26,513). Additionally, Cameron County had an unemployment rate of 10.5 percent in 2015 (or about 16,200 people), as compared to the 7.7 percent unemployment rate for the State of Texas (U.S. Census Bureau, 2015b).

Economic impacts are divided into three categories:

- direct effects – hiring of local workers and purchases of goods and services from local businesses;
- indirect effects – the additional demand for goods and services, such as replacing inventory from the firms that sell goods and services directly to the project or workers and their families; and
- induced effects – the spending of disposable income by the workers at local businesses, which in turn order new inventory from their suppliers.

Construction impacts of the Project would have a moderate economic impact due to the scale of spending. Texas LNG commissioned Aaron Economic Consulting, LLC to prepare a socioeconomic report, evaluating the potential impacts of the Project on the local economy.

Construction and capital investment during Phase 1 is estimated to last 44 months beginning in 2019 and ending in 2023. Based on the *Socioeconomics Report* prepared for the Project, the total direct, indirect, and induced impacts of Phase 1 construction is projected to be $251.8 million (in 2021 U.S. dollars).[28] The construction of Phase 1 of the Project would contribute $88.5 million to the local economy in the form of value added (increase in the gross regional product [GRP]), raising Cameron County's GRP by 2.8 percent. Indirect construction-related employment would add an estimated 166 jobs and another 180 jobs would be added

[28] Texas LNG's Socioeconomics Report is available on eLibrary under accession number 20170427-5039.

through induced effects. Texas LNG estimates that the direct average salary for construction workers would be $52,000 per year.

Construction and capital investment for Phase 2 is anticipated to last 43 months. According to the *Socioeconomics Report*, the economic impact from Phase 2 was based on the Peak Impact Scenario. The total construction impact for Phase 2 (direct, indirect, and induced effects) is estimated to be $281.9 million and would add $97.4 million in value added to the local economy (the economic impact is represented in 2025 U.S. dollars, which is when Texas LNG anticipates Phase 2 construction would be completed under the Peak Impact Scenario). This value added would result in an increase of 3.3 percent to Cameron County's GRP. Construction from Phase 2 would also add 294 indirect jobs, and an additional 309 induced jobs.

Unlike construction impacts, operation impacts on the economy are permanent. Operation of Phase 1 would result in an annual value added of $173 million to the local economy (resulting from labor compensation, proprietary income, other property type income, and net incremental value added by the project), increasing the GRP by 3.6 percent. Texas LNG would directly employ a total of 80 people for Phase 1 and pay an average annual compensation of approximately $70,000, equating to an estimated total payroll of approximately $5.6 million annually (based on the first full year of operation, estimated in 2021 U.S. dollars).

Following the completion of Phase 2 construction, the total value added to the local economy from operation of both Project phases combined would be an estimated $367 million, increasing the GRP for Cameron County by 7.2 percent. During operation of both Phase 1 and Phase 2 of the Project, Texas LNG would employ 110 personnel, resulting in a total of $9.6 million in annual payroll. These expenditures would result in a minor, but positive permanent impact on the local economy.

4.9.3 Local Taxes and Government Revenue

Texas LNG anticipates spending approximately $64 million on construction materials in the affected area during construction of Phases 1 and 2, which would generate increased local, state, and federal sales tax revenues. The expenditures of goods and services by the construction workers and their families would also generate increased tax revenues. In addition, local, state, and federal governments would tax the $45 million and $77 million in total construction workforce payroll during Phase 1 (2020 dollars) and Phase 2 (2025 dollars), respectively. This increase in tax revenue would be a minor, temporary, and positive impact on tax revenue within the affected area.

The estimated annual ad valorem tax and sales tax attributable to operation of Phase 1 of the Project is $9.7 million and $780,000, respectively (in 2021). The combined ad valorem tax and sales tax associated with operation of Phase 1 and Phase 2 would be approximately $25.5 million and $867,000, respectively. Several comments from the public were received regarding tax abatements. Texas LNG indicated that they have not requested any tax abatements for the Project. Texas LNG estimates that without tax abatements, operation of the Project over a 25-year period would result in total ad valorem tax revenue of $567 million. If tax abatements were granted, the estimated ad valorem tax revenue for the same 25-year period would be $493 million, assuming the Peak Impact Scenario. We have determined that operation of the

Project would result in permanent, positive impacts on the local economy through taxes and government revenue.

4.9.4 Housing

The number of housing units (permanent and temporary) varies across the affected area, largely based on county population and the presence or absence of a major city. Table 4.9.4-1 provides data on the rental and other temporary living options in the affected area. Based on the 2010-2014 American Community Survey (U.S. Census Bureau, 2015b), Cameron County has 144,180 housing units. Of the municipalities within Cameron County, Brownsville had the greatest number of housing units (55,618), followed by Harlingen (24,630), South Padre Island (7,360), and Port Isabel (2,207).

The total number of housing units presented in table 4.9.4-1 includes units that are temporarily occupied by persons who reside in the unit for two months or less and who have a permanent residence elsewhere. This constitutes a significant portion of the vacation homes and rentals in Cameron County, which are largely occupied by non-residents. Rental vacancy rates in the affected area range from 6.3 percent in Brownsville to 72 percent in South Padre Island, a popular tourist destination.

TABLE 4.9.4-1

Temporary and Short-term Housing Availability Within the Affected Area [a]

State/County/City	Housing Units	Vacant Housing Units [b]	Rental Vacancy Rate (percent)[c]	Median Rental Cost per Month	Hotels and Motels	Recreational Vehicle and Mobile Home Parks
Texas	10,187,189	1,173,607	8.5	$870	4,745	N/A
Cameron County	144,180	24,485	11.0	$648	142[d]	138
Brownsville	55,618	5,411	6.3	$632	111	21
Harlingen	24,630	4,068	8.9	$713		
Port Isabel	2,207	473	8.1	$591	5	2
South Padre Island	7,360	5,652	72.0	$849	26	3

a All U.S. data from 2010-2014 American Community Survey.
b Totals include all housing units occupied for 2 months or less per year.
c The proportion of rental units that are vacant.
d Total for Brownsville, Harlingen, Port Isabel, and South Padre Island only.

Sources: Source Strategies Inc. 2015; BBP and Associates, LLC. 2010; Aaron Economic Consulting, LLC. 2014.

There are about 142 hotels/motels within the affected area that could be used by the short-term workforce. The area also offers temporary housing options such as campgrounds and recreational vehicle parks, the closest of which (Port Isabel Park Center, LLC) is approximately 1.8 miles northeast of the Project site near Champion Avenue.

As stated previously, local residents would comprise approximately 80 percent of the workers hired for construction and operation of the Project; thereby minimizing the impact on local housing. However, even if all 1,312 workers during peak construction were to relocate to the Project area, the currently available housing in Cameron County would be sufficient to accommodate the workers (as well as their families, should they relocate to the area).

The proposed construction schedule for the Project could coincide with other demands for housing and temporary accommodations from tourism. Non-local workers hired temporarily who seek hotel accommodations could potentially compete with seasonal visitors in Cameron County, specifically, the destination locations of South Padre Island, Port Isabel, Harlingen, and Brownsville. Given the number of hotel rooms in the vicinity of the Project area, no serious disruptions are anticipated, and construction of the Project would have a moderate, temporary impact on housing in the affected area. Nevertheless, as discussed in section 4.13.2.10, housing constraints could occur if several of the other planned projects in the areas are constructed in the same timeframe.

Operation of Phase 1 and Phase 2 of the Project would result in approximately 22 non-local workers relocating to the affected area. However, even if all 110 operation personnel relocated to the Project area, an adequate number of housing units are available. Therefore, we conclude that operation of the Project would have a negligible but permanent impact on the local housing market.

4.9.5 Public Services

Table 4.9.5-1 provides an overview of public services available in the affected area. Within the affected area, there are a total of 168 public schools, 10 fire departments, 11 municipal and county law enforcement agencies, and 8 hospitals with a total of 1,416 beds.

TABLE 4.9.5-1

Public Services within the Affected Area

County	Public Schools [a]	Fire Departments	Municipal and County Law Enforcement Agencies [b]	Hospitals [c]	Hospital Beds [c]
Cameron	168	10	11	8	1,416

[a] Totals include Regular Instructional, Alternative Instructional, Juvenile Justice Alternative Education Program (JJAEP), and Disciplinary Alternative Education Program (DAEP) institutions.
[b] Does not include university or port-affiliated police departments, or other private enforcement agencies.
[c] Totals include acute care and psychiatric hospitals.

Source: Fire Department.net, 2016; Texas Education Agency, 2017; Texas Department of State Health Services, 2014; USA Cops, 2016.

Impacts on public services would be greatest during peak construction. As discussed in section 4.9.1, up to 262 non-local workers could relocate to the affected area with their families during peak Project construction. However, even if all of the peak construction workers relocated to the Project area with one school-aged child (based on the average family size of 3.36 persons in Cameron County [U.S. Census Bureau, 2015b]), approximately 1,312 children would enroll in area public schools. With the current student population estimated to be 128,154 children in Cameron County, this would result in a temporary increase in the student population of less than 1 percent (U.S. Census Bureau, 2015b). Therefore, measurable impacts on student-teacher ratios are not expected.

Construction of the Project would have minor, short-term impacts on the availability of local community facilities and services such as police, fire, and medical, because the non-local workforces would be small relative to the current population. Despite the anticipated sufficiency of current emergency response personnel to serve the projected increase in population as a result of non-local construction workers in the affected area, Texas LNG would coordinate with local emergency responders to ensure that individuals are trained to provide the necessary support and have appropriate equipment available during both construction and operation of the Project. Texas LNG has prepared an Emergency Response Plan that would be reviewed with local emergency response agencies. Any incremental costs incurred to train or provide support to Texas LNG would be addressed through the Cost Sharing Plan that Texas LNG would develop, working with state and local responders, in compliance with the NGA.

Following the completion of Phase 2 construction, Texas LNG estimates a total combined operation workforce of 110 workers. Assuming all workers had to relocate to the Project area, this addition represents a negligible increase in the local population. Therefore, we conclude that local public services would not be affected.

4.9.6 Transportation

Several potential impacts on vehicular and marine traffic may result from the construction and operation of the Project. Potential impacts on vehicular traffic would generally be related to construction of the Project and would be the result of the influx of workers commuting to and from the Project site as well as the transport of construction materials. Marine traffic impacts would generally result from the increase in large vessel movements in the Brownsville Ship Channel during construction and operation of the Project.

4.9.6.1 Roadway Transportation

Land access to the Project site would be primarily through the use of existing roads. Road access to the Project site would be via SH 48, north of the Brownsville Ship Channel. During construction and operation, two entrances from SH 48 would be available to access the Project site. SH 48 is a four-lane highway that is less heavily traveled than other roads in Cameron County. For example, the 2013 average annual daily traffic on Farm to Market 802, which intersects SH 48, is 20,992 vehicles while the 2013 average annual daily traffic for SH 48 near the Port of Brownsville entrance is 13,772 vehicles. However, SH 48 is one of two primary routes to access South Padre Island and thus traffic fluctuates in accordance with the season. TXDOT's (2015) estimated annual average daily traffic for SH 48 indicates that it is much less traveled near the Project site, as summarized in table 4.9.6-1.

TABLE 4.9.6-1

2013 Estimated Annual Average Daily Traffic for State Highway 48

State Highway 48 near Port of Brownsville [a]	State Highway 48 near Fisherman's Place Road [b]	State Highway 48 near State Highway 100 [c]
13,722	7,447	6,334

[a] Approximately 12 miles southwest of the Project site.
[b] Approximately 7 miles southwest of the Project site.
[c] Approximately 1.7 miles northeast of the Project site.
Source: TXDOT, 2015

During construction of the Project, traffic levels on area roadways would increase due to the presence of worker vehicles, construction vehicles, and trucks delivering materials to the site. Texas LNG estimates that the total number of vehicles arriving and departing the facility per day during peak construction of Phase 1 and Phase 2 would be 1,220 and 1,000, respectively. During the Peak Impact Scenario, an estimated 1,454 vehicles would arrive and depart the facility per day during peak construction. The majority of these vehicle trips would be associated with the construction workforce, which is estimated to arrive at the Project site prior to 7 am and depart after 5 pm, outside of peak traffic hours. During operation, Texas LNG estimates that there would be 130 vehicle trips per day during peak traffic hours.

Impacts on local users of the roadway network due to construction of the Project include potential delays from increased traffic levels and diminished roadway capacity (road failure). To identify, quantify, and recommend mitigation for traffic impacts on local roadways during construction of the Project, Texas LNG commissioned a Traffic Impact Analysis (Aldana Engineering and Traffic Design, LLC, 2016). As previously stated, there are two proposed driveways that would be used to access the Project site. The first driveway would be at the existing median crossing and the second driveway would be approximately 1,400 feet north of the existing median crossing. The proposed access point spacing for highways requires a minimum access point spacing of 425 feet.

Texas LNG's proposed driveways along SH 48 satisfy the minimum spacing requirements outlined in TXDOT's *Access Management Manual* (2011). According to the TXDOT's *Access Management Manual*, a deceleration lane should be considered when the right turn volume at a proposed driveway exceeds 50 vehicles per hour. Texas LNG anticipates that the proposed southern driveway would generate approximately 300 right turn (northbound) movements during peak times, exceeding the threshold for an auxiliary lane. Therefore, the study recommends that an auxiliary lane with deceleration, storage, and taper be constructed at the SH 48 northbound approach to the southern driveway at the Project site. Further, the study states that the auxiliary lane should be continued approximately 1,100 feet north of the northern proposed driveway to provide for acceleration with storage and taper.

Texas LNG also anticipates that many workers would make left turns (southbound) out of the site at the end of each day. Texas LNG estimates that during peak construction up to 728 vehicles (assuming 70 percent of workers turning left and 20 percent of workers carpooling) would leave the site by turning left towards Brownsville. Texas LNG also indicated that the anticipated traffic to and from the site is not sufficient to justify installation of a traffic signal, per TXDOT regulations. Therefore, to minimize traffic and safety hazards with workers turning left out of the Project site, Texas LNG has indicated that it would coordinate with the Cameron County Sherriff's office to manually control the traffic during construction as a result of employees leaving the Project site and turning left on SH 48.

Texas LNG has indicated that the auxiliary lane would be constructed by a contractor hired and paid for by Texas LNG prior to the start of Project construction, in order to minimize impacts on SH 48 users. Texas LNG would coordinate with the Cameron Count Sherriff's Office to manually direct traffic. To further minimize impacts on traffic associated with the Project **we recommend:**

- **<u>Prior to construction</u>, Texas LNG should file with the Secretary a Traffic Management Plan for review and written approval by the Director of OEP that includes additional measures to minimize impacts on roadway traffic, including transporting workers from offsite locations via buses.**

Based on the construction of the auxiliary lane and implementation of our recommendation, we have determined that the Project would have moderate, but temporary impacts on roadway traffic.

4.9.6.2 Marine Transportation

The Project site is proposed along the Brownsville Ship Channel approximately 5 miles from the Brazos Santiago Pass, where the ship channel meets the Gulf of Mexico. The proximity of the Project site to the Gulf of Mexico offers a relatively short vessel transit route, lessening the duration that vessels are in transit to the site within the Brownsville Ship Channel. The Project site would receive vessels both during construction for delivery of materials and equipment, as well as during operation when LNG carriers would call on the LNG terminal.

The Brownsville Ship Channel is essentially a straight waterway with no bridges or other obstructions for its entire length and is operated by the Brownsville Harbor Pilots for single-lane, one-way traffic to facilitate movement of large ships. The Brownsville Ship Channel is currently maintained at a width of 250 feet and a depth of -42 feet MLLW; however, the COE authorized the deepening of the channel an additional 10 feet as part of the Channel Improvement Project in 2014 in order to improve channel transportation efficiency and increase the amount of ship traffic that the channel can support (Port of Brownsville, 2013). Current vessel traffic in the Brownsville Ship Channel is about 1,057 vessels per year (not including commercial and recreational fishing boats), which equates to an average of about 88 vessels per month, including 61 barges (Port of Brownsville, 2015).

As discussed in section 4.6.2.1, commercial and recreational fishing are common in the Brownsville Ship Channel. The Port of Brownsville Fishing Harbor is approximately 7.5 miles west of the Project site and houses up to 500 fishing boats. In addition there are approximately 180 shrimp boats in Brownsville and Port Isabel which catch 13 million pounds of shrimp each year with an estimated valued of $72 million (Port of Brownsville, 2017a).

Texas LNG anticipates that the MOF would accommodate delivery of most major material supplies and equipment via barge or heavy load carrier, thus reducing the impact of truck deliveries on area roadways during construction (see section 4.9.6.1). Texas LNG estimates that the construction of both Project phases would result in approximately 109 barge/vessel deliveries to the MOF. Construction materials likely to be delivered by barge or heavy load carriers include marine pilings, foundation pilings, sheet pilings, steel, structural and process modules, and rip rap.

During operation, Texas LNG estimates that between 30 and 37 LNG carriers would call on the LNG terminal each year during operation of Phase 1 and up to 74 LNG carriers annually during operation of both Project phases. This accounts for an approximately 7 percent increase in annual vessel traffic associated with the Brownsville Ship Channel. In order to accommodate LNG carrier traffic, it is anticipated that two pilots would be needed onboard due to the size of the vessels and the complex maneuvering scenarios requiring three to four tugs. Maneuvering simulations show that two of the tugs must be capable of serving as offshore escort tugs for each inbound and outbound LNG carrier transit. Two large tugs (3,000 horsepower [hp]) are currently based in the Brownsville area; however, they are not large enough to provide escort and docking/undocking services for LNG carriers. Based on maneuvering simulations for LNG projects in similar waterways, it is expected that a minimum of three tractor tugs with bollard pull ratings of 65 tons would be necessary for docking and undocking, with at least two of these tugs capable of providing services offshore. Texas LNG would employ a fleet of four tugs, one more than necessary, to allow for normal service plus unscheduled maintenance.

One-way traffic limitations are not an issue with the Brownsville Ship Channel as it currently operates. This is partially due to the fact that small vessels (e.g., shrimp boats) are able to meet and pass deep-draft vessels that are traversing the channel. However, it would be unsafe for small vessels to meet or pass LNG carriers, as they are larger than the deep-draft vessels that currently use the Brownsville Ship Channel. The amount of water that is displaced by the LNG carriers would result in surge and suction effects that are unsafe for small vessels to travel within. Therefore, LNG carrier operations necessitate a higher level of traffic management planning within the Brownsville Ship Channel than is currently present.

The LNG carriers would navigate from the point of origination to the pilot station near the sea buoy just outside of the jetties protecting the entrance to the Brownsville Ship Channel. A pilot from the Brazos Santiago Pilots Association would navigate the LNG carrier from the sea buoy, through the Brazos Santiago Pass, into the Brownsville Ship Channel. The passage from the sea buoy to the maneuvering basin is anticipated to take 1 to 1.5 hours. Based on Texas LNG's anticipated average of six LNG carriers per month (74 LNG carriers per year), transiting LNG carriers could delay other vessel traffic within the Brownsville Ship Channel up to 18 hours per month (3 hours round trip per LNG carrier calling on the LNG terminal).

In a letter dated February 14, 2018, the Coast Guard issued the LOR for the Project, which stated that the Brownsville Ship Channel is considered suitable for LNG marine traffic in accordance with the guidance in the Coast Guard Navigation and Vessel Inspection Circular 01-2011. LNG carriers would reach the LNG terminal using existing shipping channels with the exception of the recessed maneuvering basin at the Project site. Throughout operation, LNG carriers would enter and depart the LNG terminal by transiting the Brownsville Ship Channel and Gulf of Mexico.

Based on the Coast Guard's LOR for the Project, the anticipated 7 percent increase in annual vessel traffic within the Brownsville Ship Channel during operation, and the delays of up to 18 hours per month, we have determined that the operation of the Project would have a permanent but minor impact on marine traffic within the Brownsville Ship Channel.

4.9.7 Property Values

Potential impacts on the value of a tract of land depends on many factors, including size, the values of adjacent properties, presence of other industrial facilities, the current value of the land, and the extent of development and other aspects of current land use. A potential purchaser would make an offer to purchase based on his or her own values, which may or may not take the LNG terminal into account. Therefore, potential impacts on property values resulting from the

Project are not addressed. Further, there are no residential properties within proximity of the Project.

4.9.8 Environmental Justice

For projects with major aboveground facilities, FERC regulations (18 CFR 380.12(g)(1)) direct us to consider the impacts on human health or the environment of the local populations, including impacts that would be disproportionately high and adverse for minority and low-income populations. Additionally, during Project scoping, we received comments raising concerns about the impacts of the Texas LNG Project on minority and low-income populations.

The EPA's Environmental Justice Policies (which are directed, in part, by Executive Order 12898: *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations*) focus on enhancing opportunities for residents to participate in decision making. The EPA (2011) states that Environmental Justice involves meaningful involvement so that: "(1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that would affect their environment and/or health; (2) the public's contributions can influence the regulatory agency's decision; (3) the concerns of all participants involved would be considered in the decision-making process; and (4) the decision-makers seek out and facilitate the involvement of those potentially affected." CEQ also has called on federal agencies to actively scrutinize a number of important issues with respect to environmental justice (CEQ, 1997).

As part of our NEPA review, we have evaluated potential environmental justice impacts related to the Texas LNG Project, taking into account the following:

- the racial and economic composition of affected communities;
- health-related issues that may amplify effects to minority or low-income individuals; and
- public participation strategies, including community or tribal participation in the NEPA process.

The EPA provides guidance on determining whether there is a minority or low-income community. According to this guidance, minority population issues must be addressed when they comprise over 50 percent of an affected area or when the minority population percentage of the affected area is substantially greater than the minority percentage in the larger area of the general population. Low-income populations are those that fall within the annual statistical poverty thresholds from the United States Department of Commerce, Bureau of the Census Population Reports, Series P-60 on Income and Poverty. According to 15 CFR 689(3)(A)(i), the United States Department of Housing and Urban Development defines a "low-income geographic area" as an area with a poverty rate of 20 percent or greater. Therefore, low-income populations for this analysis were determined to be those with 20 percent or greater of the population living below the poverty threshold or when the percent of the population in the affected area living below the poverty threshold is substantially greater than the percent of the population living below the poverty threshold in the larger area of the general population (e.g., county).

In accordance with these guidelines, we prepared an environmental justice analysis for the Project. In order to develop a more accurate understanding of the racial and ethnic characteristics of the communities in the immediate vicinity of the Project site, census block group-level data was used, as opposed to the larger geographic areas included in census tract and county level data. In this analysis, the minority and low-income population percentages in the State of Texas and Cameron County were compared to the respective percentages within the five census blocks intersected by a 2-mile radius around the proposed Project site. These five census block groups comprised the affected community based on the potential environmental impact. Table 4.9.8-1 identifies racial composition and economic status of the five block groups, Cameron County, and the State of Texas. Table 4.9.8-2 provides an overview of the general economic status of these areas.

TABLE 4.9.8-1

Demographics in the Vicinity of the Texas LNG Project (in percent)

State/County/Tract/Block	White, Not Hispanic or Latino	Black or African-American	Hispanic or Latino	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Other	Two or More Races
Texas	44.8	11.5	37.9	0.26	3.9	0.07	0.1	1.4
Cameron County	10.5	0.4	88.2	0.1	0.6	0.0	0.1	0.2
Census Tract 012304	18.8	0.8	80.4	0.0	0.0	0.0	0.0	0.0
Block Group 2	21.0	0.0	79.0	0.0	0.0	0.0	0.0	0.0
Block Group 3	7.6	0.1	92.4	0.0	0.0	0.0	0.0	0.0
Census Tract 012305	77.6	2.4	20.0	0.0	0.0	0.0	0.0	0.0
Block Group 1	77.6	2.4	20.0	0.0	0.0.	0.0.	0.0.	0.0
Census Tract 012700	7.8	0.0	92.2	0.0	0.0	0.0	0.0	0.0
Block Group 2	25.9	0.0	74.1	0.0	0.0	0.0	0.0	0.0
Census Tract 014200	9.2	0.2	90.6	0.0	0.0	0.0	0.0	0.0
Block Group 1	4.9	0.0	95.1	0.0	0.0.	0.0.	0.0.	0.0

Source: U.S. Census Bureau, 2016

TABLE 4.9.8-2

Demographics in the Vicinity of the Texas LNG Project (in percent)

State/County/Tract/Block	Median Household Income	Percent Below Poverty Level
Texas	$53,207	17.6
Cameron County	$33,266	34.8
Census Tract 012304	$58,621	29.9
Block Group 2	$20,106	24.1
Block Group 3	$10,577	41.0
Census Tract 012305	$42,989	21.9
Block Group 1	$42,989	21.9

TABLE 4.9.8-2 Demographics in the Vicinity of the Texas LNG Project (in percent)		
State/County/Tract/Block	**Median Household Income**	**Percent Below Poverty Level**
Census Tract 012700	$24,513	33.8
Block Group 2	$15,809	33.4
Census Tract 014200	$18,523	34.4
Block Group 1	$7,388	37.8

Source: U.S. Census Bureau, 2016

The minority populations of four of the five block groups near the Project site are greater than the general EPA guideline of 50 percent of the total population; however, they are not substantially greater than minority population of Cameron County. Also, all five block groups have poverty rates that exceed 20 percent; however, only two block groups exceed the Cameron County poverty rate of 34.8 percent. While there are two low-income block groups within 2 miles of the Project site, only one (Block Group 3, Census Tract 123.04) has residences within 2 miles. This community is approximately 1.8 miles northwest of the Project site in Port Isabel and has a poverty rate of 41.0 percent. As discussed throughout this EIS, construction and operation of the Project would not significantly affect water quality or air quality, which may contribute to environmental health risks, as discussed in sections 4.3 and 4.11.1, respectively.

Although the demographics indicate that potential environmental justice communities are present within the census blocks near the Project site, there is no evidence that these communities would be disproportionately affected by the Project or that impacts on these communities would appreciably exceed impacts on the general population. It is not anticipated that the Project would cause significant adverse health or environmental harm to any community with a disproportionate number of minority or low-income populations. Further, Texas LNG selected this site based on its proximity to the Gulf of Mexico and distance from residences, not land value or avoiding impacts on a particular community. Therefore, we have determined that the Project would have negligible impacts on environmental justice communities.

4.10 CULTURAL RESOURCES

Section 101 of the NHPA requires the identification of religious and cultural properties in the area of potential effect (APE) that may be important to Indian tribes. As discussed below, it is the obligation of the FERC to consult on a government-to-government basis with Indian tribes that may have an interest in the Project.

Section 106 of the NHPA requires the FERC to take into account the effect of its undertakings on historic properties, and to afford the ACHP an opportunity to comment. The steps in the process to comply with Section 106, outlined in the ACHP's implementing regulations at 36 CFR 800, include consultations, identification of historic properties, assessment of effects, and resolution of adverse effects. These steps, and the status of our compliance with Section 106, are summarized below.

Texas LNG, as a non-federal party, is assisting the FERC in meeting our obligations under Section 106 by preparing the necessary information, analyses, and recommendations, as authorized by 36 CFR 800.2(a)(3). This includes communications with consulting parties. However, the FERC remains responsible for all determinations of NRHP eligibility and Project effects. As the lead federal agency for the Project, the FERC will address compliance with Section 106.[29]

4.10.1 Consultations

The FERC sent copies of the NOI issued July 23, 2015 to a wide range of stakeholders, including federal agencies, such as the ACHP, EPA, COE, FWS, and NPS; state agencies including the THC representing the State Historic Preservation Office (SHPO); local governments; and Indian tribes which may have an interest in the Project area. The NOI contained a paragraph about Section 106 of the NHPA, stating that the FERC would use the NOI to initiate consultations with the SHPO, and to solicit its views, and those of other government agencies, interested Indian tribes, and the public on the Project's potential effects on historic properties.

4.10.1.1 Communications with State Historic Preservation Office

On January 6, 2015, the Natural Resources Group (NRG), representing Texas LNG, had a preliminary meeting with the THC to introduce the Project. This was followed up with a letter dated January 22, 2015, that indicated that Texas LNG intended to conduct a Phase I survey at previously recorded site 41CF8 (Garcia Pasture Site), which is within the Project site. On January 28, 2015, the THC concurred with this letter. On April 28, 2015 Texas LNG submitted the Phase I report to the THC for review and comment. The THC concurred with the findings of that report in a letter to Texas LNG dated May 27, 2016. Texas LNG submitted a research design for data recovery at site 41CF8 to the THC on August 10, 2016. The THC provided its comments regarding the data recovery research design in a letter dated August 24, 2016, and requested the preparation of a Memorandum of Agreement (MOA). In the August 24, 2016 letter, the THC requested that Texas LNG prepare a public outreach program and consult and collaborate with professional and avocational archaeologists that have experience at site 41CF8 and/or clay dune landforms in south Texas. Texas LNG prepared a public outreach program that was submitted to the THC for review on May 8, 2017. On June 9, 2017, the THC provided comments on Texas LNG's public outreach program, including local archaeologists that should be included in the program.

On March 16, 2016, Texas LNG requested the THC's opinion regarding potential cultural resources investigations at a 30.6-acre area to be dredged for a basin between the Brownville Ship Channel and the LNG terminal, and at the 704-acre PA 5A. It was Texas LNG's position that no additional investigations at either site is necessary because they have a low potential to contain historic properties; and the THC agreed on March 22, 2016.

[29] Pursuant to 36 CFR 800.2(a)(2), the EPAct 2005, and the May 2002 "Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews."

Additional correspondence between Texas LNG and the THC regarding the review of the Unanticipated Discovery Plan (UDP) is discussed in section 4.10.3.

4.10.1.2 Communications with Federal Agencies

In response to the NOI, the EPA submitted comments to the FERC dated September 4, 2015. The EPA recommended that FERC's EIS describe the process and outcome of government-to-government consultations between FERC and interested Indian tribes. The EPA also recommended that FERC's EIS address the existence of cultural resources, including Indian sacred sites, and address compliance with Section 106 of the NHPA. Documentation of our consultations with Indian tribes, and the identification of historic properties can be found below in section 4.10.1.3 and 4.10.2, respectively.

In a letter to FERC dated December 16, 2015, the COE requested copies of all correspondence between FERC, Texas LNG, and the THC; and with Indian tribes. This information was contained in Resource Report 4 filed with Texas LNG's application to FERC, which is part of the public record for this proceeding. Via a letter dated January 4, 2016, Texas LNG provided a copy of Resource Report 4 to the COE.

In a letter to FERC dated September 22, 2016, the COE acknowledged receipt of a copy of the Phase I survey report and requested a copy of the treatment plan for the Garcia Pasture Site. The COE also requested a copy of the Visual Impact Assessment on the Palo Alto Battlefield NHL. Texas LNG provided the COE with a copy of the treatment plan and Visual Impact Assessment on October 5, 2016. Based on comments received from the THC on the treatment plan, Texas LNG prepared a public outreach program (as further described below) to the COE on May 8, 2017. As of the writing of this EIS, the COE has not provided comments on the treatment plan or public outreach program.

In a letter to FERC dated October 13, 2015, the NPS indicated that the Project is in the vicinity of the Palmito Ranch Battlefield NHL and the Palo Alto Battlefield NHL. In addition, the Palo Alto Battlefield NHP is within the boundary of the Palo Alto Battlefield NHL. The NPS requested additional information about the Project in order to assess potential impacts on the battlefield NHLs. The NPS also indicated that the Project site contains the Garcia Pasture Site, a premier prehistoric archaeological site listed on the NRHP.

The NPS provided comments on Texas LNG's draft Resource Reports in a letter to FERC dated February 5, 2016. Again, the NPS expressed concerns about indirect impacts on the nearby battlefield NHLs. The NPS recommended that Texas LNG hire consultants with knowledge about local prehistory, and consider the literature on clay dune formations and excavations in that landscape. The NPS also commented on the Phase I survey report produced by NRG for Texas LNG.

In response to FERC's Notice of Application, the NPS wrote another letter dated May 5, 2016. Again, the NPS raised concerns about visual impacts on the cultural landscape of the battlefield NHLs. On May 10, 2016, Texas LNG submitted a copy of its Visual Impact

Assessment to the NPS.[30] Also, the NPS requested additional research on the Garcia Pasture Site and its prehistoric archaeological setting within the Rio Grande Delta. On September 16, 2016, Texas LNG provided the NPS with a copy of its data recovery treatment plan for the Garcia Pasture Site. Texas LNG revised the treatment plan to include a public outreach program, which was provided to the NPS on May 8, 2017. To date, the NPS has not provided comments on the treatment plan or public outreach program.

On November 30, 2016, FERC staff had a telephone discussion with representatives of the NPS and the THC regarding cultural resources issues related to the Project, as well as other LNG projects proposed in the area (see section 4.13.1).

4.10.1.3 Communications with Indian Tribes

Using basic ethnographic sources, such as the *Handbook of North American Indians*, and data provided by the applicant, FERC identified Indian tribes that historically used or occupied the Project area, and may have an interest in the Project. FERC sent copies of our July 23, 2015 NOI to the Indian tribes listed in table 4.10.1-1. As part of FERC's government-to-government consultation program with Indian tribes, we sent individual letters on January 12, 2016 to tribal leaders informing them about the Project and requesting comments or information about resources important to tribes that may be affected (see table 4.10.1-1). No responses from Indian tribes to our consultation program have been filed to date.

TABLE 4.10.1-1

Indian Tribes Contacted by FERC Staff for the Texas LNG Project

Tribes Sent Copies of the FERC's July 23, 2015 NOI for the Project	Tribes Sent the FERC's January 12, 2016 Letter for the Project	Tribal Responses
Kickapoo Traditional Tribe of Texas c/o Juan Garza, Chair	Kickapoo Traditional Tribe of Texas c/o Juan Garza, Chair	No response filed to date.
Kiowa Tribe of Oklahoma c/o Amber Toppah, Chair	Kiowa Tribe of Oklahoma c/o Amber Toppah, Chair	No response filed to date.
Mescalero Apache Tribe of New Mexico c/o Danny Breuninger, President; and Holly Houghten, THPO [a]		No response filed to date.
Tonkawa Tribe of Oklahoma c/o Donald Platterson, President	Tonkawa Tribe of Oklahoma c/o Russell Martin, Chair	No response filed to date.
Ysleta de Sur Pueblo of Texas c/o Frank Paiz, Governor		No response filed to date.

[a] THPO = Tribal Historic Preservation Officer

Texas LNG conducted its own Indian tribe contact program, separate from the FERC staff's consultations, as part of the company's data gathering efforts. On March 30, 2015, Texas LNG sent letters to the Indian tribes, informing them about the Project and requesting comments. In addition, Texas LNG sent emails on April 30, 2015, and called tribes on May 1, 2015 to follow-up. In a May 1, 2016 email back to Texas LNG, the Tribal Historic Preservation Officer

[30] Texas LNG's Visual Impact Assessment Report is available on eLibrary under accession number 20160511-5281.

(THPO) for the Comanche Nation indicated that no properties important to the tribe would be affected by the proposed Project. The THPO for the Mescalero Apache Tribe indicated no interest in the Project during a May 1, 2015 telephone conversation. In a letter to Texas LNG dated May 4, 2015, the THPO for the Ysleta Del Sur Pueblo had no comments about the Project and stated that no further communications were necessary. In addition, the Carrizo/Comecrudo Tribe of Texas emailed Texas LNG on October 16, 2016 requesting additional information regarding the Project. On October, 26, 2017, Texas LNG provided the requested information to the Carrizo/Comecrudo Tribe of Texas. Identification of Historic Properties

4.10.1.4 Definition of the Area of Potential Effect

The NPS, in a February 5, 2016 letter to the FERC, recommended a 1-mile APE for indirect impacts. Texas LNG adopted that recommendation.

In Texas LNG's March 2016 application to FERC, the direct APE was defined as the area where ground disturbance would take place. As indicated in section 2 of this EIS, that would cover 311.5 acres within the 625-acre parcel owned by the BND and the 26.5-acre area necessary outside of the parcel. The indirect APE was defined as the area where aboveground historic properties would be in the line of sight of proposed Project facilities; which would extend for about a 1-mile radius from the Project footprint. This definition of the APE was reiterated in the Phase I survey report (Stanyard et al., 2016). The THC approved this survey report; thereby, approving the definition of the direct and indirect APE. We agree.

4.10.1.5 Literature Review

Prior to conducting the Phase I survey, NRG conducted a literature review and records search at the THC and the Texas Archaeological Research Laboratory (TARL). The Texas Archaeological Sites Atlas Database was also examined. Besides the Garcia Pasture Site, six other sites were previously recorded within 1 mile of the Project site. Those six sites are outside the APE, and would not be affected by the Project.

The Garcia Pasture Site is within the proposed Project site and the direct APE. It was originally identified by local collector A.E. Anderson between 1917 and 1935. NRG examined the Anderson collection at the TARL in March 2015. The Garcia Pasture Site was registered with the State of Texas in 1969. In 1970 the Texas State Historical Survey Committee investigated the site, and the results of this survey were presented in a 1971 paper at the Conference on the Archaeology of the Gulf Coast, and later published in the *Bulletin of the Texas Archaeological Society* (Prewitt, 1974). Prewitt stated that the 1970 investigations inspected exposed surfaces and erosional gullies, and noticed projectile points (some made of glass), prehistoric pottery, and marine shell ornaments. A local collector indicated to Prewitt that a burial with grave goods had been found at the site. In 1972, the Garcia Pasture Site was listed on the NRHP.

The Palmito Ranch Battlefield NHL and the Palo Alto Battlefield and NHL were identified by the NPS in comments to FERC. While these NHLs were discussed in Texas LNG's application to FERC, they are located outside of the indirect APE and were thus not discussed in the Phase I survey report.

The Palmito Ranch Battlefield was listed as a NHL in 1997, to commemorate the last land battle of the Civil War fought May 12-13, 1865. The battlefield encompasses about 5,400 acres, and is about 4.3 miles south of the Project site.

The Palo Alto Battlefield was designated as a NHL in 1960, and in 1978 the U.S. Congress established the Palo Alto Battlefield National Historical Site to preserve and interpret the opening confrontation of the Mexican-American War on May 8, 1846. The park was extended to cover about 3,434 acres in 2008, and the NHL boundary includes about 6,600 acres. This battlefield is about 12.5 miles west of the Texas LNG terminal.

No previously recorded aboveground historic properties were identified within the APE for indirect effects.

4.10.1.6 Inventories and Testing

NRG conducted archaeological investigations within the Project site in January and February of 2015. About 490 acres outside of the mapped boundary for site 41CF8 were sporadically covered by pedestrian inventory surveys where the surface was not saturated or inundated. A small dune remnant covering about 10 acres was subjected to systematic shovel testing (12 probes). Those tests were negative. More intense investigative methods were applied to site 41CF8. Approximately 120 acres encompassing Areas 1, 3, and 4 of site 41CF8 are on the vegetated Loma del Mesquite. An additional 15 acres encompassing Areas 2 and 5 of site 41CF8 were surveyed outside of the Loma del Mesquite. Thick, native vegetation was removed along 3-meter-wide transects to facilitate systematic shovel testing investigations in this area. A total of 140 shovel tests were excavated, and an additional eight 1-by-1 meter excavation units were strategically placed across the site to assess the nature and integrity of archaeological deposits. Nineteen artifacts were collected from the surface. Only two shovel tests yielded artifacts. The five test units excavated in the Loma del Mesquite were devoid of archaeological materials; however, faunal specimens were recovered from subsurface contexts. A low density of chipped stone artifacts, shell and faunal materials were recovered from three excavation units in Areas 1 and 5 within site 41CF8. Based on the results of these investigations, NRG recommended that Areas 2, 3, and 4 do not contribute to the NRHP eligibility of site 41CF8, while Areas 1 and 5 contain intact buried cultural deposits and should be considered contributing elements.

NRG drove all the roads surrounding the Project site looking for historic architectural standing structures within the indirect APE. No historic resources were found.

4.10.2 Unanticipated Discoveries Plan

Texas LNG filed a UDP that provides protocols for protection and assessment should cultural materials or human remains be inadvertently discovered during any stage of construction for the Project.[31] Texas LNG submitted its draft UDP to the THC on July 9, 2015. The SHPO provided comments on August 14, 2016. A revised plan was filed in October of 2015. The THC

31 Texas LNG's UDP is available on eLibrary under accession number 20160331-5064.

concurred with the revised UDP in a letter dated May 27, 2016. We agree that the revised UDP is acceptable.

4.10.3 Status of Compliance with the National Historic Preservation Act

With the exception of site 41CF8, no Native American traditional cultural properties, sacred sites, aboriginal burials, or objects of cultural patrimony were identified in the APE by the NPS, the Bureau of Indian Affairs, the COE, the THC, or an interested Indian Tribe. We conclude that the Project would have no effect on sites of traditional, cultural, or religious importance to Indian Tribes, and therefore, we have completed compliance with Section 101(d)(6) of the NHPA.

The process of compliance with Section 106 of the NHPA has not yet been completed for this Project. We have identified site 41CF8 as an historic property in the APE that would be adversely affected. Texas LNG has produced a treatment plan that the THC found acceptable. Therefore, FERC would need to inform the ACHP of our finding of adverse effects and invite the ACHP to participate in the resolution of adverse effects, in accordance with Part 800.6(a)(1), and we would need to execute a MOA, pursuant to Part 800.6(c). However, the FERC staff would not produce the MOA until after the Project is authorized. Therefore, **we recommend that**:

- **Texas LNG should <u>not begin construction</u> of facilities and/or use of staging, storage, or temporary work areas and new or to-be-improved access roads <u>until</u>:**

  a. the ACHP has been afforded an opportunity to comment on the undertaking;

  b. FERC staff has executed an MOA regarding the resolution of adverse effects on cultural resources;

  c. the Director of OEP notifies Texas LNG in writing that treatment measures (including archaeological data recovery) may be implemented; and

  d. Texas LNG documents the completion of treatment, and the Director of OEP issues a written notice to proceed with construction.

4.11 AIR QUALITY AND NOISE

4.11.1 Air Quality

Air quality would be affected by construction and operation of the Project. Although air emissions would be generated by operation of equipment during construction of the Project facilities, most air emissions associated with the Project would result from the long-term operation of the Project facilities. This section of the EIS addresses the construction- and operation-based emissions from the Project, as well as applicable regulatory requirements and projected impacts on air quality.

The term *air quality* refers to the relative concentrations of pollutants in the ambient air. The subsections below describe well-established air quality concepts that are applied to characterize air quality and to determine the significance of increases in air pollution. This includes metrics for specific air pollutants known as criteria pollutants, in terms of ambient air quality standards, regional designations to manage air quality known as Air Quality Control Regions (AQCR), and the on-going monitoring of ambient air pollutant concentrations under state and federal programs.

Combustion of fossil fuels, such as natural gas, produces criteria air pollutants such as nitrogen dioxide (NO_2), carbon monoxide (CO), SO_2, and inhalable particulate matter ($PM_{2.5}$ and PM_{10}). $PM_{2.5}$ includes particles with an aerodynamic diameter less than or equal to 2.5 micrometers, and PM_{10} includes particles with an aerodynamic diameter less than or equal to 10 micrometers. Combustion of fossil fuels also produces volatile organic compounds (VOC), a large group of organic chemicals that have a high vapor pressure at room temperature; and nitrogen oxides (NO_x). VOCs react with nitrogen oxides, typically on warm summer days, to form ozone, which is another criteria air pollutant. Other byproducts of combustion are greenhouse gases (GHG) and hazardous air pollutants (HAP). HAPs are chemicals known to cause cancer and other serious health impacts.

The primary GHGs produced by fossil-fuel combustion are CO_2, methane (CH_4), and nitrous oxide (N_2O). The status of GHGs as a pollutant is not related to toxicity. GHGs are non-toxic and non-hazardous at normal ambient concentrations. GHG emissions due to human activity are the primary cause of increased levels of atmospheric GHG since the industrial age. The leading climate change scientists believe that these elevated levels of GHGs are the primary cause of warming of the global climate system. These existing and future global emissions of GHGs, unless significantly curtailed, have the potential to cause further warming and changes to the local, regional and global climate systems.

Emissions of GHGs are typically expressed in terms of CO_2 equivalents (CO_2e). The GHG CO_2e unit of measure takes into account the global warming potential (GWP) of each GHG. The GWP is a ratio relative to CO_2 that is based on the particular GHG's ability to absorb solar radiation as well its residence time within the atmosphere. Based on this definition, CO_2 has a GWP of 1, CH_4 has a GWP of 25, and N_2O has a GWP of 298. To obtain the CO_2e quantity, the mass of the particular GHG compound is multiplied by the corresponding GWP, the product of which is the CO_2e for that compound. The CO_2e value for each of the GHG compounds is summed to obtain the total CO_2e GHG emissions.

Other pollutants, not produced by combustion, are fugitive dust and fugitive emissions. Fugitive dust is a mix of $PM_{2.5}$, PM_{10}, and larger particles thrown up in to the atmosphere by moving vehicles, construction equipment, earth movement, and/or wind erosion. Fugitive emissions, in the context of this EIS, would be fugitive emissions of methane and/or VOCs from operational pipelines and aboveground facilities.

4.11.1.1 Regional Climate

The Project area climate – humid subtropical – is significantly influenced by its location in the Texas Coastal Zone (i.e., proximity to the Gulf of Mexico). In general, the Port Isabel area has very short, mild winters and long hot summers, although the sea breeze can help moderate peak temperatures. Climate data obtained from NOAA for the period 1981 to 2010 show an annual average temperature of 74 °F. Daily average high temperatures range from 68 °F during January to 91 °F during August. Daily average low temperatures range from 52 °F during January to 77 °F during July and August. The record minimum and maximum temperatures are 17 °F and 103 °F, respectively (NOAA, 2016a). The region experiences relatively high dew point values (about 75 °F in summer), resulting in higher relative humidity for the June through September period.

Monthly total rainfall tends to be highest (greater than 2 inches) during the early summer and autumn months. The annual average precipitation amounts to approximately 29 inches, with a monthly maximum of 6.3 inches in September (NOAA, 2016a). Much of this precipitation comes from thunderstorm activity, although the majority of days that receive precipitation experience light rain. Tropical storms or hurricanes, although uncommon, can also enhance summer and autumn rainfall in this region.

The overall predominant wind pattern for the year in the extreme southern Texas Coastal Zone is southeasterly winds, with northwesterly winds dominating at times in the cooler part of the year, particularly December. The annual average wind speed is approximately 10 miles per hour (mph), with the highest average monthly wind speeds occurring during spring (NOAA, 2016b). The prevailing southeast wind is further enhanced during spring and early summer by thermal winds which develop when the air over the heated land further west from the coast is warmer than the air over the relatively cooler waters of the Gulf of Mexico.

4.11.1.2 Existing Air Quality

Ambient Air Quality Standards

The EPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: SO_2, CO, O_3, NO_2, particulate matter (PM_{10} and $PM_{2.5}$), and lead. There are two classifications of NAAQS, primary and secondary standards. Primary standards set limits the EPA believes are necessary to protect human health, including sensitive populations such as children, the elderly, and asthmatics. Secondary standards are set to protect public welfare from detriments such as reduced visibility and damage to crops, vegetation, animals, and buildings.

Individual state air quality standards cannot be less stringent than the NAAQS. The federal NAAQS for criteria pollutants are the same as the state standards established by the TCEQ in accordance with 30 TAC Chapter 101.21. The TCEQ has also established 30-minute average property line standards for SO_2 and H_2S in 30 TAC Chapter 112. The federal NAAQS and Texas-specific standards (referenced as net ground-level concentrations) are summarized in table 4.11.1-1.

TABLE 4.11.1-1 Ambient Air Quality Standards				
Pollutant	Averaging Period	Primary NAAQS ($\mu g/m^3$)	Secondary NAAQS ($\mu g/m^3$)	Texas NGLC
PM_{10}	24-hr [a]	150	150	-
$PM_{2.5}$	Annual [b]	12	15	-
	24-hr [c]	35	35	-
NO_2	Annual [d]	100	100	-
	1-hr [e]	188 (100 ppb)	N/A	-
CO	8-hr [f]	10,000	N/A	-
	1-hr [f]	40,000	N/A	-
Ozone [g,h]	8-hr [i]	137 (0.070 ppm)	137 (0.070 ppm)	-
Lead [j]	Rolling 3-month average [d]	0.15	0.15	-
SO_2 [k]	3-hr [f]	N/A	1,300 (0.5 ppm)	
	1-hr [l]	196 (75 ppb)	N/A	
	30-min	-	-	1,021 [m]
H_2S	30-min	-	-	108/162 [n]

a Not to be exceeded more than once pear year on average over three years.
b 3-year average of annual mean $PM_{2.5}$ concentrations.
c 98th percentile of the 24-hr concentrations, averaged over three years.
d Not to be exceeded.
e 98th percentile of the 1-hr daily maximum concentrations, averaged over three years.
f Not to be exceeded more than once per year.
g Although EPA revoked the 1-hr ozone standard (235 micrograms per cubic meter [$\mu g/m^3$] or 0.12 ppm) in 2005 for all areas, some areas (excluding the Project area) have continuing obligations to adhere to the standard.
h Final rule for the current 8-hr ozone standard became effective December 28, 2015. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
i Annual 4th-highest daily maximum 8-hr concentration, averaged over three years.
j In areas designated nonattainment for the lead standards prior to promulgation of the current (2008) standards, and for which implmentation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standard (1.5 $\mu g/m^3$ as a calendar quarter average) also remains in effect.
k The revoked 24-hr and annual average SO_2 standards (365 $\mu g/m^3$ and 80 $\mu g/m^3$, respectively) remain in effect in any area: 1) where it is not yet one year since the effective date of designation under the current (2010) standards; and 2) for which an implementation plan providing for attainment of the current (2010) standards has not been submitted and approved and which is designated nonattainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards (40 CFR §50.4(3)).
l 99th percentile of the 1-hr daily maximum concentrations, averaged over three years.
m Net ground-level concentration not to be exceeded at the property boundary (30 TAC Chapter 112.3).
n Net ground-level concentration of 108 $\mu g/m^3$ not to be exceeded on property normally occupied by people (30 TAC Chapter 112.31) and net ground-level concentration of 162 $\mu g/m^3$ not to be exceeded on property not normally occupied by people (30 TAC Chapter 112.32).

Air Quality Control Regions and Attainment Status

AQCRs are areas established for air quality planning purposes in which SIPs describe how ambient air quality standards will be achieved and maintained. AQCRs were established by the EPA and local agencies, in accordance with Section 107 of the CAA and its amendments, as a means to implement the CAA and comply with the NAAQS through SIPs. The AQCRs are intrastate and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. The Project site is proposed in the Brownsville-Laredo Intrastate AQCR (No. 213). Likewise, emissions from ship transit would impact the same AQCR.

An AQCR, or portion thereof, is designated based on compliance with the NAAQS. AQCR designations fall under three general categories as follows: attainment (areas in compliance with the NAAQS); nonattainment (areas not in compliance with the NAAQS); or unclassifiable. AQCRs that were previously designated nonattainment, but have since met the requirements to be classified as attainment are classified as maintenance areas. The Brownsville-Laredo Intrastate AQCR is designated as unclassifiable and/or attainment for all criteria pollutants.

Transport of construction materials associated with the Project could occur within the Houston-Galveston-Brazoria (HGB) area, which is a “marginal” nonattainment area for the 2015 8-hour ozone standard. Additionally, the HGB area is still classified as a “moderate” nonattainment area for the 2008 8-hour ozone standard and a “severe” nonattainment area for the 1997 8-hour ozone standard. Construction emissions from the Project occurring within the HGB area would not be expected to result in an exceedance of applicable general conformity thresholds for the HGB area.

Air Quality Monitoring and Background Concentrations

Air quality monitors maintained by the TCEQ are located throughout the state to determine existing levels of various air pollutants. Air quality monitoring data for the period 2013-2015 were reviewed by Texas LNG to characterize ambient air quality for regulated criteria pollutants in the vicinity of the Project site. The assessment included the following pollutants: O_3, CO, NO_2, $PM_{2.5}$, PM_{10}, SO_2, and lead. Concentration data from representative monitors for the 2013-2015 period are summarized in table 4.11.1-2. The concentrations shown in this table are maximum or near maximum values (as defined by EPA – see table 4.11.1-2 footnotes) for the identified monitors, which are limited in number and location. As such, the concentrations are not necessarily representative of current actual air quality in the immediate vicinity of the Project site. For each pollutant, table 4.11.1-2 lists the available measured concentrations in terms of annual mean concentration values for each year and/or maximum short-term concentrations. As shown in the table, each of the measured pollutant concentrations is below the associated NAAQS for each applicable averaging period, thus indicating continued, on-going attainment of the standards.

TABLE 4.11.1-2

Ambient Air Quality Concentrations in the Vicinity of the Texas LNG Project

Pollutant	Averaging Period	Concentration ($\mu g/m^3$) by Year			Monitor Information	
		2015	2014	2013	Location	ID No.
CO	8-hour [a]	1,144	801	915	Cameron County	480610006
	1-hour [a]	2,173	1,258	1,716	Cameron County	480610006
NO_2	Annual [b]	6	6	6	Galveston County	481671034
	1-hour [c]	56	58	60	Galveston County	481671034
O_3	8-hour [d]	60	60	58	Cameron County	480610006
$PM_{2.5}$	Annual [b]	9	9	9	Nueces County	483550034
	24-hour [c]	23	19	26	Nueces County	483550034

TABLE 4.11.1-2						
Ambient Air Quality Concentrations in the Vicinity of the Texas LNG Project						
		Concentration (µg/m³) by Year			**Monitor Information**	
Pollutant	**Averaging Period**	**2015**	**2014**	**2013**	**Location**	**ID No.**
PM_{10}	24-hour [a]	51	62	55	Nueces County	483550034
SO_2	24-hour [a]	3	5	5	Nueces County	483550032
	1-hour [e]	11	11	11	Nueces County	483550032
Lead	3-month [f]	0.006	0.038	0.008	Cameron County	480610006

[a] 2nd highest measurement recorded for each year
[b] Annual average measurement recorded for each year
[c] 98th percentile measurement recorded for each year
[d] 4th highest 8-hour average measurement recorded for each year
[e] 99th percentile measurement recorded for each year
[f] Maximum 3-month measurement recorded for each year

Notes:
µg/m³ = micrograms per cubic meter
Except for lead, concentration values have been rounded to the nearest whole µg/m³

4.11.1.3 Regulatory Requirements for Air Quality

The Project would be potentially subject to a variety of federal and state regulations pertaining to the construction and operation of air emission sources. The TCEQ has the primary jurisdiction over air emissions produced by stationary sources associated with the Project. The TCEQ is delegated by the EPA to implement federal air quality programs. The TCEQ's air quality regulations are codified in 30 TAC Chapters 101, 106, 111-118, and 122. New facilities, such as those associated with the Project, are required to obtain an air quality permit before initiating construction.

The following sections summarize the applicability of various state and federal regulations.

Federal Air Quality Requirements

The CAA, 42 USC 7401 et seq., as amended in 1977 and 1990, and 40 CFR Parts 50 through 99 are the basic federal statutes and regulations governing air pollution in the U.S. The following federal requirements have been reviewed for applicability to the Project.

- New Source Review (NSR) / PSD;
- Title V Operating Permits;
- NSPS;
- NESHAP;
- GHG Reporting;

- Chemical Accident Prevention Provisions; and
- General Conformity.

New Source Review/Prevention of Significant Deterioration

Separate preconstruction review procedures for major new sources of air pollution (and major modifications of major sources) have been established for projects that are proposed to be built in attainment areas versus nonattainment areas. The preconstruction permit program for new or modified major sources in attainment areas is known as the PSD program. This review process is intended to keep new air emission sources from causing existing air quality to deteriorate beyond acceptable levels codified in the federal regulations. Construction of major new stationary sources in nonattainment areas must be reviewed in accordance with the nonattainment NSR regulations, which contain stricter thresholds and requirements. Because all of the stationary emission sources at the Project facilities are proposed within an attainment area for all criteria pollutants, nonattainment NSR does not apply. Rather, each facility must be reviewed to determine applicability with the PSD program. The nearest PSD Class I area – Big Bend National Park – is located more than 370 miles from the Project site, and the nearby Laguna Atascosa National Wildlife Refuge and Las Palomas Wildlife Management Area are not PSD Class I areas.

The PSD rule defines a major stationary source as any source with a potential to emit (PTE) 100 tons per year (tpy) or more of any criteria pollutant for source categories listed in 40 CFR §52.21(b)(1)(i) or 250 tpy or more of any criteria pollutant for source categories that are not listed. In addition, with respect to GHG, the major source threshold for CO_2e is 100,000 tpy; however, the CO_2e threshold is only applicable if the major source threshold for another criteria pollutant is exceeded. If a new source is determined to be a major source for any PSD pollutant, then other remaining criteria pollutants would be subject to PSD review if those pollutants are emitted at rates that exceed significant emission thresholds (100 tpy for CO; 40 tpy for NO_x, VOC, and SO_2 each; 25 tpy for total suspended particulate, 15 tpy for PM_{10}, and 10 tpy for directly-emitted $PM_{2.5}$ and 75,000 tpy for CO_2e, where the GHG emission rate is greater than 0). Stationary sources with emissions that exceed the major source threshold are then subject to a PSD review.

Table 4.11.1-3 shows the estimated annual emission rate for each PSD-regulated pollutant for the Project. As shown in this table, only emissions of CO_2e would be greater than the significant emission threshold. Therefore, the Project is not subject to PSD review per 40 CFR section 52.21 and 30 TAC Chapter 116.160, and there is no requirement for the Project to obtain a GHG PSD permit. The June 23, 2014 United States Supreme Court decision addressing the application of stationary source permitting requirements to GHG (Utility Air Regulatory Group v. Environmental Protection Agency, No. 12-1146) fundamentally changed GHG permitting requirements, regardless of whether permits are issued by EPA or the states. In summary, 1) where new sources emit GHG as the only pollutant with the potential to be emitted above the major source threshold, and 2) where existing major source modifications emit GHG as the only pollutant for which there is a significant emissions increase (and a significant net emissions increase), projects no longer require PSD or Title V permits.

TABLE 4.11.1-3 Major Stationary Source/Prevention of Significant Deterioration (PSD) Applicability Analysis for the Project			
Pollutant [a]	**Proposed Project Emissions (tpy)**	**Major Stationary Source Threshold Level (tpy)**	**PSD Review Triggered?**
PM_{10}	6.3	250	No
$PM_{2.5}$	6.3	250	No
NO_x	96.2	250	No
SO_2	76.8	250	No
CO	216.5	250	No
VOC	15.2	250	No
CO_2e	604,087	100,000	No [b]

[a] Projected emissions of other NSR/PSD-regulated pollutants are small to negligible.
[b] CO_2e threshold is only applicable if the major source threshold for another criteria pollutant is exceeded.

<u>Title V Operating Permit</u>

Title V of the CAA requires states to establish an air quality operating permit program. The requirements of Title V are outlined in the federal regulations in 40 CFR 70 and in 30 TAC Chapter 122. The operating permits required by these regulations are often referred to as Title V or Part 70 permits.

Major sources (i.e., sources with a PTE greater than a major source threshold level) are required to obtain a Title V operating permit. Title V major source threshold levels are 100 tpy for CO, SO_2, PM_{10}, or $PM_{2.5}$, 10 tpy for an individual hazardous air pollutant (HAP), or 25 tpy for any combination of HAPs. The Title V GHG Tailoring Rule also requires facilities that have the PTE GHGs at a threshold level of 100,000 tpy CO_2e be subject to Title V permitting requirements.

The Project would be subject to the Title V program because criteria pollutant emissions exceed the major source threshold for at least one pollutant (e.g., CO). Therefore, Texas LNG would need to apply for a Title V operating permit for the Project before beginning Project operation, per 30 TAC Chapter 122.130.

<u>New Source Performance Standards</u>

NSPS regulations (40 CFR 60) establish pollutant emission limits and monitoring, reporting, and recordkeeping requirements for various emission sources based on source type and size. These regulations apply to new, modified, or reconstructed sources. The following NSPS requirements were identified as potentially applicable to the specified Project sources.

Subpart A of 40 CFR 60, *General Provisions*, includes broader definitions of applicability and various methods for maintaining compliance with requirements listed in subsequent subparts of 40 CFR 60. This subpart also specifies the state agencies to which the EPA has delegated authority to implement and enforce standards of performance. The TCEQ has been delegated authority for all 40 CFR 60 standards promulgated by the EPA. Equipment at the Project facilities that would be subject to any of the NSPS subparts listed below would be subject to Subpart A.

Subpart Dc of 40 CFR 60, *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units,* applies to the two heat transfer fluid (HTF) heaters for the Project, each of which has a heat input rating of 79.5 million British Thermal Units per hour (MMBtu/hr). NSPS Subpart Dc applies to each steam generating unit that has a maximum heat input capacity of 100 MMBtu/hr or less, but greater than or equal to 10 MMBtu/hr. The two gas-fired HTF heaters would be subject to the recordkeeping and reporting requirements of NSPS Subpart Dc as defined in sections 60.48c(g)(1)-(3), i and 60.48c(a), (j).

Subpart Kb of 40 CFR 60, *Standards of Performance for Volatile Organic Liquid Storage Vessels,* applies to storage vessels containing volatile organic liquids. Regulatory applicability is dependent on the construction date, size, vapor pressure, and contents of the storage vessel. Subpart Kb applies to new tanks, unless otherwise exempted, that have a storage capacity between 75 m^3 (19,813 gallons) and 151 m^3 (39,890 gallons) and contain VOCs with a maximum true vapor pressure greater than or equal to 15.0 kilopascals (kPa). Subpart Kb also applies to tanks that have a storage capacity greater than or equal to 151 m^3 and contain VOCs with a maximum true vapor pressure greater than or equal to 3.5 kPa. Pressure tanks are exempt from the requirements of Subpart Kb.

The LNG storage tanks would operate at approximately -260°F, and the true vapor pressure of the VOC (assumed to be propane) at this temperature is 0.0007 kPa. This would be well below the applicability threshold of 3.5 kPa; therefore, Subpart Kb would not apply to the LNG storage tanks.

The storage tanks for refrigerants – propane and ethylene –at the proposed facility are exempt from Subpart Kb because both tanks qualify as pressure vessels designed to operate in excess of 204.9 kPa and without emissions to the atmosphere.

There are two condensate storage tanks at the proposed LNG terminal that each has a capacity greater than 151 m^3 and store VOCs with a maximum true vapor pressure of about 15 kPa. Because these tanks do not meet the exemptions outlined in 40 CFR 60.110b(b) and (d), they are subject to Subpart Kb, and must comply with the VOC standards in 40 CFR 60.112b(a).

Project design also includes one used solvent storage tank, one HTF storage tank, one diesel storage tank, and one process water collection tank, all with fixed roofs. The used solvent storage tank, diesel storage tank, and HTF storage tank are not subject to Subpart Kb because each would contain liquids with vapor pressures less than 3.5 kPa. The process water collection tank, with a capacity of less than 75 m^3, is not subject to Subpart Kb.

Subpart OOOOa of 40 CFR 60, *Standards of Performance for Crude Oil and Natural Gas Facilities for which Construction, Modification or Reconstruction Commenced After September 18, 2015,* applies to emissions of GHG (methane) and VOC from affected facilities listed in section 60.5365a(a) through (i). Examples of rule-identified facilities typically associated with natural gas facilities (including LNG storage/export operations) include centrifugal and reciprocating compressors, pneumatic controllers and pumps, and storage vessels. This includes equipment used for LNG storage and LNG export and import operations. The Project facility would operate reciprocating and centrifugal compressors, pneumatic controllers and pumps, and storage vessels. The centrifugal compressors are anticipated to be the dry seal-type; therefore, these units would not be subject to the Subpart OOOOa requirements (which apply only to wet seal-type centrifugal compressors). The storage vessels are projected to have VOC emissions less than the Subpart OOOOa applicability threshold of 6 tpy; therefore, these vessels are not subject to the Subpart OOOOa requirements. Monitoring for, and if necessary, repair of equipment leaks would be required.

Subpart IIII of 40 CFR 60, *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines,* applies to Project diesel-fueled stationary compression ignition internal combustion engines of any size. The rule requires manufacturers of these engines to meet emission standards based on engine size, model year, and end use. The rule also requires owners and operators to configure, operate, and maintain the engines according to specifications and instructions provided by the engine manufacturer. These requirements of Subpart IIII would apply to the eight (five 540-hp and three 810-hp) diesel-fired fire water pump engines and the five (three 2,682-hp, one 2,012-hp, and one 805-hp) diesel-fired standby emergency generators proposed for the Project. The recordkeeping and reporting requirements would also apply.

<u>National Emissions Standards for Hazardous Air Pollutants</u>

The NESHAP codified in 40 CFR 61 and 63, regulate HAP emissions. Part 61 was promulgated prior to the 1990 Clean Air Act Amendments (CAAA) and regulates specific HAPs, such as asbestos, benzene, beryllium, inorganic arsenic, mercury, radionuclides, and vinyl chloride.

The 1990 CAAA established a list of 189 HAPs, while directing EPA to publish categories of major sources and area sources of these HAPs, for which emission standards were to be promulgated according to a schedule outlined in the CAAA. These standards, also known as the Maximum Achievable Control Technology standards, were promulgated under Part 63. The 1990 CAAA defines a major source of HAPs as any source that has a PTE of 10 tpy for any single HAP or 25 tpy for all HAPs in aggregate. Area sources are stationary sources that do not exceed the thresholds for major source designation. Federal NESHAP requirements are incorporated by reference in 30 TAC Chapters 113.55 and 113.00.

The annual PTE HAP emissions from the LNG terminal would be approximately 2.6 tpy in aggregate (see section 4.11.1.5), which is below the major source threshold; therefore, the Project would be classified as an area source of HAPs. The NESHAP described in the following paragraphs have been identified as being potentially applicable to specific emission units at an area source.

Subpart A of 40 CFR 63, *General Provisions*, includes broader definitions of applicability and various methods for maintaining compliance with requirements listed in subsequent subparts of 40 CFR 63. This subpart also specifies the state agencies to which the EPA has delegated authority to implement and enforce NESHAP. The specific NESHAPs that are applicable to the Project equipment have been delegated to the TCEQ.

Subpart ZZZZ of 40 CFR 63, *NESHAP for Stationary Reciprocating Internal Combustion Engines*, applies to reciprocating internal combustion engines of all sizes at major and area sources of HAPs. The Project emergency generators and fire water pump engines are considered new emergency reciprocating internal combustion engines at an area source and would be required to comply with the requirements of 40 CFR 60 Subpart JJJJ. These engines satisfy the requirements of Subpart ZZZZ by meeting the requirements of 40 CFR 60, Subpart JJJJ, per 40 CFR section 63.6590(c)(1).

Greenhouse Gas Reporting Rule

Subpart W under 40 CFR 98, the Mandatory GHG Reporting Rule, requires petroleum and natural gas systems that emit 25,000 metric tons or more of CO_2e per year to report annual emissions of GHG to the EPA. "LNG storage" and "LNG import and export equipment" are industry segments specially included in the source category definition of petroleum and natural gas systems. Equipment subject to reporting includes storage of LNG, liquefaction of natural gas, and regasification of LNG.

Emissions of GHGs associated with the construction and operation of the Project were calculated. In addition, GHG emissions were converted to total CO_2e emissions based on the GWP of each pollutant. The reporting rule does not apply to construction emissions; however, the construction emissions have been included for accounting and disclosure purposes. GHG emissions from operation of the Project are anticipated to exceed the 25,000-metric ton threshold and therefore would be subject to the reporting rule. If actual GHG emissions from the Project operation are equal to or greater than the reporting threshold, Texas LNG would need to comply with all applicable requirements of 40 CFR 98.

Chemical Accident Prevention Provisions

The chemical accident prevention provisions, codified in 40 CFR 68, are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. The regulations contain a list of substances (including methane, propane, and ethylene) and threshold quantities for determining applicability to stationary sources. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than specified in the regulation, the facility must prepare and submit a Risk Management Plan (RMP). An RMP is not required to be submitted to the EPA until the chemicals are stored onsite at the facility.

Stationary sources are defined in 40 CFR 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities which belong to the same industrial group, that are on one or more contiguous properties, are under control of the same person (or persons under common control), and are from which an accidental release may occur. The Project facilities would store significant quantities of methane (as LNG), propane, and ethylene onsite, which are regulated under 40 CFR 68. However, the definition also states that the term stationary source does not apply to transportation, including storage incidental to transportation, of any regulated substance or any other extremely hazardous substance. The term transportation includes transportation subject to oversight or regulation under 49 CFR 192, 193, or 195. Based on these definitions, the Project facilities are subject to 49 CFR 193 and would not be required to prepare an RMP.

General Conformity

A general conformity analysis must be conducted by the lead federal agency if a federal action would result in the generation of emissions that would exceed the general conformity applicability threshold levels of the pollutants(s) for which an AQCR is in nonattainment. According to Section 176(c)(1) of the CAA (40 CFR §51.853), a federal agency cannot approve or support any activity that does not conform to an approved SIP. Conforming activities or actions should not, through additional air pollutant emissions:

- cause or contribute to new violations of the NAAQS in any area;
- increase the frequency or severity of an existing violation of any NAAQS; or
- delay timely attainment of any NAAQS or interim emission reductions.

General Conformity assessments must be completed when the total direct and indirect emissions of a planned project would equal or exceed the specified pollutant applicability emission thresholds per year in each nonattainment area.

As discussed previously in section 4.11.1.2 of this EIS, the Project facilities are proposed in an area currently designated by the EPA as in attainment of all NAAQS or unclassifiable for all criteria pollutants. Operating emissions for these facilities would be entirely within designated unclassifiable/attainment areas for all criteria air pollutants and would be subject to evaluation under the NSR permitting program; therefore, these emissions are not subject to General Conformity regulations. However, during the construction phase of the Project, barges carrying equipment and materials would travel periodically from the Port of Houston to the Project construction dock via the Gulf Intracoastal Waterway (GIWW). The Port of Houston is in the HGB "moderate" ozone nonattainment area (2008 8-hour NAAQS); therefore, each barge would spend part of its trip within the HGB ozone nonattainment area. The construction barge traffic emissions associated with travel in the HGB ozone nonattainment area would be subject to evaluation under General Conformity regulations.

The relevant general conformity pollutant thresholds for the HGB ozone nonattainment area are 25 tpy of NO_x and VOC (ozone precursors) for the portion of the Project construction-related barge/tug emissions would be in that nonattainment area (which is still classified as "severe" for the 1997 8-hour ozone standard).

Texas LNG estimated emissions from tug vessels that push the barges using EPA Tier 1 engine emissions standards (under 40 CFR 89.112[a]), supplemented with emission factors from United States Department of the Interior- and EPA-sponsored marine vessel emissions studies. The emissions were apportioned between the HGB ozone nonattainment area and the adjacent unclassifiable/attainment areas based on the emissions generated during the time spent traveling through each of these areas. Texas LNG estimated that the total potential direct and indirect emissions of NO_x and VOC from the Project construction-related activity (i.e., construction barge/tug travel in HGB ozone nonattainment area) would be less than 25 tpy for each year of the construction period. Based on these emissions, a General Conformity Determination is not required for the Project.

Applicable State Air Quality Requirements

In addition to the federal regulations identified above, the TCEQ has its own air quality regulations, codified in 30 TAC. The state requirements potentially applicable to the Project are discussed below.

- 30 TAC Chapter 101, Subchapter A – *General Rules*.
- 30 TAC Chapter 111 – *Control of Air Pollution from Visible Emissions and Particulate Matter*.
- 30 TAC Chapter 112 – *Control of Air Pollution from Sulfur Compounds*.
- 30 TAC Chapter 113 – *Control of Air Pollution from Toxic Materials*. Chapter 113 incorporates by reference the NESHAP source categories (40 CFR Part 63).
- 30 TAC Chapter 114 – *Control of Air Pollution from Motor Vehicles*.
- 30 TAC Chapter 116, Subchapter B – *Control of Air Pollution by Permits for New Construction or Modification*.
- 30 TAC Chapter 118 – *Control of Air Pollution Episodes*.
- 30 TAC Chapter 122 – *Federal Operating Permits*.

4.11.1.4 Construction Emissions and Impacts and Mitigation

Construction Emissions and Impacts

Construction of the Project facilities would result in short-term increases in emissions of some air pollutants due to the use of equipment powered by diesel fuel or gasoline and the generation of fugitive dust due to the disturbance of soil and other dust-generating activities. More specifically, the construction activities that would generate air emissions include:

- site preparation (vegetation clearing, trenching, land contouring, foundation preparation, etc.);
- construction/installation of Project facilities;
- emissions from the concrete batch plant;
- operation of off-road construction equipment and trucks during construction;
- operation of marine vessels (e.g., equipment barges/tugs) during construction;
- offshore dredging; and

- workers' vehicles used for commuting to and from the construction site and delivery trucks (i.e., on-road vehicles).

The total period of construction for the Project facilities under Phases 1 and 2 are estimated by Texas LNG to be about 44 and 43 months, respectively, including pre-commissioning and commissioning activities. These two phases could overlap; for estimating potential workforce needs, Texas LNG examined one Project development scenario where Phase 2 construction begins 18 months after Phase 1 construction starts. Under this scenario, approximately 1,312 on-site workers would be required during the peak construction period. In general, overlap of the construction schedules for Phases 1 and 2 would tend to result in periods of higher emissions at the Project site compared to that associated with non-overlapping schedules.

Emission increases associated with the Project construction activities would have short-term, localized impacts on air quality. These emissions are not subject to the air quality permitting requirements that apply to emissions from operation of stationary sources at the Project site. It should be noted that there are no residential or sensitive populations within 1.5 miles of the Project site. Nevertheless, the construction-related emission rates are discussed in this section as a means of identifying potential air quality concerns associated with the construction phase of the Project and to assist in developing mitigation.

The amount of fugitive dust generated in an area under construction would depend on numerous factors including:

- nature and intensity of the construction activity;
- speed, weight, and volume of vehicular traffic;
- size of area disturbed;
- amount of exposed soil and soil properties (silt and moisture content); and
- wind speed.

Fugitive dust would be produced primarily during the site preparation activities, when the site would be cleared of debris, leveled, and graded. In addition, approximately 1.2 million cubic yards of fill would need to be imported to the site, with up to one-third of that total coming from the dredging of the maneuvering basin. Existing paved roads (SH 48) would be used to access the Project site.

Site preparation activities for the Project site would include land clearing, grading, filling, placement of aggregate materials (e.g., for lay-down areas and access roads within the Project site boundaries), and prescribed burning of vegetation. Site preparation activities would generate fugitive dust from earthmoving and movement of construction equipment over unpaved surfaces and tailpipe emissions from construction equipment and vehicle engines. Site preparation equipment would include bulldozers, payloaders, excavators, rollers, graders, dump trucks, and other mobile construction equipment. On-road truck traffic (e.g., supply trucks) and worker commuter vehicles at the Project site also would generate fugitive dust from travel on paved and unpaved surfaces. Texas LNG intends on conducting periodic watering of unpaved roads within the site to reduce the generation of fugitive dust.

The construction of access roads at the Project site would generally follow the anticipated layout of the permanent plant roads, and would be covered with asphalt, oyster shell, or gravel, depending on the anticipated traffic loads.

The construction equipment and trucks/vehicles would be powered by internal combustion engines that would generate PM_{10}, $PM_{2.5}$, SO_2, NO_x, VOC, and CO emissions. These emissions would be generated by a variety of diesel-fueled (primarily) equipment, including off-road sources (e.g., bulldozers, cranes, payloaders, pile drivers), on-road sources (e.g., construction worker vehicles, miscellaneous trucks), and marine vessels (e.g., barges/tugs). Most of the on-road vehicles would likely burn gasoline, although supply trucks and some worker pickup trucks would burn ultra-low-sulfur diesel fuel.

The construction of the LNG terminal would include installation of two liquefaction trains, two 210,000-m^3 LNG storage tanks, LNG carrier berth and LNG transfer lines, major mechanical equipment, and piping and instrumentation, as well as construction of foundations, pipe racks, miscellaneous storage tanks, and buildings. Construction activities also would include the removal of the existing 4.5-inch diameter abandoned natural gas gathering line parallel and immediately adjacent to the edge of the Brownsville Ship Channel (see section 2.5.4.2). The Project construction equipment would include cranes, forklifts, pile drivers, manlifts, cement pump trucks, air compressors, and generators (for various duties, such as pumping, lighting, etc.), which would result in fuel combustion emissions and, for mobile equipment, fugitive dust emissions.

Construction materials would be delivered to the site by barge. Texas LNG estimates that it would need 109 marine deliveries for the two Project phases, with the peak being approximately three deliveries per day. Barge/tug operations would result in fuel combustion emissions from diesel-fired engines.

Construction of Project facilities would require large quantities of concrete. To meet those needs, a temporary concrete batch plant is planned at the Project site. Operation of the concrete batch plant would result in fuel combustion emissions from diesel-fired engines and fugitive dust emissions from material handling operations.

Project construction would also include off-shore dredging of the LNG carrier berthing area. The emissions generated by these activities would be predominantly fuel combustion emissions from diesel-fired engines associated with a hydraulic cutterhead dredge, excavator, tugboats, and survey/workboats,.

Texas LNG developed an inventory of off-road equipment and vehicles, on-road vehicles, and expected activity levels (either hours of operation or miles travelled) based on the expected duration of construction at the site for the purposes of calculating emissions. The level of activity for each piece of construction equipment was combined with the relevant EPA emission factors (e.g., MOVES2014) to quantify annual emission estimates. Texas LNG would minimize vehicle emissions through compliance with 30 TAC Chapter 114 – Control of Air Pollution from Motor Vehicles and the use of ultra-low-sulfur diesel. Fuel combustion emissions from barges/tugs were calculated using engine sizes, activity levels, and emission factors based on 1) EPA engine standards for NO_x, CO, VOC, and PM (for PM_{10} and $PM_{2.5}$); and 2) federally-sponsored marine vessel emission inventory studies for SO_2 and CO_2e. Fugitive dust emission estimates associated with land clearing activities for the Project were based on an estimate of total disturbed acreage and the use of EPA's C*ompilation of Air Pollutant Emission Factors* (AP-42) emission factors with a control factor for application of dust suppressant (i.e., watering).

The total criteria air pollutant and GHG (as CO_2e) emissions associated with construction-related activities for the Project are summarized in table 4.11.1-4. These totals include fuel combustion emissions as well as fugitive dust (i.e., particulate) emissions. The total PM_{10} and $PM_{2.5}$ emissions shown in table 4.11.1-4 are mainly the result of fugitive dust-generating activities, with most of the fugitive dust emissions associated with land clearing/grading activities. Note that the estimated annual construction emissions are based on the latest available information on Project schedule; the timing and magnitude of annual emissions could vary based on when construction activities actually occur, which is dependent on business-related and other (e.g., regulatory) factors.

TABLE 4.11.1-4

Annual Project Construction Emissions (tpy)

	Pollutant						
Year	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**CO**	**SO_2**	**VOC**	**CO_2e [a]**
2020 [b]	180.7	29.2	63.4	36.5	4.3	4.1	8,879.6
2021 [c]	812.9	131.0	284.9	164.4	19.2	18.4	39,939.6
2022 [c]	1,135.3	183.0	397.9	229.6	26.8	25.7	55,782.8
2023 [c]	694.4	111.9	243.3	140.4	16.4	15.7	34,118.2
2024 [d]	91.1	14.7	31.9	18.4	2.2	2.1	4,476.6
Total Emissions (tons per construction duration)	**2,914.4**	**469.8**	**1,021.4**	**589.3**	**68.9**	**65.9**	**143,196.8**

[a] Metric tons
[b] Phase 1 construction activity only
[c] Phase 1 and Phase 2 construction activity
[d] Phase 2 construction activity only

Emissions over the construction period would increase pollutant concentrations in the vicinity of the Project; however, the effect on ambient air quality would vary with time due to the construction schedule and extent of overlap of Project Phases 1 and 2, the mobility of the sources, and the variety of emission sources. There may be localized minor to moderate elevated levels of fugitive dust and tailpipe emissions in the vicinity of construction areas during periods of peak construction activity. In addition, there would be overlap of emissions from Phase 1 commissioning and operation and Phase 2 construction activities. Following construction of Phase 2, air quality would not revert back to previous conditions, but would transition to operational-phase emissions after commissioning and initial start-up of Phase 2. The potential impact of the overlap of emissions from construction, commissioning, and/or operations for the two Project phases are discussed in section 4.11.1.5.

Mitigation Measures

As discussed previously, fugitive dust accounts for the majority of PM emissions during the construction period for the Project. Therefore, fugitive dust controls would play an important role in reducing potential effects on air quality in the Project area. Project construction activities would be subject to 30 TAC Chapter 111.145, which requires the use of water or suitable oil or chemical for control of dust during construction activities or land-clearing operations.

In addition to the regulation-based precautions, Texas LNG developed a Fugitive Dust Control Plan (FDCP), committing to additional measures to reduce fugitive dust emissions.[32] Measures outlined in the FDCP include the following:

- use of a dedicated water truck to apply water (or water mixed with additives, as needed) to heavily used unpaved areas, as needed;
- ensure that dump trucks and other open-bodied trucks hauling soil or other dusty materials to or from the Project site are covered, as needed;
- use of signage to direct construction vehicle traffic to designated (paved or gravel) roads when practicable;
- enforcement of a 15-mph speed limit on unsurfaced roads;
- use of gravel at the construction entrance and exit locations of all access roads that are unpaved;
- for discrete activities (e.g., abrasive blasting), ensure that contractors enclose the work area, or for areas that cannot be enclosed, utilize wet-sandblasting methods; and
- use of a skid-steer or similar piece of equipment or a street sweeper to clean paved roads of deposited soil from track-out by trucks and other construction equipment.

Texas LNG would minimize vehicular exhaust and crankcase emissions from gasoline- and diesel-fired engines by complying with applicable EPA mobile source emission performance standards and by using equipment manufactured to meet these standards. Additionally, Texas LNG would implement the following work practices:

- maintain construction equipment in accordance with manufacturers' recommendations. Maintenance and tuning of all construction-related equipment

[32] Texas LNG's Fugitive Dust Control Plan is publicly available on eLibrary under accession number 20160331-5064.

would be conducted in accordance with the original equipment manufacturers' recommendations;

- minimize engine idling to the extent practicable. Texas LNG would instruct Project construction personnel to minimize the idle time of equipment to 5 minutes or less when not in active use. Texas LNG's expectations concerning minimizing on-site idling would be communicated to construction personnel during safety/environmental training sessions and enforced by construction supervisors and inspectors. Also, consistent with industry practice, unmanned equipment would be turned off and would not be left idling;

- take measures to prevent tampering with construction equipment;

- conduct unscheduled inspections to ensure that the outlined mitigation measures are followed; and

- reduce roadway traffic congestion (and the resulting increase in emissions) through implementation of the measures described in Texas LNG's *Traffic Management Plan*, to be submitted to the TXDOT and local authorities for review and comment.

Based on the projected level of construction activity, there may be localized minor to moderate elevated levels of fugitive dust and tailpipe emissions near construction areas during the 60-month construction period associated with the LNG Terminal site.

The construction emissions' impact on ambient air quality would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase at times during the construction period. Considering these factors, we determine that construction of the Project would have a minor to moderate impact on local air quality. However, construction emissions would not have a long-term, permanent effect on air quality in the area.

4.11.1.5 Operation Emissions and Impacts and Mitigation

Operating Air Emissions

Operation of the Project facilities would result in air emissions from stationary equipment (e.g., heaters, flares, oxidizers, and emergency generators) and mobile sources (e.g., LNG carriers and tugs). Operational-phase emissions from a variety of sources/equipment would be permanent. These various sources and associated criteria pollutant, GHG, and HAP emission rates are discussed in detail in the following sections.

The Project, under Phases 1 and 2, would operate up to two natural gas liquefaction trains. Stationary and mobile sources of air emissions associated with operation of the Project include:

- 13 diesel-fired engines for emergency use (five standby emergency generators and eight fire water pump engines);
- two gas-fired HTF heaters;
- five flares (for control of vented organic compound emissions);
- two thermal oxidizers (for control of acid gas emissions);
- miscellaneous storage tanks (e.g., condensate, HTF, used solvent, diesel fuel);
- fugitive VOC and GHG emissions sources (e.g., loading operations, leaks from equipment such as valves, flanges, and connectors);
- equipment maintenance, start-up, and shutdown (MSS) activities;
- maneuvering and hoteling LNG carriers; and
- truck traffic.

Emissions of NO_x, VOC, CO, PM_{10}, $PM_{2.5}$, and SO_2 would be generated primarily by the fuel combustion sources. The flares are used only for start-up, shutdown, routine maintenance, and non-routine venting of emissions due to excess pressure. Texas LNG plans to continuously operate the liquefaction facility, thus limiting start-up/shutdown events to those associated with periodic routine maintenance or the need to shut down due to equipment malfunction.

Once constructed, the LNG terminal would undergo a pre-commissioning and commissioning process before it could be fully operational. This initial start-up process, which is projected by Texas LNG to last approximately three months (approximately two months for the pre-commissioning activities and one month for the commissioning activities), would result in increased air emissions. Table 4.11.1-5 summarizes the estimated criteria pollutants, GHGs, and HAP emissions for the initial startup activities.

TABLE 4.11.1-5

Annual Emissions Associated with Initial Start-Up of the Project Terminal

	Annual Emissions (tpy)								
								HAPs	
Emission Source	NO_x	VOC	CO	SO_2	PM_{10} [b]	$PM_{2.5}$ [b]	CO_2e [a,c]	Total HAPs [d]	Single HAP [e]
Pre-Commissioning and Commissioning Activities	61.5	3.8	122.8	0.29	0	0	56,398	0.31	0.18

[a] CO_2e emissions based on GWPs of 1 for CO_2, 25 for CH_4, and 298 for N_2O
[b] Assumed to be zero or negligible based on EPA's AP-42 emission factor for non-smoking flares of 0 µg/l in exhaust
[c] CO_2 emissions account for apporximately 92 percent of the total CO2e emissions
[d] Flares emissions
[e] Highest individual HAP emission rate for flares is for hexane

After completing the pre-commissioning and commissioning process, the terminal will start commercial operations. Table 4.11.1-6 provides a summary of the estimated annual criteria air pollutant, GHG (as CO_2e), and HAP emission rates for sources, including marine vessels, associated with routine operation of the Project. The annual emissions are based on continuous operation of the liquefaction trains (8,760 hours per year), except for emergency generators, which are based on maximum allowed annual operation of 100 hours, and fire water pump engines, which are based on annual operation of 52 hours. As discussed earlier, the Project is not a major source under the PSD program and not a major source of HAPs (based on on-shore stationary source emissions).

TABLE 4.11.1-6
Annual Emissions (tpy) Associated with Operation of the Project

	Pollutant							
Source	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**CO**	**SO_2**	**VOC**	**HAPs**	**CO_2e [a]**
Phase 1 Sources								
HTF Heater #1	2.47	2.47	8.46	12.87	0.20	1.79	0.61	40,763
Standby Diesel Generators (5)	0.09	0.09	5.43	3.12	<0.01	0.28	<0.01	227
Fire Water Pump Engines (5)	<0.01	<0.01	0.45	0.40	0.05	<0.01	<0.01	30
Flares (5) [b]	-	-	0.73	6.27	<0.01	<0.01	<0.01	2,018 [c]
Thermal Oxidizer #1	0.64	0.64	4.20	7.05	37.95	0.50	0.03	120,382
Storage Tanks (5)	-	-	-	-	-	0.13	<0.01	-
Fugitives [d]	0.01	<0.01	-	-	-	2.97	0.28	107,335
Phase 2 Sources								
HTF Heater #2	2.47	2.47	8.46	12.87	0.20	1.79	0.61	40,763
Fire Water Pump Engines (3)	<0.01	<0.01	0.63	0.36	0.06	0.03	<0.01	27
Thermal Oxidizer #2	0.64	0.64	4.20	7.05	37.95	0.50	0.03	120,382
Storage Tank (Condensate)	-	-	-	-	-	0.01	<0.01	-
Fugitives [d]	0.01	<0.01	-	-	-	2.91	0.28	107,335
Across Phases								
MSS	<0.01	<0.01	63.7	166.5	0.35	4.25	0.77	64,825
Marine Vessel Emissions [e]	6.38	6.05	142.6	111.6	30.79	12.71	-	9,814
Total Emissions [f]	**12.7**	**12.4**	**238.9**	**328.1**	**107.6**	**27.9**	**2.6 [g]**	**613,901**

[a] Metric tons per year
[b] One marine flare, one acid gas flare, one cold dry flare, one warm wet flare, one spare flare
[c] Includes 566 tpy of LNG carrier inerting gas (CO_2) emissions vented to the marine flare
[d] Includes fugitive dust emissions from truck traffic
[e] See tables 411.1-8 and 411.1-9 for further details on marine vessel emissions
[f] The total project emissions shown above include marine vessel emissions, which are not required to be included in the PSD applicability determination and, therefore, are not included in the total emissions shown in table 4.11.1-3
[g] The individual HAP with the highest contribution to this total is hexane (1.7 tpy)

Although the potential annual GHG emissions for the Project exceed the *de minimis* thresholds for air quality permitting programs (e.g., see section 4.11.1.3), these emissions will be minimized by Texas LNG's proposed operating scenario. The main power load for operation of the Project will be the electric motor drivers coupled to refrigeration compressors, with the electric power being provided via the local electric transmission grid. Typically, grid-based electricity providers (mainly large power plants) use natural gas-fired combined cycle combustion turbines, which can achieve overall efficiencies of greater than 60 percent, which is much higher than the efficiencies (35 to 40 percent) achieved by natural gas-fired combustion turbines in the on-site power generation alternative. Therefore, Texas LNG's proposed operating scenario results in the lowest potential generation of GHGs, compared to a similarly sized LNG export terminal using on-site power generation.

Table 4.11.1-7 provides a summary of the estimated short-term (pounds per hour [lb/hr]) controlled criteria air pollutant and HAP emission rates for routine operation of on-shore (stationary) sources associated with the Project. Short-term emission rates associated with routine operation of the Project (including marine vessel emissions) are considered a separate operating scenario for the Project and are the basis of the short-term impact analyses presented below.

TABLE 4.11.1-7

Short-term Emissions (lb/hr) Associated with Operation of On-Shore Emission Sources for the Project [a]

	Pollutant						
Source	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**CO**	**SO_2**	**VOC**	**HAPs**
Phase 1 Emissions [b]	3.41	3.41	128.7	84.31	12.34	10.75	0.26
Phase 2 Emissions [c]	1.54	1.54	27.36	18.83	12.10	2.50	0.21
MSS [d]	1.20	1.20	963.4	2,222.5	5.13	56.05	5.52
Total Emissions [e]	**6.2**	**6.2**	**1,119.4**	**2,325.6**	**29.6**	**69.3**	**6.0**

[a] The marine vessel emissions are not included in this summary table because the lb/hr emissions cannot be summed across all activities as as they do not occur simultaneously. Only one carrier would be inside the State water line, including at Texas LNG's terminal, at any given time.
[b] Comprised of emissions for emergency generators (5), fire water pump engines (5), flares (5), thermal oxidizer, HTF heater, storage tanks (5), and fugitives
[c] Comprised of emissions from fire water pump engines (3), thermal oxidizer, HTF heater, storage tank, and fugitives
[d] Includes MSS emissions for HTF Heater #1 (Phase 1) and HTF Heater #2 (Phase 2)
[e] The emissions totals are conservatively based on concurrent operation of all emission sources, including emergency units

Although the Project is not subject to PSD review, the Texas CAA and TCEQ rules (30 TAC Chapter 116.111) stipulate that all construction permit applicants must evaluate (and apply) best available control technology (BACT) for the air emission sources. The TCEQ reviewed and approved Texas LNG's BACT analysis for the Project sources, including the HTF heaters, internal combustion engines (emergency generators and fire water pump engines), flares, and thermal oxidizers. Methods for reducing criteria pollutant emissions for each of these sources were evaluated based on technical feasibility. Texas LNG would reduce emissions of NO_x from the HTF heaters through use of ultra-low NO_x burners; CO and VOC emissions would be controlled through the use of good combustion practices. The limited-use emergency generators/engines would utilize good combustion practices and ultra-low sulfur diesel fuel to reduce emissions, especially for PM and SO_2 emissions. Emissions from the flares would be reduced through good combustion practices. Emissions from the oxidizers would be reduced through the use of low-NO_x burners and good combustion practices. BACT for the flares and oxidizers would include continuous monitoring of key operating parameters. The various storage tanks and fugitive emissions (equipment leaks) would need to comply with source-specific BACT requirements as well. The resulting BACT-based emission rates are consistent with NSPS, NESHAP, and/or TCEQ-published BACT emission standards applicable to the Project emission sources.

Flaring emissions would occur during the regularly scheduled maintenance event on an LNG train and occasionally for inerted LNG carriers. Shutdown and start-up of the LNG train for maintenance is assumed by Texas LNG to occur once per year for each train. Approximately 12 LNG carriers per year would call on the port with their tanks filled with inert gas (mixture of mainly nitrogen and CO_2), which must be blown out of the tanks directly to the carrier's forward vent mast or to the marine flare, via a gassing up and cooldown process, before loading of LNG can begin. Texas LNG projects that this process would result in total annual CO_2 emissions of approximately 566 tpy.

During operation of the LNG terminal, LNG carriers and supporting marine vessels, namely tugboats and security vessels, would routinely generate air emissions. Texas LNG assessed the emissions associated with various potential LNG carrier operating scenarios, in terms of engine duty and fuel type, in determining the highest emissions-generating scenario. All scenarios assumed a representative LNG carrier main engine size rating of 33,900 kW (45,461 hp).

Air pollutant emissions from LNG carriers would occur along the entire route from the open seas to the ships' berth. Air emissions generated during ship transit in offshore areas would be temporary, transient, and occur at distances allowing for considerable dispersion before reaching any sensitive receptors. Therefore, air emissions from ship transit outside the point where the pilot boards the vessel (which is within state territorial waters) would not be expected to result in a significant impact on air quality.

Marine vessel emissions are quantified for operation along the entire length of the reduced speed zone (RSZ) inside the state water line (9 nautical miles offshore), for maneuvering in the channel and to the pier, and for hoteling at the pier. LNG carrier maneuvering within the Coast Guard-established moored safety zone would occur over a 40-min time period (20 min arriving and 20 min departing) with the assistance of three tugboats. While the LNG carrier is docked at the pier, emissions would be generated by carrier hoteling (i.e., standby and cargo loading operations on the carrier) and tugboat idling for an approximate representative time period of 22 hours. Texas LNG considered the various on-board power generating scenarios for the maneuvering and hoteling phase of LNG carrier calls at the terminal. For the hoteling phase, Texas LNG assumed that the power requirements for the LNG carriers would be met through a 50-50 split between natural gas- and oil-firing, given that it would require carriers to use at least 50 percent natural gas as fuel while at port.

Texas LNG's emission calculations for the marine vessels transiting through the RSZ and maneuvering through the channel to the pier are based on the worst-case (i.e., highest) emission factors between EPA Tier 1 engine emissions standards (under 40 CFR 89.112[a]) and emission factors from U.S. Department of the Interior- and EPA-sponsored marine vessel emissions studies, assuming use of fuel oil with a sulfur content of 0.1 percent in the vessel's main engine. Note that the use of the 0.1 percent sulfur content is consistent with the requirements of the International Maritime Organization MARPOL Annex VI standards for the North America Emission Control Area.

Table 4.11.1-8 presents a summary of the estimated highest annual criteria air pollutant and GHG (as CO_2e) emissions associated with 1) LNG carriers and tugboats (three for each ship call) maneuvering within the moored safety zone; and 2) LNG carriers hoteling at the pier and tugboats (one for each ship call) idling nearby. Table 4.11.1-9 presents a summary of the estimated highest annual criteria air pollutant and GHG (as CO_2e) emissions associated with the operation of marine vessels outside the moored safety zone. Marine vessel operations outside this zone would include LNG carriers and support vessels (tugboats, security vessels, and pilot boats) traversing the channel and RSZ inside the state water line. These emissions, which are not subject to review under the NSR/PSD program, are based on 74 LNG carrier calls per year.

TABLE 4.11.1-8

Annual Emissions (tpy) Associated with Operation of Marine Vessels Within the Moored Safety Zone

	Pollutant						
Vessel Operation	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**CO**	**SO_2**	**VOC**	**CO_2e**
LNG Carrier Maneuvering and Hoteling[a]	1.74	1.60	45.92	26.55	13.68	3.03	2,244.6
Tugboats Support	0.63	0.63	11.02	13.69	0.18	1.57	1,265.9
Total Emissions	**2.4**	**2.2**	**56.9**	**40.2**	**13.9**	**4.6**	**3,510.5**

[a] Hoteling emissions include emissions associated with cargo loading and standby operations

TABLE 4.11.1-9

Annual Emissions (tpy) Associated with Operation of Marine Vessels Outside the Moored Safety Zone [a]

	Pollutant						
Vessel Operation	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**CO**	**SO_2**	**VOC**	**CO_2e**
LNG Carrier [b]	2.02	1.84	52.66	30.44	15.70	3.48	2,572.8
Tugboats Support	1.91	1.91	32.05	39.73	0.60	4.50	3,648.9
Coast Guard Security Vessel	0.05	0.05	0.67	0.83	0.43	0.09	56.0
Pilot Boat	0.03	0.02	0.31	0.39	0.20	0.04	26.0
Total Emissions	**4.0**	**3.8**	**85.7**	**71.4**	**16.9**	**8.1**	**6,303.7**

[a] Marine vessel operations within state waters, exluding the Moored Safey Zone
[b] Includes maneuvering and reduced speed operation

In addition to complying with regulatory requirements for support vessel emissions, Texas LNG would set forth rules and facility speed limit to ensure a safe speed in the vicinity of the dock, which would indirectly help to reduce support vessel emissions. The facility rules would also stress the importance of limiting air emissions and the need to restrict unnecessary engine idling.

The air quality impacts that could occur as a result of normal on-shore facilities operations and concurrent marine vessel operations for the Project are assessed as part of the air quality impacts analysis presented below.

Operations Impacts Assessment

To provide a more thorough evaluation of the potential impacts on air quality in the vicinity of the Project, Texas LNG conducted a quantitative assessment of air emissions associated with operation of the Project facilities. This assessment used EPA-recommended pollutant dispersion modeling methods to predict off-site (i.e., ambient) concentrations in the vicinity of the Project site for comparison against the NAAQS. Also, a TCEQ-specific Modeling and Effects Review Applicability analysis was conducted to evaluate the potential human health impacts of non-criteria pollutant emissions from the Project.

As discussed in section 4.11.1.3, the Project is not subject to review under the PSD permitting program, based on the projected magnitude of potential emissions; therefore, the Project is subject to the Texas minor NSR permitting program requirements. An air quality impacts analysis was conducted by Texas LNG, per TCEQ modeling guidelines and included on-shore Project emission sources and off-site emission sources, to satisfy TCEQ permitting requirements. In conducting the air quality impact analysis to address FERC requirements, Texas LNG built upon the analysis conducted to satisfy TCEQ modeling requirements, addressing emissions from on-shore stationary sources as well as marine vessels (LNG carriers and assist tugboats) operating in the moored safety zone. In particular, the emissions associated with the marine vessels maneuvering in the moored safety zone (including both in-bound and out-bound transits) and with LNG carrier hoteling (including LNG loading and standby operations) at the LNG terminal were accounted for. The focus of the impact analysis was assessing compliance with the NAAQS for NO_2, PM_{10}, $PM_{2.5}$, CO, and SO_2.

The impact analysis included the criteria pollutant emissions from off-site stationary sources within 10 kilometers of the Project location. This set of off-site sources included to-be constructed facilities (i.e., facilities with emissions not represented in the background concentration measurements), such as the proposed Rio Grande LNG and Annova LNG projects and the Space X Texas Launch Facility. At FERC's direction, impacts at the facility fenceline and beyond were predicted and assessed. Representative background concentrations were developed for each pollutant and associated averaging period and added to the controlling model-predicted concentrations, with the total concentrations compared against the NAAQS. The results of this analysis are summarized in table 4.11.1-10.

TABLE 4.11.1-10

Summary of Pollutant Dispersion Modeling and Air Quality Impact Analysis Results for the Project

Air Pollutant	Averaging Period	Model-Predicted Concentration ($\mu g/m^3$)	Background Concentration [a] ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	1-hour	[b]	[b]	178.5	188
	Annual	6.4	6.1	12.5	100
$PM_{2.5}$	24-hour	3.5	22.9	26.4	35
	Annual	0.2	9.1	9.3	12
PM_{10}	24-hour	3.7	62.0	65.7	150
SO_2	1-hour	11.3	10.6	21.9	196
	3-hour	20.4	10.5	30.9	1,300
	24-hour	9.1	2.9	12	365
	Annual	0.9	1.6	2.5	80
CO	1-hour	4,532	2,176	6,708	40,000
	8-hour	3,118	1,260	4,378	10,000

[a] Background concentrations are based on available representative monitoring data for the 2013-2015 period
[b] 1-hour NO_2 concentration is based on inclusion of seasonal diurnal background concentration, per EPA guidance

The results of the air quality impact analysis for the Project showed that potential ground-level concentrations were below the NAAQS. Therefore, the operation of the Project emission sources would not cause or contribute to an exceedance of the NAAQS.

As noted previously, the two liquefaction trains for the Project would be constructed in different phases over time, which will result in an overlap of construction, commissioning, and operational emissions in certain years. According to the Project schedule, in 2023, the Phase 1 liquefaction train would conduct commissioning activities and initiate operation while the Phase 2 liquefaction train is under construction. In 2024, Phase 2 construction and commissioning activities would occur concurrently with Phase 1 operations. Table 4.11.1-11 shows the Project's year-by-year total annual emissions for construction, commissioning, and operational activities for each phase.

TABLE 4.11.1-11

LNG Facility Combined Construction, Commissioning, and Operational Emissions (tpy)

	Pollutant							
Year	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**CO**	**SO_2**	**VOC**	**CO_2e[a]**	**Total HAPs**
2020[b]	180.7	29.2	63.4	36.5	4.3	4.1	8,879.6	-
2021[c]	812.9	131.0	284.9	164.4	19.2	18.4	39,939.6	-
2022[c]	1,135.3	183.0	397.9	229.6	26.8	25.7	55,782.8	-
2023[c,d,e]	699.2	116.5	417.6	417.1	51.4	30.8	263,213.3	0.9
2024[e,f,g]	100.7	24.0	319.0	449.0	71.8	28.5	406,268.8	1.6
2025[e,h]	12.7	12.4	238.9	328.1	107.6	27.9	613,901.2	2.2

[a] Metric tons
[a] Phase 1 construction activity
[b] Phase 1 and Phase 2 construction activity
[c] Phase 1 pre-commissioning/commissioning activity
[d] Phase 1 operation (including marine vessels) (start in July 2023)
[e] Phase 2 construction activity
[f] Phase 2 pre-commissioning/commissioning activity
[g] Phase 2 operation (including marine vessels)

The combination of construction, commissioning, and operational short-term emissions would, at times, be in excess of the modeled operational emissions alone in 2022, 2023, and 2024. During the concurrent construction, commissioning, and operational activities, the higher level of emissions could result in intermittent exceedances of certain NAAQS. These exceedances would not be persistent at any one time during these years due to the dynamic and fluctuating nature of construction activities within a day, week, or month.

Conclusion

During the construction period, residents in the vicinity of the Project may experience local, temporary impacts on air quality. These impacts would be reduced through the implementation of measures outlined in the FDCP and other construction work practices designed to minimize construction-generated air pollutant emissions. During operation of Phases 1 and 2 (i.e., the completed Project), we have determined that associated air emissions would have minor impacts on the local air quality and would not result in significant impacts on regional air quality.

4.11.2 Noise

Sound is a sequence of waves of pressure that propagates through compressible media such as air or water. When sound becomes excessive, annoying, or unwanted, it is referred to as noise. Construction and operation of the proposed Project would affect overall noise levels in the vicinity of Project components. The ambient sound level of a region is defined by the total noise generated within the specific environment and usually consists of natural and man-made sounds. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of a day and throughout the week.

Two measurements used by some federal agencies to relate the time-varying quality of environmental noise to its known effects on people are the equivalent-continuous sound level (L_{eq}) and the day-night sound level (L_{dn}). The single value figure most commonly used to describe sound levels that vary over time is the L_{eq}, which is defined as the sound pressure level of a noise fluctuating over a period of time, expressed as an average over the measurement period. The L_{dn} is defined as the 24-hour weighted average in which sound levels during the daytime (L_d – from 7:00 a.m. to 10:00 p.m.) are averaged with sound levels during the nighttime (L_n – 10:00 p.m. to 7:00 a.m.). In the calculation of the L_{dn}, late night and early morning (10:00 p.m. to 7:00 a.m.) noise levels are increased by 10 dB to account for people's greater sensitivity to sound during nighttime hours. If the sound energy does not vary over the given time period, the L_{dn} level would be equal to the L_{eq} level plus 6.4 dB. The 6.4 dB difference between the L_{dn} and the L_{eq} is a result of the 10 dB added to the average nighttime level.

In contrast to the time averaged L_{eq} and L_{dn}, the L_{max} is the maximum sound level measured during a given period. The L_{max} is often used to describe the sound pressure level of short-term impulsive noise sources such as impacts, as it represents the highest momentary sound level experienced during a noise event.

Decibels are relative units that compare two pressures: the sound pressure and a reference pressure. The reference pressures typically used for air and water are not the same, and a direct comparison of values between in-air and underwater noises is not appropriate. Underwater sounds use a reference pressure of 1 µPa while in-air sounds have a reference pressure of 20 µPa. For in-air sound levels, the reference pressure is often not explicitly stated, as is the case in this text. The reference pressure of underwater sounds is typically stated, and is presented in this text. This is done to remind readers of the different reference pressures between underwater and in-air sound levels, and avoid direct comparison. Therefore, in this text, in air sound levels are presented in decibels while underwater sound levels are presented as "dB referenced to (re) 1 µPa." Underwater sound levels may also include a distance to indicate setback from the sound source. For example, a setback distance of 1 meter would be expressed as "dB (re 1 µPa) at 1 meter." Propagation distances in water are farther than in air because water is denser; however, loudness underwater diminishes quickly with distance from the sound source.

Decibels are often weighted to account for the human ear's sensitivity to some frequencies. These are known as dBA. A-weighting is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies.

Table 4.11.2-1 demonstrates the relative dBA noise levels of common sounds measured in the environment and industry. A 3 dBA change of sound level is considered to be barely perceptible to the human ear, a 5 or 6 dBA change of sound level is considered noticeable, and a 10 dBA increase is perceived as if the sound intensity has doubled.

TABLE 4.11.2-1

Sound Levels and Relative Loudness

Noise Source or Activity	Sound Level (dBA)	Subjective Impression [a]	Relative Loudness
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
Loud rock concert near stage	120	Uncomfortably loud	16 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Garbage disposal / food blender (2 feet)	80	Loud	Reference loudness
Vacuum cleaner (10 feet)	70	Moderate	1/2 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	1/32 as loud
Wilderness with no wind or animal activity	25	Extremely quiet	
	0	Threshold of hearing	

[a] Barnes et. al., 1977, EPA, 1971

4.11.2.1 Noise Regulations

Federal Regulations

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA, 1974). This document provides information for state and local governments to use in developing their own ambient noise standards. The EPA determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. We have adopted this criterion and use it to evaluate the potential noise impacts from the Project at noise-sensitive areas (NSA), such as residences, schools, or hospitals. Due to the 10 dBA nighttime penalty added when calculating the L_{dn}, for a facility to meet the L_{dn} 55 dBA limit, it must be designed such that actual constant noise contributions on a 24-hour basis do not exceed 48.6 dBA L_{eq} at any NSA.

State and Local Regulations

Neither the State of Texas nor Cameron County has adopted noise regulations applicable to the construction and operation of the Project. The Project is proposed outside the city of Brownsville; therefore, the Brownsville Noise Ordinance (Chapter 46, Article III, Brownsville, Texas, Code of Ordinances n.d.) is not applicable to the Project.

4.11.2.2 Existing Sound Levels and Noise Sensitive Areas

NRG, on behalf of Texas LNG, conducted a noise survey on June 10, 2015 to characterize the existing acoustic environment in the vicinity of the Project site. Sound levels were measured for one hour during daytime hours at locations representative of the nearest residences and locations of interest. Sound level measurements were not taken during nighttime hours, so the lowest one-hour average daytime sound level of 37.9 dBA L_{eq} was used to represent the nighttime sound level at all locations. There are no NSAs within a 1-mile radius of the Project.

To evaluate noise impacts for the proposed Project, the nearest three NSAs were identified (see figure 4.11.2-1). All three NSAs were groups of residences to the northeast of the proposed Project. The three NSAs are described below:

- NSA 1 is about 1.6 miles north-northeast of the Project and represents the residential area located off of Port Road, between Industrial Drive and Bahia Drive;
- NSA 2 is about 1.6 miles north-northeast of the Project and represents residences in the Pirate's Cove development, located off of 245 Port Road between Industrial Drive and Bahia Drive; and
- NSA 3 is about 1.7 miles northeast of the Project and represents the closest residences on the northwest end of West Scallop, located northeast of the Project site.

Points of Interest / Calculation Point Locations

There are several potentially environmentally sensitive areas that are not considered NSAs but that do have the potential to be impacted by noise from the Project. Two of these areas have been designated as points of interest in this analysis. Sound levels have been predicted for three Calculation Point (CP) locations within these points of interest, to evaluate the potential noise impact on these non-NSA areas. The locations of the CPs are depicted on figures 4.11.2-1 and 4.13.2-2.

The first point of interest is the Palmito Ranch Battlefield NHL managed by the NPS. There are limited recreational opportunities within the battlefield, and it is several miles from the Project. The closest part of the Palmito Ranch Battlefield NHL is approximately 4.3 miles south of the proposed Project site. The main observation platform at the battlefield is approximately 6.8 miles southwest of the proposed Project. This observation deck was included as CP-1 in the analysis, though it is well outside the typical noise impact evaluation area.

The Laguna Atascosa NWR is approximately 0.8 mile northwest of the center of the proposed predominant noise-producing equipment, on the opposite side of SH 48. Two CPs have been included in the Laguna Atascosa NWR. The first is the closest point in the Laguna Atascosa NWR to the Texas LNG facility, designated as CP-TX. The second is a centralized calculation point at a point equidistant from the three proposed LNG projects in the area, and has been designated as CP-2 (see section 4.13.2.12). The ambient sound level was determined to be 59.0 dBA L_{dn} at a location that was approximately 280 feet southeast of the Laguna Atascosa NWR, near the entrance to the Project site, and 150 feet from SH 48. The ambient level was dominated by traffic on SH 48, and would be expected to be lower at locations in the Laguna Atascosa NWR farther from the highway.

The results of the ambient noise survey as well as the distance and direction of each identified NSA and CP from the Project site are provided in table 4.11.2-2.

TABLE 4.11.2-2

LNG Terminal Facilities - Existing Noise Levels at Nearby Noise Sensitive Areas

NSA/CP	Distance From Project (miles)	Direction from Project	Average Daytime L_{eq} (dBA)	Average Nighttime L_{eq} (dBA)	Calculated L_{dn} (dBA)
1	1.6	NNE	62.8	37.9	60.8
2	1.6	NNE	51.2	37.9	50.2
3	1.7	NE	51.2	37.9	50.2 [a]
CP-1	6.8	SW	--	--	43.0 [b]
CP-2	1.7	WSW	--	--	59.0 [c]
CP-TX	0.1	NW	--	--	59.0 [c]

[a] Ambient measurements were not taken at NSA 3. Ambient sound levels at NSA 3 are assumed to be equal to the ambient noise levels at the nearby NSA 2.
[b] Adopted from the Annova LNG Project FERC application (FERC Docket No. CP16-480-000) noise results for NSA 4. See section 4.13.2.12 for additional detail regarding this data.
[c] Measured at a location 280 feet south of the Laguna Atascosa NWR.

FIGURE 4.11.2-1 Terminal and Dredging NSA Locations and Distances

(More precise locations of CP-1 and CP-2 are shown on figure 4.13.2-2)

4.11.2.3 Construction Noise Impacts and Mitigation

Texas LNG anticipates that construction activities at the Project site would be staggered, occurring throughout the approximately five-year construction period (assuming overlapping construction of Phases 1 and 2). Construction activities would occur predominantly during the day, between 7:00 a.m. and 7:00 p.m., Monday through Friday, with activities potentially occurring on Saturdays. Site preparation and construction activities (including pile driving) would be limited to daytime hours. However, dredging may occur up to 24 hours per day, 7 days per week. Construction activities at the Project site would include clearing and grading associated with site preparation; materials and equipment delivery; installation of the facility foundations (e.g., pile driving) and LNG trains; construction of the loading and ship berthing facilities, LNG storage tanks, and processing areas; and site restoration. These activities are described in detail in section 2.5.

Noise-generating equipment and activities during construction of the Project would primarily result from pile driving, internal combustion engines associated with general construction equipment, and dredging. The various types of construction activities proposed at the Project site and the associated noise levels are described below.

Texas LNG developed noise models for three different combinations of construction and operational noise components: the construction of Phase 1, the simultaneous operation of Phase 1 and construction of Phase 2, and the simultaneous operation of Phases 1 and 2. Construction noise would be temporary and mainly localized to the Project Site. Based on the projected noise contributions there would be a temporary and moderate, but not significnat, impact due to construction noise at the nearest NSAs.

Noise levels resulting from construction would vary over time and would depend on the number and type of equipment in simultaneous operation, the operating conditions, and the distances between sources and receptors. Pile driving, dredging, and facility construction are the three major construction activities that have the potential to produce noise impacts. Table 4.11.2-3 provides the estimated noise levels for site preparation and facility construction used in the analysis.

TABLE 4.11.2-3

LNG Terminal - Construction Noise Estimates

Construction Equipment Type	Quantity	Duty Cycle	Sound Pressure Level at 50 feet (dBA L_{eq})
Pile Drivers	10	20%	100
Dredges	1	100%	80
Trucks	10	5%	85
Cranes	5	20%	85
Rollers	10	20%	80
Bulldozers	10	33%	85
Pickup Trucks	50	20%	55
Backhoes	10	20%	80

Sources: Federal Highway Administration Highway Construction Noise Handbook (Federal Highway Administration Highway, 2006) and Vista del Sol Final EIS (FERC, 2005)

Pile Driving Activities

Most structures (e.g., liquefaction trains, LNG storage tanks, administration building) would be supported by 18-inch-square precast concrete piles; the LNG carrier dock and loading platform, MOF, breasting dolphins, and mooring dolphins would be supported by open-ended steel pipe piles with 42-inch and 48-inch diameters. To be conservative, the piles for the potential vapor wall were included in the construction noise model, although the vapor wall itself was not included as a noise barrier.

Pile driving activities would occur between the hours of 7:00 a.m. and 5:00 p.m. for up to 6 days per week as a worst-case scenario (pile driving would typically occur Monday through Friday, although pile driving may also occur on Saturdays). Onshore piles would be driven by impact pile drivers. Marine piles would be driven by vibratory pile drivers and finished with impact pile drivers, which may include both land-based and floating rigs. It is further assumed that up to ten pile drivers would be operating simultaneously, with each pile driver making one strike every 2 seconds and a duty cycle of 20 percent. The ten pile locations nearest to the NSAs were modeled to estimate the greatest impact scenario. For each phase, pile driving operations would take place over approximately 13 months, but peak pile driving would occur over about 4 months. No noise mitigation measures were considered in the noise model, to develop a conservative estimated impact on the NSAs.

Due to the short-term impact noise generated by pile driving activities, the maximum sound levels (L_{max}) of pile driving activities have also been evaluated. Typical pile driving activities, without any noise mitigation, can produce sound levels of 95 to 105 dBA L_{max} at a distance of 50 feet. The L_{max} sound level contribution of the pile driving activities was predicted for the closest NSAs using the same sound propagation methodologies as for other construction and operations sound level calculations.

Dredging Activities

Excavation and dredging would be required to create the LNG berth and maneuvering basin. The maneuvering basin would be recessed within the existing shoreline of the Project Site. A total of about 3.9 million cubic yards would be dredged to create the maneuvering basin and connect the LNG berthing area to the navigational channel.

Dredging would be carried out using a conventional barge-mounted hydraulic cutterhead, with a diameter of 30 inches or less. Dredging would be conducted 24 hours per day for an estimated 11 months. Primary noise sources include diesel powered dredges with associated pumps as well as tugboats and other support vessels used to position the dredges. No noise mitigation measures were considered in the models, to develop a conservative estimated impact on the NSAs.

Table 4.11.2-4 lists the predicted noise impacts due to Phase 1 construction noise, which includes pile driving and dredging noise sources. Distances shown in the tables refer to the approximate closest edge of the Project workspace. The predicted construction equipment noise combined with the existing ambient would temporarily increase the environmental sound levels by 1.0 to 5.9 decibels at the three nearest NSAs and by 1.2 to 5.9 decibels at the CPs.

TABLE 4.11.2-4						
LNG Phase 1 Construction - Predicted Sound Levels at Noise Sensitive Areas and Calculation Points						
NSA / CP	**Distance From Terminal (miles) [a]**	**Direction from Terminal**	**Existing Ambient L_{dn} (dBA)**	**Predicted LNG Phase 1 Construction L_{dn} (dBA)**	**Ambient + LNG Terminal L_{dn} (dBA)**	**Potential Increase in Ambient Noise Level (dBA)**
1	1.6	NNE	60.8	54.7	61.8	1.0
2	1.6	NNE	50.2	54.8	56.1	5.9
3	1.7	NE	50.2 [b]	54.5	55.9	5.7
CP-1	6.8	SW	43.0	42.1	45.6	2.6
CP-2	1.7	WSW	59.0	54.2	60.2	1.2
CP-TX	0.1	NW	59.0	63.5	64.8	5.9

a Distances shown reference the approximate closest edge of the Project.
b Ambient measurements were not taken at NSA 3. Ambient sound levels at NSA 3 are assumed to be equal to the ambient noise levels at the nearby NSA 2.

Phase 2 construction noise was modeled in simultaneous occurrence with Phase 1 operational noise, and the predicted sound levels are summarized in table 4.11.2-5. The results were very similar to Phase 1 construction noise impacts because the operational noise of Phase 1 is predicted to be considerably quieter than construction noise.

TABLE 4.11.2-5						
LNG Phase 1 Operation and Phase 2 Construction - Predicted Sound Levels at Noise Sensitive Areas & Calculation Points						
NSA / CP	**Distance From Terminal (miles) [a]**	**Direction from Terminal**	**Existing Ambient L_{dn} (dBA)**	**Predicted Project Contribution L_{dn} (dBA)**	**Ambient + LNG Terminal L_{dn} (dBA)**	**Potential Increase in Ambient Noise Level (dBA)**
1	1.6	NNE	60.8	54.8	61.8	1.0
2	1.6	NNE	50.2	54.9	56.2	6.0
3	1.7	NE	50.2 [b]	54.6	55.9	5.7
CP-1	6.8	SW	43.0	42.2	45.6	2.6
CP-2	1.7	WSW	59.0	54.3	60.3	1.3
CP-TX	0.1	NW	59.0	63.7	65.0	6.0

a Distances shown reference the approximate closest edge of the Project.
b Ambient measurements were not taken at NSA 3. Ambient sound levels at NSA 3 are assumed to be equal to the ambient noise levels at the nearby NSA 2.

Table 4.11.2-6 shows the predicted L_{max} sound levels at the NSAs for land-based and water-based pile driving activities. The predicted L_{max} sound levels are shown along with the ambient daytime and overall 24-hour L_{dn} sound levels at each NSA.

The L_{max} is the maximum sound level expected during a pile driving event using the fast time constant and is used to characterize short-term, impulsive events rather than the long-term average sound levels in an area. The L_{max} is a substantially different metric than the equivalent sound levels shown for the ambient level. The L_{max} captures the highest sound pressure level during a given period while the equivalent sound level, L_{eq}, gives the sound level with the same energy as the time varying sounds over a given period, essentially an energy average. The ambient sound level measurements were one-hour in duration and are reported as one-hour L_{eq}s. During that hour, there were likely many L_{max} events with sound levels that were much higher than the L_{eq}. Impulsive L_{max} events generally do not have a significant effect on a long-term L_{eq} due to their short duration.

TABLE 4.11.2-6

Predicted L_{max} Sound Levels at NSAs During Pile Driving

Location	Direction / Distance from Land / Water Pile Driving	Daytime L_{eq} (dBA) [a]	Ambient L_{dn} (dBA) [b]	Land-Based Pile Driving Noise Level (dBA L_{max}) [a]	Water-Based Pile Driving Airborne Noise Level (dBA L_{max}) [a]
NSA 1	North-northeast / 1.6 miles / 2.5 miles	62.8	60.8	56.0	51.6
NSA 2	North-northeast / 1.6 miles / 2.5 miles	51.2	50.2	56.0	51.6
NSA 3	Northeast / 1.7 miles / 2.5 miles	51.2	50.2 [c]	55.4	51.6

[a] The daytime sound levels are shown, as pile driving activities would only occur during daytime hours.
[b] L_{max} is a sound measurement typically used with variable noise sources, such as construction equipment or vehicles, that corresponds to the maximum sound level observed during a measurement period or noise event (EPA, 1974).
[c] Ambient measurements were not taken at NSA 3. Ambient sound levels at NSA 3 are assumed to be equal to the ambient noise levels at the nearby NSA 2.

Due to the expected duration of pile driving activities during construction, there would be moderate impacts on the daytime sound levels at nearby NSAs. Pile driving events would likely be audible, especially when activities are taking place at the closest pile driving locations to the NSAs. However, pile driving is not planned for nighttime hours, so the potential for sleep disturbance is reduced. The impact sound level events from pile driving activities are expected to cause at most a moderate impact at nearby NSAs because pile driving activities would be limited to day time hours, the predicted L_{max} levels are below 60 dBA, and the predicted L_{max} levels are less than 10 dB above the existing ambient.

To ensure that actual noise from pile-driving activities is not significantly greater than predicted, **we recommend that:**

- **Texas LNG should monitor sound levels during pile-driving activities, and file <u>weekly</u> noise data with the Secretary <u>following the start of pile-driving activities</u> that identify the noise impact on the nearest NSAs. If any measured noise impacts due to pile driving (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, Texas LNG should:**

  a. cease pile-driving activities and implement noise mitigation measures; and

  b. file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile driving may resume.

Vibration

Impacts due to construction activities such as pile driving can generate groundborne vibration. High levels of vibration at close proximity can cause perceptible vibration or even damage to structures. However, due to the large distances between the Project site and the closest NSAs and CPs, there is no expectation that there would be any perceptible increase in groundborne vibration. Vibration levels detectable to humans would not extend beyond about 500 feet from the pile driving operation (Maekawa, 1994). No NSAs or structures have been identified within 500 feet of the proposed pile driving activities.

There is some possibility that low-frequency sound levels from the Project operations or construction could result in noise-induced vibration of structures. Based on the predicted sound levels due to pile driving and other construction activities, it is unlikely that the low-frequency sound levels would be high enough to exceed the threshold for causing noise induced vibration.

Underwater Noise

The Project would include several different construction activities that have the potential to cause underwater noise impacts. Pile driving and dredging activities associated with the Project have the greatest potential to result in increased underwater noise, which can adversely impact aquatic resources. Underwater noise impacts are discussed in greater detail in sections 4.6.2.2, 4.7.1.3, and 4.7.2.2.

Construction Conclusion

Based on the construction noise estimates provided by Texas LNG, the maximum sound levels generated by construction activities would increase the existing daytime noise at the nearest NSAs, and would cause increases of up to 6 dBA in the 24-hour L_{dn}. Overall, construction sound levels are expected to be lower than 55 dBA L_{dn} at all NSAs. In order to limit potential adverse impacts due to pile driving, we have recommended that Texas LNG monitor sound levels from pile driving and install noise mitigation to address any pile driving sound levels that exceed an L_{dn} value of 55 dBA L_{dn} or L_{max} levels greater than 10 dB above the existing ambient sound levels. In addition, Texas LNG would utilize bubble curtains or cushion blocks for all in-water pile driving activities (see section 4.6.2.2). Therefore, we conclude that construction noise impacts on the surrounding areas would be audible, but not significant during construction of the Project.

4.11.2.4 Operation Noise Impacts and Mitigation

The Project would include the following major noise-producing sources:

- mixed refrigerant compressors and associated coolers;
- propane compressors and associated heaters, condensers, and coolers;
- residue gas compressor and associated coolers and condensers;
- heat transfer fluid system and associated coolers;
- acid gas removal unit and associated condensers and coolers;

- boil-off gas compressor and associated coolers;
- liquefaction unit exchangers, separators, and suction drums;
- miscellaneous pumps of various types scattered throughout the facility;
- flaring events during commissing and maintenance activities; and
- LNG carrier loading activities.

Noise contributions for the Project during operation were calculated using environmental noise prediction software SoundPlan Essential 2.0. The model calculates the total sound pressure level at a specified receiver location or over a grid from all sources. Standard vendor supplied noise controls are included in the analysis.

Predicted operational noise L_{dn} values from the Project are shown in table 4.11.2-7 for Phase 1 and table 4.11.2-8 for Phases 1 and 2 combined. The predicted Project sound levels are shown on figure 4.11.2-2 as the A-weighted 24-hour L_{dn} levels. The Project would result in a maximum sound level contribution of 45.7 dBA L_{dn} at the most impacted NSA.

TABLE 4.11.2-7

LNG Terminal Phase 1 Operation - Predicted Sound Levels at Noise Sensitive Areas / Calculation Points

NSA / CP	Distance From Terminal (miles) [a]	Direction from Terminal	Existing Ambient L_{dn} (dBA)	Predicted LNG Terminal Phase 1 L_{dn} (dBA)	Ambient + LNG Terminal Ldn (dBA)	Potential Increase in Ambient Noise Level (dBA)
1	1.5	NNE	60.8	42.5	60.9	0.1
2	1.5	NNE	50.2	42.8	51.0	0.7
3	1.6	NE	50.2	41.6	50.8	0.6
CP 1	6.8	SW	43.0	25.5	43.1	0.1
CP 2	1.7	WSW	59.0	38.0	59.0	0.0
CP-TX	0.1	NW	59.0	51.0	59.6	0.6

[a] Distances shown reference the approximate closest edge of the Project.

TABLE 4.11.2-8

LNG Terminal Combined Phases 1 and 2 Operation - Predicted Sound Levels at Noise Sensitive Areas / Calculation Points

NSA / CP	Distance From Terminal (miles) [a]	Direction from Terminal	Existing Ambient L_{dn} (dBA)	Predicted LNG Terminal Phases 1 & 2 L_{dn} (dBA)	Ambient + LNG Terminal L_{dn} (dBA)	Potential Increase in Ambient Noise Level (dBA)
1	1.5	NNE	60.8	45.3	61.0	0.1
2	1.5	NNE	50.2	45.7	51.5	1.3
3	1.6	NE	50.2	44.6	51.3	1.0
CP 1	6.8	SW	43.0	28.5	43.2	0.2
CP 2	1.7	WSW	59.0	41.0	59.1	0.1
CP-TX	0.1	NW	59.0	52.9	60.0	1.0

TABLE 4.11.2-8 LNG Terminal Combined Phases 1 and 2 Operation - Predicted Sound Levels at Noise Sensitive Areas / Calculation Points						
NSA / CP	Distance From Terminal (miles) [a]	Direction from Terminal	Existing Ambient L_{dn} (dBA)	Predicted LNG Terminal Phases 1 & 2 L_{dn} (dBA)	Ambient + LNG Terminal L_{dn} (dBA)	Potential Increase in Ambient Noise Level (dBA)

[a] Distances shown reference the approximate closest edge of the Project.

Based on these results, operation of the Project would comply with the FERC 55 dBA L_{dn} criterion. The increases during operations are equal to or less than 1 dBA for the CP locations, including the closest area of the Laguna Atascosa NWR to the Project (CP-TX). These increases would be considered imperceptible to most listeners. Therefore, noise impacts due to operation of the Project would not be significant. However, to ensure that the actual noise impact resulting from operation of the Project are consistent with the modeling used in our analysis, **we recommend that:**

- **Texas LNG should file a full power load noise survey with the Secretary for the LNG Terminal <u>no later than 60 days</u> after each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG Terminal exceeds an L_{dn} of 55 dBA at the nearest NSA, <u>within 60 days</u> Texas LNG should modify operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. Texas LNG should confirm compliance with the above requirement by filing a second noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

In addition, **we recommend that:**

- **Texas LNG should file a noise survey with the Secretary <u>no later than 60 days</u> after placing the entire LNG Terminal into service. If a full load condition noise survey is not possible, Texas LNG should provide an interim survey at the maximum possible horsepower load <u>within 60 days</u> of placing the LNG Terminal into service and provide the full load survey <u>within 6 months</u>. If the noise attributable to operation of the equipment at the LNG Terminal exceeds an L_{dn} of 55 dBA at the nearest NSA under interim or full horsepower load conditions, Texas LNG should file a report on what changes are needed and should install the additional noise controls to meet the level <u>within 1 year</u> of the in-service date. Texas LNG should confirm compliance with the above requirement by filing an additional noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

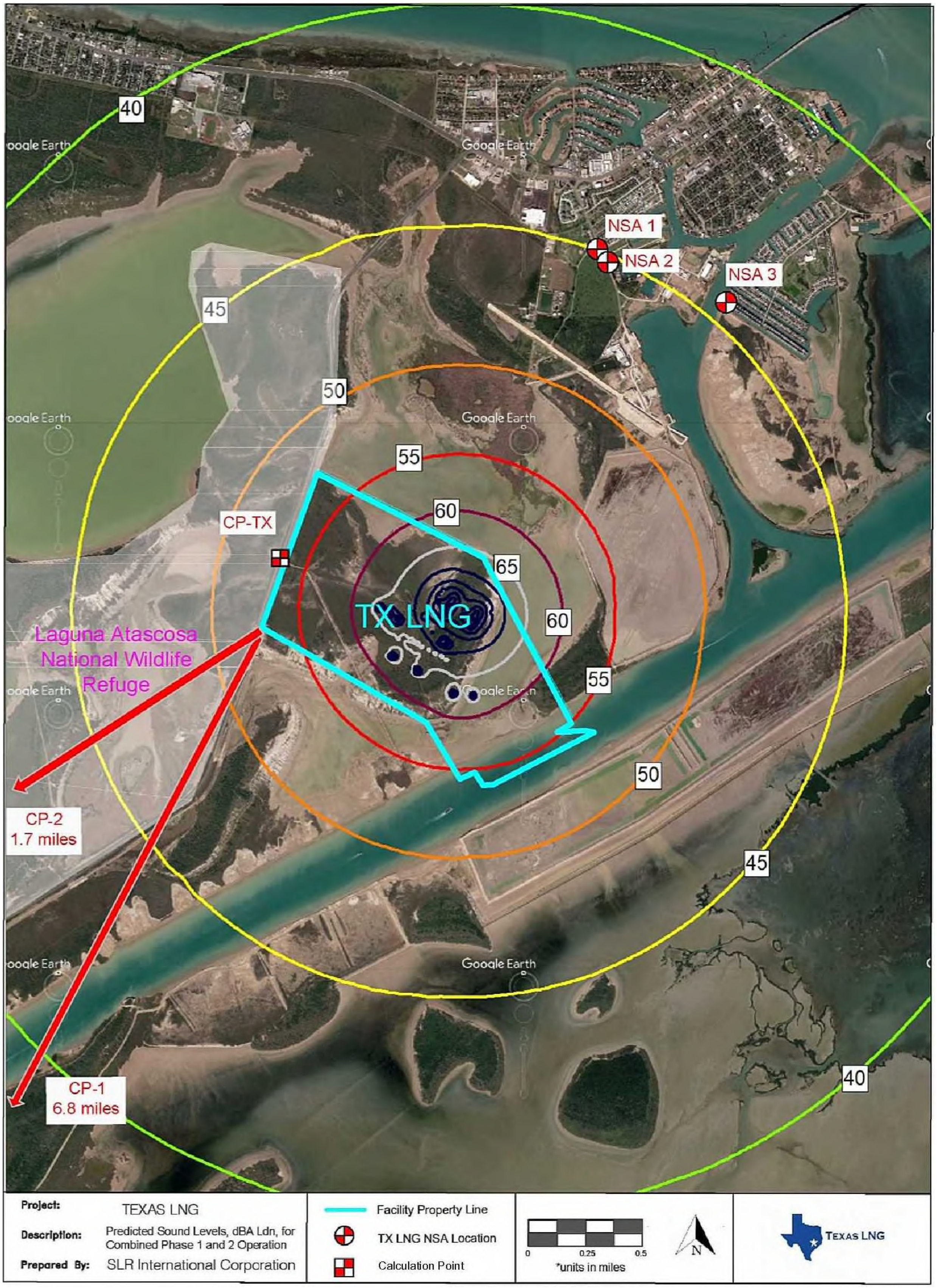

FIGURE 4.11.2-2 Predicted Sound Levels, dBA L_{dn}, for Combined Phase 1 and 2 Operation

Flaring Noise

The purpose of a flare system is to safely and reliably protect plant systems from overpressure during start-up, shutdown, plant upsets, and emergency conditions. The flare system includes a main flare, expected to operate for about 372 hours per year, and a marine flare, expected to operate for about 264 hours per year. The flare system is described in more detail in section 2.1.7.

During normal operation of the facility, flares are not expected to produce significant noise levels as they would not be flaring a significant amount of gas. According to Texas LNG, during the worst case emergencies, the noise level at the base of the main flare is expected to be approximately 94 dBA, which corresponds to a noise level of approximately 42.8 dBA at the nearest NSA.

The marine flare will operate sporadically during LNG carrier loading activities. Texas LNG did not provide information about nose associated with the marine flare planned for the Project. Marine flare sound levels from the Annova LNG Project (124 dBA at 3 feet) and the Rio Grande LNG Project (80 dBA at 1,500 feet) were used to estimate the marine flare contribution at the nearby NSAs. The distance from the marine flare to the closest NSA is about 11,400 feet, so the predicted sound levels range from 52.4 dBA (using the Annova LNG data) to 62.4 dBA (using the Rio Grande LNG data). These levels indicate that marine flare activities could cause an increase in sound levels of between 14 to 24 dB at night at the nearby NSAs. Increases during daytime hours would range from 2.7 to 11.5 dB, using the Rio Grande estimate, and 0.4 to 3.7 dB using the Annova estimates. These increases range from a minor to potentially significant impact on sound levels at the NSAs. However, Texas LNG anticipates that use of the marine flare would be limited to 264 hours per year. Due to the intermittent use, we conclude that noise impacts as a result of the marine flare would not be significant.

During commissioning of the Project, flare operations can occur for extended time periods, in some cases for weeks or months. However, flare use should be uncommon during steady-state facility operation. Based on the sound level predictions from Texas LNG, flaring noise levels are not expected to exceed background noise levels at the nearest NSAs. Due to the low sound levels expected for flaring events, flaring is not expected to have a significant impact on sound levels at the closest NSAs.

Vibration

Due to the large distance between the Project and the closest NSAs, operation of the Project would not result in an increase in perceptible ground-borne vibration at nearby NSAs. There is some possibility of noise-induced vibration due to low-frequency noise especially from flaring activities which can have a low-frequency intensive “rumbly” quality. Based on the sound level predictions provided by Texas LNG, it is unlikely that typical operations noise (without flaring) would contain sufficient low-frequency energy to cause noise-induced vibration of structures. However, flaring activities could cause noise-induced vibration in lightweight residential structures. Such vibrations can be annoying to residents, especially when combined with the 24-hours per day continuous flaring activities that can occur during commissioning;

however, the levels are below any potential damage threshold. Flaring has the potential to cause a minor to moderate noise-induced vibration impact during commissioning, emergencies, or maintenance outages.

Maintenance Dredging

Occasional maintenance dredging would be required during the operational lifespan of the Project to maintain the channel, turning basin, and other marine facilities associated with the Project. Texas LNG anticipates that maintenance dredging would be necessary every 3 to 5 years as described in section 2.5.4.2. Maintenance dredging activities would be substantially quieter than the sound levels reported with construction sound level predictions, as the predicted construction levels also include pile driving, general construction, and dredging activities. The Brownsville Ship Channel is an active waterway that already has ongoing and regular maintenance dredging. The additional maintenance dredging activities associated with the Project are not expected to cause a significant noise impact at the NSAs.

Operations Conclusion

Operation of the Project has the potential to create long-term environmental sound level impacts in the areas surrounding the Project. Normal operations, flaring, and maintenance dredging would create noise that would change the acoustical environment surrounding the Project. Operational noise predictions indicate that the Project would contribute significantly less than 55 dBA L_{dn} at the closest NSAs, with full operations sound level predictions between 44.6 and 45.7 dBA L_{dn}. We have recommended that Texas LNG conduct post-construction sound level testing to ensure that operational sound level contributions are less than 55 dBA L_{dn}. As such, we anticipate no significant impacts due to operational noise. Based on the sound level predictions provided by Texas LNG, flare noise is not expected to have a significant impact. The marine flare could result in a substantial increase in noise; however, use of this flare would be very limited. Therefore, we conclude that the marine flare would not cause a significant noise impact. Further, noise-induced vibration may be noticeable in lightweight residential construction during flaring.

4.12 RELIABILITY AND SAFETY

4.12.1 LNG Facility Reliability, Safety, and Security Regulatory Oversight

LNG facilities handle flammable and sometimes toxic materials that can pose a risk to the public if not properly managed. These risks are managed by the companies owning the facilities, through selecting the site location and plant layout as well as through suitable design, engineering, construction, and operation of the LNG facilities. Multiple federal agencies share regulatory authority over the LNG facilities and the operator's approach to risk management. The safety, security, and reliability of Texas LNG's Liquefaction Project would be regulated by the DOT, Coast Guard, and FERC.

In February 2004, the DOT, Coast Guard, and FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals, including terminal facilities and LNG carrier operations, and maximizing the exchange of information related to the safety and security aspects of LNG facilities and related marine operations. Under the Interagency Agreement, FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The DOT and the Coast Guard participate as cooperating agencies but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, and operation. All three agencies have some oversight and responsibility for the inspection and compliance during the LNG facility's operation.

The DOT establishes and has the authority to enforce the federal safety standards for the siting, construction, operation, and maintenance of onshore LNG facilities, as well as for the siting of marine cargo transfer systems at waterfront LNG facilities, under the Natural Gas Pipeline Safety Act (49 USC. 1671 *et seq.*). The DOT's LNG safety regulations are codified in 49 CFR 193, which prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that are subject to federal pipeline safety laws (49 USC 60101 *et seq.*), and 49 CFR 192. On August 31, 2018, the DOT and FERC signed a MOU regarding methods to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. In the MOU, the DOT agreed to issue a Letter of Determination (LOD) stating whether a proposed LNG facility would be capable of complying with location criteria and design standards contained in Subpart B of Part 193. The Commission committed to rely upon the DOT determination in conducting its review of whether the facilities would be in the public interest. The issuance of the LOD does not abrogate the DOT's continuing authority and responsibility over a proposed project's compliance with Part 193 during construction and future operation of the facility. The DOT's conclusion on the siting and hazard analysis required by Part 193 would be based on preliminary design information which may be revised as the engineering design progresses to final design. DOT regulations also contain requirements for the design, construction, installation, inspection, testing, operation, maintenance, and contingency plans for LNG facilities, which would be completed during later stages of the Liquefaction Project. If the project is constructed and becomes operational, the liquefaction facilities would be subject to the DOT's inspection program to ensure compliance with the requirements of 49 CFR 193.

The Coast Guard has authority over the safety of an LNG terminal's marine transfer area and LNG marine traffic, as well as security plans for the entire LNG terminal and LNG marine traffic. The Coast Guard regulations for LNG facilities are codified in 33 CFR 105 and 33 CFR 127. As a cooperating agency, the Coast Guard assists the FERC staff in evaluating whether an applicant's proposed waterway would be suitable for LNG marine traffic and whether the terminal facilities would be operated in accordance with 33 CFR 105 and 33 CFR 127. If the facilities are constructed and become operational, the facilities would be subject to the Coast Guard inspection program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

The FERC authorizes the siting and construction of LNG facilities under the NGA and delegated authority from the DOE. The FERC requires standard information to be submitted to perform safety and reliability engineering reviews. FERC's filing regulations are codified in 18 CFR 380.12 (m) and (o), and requires each applicant to identify how its proposed design would comply with the DOT's siting requirements of 49 CFR 193, Subpart B. The level of detail necessary for this submittal requires the project sponsor to perform substantial front-end engineering of the complete project. The design information is required to be site-specific and developed to the extent that further detailed design would not result in significant changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs. As part of the review required for a FERC order, we use this information from the applicant to assess whether the proposed facilities would have a public safety impact and to suggest additional mitigation measures for the Commission to consider for incorporation as conditions in the order. If the facilities are approved and the suggested mitigation measures are incorporated into the order as conditions, FERC staff would review material filed to satisfy the conditions of the order and conduct periodic inspections throughout construction and operation.

In addition, the Energy Policy Act of 2005 requires FERC to coordinate and consult with the U.S. Department of Defense (DOD) on the siting, construction, expansion, and operation of LNG terminals that would affect the military. On November 21, 2007, the FERC and the DOD (http://www.ferc.gov/legal/mou/mou-dod.pdf) entered into a MOU formalizing this process. In accordance with MOU, the FERC sent a letter to the DOD on October 2, 2015 requesting their comments on whether the planned project could potentially have an impact on the test, training, or operational activities of any active military installation. On June 4, 2018, the FERC received a response letter from the DOD Siting Clearinghouse stating that Texas LNG's Facility would have a minimal impact on military training and operations conducted in Cameron County, Texas.

4.12.2 DOT Safety Regulatory Requirements and 49 CFR 193 Subpart B Determination

Siting the liquefaction facilities with regard to ensuring that the proposed site selection and location would not pose an unacceptable level or risk to public safety is required by DOT's regulations in 49 CFR 193, Subpart B. The Commission's regulations under 18 CFR 380.12 (o) (14) require Texas LNG to identify how the proposed design complies with the siting requirements in DOT regulations under of 49 CFR 193, Subpart B. The scope of DOT's siting authority under 49 CFR 193 applies to LNG facilities used in the transportation of gas by pipeline subject to the federal pipeline safety laws and 49 CFR 192.[33]

DOT reviews the information and criteria submitted by Texas LNG to demonstrate compliance with the safety standards prescribed in 49 CFR 193 Subpart B and issues a LOD to the Commission on whether the proposed facilities would meet the DOT siting standards. The LOD will evaluate the hazard modeling results and endpoints used to establish exclusion zones, as well as Texas LNG's evaluation on potential incidents and safety measures incorporated in the design or operation of the facility specific to the site that have a bearing on the safety of plant personnel and the surrounding public. The LOD will serve as one of the considerations for the Commission to deliberate in its decision to authorize, with or without conditions, or deny an application.

The requirements in 49 CFR 193 Subpart B state that an operator or government agency must exercise legal control over the activities as long the facility is in operation that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release of LNG or ignition of LNG vapor. Approved mathematical models must be used to calculate the

[33] 49 CFR 193.2001(b)(3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the LNG carrier and the last manifold or valve immediately before a storage tank.

dimensions of these exclusion zones. The siting requirements of the 2001 edition of NFPA 59A, an industry consensus standard for LNG facilities, are incorporated into 49 CFR 193 Subpart B by reference, with regulatory preemption in the event of conflict. The following sections of 49 CFR 193 Subpart B specifically address siting requirements:

- Section 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail.

- Section 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with section 2.2.3.2 of NFPA 59A (2001).

- Section 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001).

- Section 193.2067, Wind forces, requires that shop fabricated containers of LNG or other hazardous fluids less than 70,000 gallons must be designed to withstand wind forces based on the applicable wind load data in American Society of Civil Engineers (ASCE) 7 (2005). All other LNG facilities must be designed for a sustained wind velocity of not less than 150 mph unless the DOT Administrator finds a lower wind speed is justified or the most critical combination of wind velocity and duration for a 10,000-year mean return interval.

As stated in section 193.2051, LNG facilities must meet the siting requirements of NFPA 59A (2001), Chapter 2, and include but may not be limited to:

- NFPA 59A (2001) section 2.1.1(c) requires consideration of protection against forces of nature. Section 2.1.1(d) also requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.

- NFPA 59A (2001) section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 British thermal units per square foot per hour (Btu/ft^2-hr) from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE3 or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that have been approved by DOT.

- NFPA 59A (2001) section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard.

> Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or approved alternative models that take into account physical factors influencing LNG vapor dispersion.[34]

Taken together, 49 CFR 193 Subpart B and NFPA 59A (2001) require that flammable LNG vapors from design spills do not extend beyond areas in which the operator or a government agency legally controls all activities. Furthermore, consideration of other hazards which may affect the public or plant personnel must be evaluated as prescribed in NFPA 59A (2001) section 2.1.1(d).

Title 49 CFR 193 Subpart B and NFPA 59A (2001) also specify three radiant heat flux levels which must be considered for LNG storage tank spills for as long as the facility is in operation:

- 1,600 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that are used for outdoor assembly by groups of 50 or more persons;[35]
- 3,000 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that contain assembly, educational, health care, detention or residential buildings or structures;[36] and
- 10,000 Btu/ft^2-hr - This level cannot extend beyond the plant property line that can be built upon.[37]

The requirements for design spills from process or transfer areas are more stringent. For LNG spills, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the plant property line onto a property that can be built upon.

In addition, section 2.1.1 of NFPA 59A (2001) requires that factors applicable to the specific site with a bearing on the safety of plant personnel and surrounding public must be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. DOT has indicated that potential incidents, such as vapor cloud explosions and toxic releases should also be considered to comply with Part 193 Subpart B.[38]

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[34] DOT has approved two additional models for the determination of vapor dispersion exclusion zones in accordance with 49 CFR §193.2059: FLACS 9.1 Release 2 (Oct. 7, 2011) and PHAST-UDM Version 6.6 and 6.7 (Oct. 7, 2011).

[35] The 1,600 Btu/ft^2-hr flux level is associated with producing pain in less than 15 seconds, first degree burns in 20 seconds, second degree burns in approximately 30-40 seconds, 1% mortality in approximately 120 seconds, and 100% mortality in approximately 400 seconds, assuming no shielding from the heat, and is typically the maximum allowable intensity for emergency operations with appropriate clothing based on average 10 minute exposure.

[36] The 3,000 Btu/ft^2-hr flux level is associated with producing pain in less than 5 seconds, first degree burns in 5 seconds, second degree burns in approximately 10-15 seconds, 1% mortality in approximately 50 seconds, and 100% mortality in approximately 180 seconds, assuming no shielding from the heat, and is typically the critical heat flux for piloted ignition of common building materials (e.g., wood, PVC, fiberglass, etc.) with prolonged exposures.

[37] The 10,000 Btu/ft^2-hr flux level is associated with producing pain in less than 1 seconds, first degree burns in 1 seconds, second degree burns in approximately 3 seconds, 1% mortality in approximately 10 seconds, and 100% mortality in approximately 35 seconds, assuming no shielding from the heat, and is typically the critical heat flux for unpiloted ignition of common building materials (e.g., wood, PVC, fiberglass) and degradation of unprotected process equipment after approximate 10 minute exposure and to reinforced concrete after prolonged exposure.

[38] The US DOT PHMSA's "LNG Plant Requirements: Frequently Asked Questions" item H1, https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-plant-requirements-frequently-asked-questions, accessed Aug 2018.

On June 22, 2018, the DOT provided a letter to FERC staff regarding its preliminary review of the information filed by Texas LNG that stated it had no objection to the design spill methodologies being used for the selection of leakage sources to meet the requirements of 49 CFR 193 Subpart B.[39] In addition, the DOT's letter also stated that the vapor dispersion results extend beyond the boundary of the proposed Texas LNG export terminal into an area belonging to the BND. The DOT noted that Texas LNG is working with the BND to secure a land use agreement to satisfy the requirements of Part 193. In addition, as an alternative, Texas LNG could apply for a special permit from DOT for any measures that would provide equal or greater level of safety as the DOT's exclusion zone regulations.

In accordance with the August 31, 2018 MOU, the DOT will issue a LOD to the Commission after the DOT completes its analysis of whether the proposed liquefaction facilities would meet the DOT's siting standards. The LOD will evaluate the hazard modeling results and endpoints used to establish exclusion zones, as well as Texas LNG's evaluation on potential incidents and safety measures incorporated in the design or operation of the facility specific to the site that have a bearing on the safety of plant personnel and surrounding public. The LOD will serve as one of the considerations for the Commission to deliberate in its decision to authorize or deny an application.

The DOT's conclusion on the siting and hazard analysis required by Part 193 would be based on preliminary design information which may be revised as the engineering design progresses to final design. DOT regulations also contain requirements for the design, construction, installation, inspection, testing, operation and maintenance, and contingency plans for LNG facilities, which would be completed during later stages of the Liquefaction Project. If the facilities are approved and constructed, final compliance with the requirements of 49 CFR 193 will be subject to the DOT's inspection and enforcement programs.

4.12.3 Coast Guard Safety Regulatory Requirements and Letter of Recommendation

4.12.3.1 LNG Marine Carrier Historical Record

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG carrier. There are more than 370 LNG carriers in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been thousands of individual LNG carrier arrivals at terminals in the U.S. For more than 40 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG carriers, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG carrier fleet, are described below:

[39] June 22, 2018 letter "Re: Texas LNG Liquefaction Project (Project), FERC Docket CP16-116" from Kenneth Lee to Rich McGuire. Filed in Docket Number CP16-116-000 on June 29, 2018. Accession Number 20180629-3018.

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, no cargo was released because no damage was done to the cargo tanks. The entire cargo of LNG was subsequently transferred to another LNG carrier and delivered to its U.S. destination.

- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the LNG carrier and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.

- **Mostefa Ben Boulaid** had an electrical fire in the engine control room during unloading at Everett, Massachusetts. The ship crew extinguished the fire and the ship completed unloading.

- **Khannur** had a cargo tank overfill into the LNG carrier's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.

- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The LNG carrier was required to discharge its cargo, after which it proceeded to dock for repair.

- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m^3 LNG carrier, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.

- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The LNG carrier was refloated, repaired, and returned to service.

- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.

- **Catalunya Spirit** lost propulsion and became adrift 35 miles east of Chatham, Massachusetts on February 11, 2008. Four tugs towed the LNG carrier to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.

- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No loss of LNG was reported.

- **Al Oraiq** collided with a freight carrier, Flinterstar, near Zeebrugge, Belgium on October 6, 2015. The freight carrier sank, but the Al Oraiq was reported to have sustained only minor damage to its bow and no damage to the LNG cargo tanks. According to reports, the Al Oraiq took on a little water but was towed to the Zeebrugge LNG terminal where its cargo was unloaded using normal procedures. No loss of LNG was reported.

- **Al Khattiya** suffered damage after a collision with an oil tanker off the Port of Fujairah on February 23, 2017. Al Khattiya had discharged its cargo and was anchored at the time of the incident. A small amount of LNG was retained within the LNG carrier to keep the cargo tanks cool. The collision damaged the hull and two ballast tanks on the Al Khattiya, but did not cause any injury or water pollution. No loss of LNG was reported.

4.12.3.2 LNG Carrier Safety Regulatory Oversight

The Coast Guard exercises regulatory authority over LNG carriers under 46 CFR 154, which contains the United States safety standards for LNG carriers transporting LNG in bulk. The LNG carriers visiting the proposed facility would also be constructed and operated in accordance with the International Maritime Organization (IMO) *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and the *International Convention for the Safety of Life at Sea*. All LNG carriers entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a Coast Guard Certificate of Inspection (for U.S. flag vessels) or a Coast Guard Certificate of Compliance (for foreign flag vessels). These documents certify that the LNG carrier is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG carriers under Title 46 CFR 154.

The LNG carriers which would deliver or receive LNG to or from the proposed facility would also need to comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code* in 2002. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on board ships and in port areas. All LNG carriers, as well as other cargo vessels, and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for ships are as follows:

- ships must develop security plans and have a Vessel Security Officer;

- ships must have a ship security alert system. These alarms transmit ship-to-shore security alerts identifying the ship, its location, and indication that the security of the ship is under threat or has been compromised;

- ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and

- ships may have equipment onboard to help maintain or enhance the physical security of the ship.

In 2002, the MTSA was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the *International Ship and Port Facility Security Code* and the *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and the *International Convention for the Safety of Life at Sea*. The Coast Guard's regulations in 33 CFR 104 require vessels to conduct a vessel security assessment and develop a vessel security plan that addresses each vulnerability identified in the vessel security assessments. All LNG carriers servicing the facility would have to comply with the MTSA requirements and associated regulations while in U.S. waters.

The Coast Guard also exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC section 1221, et seq.); and the MTSA of 2002 (46 USC section 701). The Coast Guard is responsible for matters related to navigation safety, LNG carrier engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in Title 33 CFR 105.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG carrier and the last manifold or valve immediately before the receiving tanks. 33 CFR 127 applies to the marine transfer area for LNG of each new waterfront facility handling LNG and to new construction in the marine transfer areas for LNG of each existing waterfront facility handling LNG. The scope of the regulations includes the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of the marine transfer area of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR 127.019, Texas LNG would be required to submit two copies of its Operations and Emergency Manuals to the Coast Guard Captain of the Port (COTP) for examination.

Both the Coast Guard regulations under 33 CFR 127 and FERC regulations under 18 CFR 157.21, require an applicant who intends to build an LNG terminal facility to submit a Letter of Intent (LOI) to the Coast Guard no later than the date that the owner/operator initiates pre-filing with FERC, but, in all cases, at least 1 year prior to the start of construction. In addition, the applicant must submit a Preliminary WSA to the COTP with the LOI.

The Preliminary WSA provides an initial explanation of the port community and the proposed facility and transit routes. It provides an overview of the expected impacts LNG operations may have on the port and the waterway. Generally, the Preliminary WSA does not contain detailed studies or conclusions. This document is used by the COTP to begin his or her evaluation of the suitability of the waterway for LNG marine traffic. The Preliminary WSA must provide an initial explanation of the following:

- port characterization;
- characterization of the LNG facility and the LNG carrier route;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

A Follow-On WSA must be provided no later than the date the owner/operator files an application with FERC, but in all cases at least 180 days prior to transferring LNG. The Follow-on WSA must provide a detailed and accurate characterization of the LNG facility, the LNG carrier route, and the port area. The Follow-on WSA provides a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine traffic, along with appropriate risk management measures and the resources (federal, state, local, and private sector) needed to carry out those measures. Until a facility begins operation, applicants must also annually review their WSAs and submit a report to the COTP as to whether changes are required. This document is reviewed and validated by the Coast Guard and forms the basis for the agency's LOR to the FERC.

In order to provide the Coast Guard COTPs/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic, the Coast Guard has published a Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 01-11).

NVIC 01-11 directs the use of the three concentric Zones of Concern, based on LNG carriers with a cargo carrying capacity up to 265,000 m^3, used to assess the maritime safety and security risks of LNG marine traffic. The Zones of Concern are:

- <u>Zone 1</u> – impacts on structures and organisms are expected to be significant within 500 meters (1,640 feet). The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kilowatt per square meter (kW/m^2) (12,000 Btu/ft^2-hr) from a pool fire.
- <u>Zone 2</u> – impacts would be significant but reduced, and damage from radiant heat levels are expected to transition from severe to minimal between 500 and 1,600 meters (1,640 and 5,250 feet). The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m^2 (1,600 Btu/ft^2-hr) from a pool fire.
- <u>Zone 3</u> – impacts on people and property from a pool fire or an un-ignited LNG spill are expected to be minimal between 1,600 meters (5,250 feet) and a

conservative maximum distance of 3,500 meters (11,500 feet or 2.2 miles). The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the lower flammability limit from a worst case un-ignited release. Impacts to people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source.

Once the applicant submits a complete Follow-On WSA, the Coast Guard reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic both in the waterway and when in port.

As required by its regulations (33 CFR 127.009), the Coast Guard is responsible for issuing a LOR to the FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;
- the LNG carrier's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG carriers en route to the facility, within 25 kilometers (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other manmade obstructions in the waterway;
- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables; and
- distance of berthed LNG carriers from the channel and the width of the channel.

The Coast Guard may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic.

4.12.3.3 Texas LNG's Waterway Suitability Assessment

On February 16, 2015, Texas LNG submitted a LOI and a Preliminary WSA to the COTP, Sector Corpus Christi to notify the Coast Guard that it proposed to construct an LNG export terminal. In the development of the Follow-On WSA, Texas LNG consulted with the Coast Guard and other port stakeholders. As part of its assessment of the safety and security aspects of this project, the COTP Sector Corpus Christi consulted various safety and security working groups, including representatives from Port of Brownsville Navigation District, Port Isabel Navigation District, local facility security, the Brazos-Santiago Pilots Association, and Signet Maritime. In addition, the Coast Guard participated in meetings with the working group listed above, and other federal, state, and local agencies. Texas LNG submitted the Follow-On WSA to the Coast Guard on February 25, 2016.

4.12.3.4 LNG Carrier Routes and Hazard Analysis

An LNG carrier's transit to the terminal would begin when it enters the U.S. Exclusive Economic Zone from well-established shipping lanes through the Gulf of Mexico. The LNG carrier would then enter the U.S. Territorial Sea limit (State Waters) to arrive at the Bravos Santiago Pass ocean buoy. At the Santiago Pass ocean buoy, pilots would board the LNG carrier before entering the Brownsville Ship Channel. From here, the LNG carrier transit would be executed with tug support at limiting speeds of 5 to 10 knots until it reaches the terminal. An LNG carrier port time with pilotage would normally be less than three hours for inbound transits (this includes time needed to turn the LNG carrier around and safely moor the LNG carrier along the berth) and no more than two hours for outbound transits. Pilotage is compulsory for foreign vessels and U.S. vessels under registry in foreign trade when in U.S. waters. All deep draft ships currently entering the shared waterway would employ a U.S. pilot. The National Vessel Movement Center in the U.S. would require a 96-hour advance notice of arrival for deep draft vessels calling on U.S. ports. During transit, LNG carriers would be required to maintain voice contact with controllers and check in on designated frequencies at established way points.

NVIC 01-11 references the "Zones of Concern" for assisting in a risk assessment of the waterway. As LNG carriers proceed along the intended transit route, Hazard Zone 1 would encompass coastal areas along South Padre Island, Port Isabel and the Brownsville Navigation District, including a public boat ramp and approximately 30 Recreational Vehicles hook-ups on South Padre Island. Commercial vessels, recreational and fishing vessels may also fall within Zone 1, depending on their course. Transit of such vessels through a Zone 1 area of concern can be avoided by timing and course changes, if conditions permit. Zone 2 would cover a wider swath of coastal areas along South Padre Island, Port Isabel, and the Brownsville Navigation District, including the Coast Guard Station at South Padre Island, multiple residential buildings, commercial buildings, industrial buildings, a church, a university lab building, Schlitterbahn Water Park, and Long Island. Zone 3 would span larger portions of South Padre Island, Port Isabel and the BND, including the Port Isabel Police and Fire Departments, multiple residential, commercial, and industrial buildings, 9 churches, 2 elementary schools, and the causeway between Port Isabel and South Padre Island.

The areas impacted by the three different hazard zones are illustrated for accidental events in figure 4.12.3-1. The areas impacted by the three different hazard zones are illustrated for intentional events in figure 4.12.3-2.

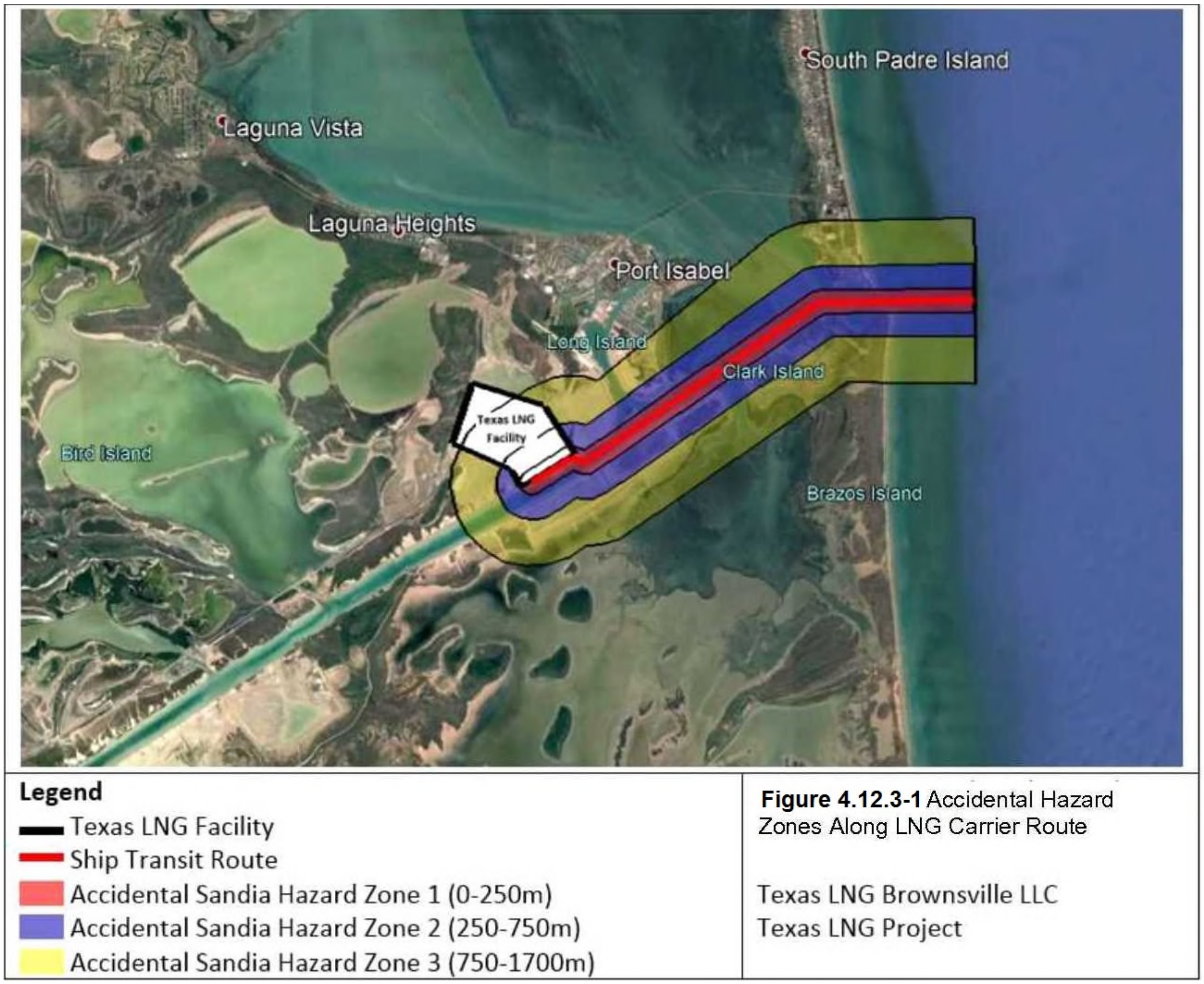

FIGURE 4.12.3-1 Accidental Hazard Zones Along LNG Carrier Route

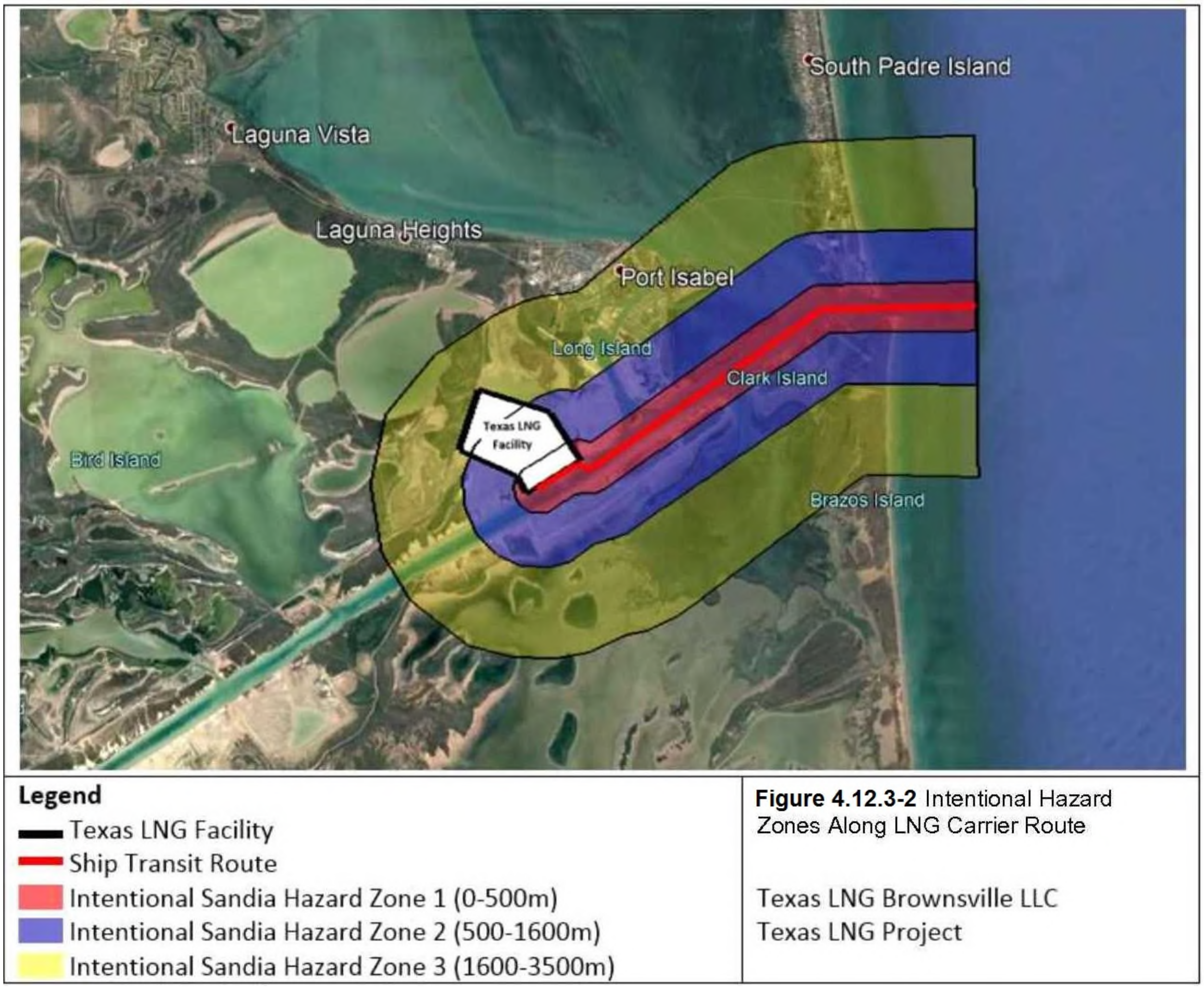

FIGURE 4.12.3-2 Intentional Hazard Zones Along LNG Carrier Route

4.12.3.5 Coast Guard Letter of Recommendation and Analysis

In a letter dated February 14, 2018, the Coast Guard issued an LOR and LOR Analysis to FERC stating that the Brownsville Ship Channel would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project. The LOR was based on full implementation of the strategies and risk management measures identified by the Coast Guard to Texas LNG in its WSA.

Although Texas LNG has suggested mitigation measures for responsibly managing the maritime safety and security risks associated with LNG marine traffic, the necessary vessel traffic and/or facility control measures may change depending on changes in conditions along the waterway. The Coast Guard regulations in 33 CFR 127 require that applicants annually review WSAs until a facility begins operation. The annual review and report to the Coast Guard would identify any changes in conditions, such as changes to the port environment, the LNG facility, or the LNG carrier route, that would affect the suitability of the waterway for LNG marine traffic.

The Coast Guard's LOR is a recommendation, regarding the current status of the waterway, to the FERC, the lead agency responsible for siting the on-shore LNG facility. Neither the Coast Guard nor the FERC has authority to require waterway resources of anyone other than the applicant under any statutory authority or under the Emergency Response Plan (ERP) or the Cost Sharing Plan. As stated in the LOR, the Coast Guard would assess each transit on a case by case basis to identify what, if any, safety and security measures would be necessary to safeguard the public health and welfare, critical infrastructure and key resources, the port, the marine environment, and the LNG carrier.

Under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA, and the Security and Accountability For Every Port Act, the COTP has the authority to prohibit LNG transfer or LNG carrier movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If this Project is approved and if appropriate resources are not in place prior to LNG carrier movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

4.12.4 LNG Facility Security Regulatory Requirements

The security requirements for the proposed Liquefaction Project are governed by 33 CFR 105, 33 CFR 127, and 49 CFR 193, Subpart J. Title 33 CFR 105, as authorized by the MTSA, requires all terminal owners and operators to submit a Facility Security Assessment (FSA) and a Facility Security Plan (FSP) to the Coast Guard for review and approval before commencement of operations of the proposed project facilities. Texas LNG would also be required to control and restrict access, patrol and monitor the plant, detect unauthorized access, and respond to security threats or breaches under 33 CFR 105. Some of the responsibilities of the applicant include, but are not limited to:

- designating a Facility Security Officer with a general knowledge of current security threats and patterns, security assessment methodology, vessel and facility operations, conditions, security measures, emergency preparedness, response, and contingency plans, who would be responsible for implementing the FSA and FSP and performing an annual audit for the life of the Liquefaction Project;

- conducting a FSA to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures; developing a FSP based on the FSA, with procedures for: responding to transportation security incidents; notification and coordination with federal, state, and local authorities; prevention of unauthorized access; measures to prevent or deter entrance with dangerous substances or devices; training; and evacuation;

- defining the security organizational structure with facility personnel with knowledge or training in current security threats and patterns; recognition and detection of dangerous substances and devices, recognition of characteristics and behavioral patterns of persons who are likely to threaten security; techniques to circumvent security measures; emergency procedures and contingency plans;

operation, testing, calibration, and maintenance of security equipment; and inspection, control, monitoring, and screening techniques;

- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, LNG carrier stores and bunkers, and monitoring; ensuring that the Transportation Worker Identification Credential (TWIC) program is properly implemented;

- ensuring coordination of shore leave for LNG carrier personnel or crew change out as well as access through the facility for visitors to the LNG carrier;

- conducting drills and exercises to test the proficiency of security and facility personnel on a quarterly and annual basis; and

- reporting all breaches of security and transportation security incidents to the National Response Center.

Title 33 CFR 127 has requirements for access controls, lighting, security systems, security personnel, protective enclosures, communications, and emergency power. In addition, an LNG facility regulated under 33 CFR 105 and 33 CFR 127 would be subject to the TWIC Reader Requirements Rule issued by the Coast Guard on August 23, 2016. This rule requires owners and operators of certain vessels and facilities regulated by the Coast Guard to conduct electronic inspections of TWICs (e.g., readers with biometric fingerprint authentication) as an access control measure. The final rule would also include recordkeeping requirements and security plan amendments that would incorporate these TWIC requirements. The TWIC program, including the electronic reader and authentication requirements in this final rule, is an important component of the Coast Guard's multi-layered system of access control requirements designed to enhance maritime security. The implementation of the rule was first proposed to be in effect August 23, 2018. In a subsequent notice issued on June 22, 2018, Coast Guard indicated delaying the effective date for certain facilities by 3 years, until August 23, 2021. On August 2, 2018, the President of the United States signed into law the Transportation Worker Identification Credential Accountability Act of 2018 (H.R. 5729). This prohibits the Coast Guard from implementing the rule requiring electronic inspections of TWICs until after the Department of Homeland Security (DHS) has submitted a report to the Congress. Although the effective date of this rule has been postponed for certain facilities, the company should consider the rule when developing access control and security plan provisions for the facility.

Title 49 CFR 193 Subpart J also specifies security requirements for the onshore component of LNG terminals, including requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs.

If the Liquefaction Project is constructed and operated, compliance with the security requirements of 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J would be subject to the respective Coast Guard and DOT inspection and enforcement program.

Texas LNG provided preliminary information on these security features and indicated additional details would be completed in the final design. In accordance with the February 2004

Interagency Agreement among FERC, DOT, and Coast Guard, FERC staff would collaborate with Coast Guard and DOT on the Liquefaction Project's security features.

4.12.5 FERC Engineering and Technical Review of the Preliminary Engineering Designs

4.12.5.1 LNG Facility Historical Record

The operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment with the exception of the October 20, 1944, failure at an LNG plant in Cleveland, Ohio. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[40] The failure of the LNG storage tank was due to the use of materials not suited for cryogenic temperatures. LNG migrated through streets and into underground sewers due to inadequate spill impoundments at the site. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used in the design and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for proposed LNG facilities, we evaluate the preliminary and final specifications for suitable materials of construction and for the design of spill containment systems that would properly contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG plant in Lusby, Maryland. A pump electrical seal located on a submerged electrical motor LNG pump leaked causing flammable gas vapors to enter an electrical conduit and settle in a confined space. When a worker switched off a circuit breaker, the flammable gas ignited, causing heavy damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident led to changes in the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for proposed facilities that have electrical seal interfaces, we evaluate preliminary designs and recommend in section 4.12.6 that Texas LNG provide, for review and approval, the final design details of the electrical seal design at the interface between flammable fluids and the electrical conduit or wiring system, electrical seal leak detection system, and the details of a downstream physical break (i.e., air gap) in the electrical conduit to prevent the migration of flammable vapors.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction plant that killed 27 and injured 56 workers. No members of the public were injured. The investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced into a high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for proposed facilities, we evaluate the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they

[40] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

are adequately covered by hazard detection equipment that could isolate and deactivate any combustion equipment whose continued operation could add to or sustain an emergency. We also recommend in section 4.12.6 that Texas LNG provide, for review and approval, the final design drawings of hazard detection equipment, including the location and elevation of all detection equipment, instrument tag numbers, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

On March 31, 2014, a detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington.[41] This internal detonation subsequently caused the failure of pressurized equipment, resulting in high velocity projectiles. The plant was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured, but one worker was sent to the hospital for injuries. As a result of the incident, the liquefaction trains and a compressor station located onsite were rendered inoperable. Projectiles from the incident also damaged the control building that was located near the pre-treatment facilities and penetrated the outer shell of one of the single containment LNG storage tanks. All damaged facilities were ultimately taken out of service for repair. The accident investigation showed that an inadequate purge after maintenance activities resulted in a fuel-air mixture remaining in the system. The fuel-air mixture auto-ignited during startup after it passed through the gas heater at full operating pressure and temperature. To ensure that this potential hazard would be addressed for proposed facilities, FERC staff recommends in section 4.12.6 that Texas LNG provide a plan for purging, for review and approval, which addresses the requirements of the American Gas Association *Purging Principles and Practice* and to provide justification if not using an inert or non-flammable gas for purging. In evaluating such plans, we would assess whether the purging could be done safely based on review of other plans and lessons learned from this and other past incidents. If a plan proposes the use of flammable mediums for cleaning, dry-out or other activities, we evaluate the plans against other recommended and generally accepted good engineering practices, such as NFPA 56, *Standard for Fire and Explosion Prevention during Cleaning and Purging of Flammable Gas Piping Systems*.

We also recommend in section 4.12.6 that Texas LNG provide for review and approval operating and maintenance plans, including safety procedures, prior to commissioning. In evaluating such plans, we would assess whether the plans cover all standard operations, including purging activities associated with startup and shutdown. Also, in order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we recommend in section 4.12.6 that Texas LNG incorporate mitigation into their final design with supportive information, for review and approval, that demonstrates it would mitigate the risk of a pressure vessel burst or boiling liquid expanding vapor explosion (BLEVE) from occurring.

FERC requires an applicant to provide safety, reliability, and engineering design information as part of its application, including hazard identification studies and front-end-engineering-design (FEED) information for a proposed project. FERC staff evaluates this information with a focus on potential hazards from within and nearby the site, including external

[41] For a description of the incident and the findings of the investigation, see Root Cause Failure Analysis, Plymouth LNG Plant Incident Investigation under CP14-515.

events, which may have the potential to cause damage or failure to the Liquefaction Project facilities, and the engineering design and safety and reliability concepts of the various protection layers to mitigate the risks of potential hazards.

The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard or interruption of service. In general, FERC staff considers an acceptable design to include various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public. These layers of protection are generally independent of one another so that any one layer would perform its function regardless of the initiating event or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events, including the use of inherently safer designs; suitable materials of construction; adequate design margins from operating limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;

- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure that the facility stays within the established operating and design limits;

- safety instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;

- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and cryogenic, overpressure, and fire structural protection, to prevent escalation to a more severe event;

- site security measures for controlling access to the plant, including security inspections and patrols, response procedures to any breach of security, and liaison with local law enforcement officials; and

- onsite and offsite emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders, to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

We believe the inclusion of such protection systems or safeguards in a plant design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the offsite public. The review of the engineering design for these layers of protection is initiated in the application process and carried through to the next phase of the proposed project in final design if authorization is granted by the Commission.

The reliability of these layers of protection is informed by occurrence and likelihood of root causes and the potential severity of consequences based on past incidents and validated hazard modeling. As a result of the continuous engineering review, FERC staff recommends mitigation measures and continuous oversight to the Commission for consideration to include as conditions in the Order. If a facility is authorized and recommendations are adopted as conditions to the Order, FERC staff would continue its engineering review through final design, construction, commissioning, and operation.

4.12.5.2 Process Design Review

In order to liquefy natural gas, most liquefaction technologies require that the feed gas stream be pre-treated to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process or equipment, including mercury, H_2S, CO_2, water, and heavy hydrocarbons. For example, mercury is typically limited to concentrations of less than 0.01 micrograms per normal cubic meter because it can induce embrittlement and corrosion resulting in a catastrophic failure of equipment.

The inlet gas would be conditioned to remove solids and water droplets and for pressure regulation prior to entering feed gas pretreatment processes. Once the inlet gas is conditioned, the feed gas would enter the mercury removal system consisting of mercury adsorber(s) to reduce the mercury concentration in the feed gas. Once the mercury is removed, the feed gas would enter an amine solution based absorber tower to strip acid gas (i.e., CO_2 and H_2S) from the feed gas. The acid gas present in the amine solution would be removed in the amine regeneration unit and would be sent to a thermal oxidizer where acid gas and any remaining traces of hydrocarbons would be incinerated. The feed gas exiting the absorber tower would enter the dehydration unit to remove water by using molecular sieve beds. After water is removed, a Heavy Hydrocarbon Removal Unit would be used to extract the heavy hydrocarbons from the feed gas. The resulting heavy hydrocarbon stream would be stabilized and sent to the condensate storage tank and removed by truck.

After the heavy hydrocarbons and other impurities are removed, the feed gas would be pre-cooled by thermal exchange with propane and further cooled using a mixed refrigerant (MR) stream to condense the natural gas into a liquid at -260°F. The Liquefaction Project expects to utilize a liquefaction process designed and optimized by APCI. The MR process stream is comprised of a mixture of nitrogen, methane, ethylene, and propane designed to achieve the liquefaction temperature. Refrigerants required for the liquefaction process would be unloaded from trucks and stored onsite for initial filling and use, as needed, for make-up. Propane and ethylene refrigerant make-up storage vessels would be provided and the refrigerant truck unloading facility would serve to unload make-up refrigerants brought to the site.

After cooling the natural gas into its liquid form, this LNG would be stored in two full-containment LNG storage tanks where it would be stored and sent out through in-tank pumps to a marine transfer line and marine transfer arms connected to LNG ships. The LNG transferred to the ships would displace vapors from the ships, which would be sent into the BOG system. Once loaded, the LNG ship would be disconnected and leave for export.

Low pressure BOG generated from stored LNG (LNG is continuously boiling) as well as vapors returned during LNG carrier filling operations would be compressed and would primarily be sent to the fuel gas system. The closed BOG system would prevent the release of BOG to the atmosphere and would be in accordance with NFPA 59A. This would be an inherently safer design when compared to allowing the BOG to vent to the atmosphere.

In addition, the Liquefaction Project would include many utilities and associated auxiliary equipment. The major auxiliary systems required for the operation of the liquefaction facility include fuel gas, hot oil, flares, instrument and utility air supply, water supply, demineralized water, nitrogen, and backup power. Furthermore, hot oil would be used to provide the heat demand to the inlet gas heater, molecular sieve regeneration gas heater, amine regeneration reboiler, demethanizer reboiler, condensate stabilizer reboiler, and process water heater. There would be three flare systems: warm (wet), cold (dry), and acid gas plus a spare flare. In addition, a separate marine flare would be provided. Each flare system would be routed to a separate flare stack and would be designed to handle and control the vent gases from the process areas. Diesel would be stored in both a bulk diesel storage tank, as well as in dedicated tanks for their respective equipment, which includes essential firewater pumps and diesel generators. Electric power would be provided from a transmission line connected to the local electrical transmission grid. Nitrogen would be supplied by either an onsite nitrogen generator or from liquid nitrogen trucks and would be stored and subsequently vaporized in ambient exchangers.

The failure of process equipment could pose potential harm if not properly safeguarded through the use of appropriate controls and operation. Texas LNG would install process control valves and instrumentation to safely operate and monitor the facilities. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset. Texas LNG would develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. Texas LNG would design their control systems and human machine interfaces (HMI) to the International Society for Automation (ISA) Standards 5.3, 5.5, 60.1, 60.3, 60.4, and 60.6, and other standards and recommended practices. FERC staff recommends in section 4.12.6 that Texas LNG provide more information, for review and approval, on the operating and maintenance procedures, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training prior to commissioning. We would evaluate these procedures to ensure that an operator can operate and maintain all systems safely, based on benchmarking against other operating and maintenance plans and comparing against recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers (AIChE), *Guidelines for Writing Effective Operating and Maintenance Procedures*. In addition, FERC staff recommends in section 4.12.6 that Texas LNG tag and label instrumentation and valves, piping, and equipment and provide car-seals/locks to address human factor considerations and improve facility safety and prevent incidents. We also recommend in section 4.12.6 that Texas LNG develop and implement an alarm management program, for review and approval to ensure the effectiveness of the alarms. FERC staff would evaluate the alarm management program against recommended and generally accepted good engineering practices, such as ISA Standard 18.2.

In the event of a process deviation, emergency shutdown (ESD) valves and instrumentation would be installed to monitor, alarm, shut down, and isolate equipment and piping during process upsets or emergency conditions. The Liquefaction Project would have plant-wide ESD system to initiate closure of valves and shutdown of the process during emergency situations. Safety-instrumented systems would comply with International Electrotechnical Commission 61508/ISA Standard 84.00.01 and other recommended and generally accepted good engineering practices. FERC staff recommends in section 4.12.6 that

Texas LNG file information, for review and approval, of the final design, installation, and commissioning of instrumentation and ESD equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the ESD system in the plant control room and throughout the plant.

In developing the FEED, Texas LNG conducted a hazard identification review to identify potential hazards (both safety and environmental) associated with the proposed facility location, site layout, process design, marine operations, simultaneous operations, and construction. A more detailed hazard and operability review (HAZOP) analysis would be performed by Texas LNG during the final design to identify the major process hazards that may occur during the operation of the facilities. The HAZOP study would be intended to address hazards of the process, engineering and administrative controls and would provide a qualitative evaluation of a range of possible safety, health, and environmental consequences that may result from the process hazard, and identify whether there are adequate safeguards (e.g. engineering and administrative controls) to prevent or mitigate the risk from such events. Where insufficient engineering or administrative controls are identified, recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. FERC staff recommends in section 4.12.6 that Texas LNG file the HAZOP study on the completed final design for review and approval. We would evaluate the HAZOP to ensure all systems and process deviations are addressed appropriately based on likelihood, severity and risk values with commensurate layers of protection in accordance with recommended and generally accepted good engineering practices, such as AIChE, *Guidelines for Hazard Evaluation Procedures*. We also recommend in section 4.12.6 that Texas LNG file the resolutions of the recommendations generated by the HAZOP for review and approval by FERC staff. Once the design has been subjected to a HAZOP review, the design development team tracks, manages and keeps records of changes in the facility design, construction, operations, documentation, and personnel. Texas LNG would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on its management of change procedures. If FERC staff's recommendations are adopted into the Commission Order, resolutions of the recommendations generated by the HAZOP review would be monitored by FERC staff. We also recommend in section 4.12.6 that Texas LNG file all changes to their FEED for review and approval by FERC staff. However, major modifications could require an amendment or new proceeding.

If the project is authorized and constructed, Texas LNG would install equipment in accordance with its design. FERC staff recommends in section 4.12.6 that the project facilities be subject to construction inspections and that Texas LNG provide, for review and approval, commissioning plans, procedures and commissioning demonstration tests that would verify the performance of equipment. In addition, we FERC staff recommends in section 4.12.6 that Texas LNG provide semi-annual reports that include abnormal operating conditions and facility modifications. Furthermore, FERC staff recommends in section 4.12.6 that the project facilities would be subject to regular inspections throughout the life of the facilities to verify that equipment is being properly maintained and to verify basis of design conditions, such as feed gas and sendout conditions, do not exceed the original basis of design.

4.12.5.3 Mechanical Design Review

Texas LNG provided codes and standards for the design, fabrication, construction and installation of piping and equipment and specifications for the facility. The design specifies materials of construction and ratings suitable for the pressure and temperature conditions of the process design. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the American Society of Mechanical Engineers (ASME) Standards B31.3, B36.10, and B36.19. Pressure vessels would be designed, fabricated, inspected, examined, and tested in accordance with ASME Boiler and Pressure Vessel Code section VIII per 49 CFR 193 and the NFPA 59A (2001). Portions of the facility regulated under 33 CFR 127 for the marine transfer system, including piping, hoses, and loading arms should also be tested in accordance with 33 CFR 127.407. In addition, the operator should verify the set pressure of the pressure relief valves meet the requirements in 33 CFR 127.407.

Low-pressure storage tanks such as the LNG, amine, and condensate storage tanks, would be designed, inspected, and maintained in accordance with the API Standards 620, 625, 650, and 653. Concrete LNG storage tanks would also be designed in accordance with ACI 376. All LNG storage tanks would also include boil-off gas compression to prevent the release of boil-off to the atmosphere in accordance with NFPA 59A for an inherently safer design. Heat exchangers would be designed to ASME Boiler and Pressure Vessel Code section VIII standards; API Standards 660 and 661; and the Tubular Exchanger Manufacturers Association (TEMA) standards. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 613, 614, 616, 617, 670, 671, 675, 676, and 682; and ASME Standards B73.1 and B73.2. Valves would be designed to standards and recommended practices such as API Standards 594, 598, 600, 602, 603, 607, 608, and 609; ASME Standards B16.5, B16.10, B16.20, B16.25, and B16.34; and ISA Standards 75.01.01, 75.05.01, and 75.08.01.

Pressure and vacuum safety relief valves and flares would be installed to protect the storage containers, pressure vessels, process equipment, and piping. The safety relief valves would be designed to handle process upsets and thermal expansion, per NFPA 59A (2001) and ASME section VIII; and would be designed in accordance with API Standards 520, 521, 526, 527, 537, 2000, and other recommended and generally accepted good engineering practices. In addition, FERC staff recommends in section 4.12.6 that Texas LNG provide final design information on pressure and vacuum relief devices, for review and approval, to ensure that the final sizing, design, and installation of these components are adequate and in accordance with the standards referenced and other recommended and generally accepted good engineering practices.

If the project is authorized and constructed, Texas LNG would install equipment in accordance with its design and FERC staff would verify equipment nameplates to ensure equipment is being installed based on approved design. In addition, FERC staff would conduct construction inspections including reviewing quality assurance and quality control plans to ensure construction work is being performed according to proposed project specifications, procedures, codes and standards. FERC staff recommends in section 4.12.6 that Texas LNG provide semi-annual reports that include equipment malfunctions and abnormal maintenance activities. In addition, FERC staff recommends in section 4.12.6 that the project facilities be subject to inspections throughout the life of the facility to verify that the plant equipment is being properly maintained.

4.12.5.4 Hazard Mitigation Design Review

If operational control of the facilities were lost and operational controls and emergency shutdown systems failed to maintain the Liquefaction Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. FERC regulations under 18 CFR 380.12(o) (1) through (4) require applicants to provide information on spill containment, spacing and plant layout, hazard detection, hazard control, and firewater systems. In addition, 18 CFR 380.12 (o) (7) require applicants to provide engineering studies on the design approach and 18 CFR 380.12 (o) (14) requires applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A. As required by 49 CFR 193 Subpart I and by incorporation of section 9.1.2 of NFPA 59A (2001), fire protection must be provided for all DOT regulated LNG facilities based on an evaluation of sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property. NFPA 59A (2001) also requires the evaluation determine type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, and emergency response equipment, training, and qualifications. All facilities, once constructed, must comply with the requirements of 49 CFR 193 Subpart I and would be subject to DOT's inspection and enforcement programs. However, NFPA 59A (2001) also indicates the wide range in size, design, and location of LNG facilities precludes the inclusion of detailed fire protection provisions that apply to all facilities comprehensively and includes subjective performance based language on where ESD systems and hazard control are required and does not provide any additional guidance on placement or selection of hazard detection equipment and provides minimal requirements on firewater. Also, the project marine facilities would be subject to 33 CFR 127, which incorporates sections of NFPA 59A (1994), which have similar performance-based guidance. Therefore, FERC staff evaluated the proposed spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response to ensure they would provide adequate protection of the LNG facilities as described below.

Texas LNG performed a preliminary fire protection evaluation to ensure that adequate mitigation would be in place, including spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. FERC staff recommends in section 4.12.6 that Texas LNG provide a final fire protection evaluation and to provide more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, firewater systems, structural fire protection, and onsite and offsite emergency response procedures for review and approval.

Spill Containment

In the event of a release, sloped areas at the base of storage and process facilities would direct a spill away from equipment and into the impoundment system. This arrangement would minimize the dispersion of flammable vapors into confined, occupied, or public areas and minimize the potential for heat from a fire to impact adjacent equipment, occupied buildings, or public areas if ignition were to occur.

Title 49 CFR 193.2181 Subpart C specifies that each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110% of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank, unless surge is accounted for in the impoundment design. All facilities, once constructed, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to DOT's inspection and enforcement programs. For full containment LNG tanks, we also consider it prudent to provide a barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property). The purpose of the barrier is to prevent liquid from flowing off the plant property and does not define containment or an impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements already met by sumps and impoundments throughout the site. Texas LNG proposes two full-containment LNG storage tanks for which the outer tank wall would serve as the impoundment system. FERC staff verified that the LNG storage tank's outer concrete wall would have a liquid capacity of at least 110% of the inner LNG tank's maximum liquid capacity. In addition, Texas LNG would also install a berm (i.e., earthen dike with a crest elevation of 10 feet) around the LNG storage tanks to prevent liquid from flowing off-site in the event of an outer tank failure.

Texas LNG proposes to install spill impoundment basins. The locations of impoundment basins would include between the loading berth and LNG tank storage, in the refrigerant storage area, in the liquid storage area, and in each LNG liquefaction process area. All basins would be designed to contain either the largest flow capacity from a single pipe for 10 minutes or the capacity of the largest vessel served, whichever is greater. Additional localized dike walls would be provided around the Fresh Solvent Storage Tank, Used Solvent Storage Tank, and the Process Water Collection Tank.

Under NFPA 59A (2001) section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT. All DOT regulated facilities, once constructed, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to DOT's inspection and enforcement programs. The impoundment system design for the marine facilities would be subject to the Coast Guard's 33 CFR 127, which does not specify a spill or duration for impoundment sizing. However, FERC staff evaluates whether all hazardous liquids are provided with spill containment based on the largest flow capacity from a single pipe for 10 minutes or the liquid capacity of the largest vessel served, whichever is greater. In addition, FERC staff recommends in section 4.12.6 that Texas LNG provide additional information on the final design of the impoundment systems for review and approval.

Texas LNG indicated that all piping, hoses, and equipment that could produce a hazardous liquid spill would be provided with spill collection and/or spill conveyance systems. In addition, Texas LNG indicated that the stormwater pumps would be automatically operated by level control and interlocked using low temperature detectors to prevent pumps from operating if LNG is present. If a project is authorized and constructed, Texas LNG would install spill impoundments in accordance with its design and FERC staff would verify during construction inspections that the spill containment system including dimensions, and slopes of curbing and trenches, and capacity matches final design information. In addition, FERC staff recommends in section 4.12.6 that Texas LNG be subject to regular inspections throughout the life of the facility to verify that impoundments are being properly maintained. If the facilities are approved and constructed, final compliance with the requirements of 49 CFR 193 Subpart C would be subject to DOT's inspection and enforcement programs.

Spacing and Plant Layout

The spacing of vessels and equipment between each other, from ignition sources, and to the property line would need to meet the requirements of 49 CFR 193 Subparts C, D, and E, which incorporates NFPA 59A (2001). NFPA 59A further references NFPA Standards 30, NFPA 58, and NFPA 59 for additional spacing and plant layout determinations. If the facilities are approved and constructed, final compliance with the requirements of 49 CFR 193 would be subject to DOT's inspection and enforcement programs.

To minimize risk for flammable or toxic vapor ingress into buildings, FERC staff recommends in section 4.12.6 that Texas LNG conduct a technical review of the facility, for review and approval, identifying all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and verify that these areas would be adequately covered by hazard detection devices that would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. FERC staff also recommends in section 4.12.6 that Texas LNG be subject to periodic inspections during construction to verify flammable/toxic gas detection equipment is installed in heating, ventilation, and air condition intakes of buildings at appropriate locations. In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to continue to verify that flammable/toxic gas detection equipment installed in building air intakes function as designed and are being maintained and calibrated.

If the project is authorized, Texas LNG would finalize the plot plan, and FERC recommends in section 4.12.6 that Texas LNG provide any changes for review and approval to ensure capacities and setbacks are maintained. If the facilities are constructed, Texas LNG would install equipment in accordance with the spacing indicated on the plot plans, and FERC staff recommends in section 4.12.6 that project facilities be subject to periodic inspections during construction to verify equipment is installed in appropriate locations and the spacing is met in the field. In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to continue to verify that equipment setbacks from other equipment and ignition sources are being maintained during operation.

Ignition Controls

Texas LNG's plant areas would be designated with an appropriate hazardous electrical classification and process seals commensurate with the risk of the hazardous fluids being handled in accordance with NFPA 59A (2001), 70, 497, and API RP 500. All facilities subject to DOT regulations, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs, which require compliance, by incorporation by reference, with NFPA 59A (2001) and NFPA 70 (1999). The marine facilities must comply with similar electrical area classification requirements of NFPA 59A (1994) and NFPA 70 (1993), which are incorporated by reference into the USCG regulations in 33 CFR 127. Depending on the risk level, these areas would either be unclassified or classified as Class 1 Division 1, or Class 1 Division 2. Electrical equipment located in these classified areas would be designed such that in the event a flammable vapor is present, the equipment would have a minimal risk of igniting the vapor. FERC staff evaluated the electrical area classification drawings to determine whether Texas LNG would generally meet these electrical area classification requirements and good engineering practices in NFPA 59A, 70, 497, and API RP 500. If the project is authorized, Texas LNG would finalize the electrical area classification drawings and would describe changes made from the FEED design. FERC staff recommends in section 4.12.6 that Texas LNG file, for review and approval, the final design of the electrical area classification drawings. If facilities are constructed, Texas LNG would install appropriately classed electrical equipment, and FERC staff recommends in section 4.12.6 that project facilities be subject to periodic inspections during construction for FERC staff to spot check electrical equipment and verify equipment is installed per classification and are properly bonded or grounded in accordance with NFPA 70.

In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to ensure electrical equipment is maintained (e.g., bolts on explosion proof equipment properly installed and maintained, panels provided with purge, etc.) and electrical equipment are appropriately de-energized and locked out and tagged out when being serviced.

Submerged electrical motor pumps and instrumentation would be equipped with electrical process seals, and instrumentation in accordance with NFPA 59A (2001) and NFPA 70. FERC staff recommends in section 4.12.6 that Texas LNG provide, for review and approval, final design drawings showing process seals installed at the interface between a flammable fluid system and an electrical conduit or wiring system that meet the requirements of NFPA 59A (2001) and NFPA 70. Furthermore, FERC staff recommends in section 4.12.6 that Texas LNG file, for review and approval, details of an air gap or vent equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. In addition, we recommend in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to ensure electrical process seals for submerged pumps continue to conform to NFPA 59A and NFPA 70 and that air gaps are being properly maintained.

Hazard Detection, Emergency Shutdown, and Depressurization Systems

Texas LNG would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an emergency shutdown, depressurization, or initiate appropriate procedures, and would meet NFPA 72, ISA 12.13, and other recommended and generally accepted good engineering practices.

FERC staff evaluated the adequacy of the general hazard detection type, location and layout to ensure adequate coverage to detect cryogenic spills, flammable and toxic vapors, and fires near potential release sources (i.e., pumps, compressors, sumps, trenches, flanges, and instrument and valve connections). FERC staff also review the cause and effect matrices that show which conditions would initiate an alarm, shutdown, depressurization, or other action based on the FEED. FERC staff recommends in section 4.12.6 that Texas LNG provide additional information, for review and approval, on the final design of all hazard detection systems (e.g., manufacturer and model, elevations, etc.) and hazard detection layout drawings. If the project is authorized and constructed, Texas LNG would install hazard detectors according to its specifications, and FERC staff recommends in section 4.12.6 that project facilities be subject to periodic inspections during construction to verify hazard detectors and ESD pushbuttons are appropriately installed per approved design and functional based on cause and effect matrices prior to introduction of hazardous fluids. In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to verify hazard detector coverage and functionality is being maintained and are not being bypassed without appropriate precautions.

Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A (2001); NFPA 10, 12, 15, 17, and 2001; API 2218, and 2510A; as well as other recommended and generally accepted good engineering practices. FERC staff evaluated the adequacy of the number and availability of handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. FERC staff also evaluated whether the spacing of the fire extinguishers would meet NFPA 10. In addition, FERC staff evaluated whether clean agent systems would be installed in all electrical switchgear, and instrumentation buildings systems in accordance with NFPA 2001 and CO_2 systems in gas turbine enclosures in accordance with NFPA 12. In addition, FERC staff recommends in section 4.12.6 that Texas LNG file additional information, for review and approval, on the final design of these systems (e.g., manufacturer and model, elevations, flowrate, capacities, etc.) and where the final design could change as a result of these details or other changes in the final design of the Liquefaction Project. If the project is authorized and constructed, Texas LNG would install hazard control equipment, and FERC staff recommends in section 4.12.6 that project facilities be subject to periodic inspections during construction to verify hazard control equipment is installed in the field and functional prior to introduction of hazardous fluids. In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to verify in the field that hazard control coverage and is being properly maintained and inspected.

Passive Cryogenic and Fire Protection

If a fire could not be separated, controlled, or extinguished to limit fire exposures or cryogenic releases onto facility components to insignificant levels, passive fire protection (e.g. fireproofing structural steel) should be provided to prevent failure of structural supports of equipment and pipe racks. The structural fire protection would comply with NFPA 59A (2001) and other recommended and generally accepted good engineering practices. FERC staff evaluated whether passive cryogenic and fire protection would be applied to pressure vessels and structural supports to facilities that could be exposed to cryogenic liquids or to radiant heats of 4,000 Btu/ft^2-hr or greater from fires with durations that could result in failures[42] and that they are specified in accordance with recommended and generally accepted good engineering practices with a fire protection rating of a commensurate to the radiant heat and duration. In addition, FERC staff recommends in section 4.12.6 that Texas LNG file additional information, for review and approval, on the final design of these systems where details are yet to be

[42] Pool fires from impoundments are generally mitigated through use of emergency shutdowns, depressurization systems, structural fire protection, and firewater, while jet fires are primarily mitigated through the use of emergency shutdowns, depressurization systems, and firewater without structural fire protection.

determined (e.g., calculation of structural fire protection materials, thicknesses, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

If the project is authorized and constructed, Texas LNG would install structural cryogenic and fire protection according to its design, and FERC staff recommends in section 4.12.6 that project facilities be subject to periodic inspections during construction to verify structural cryogenic and fire protection is properly installed in the field as designed prior to introduction of hazardous fluids. In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to continue to verify that passive protection is being properly maintained.

Firewater Systems

Texas LNG would also provide firewater systems, including remotely operated firewater monitors, sprinkler systems, fixed water spray systems, and firewater hydrants and hoses for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire. These firewater systems would be designed to meet NFPA 59A (2001), 13, 15, 20, 22, and 24 requirements. Texas LNG would also install a low expansion foam and high expansion foam systems as well as an on-site foam fire truck to suppress hydrocarbon spills and fires as well as to reduce vaporization rates from LNG pools and would meet NFPA 59A and 11. FERC staff evaluated the adequacy of the general firewater or foam system coverage and verify the appropriateness of the associated firewater demands of those systems and worst case fire scenarios to size the firewater and foam pumps. Texas LNG provided firewater coverage drawings for the firewater monitors.

FERC staff also assesses whether the reliability of the firewater pumps and firewater source or onsite storage volume would be appropriate. In addition, recommends in section 4.12.6 that Texas LNG file, for review and approval, an updated fire protection evaluation on the final design where details are yet to be determined (e.g., manufacturer and model, nozzle types, etc.) and where the final design could change as a result of these details or other changes in the final design of the Liquefaction Project. If the project is authorized and constructed, Texas LNG would install the firewater and foam systems as designed, and FERC staff recommends in section 4.12.6 that project facilities be subject to periodic inspections during construction and that companies provide results of commissioning tests to verify the firewater and foam systems are installed and functional as designed prior to introduction of hazardous fluids. In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to ensure firewater and foam systems are being properly maintained and tested.

4.12.5.5 Geotechnical and Structural Design

Texas LNG provided geotechnical and structural design information for its facilities to demonstrate the site preparation and foundation designs would be appropriate for the underlying soil characteristics and to ensure the structural design of the Project facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practices. The application focuses on the resilience of the Project facilities against natural hazards, including extreme geological, meteorological, and hydrological events, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism.

Geotechnical Evaluation

FERC regulations under 18 CFR 380.12 (h) (3) require geotechnical investigations to be provided. In addition, FERC regulations under 18 CFR 380.12 (o) (14) require an applicant demonstrate compliance with regulations under 49 CFR 193 and NFPA 59A. All facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations incorporate by reference NFPA 59A (2001). NFPA 59A (2001) section 2.1.4 requires soil and general investigations of the site to determine the design basis for the facility. However, no additional requirements are set out in 49 CFR 193 or NFPA 59A on minimum requirements for evaluating existing soil site conditions or evaluating the adequacy of the foundations, therefore FERC staff evaluated the existing site conditions, geotechnical report, and proposed foundations to ensure they are adequate for the LNG facilities as described below.

The Project would be located in the West Gulf section of the Coastal Plain physiographic province (USGS, 2000). The Coastal Plain lies along the Atlantic seaboard and Gulf Coast of the U.S., stretching 100 to 200 miles inland and 100 to 200 miles offshore, to the edge of the continental shelf. This belt of Late Cretaceous to Holocene sedimentary rocks comprises an elevated sea bottom with low topographic relief dipping seaward. In Texas, the Coastal Plain includes a system of alternating synclines (troughs) and anticlines (peaks) oriented perpendicular to the coastline (Hosman, 1996). The surficial geology underlying the region is composed of Quaternary Holocene and Pleistocene-aged sediments made of alluvium of the Rio Grande and coastal deposits of dune, estuary, lagoon, deltaic, tidal-flat, beach, and barrier island environments (Page et al., 2005).

Texas LNG contracted Professional Services, Inc. (PSI) to conduct geotechnical investigations and report existing soil site conditions and proposed foundation design for the Project. The existing site grade ranges between +6.0 feet to +15.0 feet NAVD 88 within the proposed LNG tank area, +3.5 feet to +25.0 feet NAVD 88 within the proposed liquefaction train module area, and +5.0 feet to +6.0 feet NAVD 88 within the proposed office and administration building areas. The site would be cleared, grubbed, and prepared using standard earthmoving and compaction equipment. Site preparation would result in final grades of +10.0 NAVD 88 in the LNG tank area, +20.0 feet NAVD 88 for the LNG tank berms, and +16.0 feet NAVD 88 for all areas adjacent to the channel (including process areas and areas surrounding tank berms) and the administration areas. A final general site grade of +16 feet NAVD 88 was determined in these areas to protect the facilities from storm surge as discussed in more detail later in this section. Cut and fill requirements range throughout the site, with cut and fill of less than 4 feet required for the tank areas, fill of between 5 and 14 feet required for the proposed LNG tank berms, and fill of up to 11 feet and cut of up to 9 feet for the process areas. The offshore berth area would be dredged to -43 feet MLLW. Fill to raise the site will fall into two classes: Class I Structural fill to be used for shallow foundations, slabs, and storage tanks with a net soil pressure of more than 750 psf under foundation, and Class II structural fill to be used for shallow foundations, slabs, and storage tanks with a net soil pressure less than 750 psf under foundation. Both classes of fill will be placed in loose lifts no greater than 8 inches. Class I fill will be compacted to at least 98% of maximum dry density obtained by standard proctor test (American Society for

Testing and Materials [ASTM] D698) to within -2% to +3% of optimum moisture content. Class II fill will be compacted to at least 95% of maximum dry density obtained by standard proctor test (ASTM D698) to within -2% to +3% of optimum moisture content. The fill would also have requirements for size, classification, plasticity, organic content, and water content accordance with ASTM standards.

PSI conducted 19 soil borings to depths ranging from 10 feet to 300 feet below existing grade, 15 cone penetration tests to 100 feet below existing grade, two seismic cone penetration tests at 100 and 150 feet, piezometers to measure groundwater levels, and 14 different tests on more than 400 recovered soil samples, including classification tests (water content, Atterberg liquid and plastic limits, sieve tests, compression tests, consolidation tests, shear tests), corrosion potential tests (pH, sulfate, chloride, electrical resistivity) in general accordance with pertinent ASTM standards. FERC staff evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, cone penetration tests, seismic cone penetration, and other tests, and found them to adequately cover all major facilities, including the marine facilities, LNG storage tanks, liquefaction areas, pretreatment areas, flare system, buildings, and berms. FERC staff will continue its review of the results of the geotechnical investigation to ensure foundation designs are appropriate prior to construction of final design and throughout the life of the facility.

Based on the test borings conducted, the subsoil composition varies through the site, as follows:

<u>LNG Tank and Flare Area</u>

- +6 to -25 feet: Lean clay, lean clay with sand, sandy lean clay, fat clay, silt with sand, sandy silt (very soft to very stiff) with intermittent layers of silty sand (very loose to very dense).
- -25 to -85 feet: Silty sand, clayey sand (medium dense to dense) with frequent layers of clay.
- -85 to -294 feet: Silty sand, poorly graded sand with silt, clayey sand (dense to very dense), with occasional layers of fat clay.

<u>Liquefaction Train Area</u>

- +6 to -60 feet: Lean clay, lean clay with sand, sandy lean clay, fat clay, silt and sand, sandy silt (very soft to stiff) with intermittent layers of silty sand and poorly graded sand with silt (very loose to medium dense).
- -60 to -95 feet: Silty sand, poorly graded sand with silt, clayey sand (dense to very dense) with occasional layers of lean clay and fat clay.

<u>Office and Administration Building Area</u>

- +6 to -44 feet: Lean clay, lean clay with sand, sandy lean clay, fat clay, silt with sand (very soft to stiff) with intermittent layers of silty sand (very loose to medium dense).
- -44 to -74 feet: Silty sand, clayey silt (dense to very dense) with occasional layers of sandy fat clay and sandy lean clay.

Corrosion tests indicate surficial soils are extremely corrosive for steel based on electrical resistivity results (chloride ion concentration generally indicated high and pH generally indicated mild corrosion potential), and negligible to severe concrete deterioration potential, depending on testing location, based on sulfate ion concentrations. Measurements from temporary piezometers show groundwater levels varied from +1.1 feet to +4.1 feet NAVD 88.

Considering the subsurface conditions for the Texas LNG site, shallow foundations (spread footings, mat, or grade beam system) would be suitable for lightly loaded structures; however, as is common for heavier structures in areas with these types of soil conditions, the LNG storage tanks, liquefaction trains, and many associated structures would require deep foundations. Therefore, Texas LNG is proposing to drive precast square concrete piles for deep foundations for heavily loaded structures and settlement sensitive structures. The shallow foundations are recommended to be placed at a depth two (2) feet or deeper below the final grade, while the piles are proposed to be embedded at least 60 feet, but will vary depending on the equipment being supported and pile spacing. Downdrag forces on the piles in areas of fill would be accounted for the in the design of the piles.

Subsidence is the sudden sinking or gradual downward settling of land with little or no horizontal motion, caused by movements on surface faults or by subsurface mining or pumping of oil, natural gas, or ground water. The results of Texas LNG's geotechnical investigation at the Liquefaction Project site indicate that subsurface conditions are generally suitable for the proposed facilities, if adequate site preparation, foundation design, and construction methods are implemented. Even though subsidence is considered a negligible risk at the Liquefaction Project site (as discussed later in this section), Texas LNG proposes to install all key liquefaction facilities on piles, including but not limited to: loading facilities and trestles, LNG storage tanks, LNG booster pumps, pre-treatment and liquefaction equipment, and all compressors and blowers. FERC recommends in section 4.12.6 that Texas LNG monitor foundations and other critical facilities to ensure they are maintained within acceptable limits and site preparation activities be monitored to ensure adherence to the geotechnical design.

Dredging would also need to occur to create a recessed maneuvering basin and berth access for the Brownsville Ship Channel. Total dredging required for the project will require approximately 3.9 million cubic yards of sediment be removed from a 73.5-acre area. The existing shoreline of the Brownsville Ship Channel would be excavated, dredged, and sloped during construction. The post-construction shoreline would be approximately 500 feet east of the current location. To prevent slumping of the dredged slope, maintain the berthing line position, and provide structural integrity support to the landside facilities, the portions excavated shoreline within the maneuvering area would be reinforced with rip-rap armoring. Additional consideration for shoreline erosion is the increase in large ship traffic within the Brownsville Ship Channel. Texas LNG has been consulting with the U.S. Coast Guard on its Follow-on Waterway Suitability Assessment to address impacts from passing ships. The proposed rip-rap armoring would minimize the potential for erosion where the shoreline would be excavated.

The results of Texas LNG's geotechnical investigation at the project site indicate that subsurface conditions are generally suitable for the proposed facilities, if proposed site preparation, foundation design, and construction methods are implemented appropriately.

Structural and Natural Hazard Evaluation

FERC regulations under 18 CFR 380.12 (m) requires applicants address the potential hazard to the public from failure of facility components resulting from accidents or natural catastrophes, evaluate how these events would affect reliability, and describe what design features and procedures that would be used to reduce potential hazards. In addition, 18 CFR 380.12 (o) (14) require an applicant to demonstrate how they would comply with 49 CFR 193 and NFPA 59A. DOT regulations under 49 CFR 193 have some specific requirements on designs to withstand certain loads from natural hazards and also incorporates by reference NFPA 59A (2001 and 2006) and ASCE 7-05 and ASCE 7-93 via NFPA 59A (2001). NFPA 59A (2001) section 2.1.1. (c) also requires that RG LNG consider the plant site location in the design of the Project, with respect to the proposed facilities being protected, within the limits of practicality, against natural hazards, such as from the effects of flooding, storm surge, and seismic activities. This would be covered in DOT PHMSA's LOD on 49 CFR 193 Subpart B. However, the LOD would not cover whether the facility is designed appropriately against these hazards, which would be part of 49 CFR 193 Subpart C. Unlike other natural hazards, wind loads are covered in 49 CFR 193 Subpart B and would be covered in the LOD. All facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs.

In addition, the facilities would be constructed to the requirements in the 2012 International Building Code, ASCE 7-05, and ASCE 7-10 for seismic design. These standards require various structural loads to be applied to the design of the facilities, including live (i.e., dynamic) loads, dead (i.e., static) loads, and environmental loads. FERC staff also evaluated potential engineering design to withstand impacts from natural hazards, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. In addition, we recommend in section 4.12.6 that Texas LNG file final design information (e.g., drawings, specifications, and calculations) and associated quality assurance and control procedures with the documents stamped and sealed by the professional engineer of record. If a project is authorized and constructed, the company would install equipment in accordance with its final design. In addition, we recommend in section 4.12.6 that Texas LNG file, for review and approval, settlement results during hydrostatic tests of the LNG storage containers and periodically thereafter to verify settlement is as expected and does not exceed the applicable criteria in API 620, API 625, API 653, and ACI 376.

Earthquakes, Tsunamis, and Seiche

FERC regulations under 18 CFR 380.12 (h) (5) requires evaluation of earthquake hazards based on whether there is potential seismicity, surface faulting, or liquefaction. Earthquakes and tsunamis have the potential to cause damage from shaking ground motion and fault ruptures. Earthquakes and tsunamis often result from sudden slips along fractures in the earth's crust (i.e., faults) and the resultant ground motions caused by those movements, but can also be a result of volcanic activity or other causes of vibration in the earth's crust. The damage that could occur as a result of ground motions is affected by the type/direction and severity of the fault activity and the distance and type of soils the seismic waves must travel from the hypocenter (or point below the epicenter where seismic activity occurs). To assess the potential impact from earthquakes and tsunamis, Texas LNG evaluated historic earthquakes along fault locations and their resultant ground motions.

The USGS maintains a database containing information on surface and subsurface faults and folds in the United States that are believed to be sources of earthquakes of greater than

6.0 magnitude occurring during the past 1.6 million years (Quaternary Period) (USGS, 2018a). The location of the Liquefaction Project is within the Gulf Coast Basin geologic tectonic province. The Gulf Coast Basin is characterized as having thick sedimentary rocks above basement rock structures. The province's sedimentary strata thickens toward the south, with salt domes and relatively shallow listric growth faults that run parallel to the Gulf of Mexico Coastline and extend outside of Texas. Movement within the fault system has been classified as a general creep as opposed to the breaking of rocks, which is often associated with earthquake events (Stevenson and McCulloh, 2001). Salt domes are prevalent throughout the Gulf Coast Basin and are characterized by having a system of faults arranged in a circular pattern around them (Gagliano, 1999).

PSI hired URS Corporation to perform a site-specific fault and seismic analysis for the Liquefaction Project involving investigations which were previously conducted in the project area and historical data (no new field investigations were performed). Texas LNG's *Seismic and Tsunami Hazard Evaluations* states the site would not be near such faults, which are primarily on the West Coast. However, in the Gulf Coastal Plains, there are several hundred growth faults that are known or suspected to be active. Most of these growth faults are located within the Houston-Galveston (Texas) area subsidence bowl, but many others are known to exist from Brownsville, Texas to east of New Orleans, Louisiana. Evidence of modern activity of these growth faults includes changes in elevation that can lead to damage to pavement, buildings, and other structures. Site-specific investigation would be required to characterize any potential for surface deformation from growth fault activity; however, if such an investigation were to yield the presence of subsurface growth faults, the expected activity rate would be low and would not pose a significant surface rupture hazard at the site (URS, 2016). Additionally, while the presence of faults can require special consideration, the presence or lack of faults identified near the site does not define whether earthquake ground motions can impact the site because ground motions can be felt large distances away from an earthquake hypocenter depending on a number of factors.

To address the potential ground motions at the site, DOT regulations in 49 CFR 193.2101 Subpart C require that field-fabricated LNG tanks must comply with NFPA 59A (2006), section 7.2.2 and be designed to continue safely operating with earthquake ground motions at the ground surface at the site that have a 10% probability of being exceeded in 50 years (475 year mean return interval), termed the operating basis earthquake (OBE). In addition, DOT regulations in 49 CFR 193.2101 Subpart C require that LNG tanks be designed to have the ability to safely shutdown when subjected to earthquake ground motions which have a 2% probability of being exceeded in 50 years (2,475 year mean return interval) at the ground surface at the site (termed the safe shutdown earthquake [SSE]). DOT regulations in 49 CFR 193.2101 Subpart C also incorporate by reference NFPA 59A (2001) Chapter 6, which require piping systems conveying flammable liquids and flammable gases with service temperatures below -20 degrees Fahrenheit, be designed as required for seismic ground motions. The facilities, once constructed, are subject to the DOT's inspection and enforcement programs.

In addition, FERC staff recognizes Texas LNG would also need to address hazardous fluid piping with service temperatures at -20 degrees Fahrenheit and higher and equipment other than piping, and LNG storage (shop built and field fabricated) containers. We also recognize the current FERC regulations under 18 CFR 380.12(h) (5) continue to incorporate National Bureau of Standards Information Report (NBSIR) 84-2833. NBSIR 84-2833 provides guidance on classifying stationary storage containers and related safety equipment as Category I and classifying the remainder of the LNG project structures, systems, and components as either Category II or Category III, but does not provide specific guidance for the seismic design requirements for them. Absent any other regulatory requirements, this guidance recommends that other LNG project structures classified as Seismic Category II or Category III be seismically designed to satisfy the Design Earthquake (DE) and seismic requirements of the ASCE 7-05 in order to demonstrate there is not a significant impact on the safety of the public. ASCE 7-05 is recommended as it is a complete American National Standards Institute consensus design standard, its seismic requirements are based directly on the National Earthquake Hazards Reduction Program Recommended Provisions, and it is referenced directly by the IBC. Having a link directly to the IBC and ASCE 7 is important to accommodate seals by the engineer of record because the IBC is directly linked to state professional licensing laws while the National Earthquake Hazards Reduction Program Recommended Provisions are not.

The geotechnical investigations of the existing site indicate the site is classified as Site Class D in accordance with ASCE 7-05 and IBC 2006 based on a site average shear wave velocities (V_s) which range between 200 and 220 meters feet per second for the top 100 feet of the site soil profiles. This is in accordance with ASCE 7-05, which is incorporated directly into 49 CFR 193 for shop fabricated containers less than 70,000 gallons and via NFPA 59A (2006) for field fabricated containers.[43] This is also in accordance with IBC (2006). Sites with soil conditions of this type would experience significant amplifications of surface earthquake ground motions. However, due to the absence of a major fault in proximity to the site and lower ground motions, the seismic risk to the site is considered low.

URS performed a site-specific seismic hazard study based on historical seismic data. The study concluded that the site would have an OBE peak ground acceleration (PGA) of 0.008 g, a SSE PGA of 0.027 g, a 0.2-second spectral acceleration (S_{DS}) value of 0.038 g, and a 1.0-second spectral acceleration (S_{D1}) at the site of 0.046 g (URS, 2016). FERC staff independently evaluated the OBE PGA, SSE PGA, S_{DS}, and S_{D1} for the site using the USGS Earthquake Hazards Program Seismic Design Maps and Unified Hazard tools for all occupancy categories (I through IV). FERC believes the SSE PGA, OBE PGA, and 5%-damped spectral design accelerations (S_{DS} and S_{D1}) used by Texas LNG are acceptable. These ground motions are relatively low compared to other locations in the United States. Based on the design ground motions for the site and the importance of the facilities, the facility seismic design is assigned Seismic Category I for LNG containers, systems required for isolation of LNG containers, and systems required for safe shutdown or fire protection. Seismic Category 2 structures include facilities and systems not included in Category 1 required for safe plant operation, which include LNG liquefaction trains, inlet facilities, pre-treatment area(s), power generation area(s), fuel gas system, interconnecting piping systems, metering systems, LNG pumps, and other items. Seismic Category 3 includes all other facilities that are not included in Categories 1 and 2,

[43] Site Class E is analogous Soil Profile Type S_4 criteria in ASCE 7-93, which is incorporated into 49 CFR 193 via NFPA 59A (2001) for piping systems conveying flammable liquids and flammable gases with service temperatures below 20 degrees Fahrenheit.

including administration buildings, dock service equipment, waste treatment plant, and incoming electrical power supply.

ASCE 7-05 also requires determination of the Seismic Design Category based on the Occupancy Category (or Risk Category in ASCE 7-10 and 7-16) and severity of the earthquake design motion. The Occupancy Category (or Risk Category) is based on the importance of the facility and the risk it poses to the public.[44] FERC staff has identified the project as a Seismic Design Category A based on the ground motions for the site and an Occupancy Category (or Risk Category) of III or IV, this seismic design categorization would appear to be consistent with the IBC (2006) and ASCE 7-05 (and ASCE 7-10).

Seismic events can also result in soil liquefaction in which saturated, non-cohesive soils temporarily lose their strength/cohesion and liquefy (i.e., behave like viscous liquid) as a result of increased pore pressure and reduced effective stress when subjected to dynamic forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include saturated soils that are generally sandy or silty. Typically, these soils are located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. The correlation for assessing liquefaction for the project's site is the clean-sand blow count; the Liquefaction Project site's minimum blow per foot count is between 8 and 10 blow per foot count. The latest available database of case histories (Idriss and Bouldanger, 2010) was used to determine the potential for liquefaction at the site. Of over 230 cases investigated, only six had PGAs of less than 0.1 g that would liquefy and none had PGA's less than 0.05 g that would liquefy. Since the project's site has a surface PGA of 0.03 g the risk of soil liquefaction at the site is considered negligible. Additionally, heavily-loaded LNG facilities (LNG tanks, liquefaction trains, and associated structures) at the site would be constructed on deep foundations, which would mitigate any potential impacts of soil liquefaction.

Seismic events in waterbodies can also cause tsunamis or seiches by sudden displacement of the sea floors in the ocean or standing water. Tsunamis and seiche may also be generated from volcanic eruptions or landslides. Tsunami wave action can cause extensive damage to coastal regions *and facilities. The Terminal site's low lying position would make it potentially vulnerable were a tsunami to occur. There is little evidence to suggest that the Gulf of Mexico is prone to tsunami events, but the occurrence of a tsunami is possible.* Two did occur in the Gulf of Mexico in the early 20th century and had wave heights of 3 feet or less (USGS, 2009), which is not significantly higher than the average breaking wave height of 1.5 feet (Owen, 2008). Hydrodynamic modeling conducted off the coast of south Texas in 2004 indicated that the maximum tsunami run-up could be as high as 12 feet above mean sea level. No earthquake

[44] ASCE 7-05 defines Occupancy Categories I, II, III, and IV. Occupancy Category I represents facilities with a low hazard to human life in even of failure, such as agricultural facilities; Occupancy Category III represents facilities with a substantial hazard to human life in the event of failure or with a substantial economic impact or disruption of day to day civilian life in the event of failure, such as buildings where more than 300 people aggregate, daycare facilities with facilities greater than 150, schools with capacities greater than 250 for elementary and secondary and greater than 500 for colleges, health care facilities with 50 or more patients, jails and detention facilities, power generating stations, water treatment facilities, telecommunication centers, hazardous facilities that could impact public; Occupancy Category IV represents essential facilities, such as hospitals, fire, rescue, and police stations, emergency shelters, power generating stations and utilities needed in an emergency, aviation control towers, water storage and pump structures for fire suppression, national defense facilities, and hazardous facilities that could substantially impact public; and Occupancy Category II represents all other facilities. ASCE 7-10 changed the term to Risk Categories I, II, III, and IV with some modification.

generating faults have been identified that are likely to produce tsunamis, despite recorded seismic activity in the area.

The potential for tsunamis associated with submarine landslides is more likely a source in the Gulf of Mexico and remains a focus of government research (USGS, 2009). Texas LNG's *Seismic and Tsunami Hazard Evaluations* report included a Tsunami Hazard Assessment for the Project area. There are four main submarine landslide hazard zones in the Gulf of Mexico including the Northwest Gulf of Mexico, Mississippi Canyon and Fan, the Florida Escarpment, and the Campeche Escarpment (USGS, 2009). Based on modeling and limited historical data, it is estimated that tsunamis generated from landslides would be significantly less than the hurricane design storm surge elevations discussed below, so any tsunami hazard has been considered in design.

Hurricanes, Tornadoes, and other Meteorological Events

Hurricanes, tornadoes, and other meteorological events have the potential to cause damage or failure of facilities due to high winds and floods, including failures from flying or floating debris. To assess the potential impact from hurricanes, tornadoes, and other meteorological events, Texas LNG evaluated such events historically. The severity of these events are often determined on the probability that they occur and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval.

Because of its location, the Project site would likely be subject to hurricane force winds during the life of the Project. Texas LNG states that all LNG facilities would be designed to withstand a sustained wind speed of 150 mph (which equivalent to 183-mph 3-second gust) in accordance with 49 CFR 193.2067. Other facilities such as Administration Building and Guard houses would be designed in accordance with the design speed specified in ASCE 7-05. A 183 mph 3-second gust converts to a sustained wind speed of 150 mph using the Durst Curve in ASCE 7-05 or using a 1.23 gust factor recommended for offshore winds at a coast line in World Meteorological Organization, *Guidelines for Converting between Various Wind Averaging Periods in Tropical Cyclone Conditions* (2010). This wind speed is equivalent to approximately a 26,400-year return interval or 0.19% probability of exceedance in a 50-year period for the site. The 183 mph 3-second gust equates to a strong Category 4 Hurricane using the Saffir-Simpson scale (130-156 mph sustained winds, 166-195 mph 3-second gusts). As a result, FERC staff believes the use of a sustained wind speed of 150 mph, 183 mph 3-second gust, is adequate for the LNG storage tanks and conservative from a risk standpoint for all other LNG facilities. Texas LNG must meet 49 CFR 193.2067 under Subpart B for wind load requirements.

Texas LNG must meet 49 CFR 193.2067 Subpart B for wind load requirements. In accordance with the MOU, the DOT will evaluate in its LOD whether an applicant's proposed project meets the DOT requirements under Subpart B. If the project is constructed and becomes operational, the facilities would be subject to the DOT's inspection and enforcement programs. Final determination of whether the facilities are in compliance with the requirements of 49 CFR 193 Subpart B would be made by the DOT staff.

In addition, as noted in the limitation of ASCE 7-05, tornadoes were not considered in developing basic wind speed distributions. This leaves a potential gap in potential impacts from tornadoes. Therefore, FERC staff evaluated the potential for tornadoes. Appendix C of ASCE 7-05 makes reference to American Nuclear Society 2.3 (1983 edition), *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. This document has since been revised in 2011 and reaffirmed in 2016 and is consistent with NUREG/CR-4461, *Tornado Climatology of the Contiguous U.S.*, Rev. 2 (NUREG2007). These documents provide maps of a 100,000 mean year return period for tornadoes using 2 degree latitude and longitude boxes in the region to estimate a tornado striking within 4,000-feet of an area. Figures 5-8 and 8-1 from NUREG/CR-4461 indicate a 100,000-year maximum tornado wind speeds would be approximately 114 mph 3-second gusts for the project site location. Later editions of ASCE 7 (ASCE 7-10 and ASCE 7-16) make reference to International Code Council (ICC) 500, *Standard for Design and Construction of Storm Shelters*, for 10,000 year tornadoes. However, the ICC 500 maps were conservatively developed based on tornadoes striking regions and indicate a 200 mph 3-second gust for a 10,000 year event, which is higher than the 114 mph 3-second gust in ANS 2.3 and NUREG/CR-4461. As a result, FERC staff believes the use of a of 150 mph sustained wind speed, 183 mph 3-second gust, is adequate for the LNG storage tanks and conservative from a risk standpoint for the other LNG facilities

The DOT regulations in 49 CFR 193.2067 Subpart B would require the impounding system for the LNG storage tanks to withstand impact forces from wind borne missiles. ASCE 7 also recognizes the facility would be in a wind borne debris region. Windborne debris has the potential to perforate equipment and the LNG storage tanks if not properly designed to withstand such impacts. The potential impact is dependent on the equivalent projectile wind speed, characteristics of projectile, and methodology or model used to determine whether penetration or perforation would occur. However, no criteria are provided in 49 CFR 193 or ASCE 7 for these specific parameters. NFPA 59A (2016) recommends CEB 187 be used to determine projectile perforation depths. In order to address the potential impact, we recommend in section 4.12.6 that Texas LNG provide a projectile analysis for review and approval to demonstrate that the outer concrete impoundment wall of a full-containment LNG tank could withstand wind borne projectiles prior to construction of the final design. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. FERC staff would compare the analysis and specified projectiles and speeds using established methods, such as CEB 187, and DOE and Nuclear Regulatory Commission (NRC) guidance.

In addition, FERC staff evaluated historical tropical storm, hurricane, and tornado tracks in the vicinity of the project facilities using data from the DHS Homeland Infrastructure Foundation Level Data (HILFD) and NOAA Historical Hurricane Tracker (DHS, 2017; NOAA, 2018). Brownsville has had 30 tropical storms or hurricanes hit within 65 nautical miles since 1900, and *Cameron County has been impacted by 10 hurricanes or tropical storms since 1900. The most recent major hurricane was Hurricane Bret, 1999, just north of Cameron County, which peaked as a Category 4 hurricane with 144 mph sustained winds and made landfall as a Category 3 hurricane with 115 mph sustained winds.*[45] *Prior to Hurricane Bret, Cameron County was hit by Hurricane Allen (Cat 5 peak, Cat 3 landfall) in 1980, Hurricane Beulah (Cat 5 peak, Cat 5 landfall) in 1967 and two unnamed hurricanes in 1933 (Cat 5 peak, Cat 3 landfall) and 1916 (Cat 4 peak, Cat 4 landfall).* Hurricanes in Cameron County have been

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45 A major hurricane is defined as a hurricane that has been classified as Hurricane Category 3 or higher.

observed to have peaked when reaching landfall with 161 mph sustained winds and to have produced storm surges up to 18 feet. *The estimated return period for a major hurricane passing within 50 nautical miles of the coast of Cameron County is about 30 years (NOAA 2016a).*

Potential flood levels may also be informed from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps, which identifies Special Flood Hazard Areas (base flood) that have a 1% probability of exceedance in 1 year to flood (or a 100-year mean return interval) and moderate flood hazard areas that have a 0.2% probability of exceedance in 1 year to flood (or a 500-year mean return interval). According to the FEMA National Flood Insurance Rate Maps for Cameron County, Texas, the project site is located in the 100-year floodplain with a base flood elevation of +9 feet NAVD 88 for the majority of the project site. Note a portion of the channel-side area of the project site is not located within either the 100-year or 500-year floodplain (FEMA, 2018a). FERC staff recognizes that a 500 year flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24, *Flood Resistant Design and Construction*. Therefore, we believe it is good practice to design critical energy infrastructure to withstand 500-year event from a safety and reliability standpoint for the standing water elevation (SWEL) and wave crests. Furthermore, FERC staff believes the use of intermediate values from NOAA for sea level rise and subsidence is more appropriate for design and higher projections are more appropriate for planning in accordance with NOAA (2017)[46], which recommends defining a central estimate or mid-range scenario as baseline for shorter-term planning, such as setting initial adaptation plans for the next two decades and defining upper bound scenarios as a guide for long-term adaptation strategies and a general planning envelope. The Texas LNG site is design to withstand a 500-year storm surge, as discussed below.

The project site is graded to +16 feet NAVD 88 along the channel and berth side of the project site, the liquefaction trains and supporting process equipment areas, areas largely surrounding the LNG storage tanks, and the administrative and electrical substation areas. The design flood level used by Texas LNG is 15.9 feet NAVD 88, which is comprised of 13.2 feet NAVD 88 500-year SWEL, 2.3 feet of 500-year wave effects, and 0.4 feet of sea level rise and subsidence. FERC evaluated the 500-year storm surge provided by Texas LNG against the 2018 FEMA Flood Insurance Study (FIS) for Cameron County, Texas (FEMA, 2018b). The FIS provides various transection lines and associated 10-, 50-, 100-, and 500-year SWELs, 500-year wave envelopes, and 500-year wave effects along the length of the transection lines. Transection line 45 from the FIS transects the channel-side of Texas LNG's site and has a maximum 500-year SWEL of 12.5 feet NAVD 88 and a maximum wave height of 3 feet NAVD 88. Typically, FEMA computes a wave crest as 70% of the total wave height above the still water level; that is, the 500-year wave effect is taken as 70% of 3 feet, or 2.1 feet. FERC also evaluated sea level rise using the NOAA / U.S. Army Corps of Engineers (USACE) Sea Level Rise Calculator and found the intermediate sea level rise projection from the period of 2020 through 2050 to be 1.01 feet (NOAA, 2017b). As a result of FEMA FIS data and NOAA / USACE sea level rise projections, we would expect a berm height or site grade of at least 15.6 feet NAVD 88 along the channel. Additionally, FERC notes the LNG storage tank grade of 10 feet NAVD 88 which are surrounded by earthen berms at 20 feet NAVD 88 (i.e., 10-foot high

[46] *Global And Regional Sea Level Rise Scenarios for the United States*, U.S. Department Of Commerce, National Ocean and Atmospheric Administration, National Ocean Service Center for Operational Oceanographic Products and Services, January 2017.

berms). As a result, FERC staff believes the facility would be able to withstand storm surge without damage during a 500-year storm event. FERC staff recommends in section 4.12.6 that Texas LNG employ a settlement monitoring program to ensure the site grade is always maintained at a minimum of 16.0 feet NAVD 88 and LNG earthen impoundment berms are maintained at a minimum crest of 20 feet NAVD 88. FERC staff also recommend in section 4.12.6 that Texas LNG provide the monitoring and maintenance plan prior commencement of service.

The Texas and Louisiana Gulf Coast area is experiencing the highest rates of coastal erosion and wetland loss in the United States (Ruple, 1993). The average coastal erosion rates is -1.2 meters per year between 2000 and 2012 along the Texas coastal shoreline, with South Padre Island experiencing a shoreline loss rate of -1.6 meters per year between 2000 and 2012 (McKenna, 2014). Shoreline erosion could occur at the Project site and along the opposite shoreline as a result of waves, currents, and vessel wakes. To prevent erosion, new revetment in the form rip rap would be installed in the dredged marine berth and maneuvering areas. Even though shoreline erosion is a concern at the site, the proposed mitigation measures would minimize erosion and scour impacts.

Landslides and other Natural Hazards

Due to the low relief across the Texas LNG site, there is little likelihood that landslides or slope movement at the site would be a realistic hazard. Landslides involve the downslope movement of earth materials under force of gravity due to natural or human causes. The Project area has low relief which reduces the possibility of landslides.

Volcanic activity is primarily a concern along plate boundaries on the West Coast and Alaska and also Hawaii. Based on FERC staff review of maps from USGS (2017) and DHS (2017) of the nearly 1,500 volcanoes with eruptions since the Holocene period (in the past 10,000 years) there are no known active or historic volcanic activity within proximity of the site with the closest being over 400 miles away across the Gulf of Mexico in Los Atlixcos, Mexico.

Geomagnetic disturbances (GMDs) may occur due to solar flares or other natural events with varying frequencies that can cause geomagnetically induced currents, which can disrupt the operation of transformers and other electrical equipment. USGS (2018b) provides a map of GMD intensities with an estimated 100 year mean return interval. The map indicates the Texas LNG site could experience GMD intensities of 100-150 nano-Tesla with a 100 year mean return interval. However, Texas LNG would be designed such that if a loss of power were to occur the valves would move into a fail-safe position. In addition, Texas LNG is an export facility that does not serve any U.S. customers.

4.12.5.6 External Impact Review

To assess the potential impact from external events, FERC staff conducted a series of reviews to evaluate transportation routes, land use, and activities within the facility and surrounding the Liquefaction Project site and the safeguards in place to mitigate the risk from events, where warranted. FERC staff coordinated the results of the reviews with other federal agencies to assess potential impacts from vehicles and rail; aircraft impacts to and from nearby airports and heliports; pipeline impacts from nearby pipelines; impacts to and from adjacent facilities that handle hazardous materials under EPA's Risk Management Plan (RMP) regulations and power plants, including nuclear facilities under NRC's regulations; and impacts to military facilities and operations. Specific mitigation of impacts from use of external roadways, rail, helipads, airstrips, or pipelines are also considered as part of the engineering review done in conjunction with the NEPA review.

FERC staff uses a risk based approach to assess the potential impact of the external events and the adequacy of the mitigation measures. The risk based approach uses data based on the frequency of events that could lead to an impact and the potential severity of consequences posed to the Liquefaction Project site and the resulting consequences to the public beyond the initiating events. The frequency data is based on past incidents and the consequences are based on past incidents and/or hazard modeling of potential failures.

Road

FERC staff reviewed whether any truck operations would be associated with the project and whether any existing roads would be located near the site. FERC staff uses this information to evaluate whether the project and any associated truck operations could increase the risk along the roadways and subsequently to the public and whether any pre-existing unassociated vehicular traffic could adversely increase the risk to a project site and subsequently increase the risk to the public. In addition, all facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (a) (5) (ii) Subpart C requires that structural members of an impoundment system be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a tank truck that could reasonably be expected to cause the most severe loading if the LNG facility adjoins the right-of-way of any highway. Similarly, NFPA 59A (2001), section 8.5.4, incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the DOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts.

FERC staff evaluated the risk of the truck operations based on the frequency of trucks, consequences from a release, incident data from DOT Federal Highway Administration, National Highway Traffic Safety Administration, and PHMSA, and proposed mitigation to prevent or reduce the impacts of a vehicular incident. Incident data indicates hazardous material incidents are very infrequent (4e-3 incidents per lane mile per year) and nearly 75-80% of hazardous material vehicular incidents occur during unloading and loading operations while the other 20-25% occur while in transit or in transit storage. In addition, approximately 99% of releases are 1,000 gallons or less and catastrophic events that would spill 10,000 gallons or more make up less than 0.1% of releases and less than 1% result in injuries and less than 0.1% result in fatalities.

State Highway 48 would border the western side of the proposed site. SH 48 is a four-lane highway with speed limits up to 75 mph. Texas LNG intends to add an auxiliary turning lane to provide access from the State Highway to the site. Additionally, the facility is set back from the road with at least 2,000 feet between process piping and the State Highway. We believe this layout would provide adequate protection from most potential accidental and intentional vehicle impacts. There were no other major highways or roads within close proximity to piping or equipment containing hazardous materials at the site that would raise concerns of direct impacts from a vehicle impacting the site.

During operation of the project, trucks or tanker trucks would transport commodities (e.g., LNG, refrigerants, diesel, hot oil, condensate product, etc.) to or from the facility. Distances from external roads is approximately 2,000 feet to piping and equipment. Unmitigated consequences under worst case weather conditions from catastrophic failures of trucks proposed at the site generally can range from 200 to 2,000 feet for flammable vapor dispersion, 850 to 1,500 feet for radiant heat of $5kW/m^2$ from fireballs, and 275 to 350 feet for radiant heat of $5kW/m^2$ from jet fires with projectiles from BLEVEs possibly extending farther. These values are also close to the distances provided by DOT Federal Highway Administration for designating hazardous material trucking routes (0.5 miles for flammable gases for potential impact distance) and DOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases). Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in much more modest distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. In addition, the separation distance of 2,000 feet between the facility and highway would provide protection from flammable vapor dispersion and radiant heats. Therefore, hazardous material incidents would not present a significant risk or increase in risk of impacting the existing LNG facilities. Depending on the hazardous material truck routes, which are decided by the state, and frequency and consequences of potential incidents, there would also be insignificant risk or increase in risk to the public above existing levels.

We believe the relative distance between the State Highway and plant equipment and perimeter fence, would provide adequate protection from most potential accidental and intentional vehicle impacts. Furthermore, Texas LNG would install deceleration, acceleration, and turning lanes at all vehicle access points for safe vehicular access/departure. Each entrance would also have vehicular barriers and Texas LNG would install crash barriers, bollards, and guard posts to protect onsite process equipment to further mitigate accidental and intentional vehicle impacts. FERC staff recommends in section 4.12.6 that Texas LNG provide, for review and approval, final design details of vehicular barriers at each entrance to the site.

As a result of the separation distances protecting piping and equipment containing hazardous materials and a negligible increase in risk of hazardous material incidents impacting the facilities and nearby population, FERC staff does not believe the proposed project would pose a significant risk or significant increase in risk to the public due to vehicle impacts.

Rail

FERC staff reviewed whether any rail operations would be associated with the project and whether any existing rail lines would be located near the site. FERC staff uses this information to evaluate whether the project and any associated rail operations could increase the risk along the rail line and subsequently to the public and whether any pre-existing unassociated rail operations could adversely increase the risk to the Texas LNG site and subsequently increase the risk to the public. In addition, all facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (a) (5) (ii) Subpart C states if the LNG facility adjoins the right-of-way of any railroad, the structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a train or tank car that could reasonably be expected to cause the most severe loading. Section 8.5.4 of NFPA 59A (2001), incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the DOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. Therefore, FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts. There would be no rail transportation associated with the Liquefaction Project.

FERC staff evaluated the risk of rail operations based on consequences from a release, incident data from DOT Federal Railroad Administration and DOT PHMSA, and frequency of rail operation nearby Texas LNG.

Unmitigated consequences under worst case weather conditions from catastrophic failures of rail cars containing various flammable products generally can range from 300 to 3,000 feet for flammable vapor dispersion, 1,250 to 2,100 feet for radiant heat of $5kW/m^2$ from fireballs, and 450 to 575 feet for radiant heat of $5kW/m^2$ from jet fires with projectiles from BLEVEs possibly extending farther. These values are also close to the distances provided by DOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases). Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in much more modest distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires.

Incident data indicates hazardous material incidents are very infrequent (6e-3 incidents per rail mile per year). In addition, approximately 95% of releases are 1,000 gallons or less, and catastrophic events that would spill 30,000 gallons or more make up less than 1% of releases. In addition, less than 1% of hazardous material incidents result in injuries and less than 0.1% of hazardous material incidents result in fatalities.

The closest rail line is located approximately 5 miles to the west of the Liquefaction Project site. Given the distance and position of the closest rail lines relative to the populated areas to the east of the LNG terminal, FERC staff does not believe the proposed Project would pose a significant increase in risk to the public as a result of the proximity of the Liquefaction Project to the rail lines.

Air

FERC staff reviewed whether any aircraft operations would be associated with the project and whether any existing aircraft operations would be located near the site. FERC staff uses this information to evaluate whether the project and any associated aircraft operations could increase the risk to the public and whether any pre-existing unassociated aircraft operations could adversely increase the risk to the Liquefaction Project site and subsequently increase the risk to the public. In addition, all facilities, once constructed, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155(b) Subpart C requires that an LNG storage tank must not be located within a horizontal distance of one mile from the ends, or 1/4 mile from the nearest point of a runway, whichever is longer and that the height of LNG structures in the vicinity of an airport must comply with FAA requirements.

Texas LNG has provided drawings that indicate a possible helipad within the facility on the control room building rooftop and a possible designated helicopter landing area in the administrative building's parking lot, however, no information on the design or function of these areas were provided. Therefore, FERC staff recommends prior to the end of the DEIS comment period that Texas LNG file clarification on any potential helicopter landing areas, including consideration of other locations away from critical buildings and equipment. Included in this clarification, Texas LNG should file a description of its intended use (e.g., emergency response, annual exercises, executive transportation, etc.), expected operational frequencies, analysis of crash impact probabilities, and evaluation of potential consequences. The closest airports to the Texas LNG Project site would be the Port Isabel Cameron County Airport located approximately 11 miles to the northwest and the Brownsville South Padre Airport located approximately 12 miles to the west. FERC staff also identified 2 smaller airports within a 20 mile radius from the proposed site: Drennan Farm located approximately 13 miles away and Rancho Buena Vista Airport located approximately 16 miles away. In addition, FERC staff identified 3 heliports: U.S. Coast Guard Station Heliport located approximately 6 miles to the northeast, Southeastern Helicopters Heliport located approximately 8 miles to the northeast, and Columbia Valley Regional Heliport located approximately 14.5 miles to the west of the Liquefaction Project site.

FERC staff analyzed existing aircraft operation frequency data based on the airports identified above and their proximity to the LNG storage tanks and process areas, type and frequency of aircraft operations, take-off and landing directions, and non-airport flight paths using the DOE Standard, DOE-STD-3014-2006, *Accident Analysis for Aircraft Crash into Hazardous Facilities*. Based upon that review, FERC staff determined the proposed Project would not pose a significant risk to the public as a result of the proximity of the Liquefaction Project to the airports.

FAA regulations in 14 CFR 77 require Texas LNG to provide notice to the FAA of its proposed construction. This notification should identify all equipment that are more than 200 feet above ground level or lesser heights if the facilities are within 20,000 feet of an airport (at 100:1 ratio or 50:1 ratio depending on length of runway) or within 5,000 feet of a helipad (at 100:1 ratio). In addition, mobile objects, including the LNG carrier that would be above the height of the highest mobile object that would normally traverse the waterway would require notification to DOT FAA. On April 19, 2017 Texas LNG received a DOT FAA Determination of No Hazard to Air Navigation in accordance with 14 CFR 77 for the structures that would exceed 200 feet in height. Texas LNG would also need to file a notice to FAA if the LNG carrier is higher than other objects that traverse the waterway in accordance with 14 CFR 77. Therefore, FERC staff recommends in section 4.12.6 that Texas LNG indicate if the LNG carrier would be above the height of the highest mobile object that would normally traverse the waterway, and if so for Texas LNG to file documentation demonstrating it has received a determination of no hazard (with or without conditions) by DOT FAA for LNG carriers that may exceed the height requirements in 14 CFR 77.9.

Finally, comments from the public and feedback from FAA indicated potential impacts to and from the Liquefaction Project and the nearby SpaceX launch facility. FERC staff conducted internal analyses, utilized a third party contractor, and requested information from the applicant on the likelihood and consequences from a potential launch failure impacting the Liquefaction Project. In our review, we determined while there would be debris above a threshold of 3e-5 years, which is the failure rate level we evaluate the potential for cascading damage and the failure rates used by FAA in space launch failures prior to 2017[47], the cascading damage at the Liquefaction Project site would not impact the public. In addition, the Coast Guard would determine any mitigation measures needed on a case by case basis to safeguard public health and welfare from LNG carrier operations during rocket launch activity. However, our review determined that rocket launch failures could impact onsite construction workers and plant personnel. Therefore, FERC staff recommends in section 4.12.6 that construction crews be positioned outside of higher risk areas during rocket launch activity and for plant personnel to monitor the rocket launches and shut down operating equipment in the event of a rocket launch failure.

In addition, the federal government indemnifies, subject to Congressional appropriations, commercial space licensees from liability for any claims above the liability insurance required under regulation. The maximum probable loss used to determine the insurance and liability uses $3 million for each casualty from direct and indirect effects from a failed launch. Since the LNG facilities would be valued up to approximately $25 billion, conventional LNG ships would be valued at $200-250 million, and a peak construction workforce would total over 1,300 workers, a potential exists for the federal government to be liable for a large sum of money that could exceed the current indemnification levels by a large margin. As a result, the Liquefaction Project may have possible impact to the SpaceX operation due to the insurance premiums that could increase costs to SpaceX, limit the frequency and types of launches out of the Brownsville SpaceX launch site. Depending on the reliance of the National Space Program on the Brownsville SpaceX launch site, this could also have an impact on the National Space Program. There is also potential impact to the liability of the federal government due to indemnification by the federal government for losses above 3.1 billion dollars. However, the extent of these impacts would be not be fully known until SpaceX submits an applications requesting to launch with the FAA and whether the LNG plant is under construction or in operation.

Pipelines

FERC staff reviewed whether any pipeline operations would be associated with the project and whether any existing pipelines would be located near the site. FERC staff uses this information to evaluate whether the project and any associated pipeline operations could increase the risk to the pipeline facilities and subsequently to the public and whether any pre-existing unassociated pipeline operations could adversely increase the risk to the Liquefaction Project site and subsequently increase the risk to the public. The Project will receive natural gas from an intrastate natural gas pipeline.

For existing pipelines, FERC staff identified two abandoned gas transmission pipeline located approximately 5 miles and 0.3 miles from the Liquefaction Project site. The nearest active pipeline would be located approximately 6.8 miles to the north of the Liquefaction Project site and would be too far to impact the project site.

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[47] FAA's 14 CFR §417.107(b) regulations were updated from 3e-5 casualties for three different events (in 2016 edition) to 1e-4 casualties cumulative (in 2017 edition).

In addition, FERC identified Enbridge's 42-inch diameter non-jurisdictional VCP currently under construction routed adjacent to the Liquefaction Project site. The VCP will be a 2.6 Bcf/d cross-border natural gas pipeline between Texas and Mexico that will be used for power generation and industrial customers. The VCP is to extend southwest from a header system in Nueces County, near the Agua Dulce Hub near Corpus Christi, to the proposed border-crossing facility, and would be subject to the jurisdiction of the RRC. Two compressor stations, multiple meter stations and ancillary facilities are also under construction. The VCP route runs along a portion of the proposed Project's western property line, as well as through the proposed Rio Grande LNG Project[48] site's 75-feet wide utility easement.

Based on a February 1, 2018 FERC information request on the RG LNG Project, FERC in consultation with DOT indicated that the VCP would have a Potential Impact Radius (PIR) of 1,587 feet (based on the pipeline diameter of 42 inches and a maximum allowable operating pressure of 3,000 pounds per square inch).[49] The LNG facilities proposed at the site will not be located within the 1,587-feet PIR of the VCP. In Enbridge's responses provided in the February 1, 2018 RG LNG information request, Enbridge indicated that the VCP will have one mainline valve located at Mile Post 146 installed to the west of the Project, and the approximately 8-mile VCP segment between the upstream Brownsville Compressor Station and mainline valve may release approximately 80 million standard cubic feet of natural gas in the event of a leak or rupture.[50] Furthermore, in Enbridge's responses to DOT, it indicated that the amount of natural gas loss in the event of leak or rupture event will be 2,082 million standard cubic feet based on the pipeline isolation of the mainline valve at Mile Post 146 and at a valve downstream on the VCP where the receiving pipeline comes onshore in Mexico.

FERC staff has evaluated the potential risk from an incident from the pipeline and its potential impact. Based on the proposed route and evaluation of the potential likelihood of pipeline incidents and potential consequences from a pipeline incident, FERC staff does not believe the proposed project would significantly increase the risk to the public beyond existing risk levels that would be present from the pipeline in a leak or pipeline rupture worst-case event within the vicinity of the Project site. FERC staff evaluated and accounted for a worst-case large volume leak or rupture scenario in their evaluation of the Project near the VCP. FERC staff does not believe the proposed Project would pose a significant increase in risk to the public as a result of the proximity of the Project to the VCP.

Based an evaluation of the potential likelihood of pipeline incidents and potential consequences from a pipeline incident, FERC staff does not believe the proposed project would significantly increase the risk to the public beyond existing risk levels that are present from the pipelines. Therefore, FERC staff does not believe the proposed project would pose a significant increase in risk to the public as a result of the proximity of the project to the pipelines.

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[48] On May 5, 2016, Rio Grande LNG, LLC (RG LNG) filed an application with the FERC in Docket Number CP16-454-000 to construct and operate natural gas pipelines and a liquefaction export terminal along the Brownsville Ship Channel about 5.5 miles inland from the channel entrance, in Cameron County, Texas.

[49] Potential impact radius (PIR) is defined in 49 CFR 192.903 as the radius of a circle on either side of a pipeline centerline ewhich the potential failure of the pipeline could have significant impact on people or property. PIR is determined based upon a calculation using the pipeline diameter, maximum allowable operating pressure (MAOP), and a composition factor for natural gas.

[50] FERC Accession Number 20180221-5148.

Hazardous Material Facilities and Power Plants

FERC staff reviewed whether any EPA RMP regulated facilities handling hazardous materials and power plants were located near the site to evaluate whether the Texas LNG site could increase the risk to the EPA RMP facilities and power plants and subsequently increase the risk to the public.

There were no facilities handling hazardous materials or nuclear power plants identified adjacent to the site. The closest EPA RMP regulated facilities handling hazardous materials would be the Port Isabel Wastewater Treatment Plant located approximately 1.2 miles away, and the Isla Blanca Waste Water Treatment Plant located approximately 1.3 miles away. The closest power plant identified would be Silas Ray Gas Plant approximately 20 miles away. The closest nuclear plant located over 200 miles to the northeast of the site.

In addition, the proposed Rio Grande LNG terminal would border the site to the west and the proposed Annova LNG terminal would be located across the Brownsville Ship Channel. These proposals would be subject to 49 CFR 193 Subpart B regulatory requirements that establishes exclusion zones for safety of plant personnel and the surrounding public. Each proposal would consider potential incidents and safety measures that would need to be incorporated in the design or operation to ensure risk to surrounding public is not increased.

Given the distances and locations of the facilities relative to the populated areas of the Port Isabel, South Padre Island, and Brownsville communities, FERC staff does not believe the proposed project would pose a significant increase in risk to the public or that the hazardous material facilities and power plants would pose a significant risk to the project and subsequently to the public.

4.12.5.7 Onsite and Offsite Emergency Response Plans

As part of its application, Texas LNG indicated that the Liquefaction Project would develop a comprehensive ERP with local, state, and federal agencies and emergency response officials to discuss the Facilities. Texas LNG would continue these collaborative efforts during the development, design, and construction of the Liquefaction Project. The emergency procedures would provide for the protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the project facilities. The facility would also provide appropriate personnel protective equipment to enable operations personnel and first responder access to the area.

As required by 49 CFR 193.2509 Subpart F, Texas LNG would need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, 49 CFR 193.2509(b)(3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…," which sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank. DOT regulations under 49 CFR 193.2905 Subpart J also require at least two access points in each protective enclosure to be located to minimize the escape distance in the event of emergency.

Title 33 CFR 127.307 also requires the development of emergency manual that incorporates additional material, including LNG release response and emergency shutdown procedures, a description of fire equipment, emergency lighting, and power systems, telephone contacts, shelters, and first aid procedures. In addition, 33 CFR 127.207 establishes requirements for warning alarm systems. Specifically, 33 CFR 127.207 (a) requires that the LNG marine transfer area to be equipped with a rotating or flashing amber light with a minimum effective flash intensity, in the horizontal plane, of 5000 candelas with at least 50% of the required effective flash intensity in all directions from 1.0 degree above to 1.0 degree below the horizontal plane. Furthermore, 33 CFR 127.207(b) requires the marine transfer area for LNG to have a siren with a minimum 1/3- octave band sound pressure level at l meter of 125 decibels referenced to 0.0002 microbars. The siren must be located so that the sound signal produced is audible over 360 degrees in a horizontal plane. Lastly, 33 CFR 127.207 (c) requires that each light and siren be located so that the warning alarm is not obstructed for a distance of 1.6 km (1 mile) in all directions. The warning alarms would be required to be tested in order to meet 33 CFR 127. Texas LNG would be required to meet the warning alarms requirements specified in 33 CFR 127.207.

In accordance with the EPAct 2005, FERC must also approve an emergency response plan covering the terminal and ship transit prior to construction. Section 3A(e) of the NGA, added by section 311 of the EPAct 2005, stipulates that in any order authorizing an LNG terminal, the Commission must require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The final ERP would need to be evaluated by appropriate emergency response personnel and officials. Section 3A(e) of the NGA (as amended by EPAct 2005) specifies that the ERP must include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicant agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG marine carriers that serve the facility. The Cost-Sharing Plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG marine carrier, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, firefighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The cost-sharing plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources.

Texas LNG described the ERP that would be developed to addresses emergency events and potential release scenarios described in the application. The ERP would include public notification, protection, and evacuation. As part of FEED, FERC staff evaluates the initial draft of the emergency response procedures to assure that it covers the hazards associated with the Liquefaction Project. In addition, FERC staff recommends in section 4.12.6 that Texas LNG provide additional information, for review and approval, on the development of updated emergency response plans prior to initial site preparation. FERC staff also recommends in section 4.12.6 that Texas LNG provide three-dimensional drawings, for review and approval, which demonstrate there is a sufficient number of access and egress locations. If the project is authorized and constructed, Texas LNG would coordinate with local, state, and federal agencies on the development of an emergency response plan and cost sharing plan. FERC staff recommends in section 4.12.6 that Texas LNG provide periodic updates on the development of these plans and ensure they are in place prior to introduction of hazardous fluids. In addition, FERC staff recommends in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility and would continue to require Texas LNG to provide updates to the ERP.

4.12.6 Recommendations from FERC Preliminary Engineering and Technical Review

Based on our preliminary engineering and technical review of the reliability and safety of the Liquefaction Project, FERC staff recommends the following mitigation measures to the Commission for consideration to incorporate as possible conditions to an order. These recommendations would be implemented prior to the end of the DEIS comment period, prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility to enhance the reliability and safety of the facility and to mitigate the risk of impact on the public.

- **<u>Prior to the end of the DEIS comment period</u>, Texas LNG should file clarification on any potential helicopter landing areas, including consideration of other locations away from critical buildings and equipment. Included in this clarification, Texas LNG should file a description of its intended use (e.g., emergency response, annual exercises, executive transportation, etc.), expected operational frequencies, analysis of crash impact probabilities, and evaluation of potential consequences.**
- **<u>Prior to initial site preparation</u>, Texas LNG should file with the Secretary documentation demonstrating it has received a determination of no hazard (with or without conditions) by DOT FAA for LNG carriers that may exceed the height requirements in 14 CFR 77.9.**
- **<u>Prior to construction of the final design,</u> Texas LNG should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Texas:**

    a) site preparation drawings and specifications prior to construction;

    b) LNG storage tank and foundation design drawings and calculations prior to construction;

    c) LNG terminal structures and foundation design drawings and calculations prior to their construction;

    d) seismic specifications for procured Seismic Category I equipment prior to the issuing of requests for quotations; and

    e) quality control procedures to be used for civil/structural design and construction early in the design phase.

    In addition, Texas LNG should file, in its Implementation Plan, the schedule for producing this information.

- **<u>Prior to commencement of service</u>, Texas LNG should file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, for the site grade and LNG earthen impoundment berms which ensures the minimum elevation relative to mean sea level will be maintained for the life of the facility considering settlement, subsidence, and sea level rise.**

Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each recommendation. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See *Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information*, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information should be filed <u>a minimum of 30 days</u> before approval to proceed is requested.

- **<u>Prior to initial site preparation</u>, Texas LNG should develop, file, and implement procedures to position construction crews outside of areas that could be impacted by rocket debris of a failed launch during initial moments of rocket launch activity from the Brownsville SpaceX facility.**
- **<u>Prior to initial site preparation</u>, Texas LNG should file an overall Project schedule, which includes the proposed stages of the commissioning plan.**
- **<u>Prior to initial site preparation</u>, Texas LNG should file quality assurance and quality control procedures for construction activities for both the Engineering Procurement Contractor and Texas LNG to monitor construction activities.**
- **<u>Prior to initial site preparation</u>, Texas LNG should file procedures for controlling access during construction.**
- **<u>Prior to initial site preparation</u>, Texas LNG should develop an Emergency Response Plan (ERP) (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:**
    a. **designated contacts with state and local emergency response agencies;**
    b. **scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;**
    c. **procedures for notifying residents and recreational users within areas of potential hazard;**
    d. **evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;**
    e. **locations of permanent sirens and other warning devices; and**

f. **an "emergency coordinator" on each LNG carrier to activate sirens and other warning devices.**

Texas LNG should notify the FERC staff of all planning meetings in advance and should report progress on the development of its ERP at 3-month intervals.

- **<u>Prior to initial site preparation</u>, Texas LNG should file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Texas LNG should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost Sharing Plan <u>at 3-month intervals</u>.**

- **<u>Prior to construction of final design</u>, Texas LNG should file change logs that list and explain any changes made from the front end engineering design provided in Texas LNG's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings. Records of changes should be kept so FERC staff can verify during construction inspections.**

- **<u>Prior to construction of final design</u>, Texas LNG should file information/revisions pertaining to Texas LNG's response numbers 5, 11, 12, 15, 19, 20, 21, 22, 23, and 25 of its July 29, 2016 filing, which indicated features to be included or considered in the final design.**

- **<u>Prior to construction of final design</u>, Texas LNG should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**

- **<u>Prior to construction of final design</u>, Texas LNG should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **<u>Prior to construction of final design</u>, Texas LNG should file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances.**

- **<u>Prior to construction of final design</u>, Texas LNG should file a complete specification and drawings of the proposed LNG tank design and installation.**

- **<u>Prior to construction of final design</u>, Texas LNG should file the evaluation and conclusions by the tank manufacturer regarding the potential for the layering effect and the steps to avoid rollover for various LNG rundown scenarios, especially bottom fill, during the production of excessively warm LNG. This evaluation should consider the suppression of flashing in the bottom fill downpipe caused by static pressure in the column resulting in failure of the LNG to completely reach equilibrium temperature at tank operating pressure.**

- **<u>Prior to construction of final design</u>, Texas LNG should file engineering information that protects the LNG rundown system from the high pressure liquefaction system, including consideration for specifying the LNG rundown system from the main cryogenic heat exchanger (MCHE) to the LNG storage tanks at the same pressure**

as the LNG side of the MCHE with the specification break should occur downstream of the motor operated valve (MOV) valves (i.e., MOV-51001 and 51002) located on the LNG storage tank fill lines. The evaluation should consider removal of the end flash gas separator 1410-V-101 from the LNG product rundown system or a high-high liquid shutdown capability to ensure LNG would not overfill the drum and release LNG into the vapor handling system. In addition, Texas LNG should provide the control loop simulation summary for the LNG rundown system.

- **<u>Prior to construction of the final design</u>, Texas LNG should file engineering information that demonstrates unobstructed flow of the LNG tank recycle line, including consideration for the 16-inch-diameter pump recirculation piping connection to the LNG storage tank top fill line being downstream of the motor control valves (i.e., MOV-51001).**
- **<u>Prior to construction of the final design</u>, Texas LNG should file engineering information that demonstrates detection and protection as a result of cryogenic temperature conditions in the Demethanizer, including consideration for the addition of low temperature shutdown capabilities on temperature transmitters TI-21056 and TIC-21015 on the Demethanizer 1210-T-101 that would close the bottom outlet valve XZV-21006 in the event of depressurization that results in cryogenic temperatures at the bottom of the Demethanizer with the bottom outlet valve XZV-21006 remaining closed until the cryogenic temperature condition has been removed.**
- **<u>Prior to construction of the final design</u>, Texas LNG should file engineering information that demonstrates protection of the Demethanizer Reboiler from cryogenic temperatures, including consideration for specifying the hot oil tubing and tube sheet within the Demethanizer Reboiler 1210-E-102 for cryogenic service.**
- **<u>Prior to construction of the final design</u>, Texas LNG should file engineering information that demonstrates protection of the carbon steel condensate line from cryogenic fluid on the Spare Flare KO Drum 1840-V-103, including consideration of an automatic shutoff valve on the 4-inch-diameter condensate line (1840-PC-84002-4") downstream of the ¾-inch bleed valve controlled by low-low temperature, as well as designing the piping segment between the Spare Flare KO Drum and this low-low temperature shutoff valve for cryogenic temperatures.**
- **<u>Prior to construction of final design</u>, Texas LNG should file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications should include :**

  a. **Building Specifications (control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);**

  b. **Mechanical Specifications (piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);**

  c. **Electrical and Instrumentation Specifications (power system specifications, control system specifications, safety instrument system (SIS) specifications, cable specifications, other electrical and instrumentation specifications); and**

  d. **Security and Fire Safety Specifications (security, passive protection, hazard detection, hazard control, firewater)**

- **<u>Prior to construction of final design</u>, Texas LNG should file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs should include heat and material balances. The P&IDs should include the following information:**
    a. **equipment tag number, name, size, duty, capacity, and design conditions;**
    b. **equipment insulation type and thickness;**
    c. **storage tank pipe penetration size and nozzle schedule;**
    d. **valve high pressure side and internal and external vent locations;**
    e. **piping with line number, piping class specification, size, and insulation type and thickness;**
    f. **piping specification breaks and insulation limits;**
    g. **all control and manual valves numbered;**
    h. **relief valves with size and set points; and**
    i. **drawing revision number and date.**
- **<u>Prior to construction of final design</u>, Texas LNG should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities.**
- **<u>Prior to construction of final design</u>, Texas LNG should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.**
- **<u>Prior to construction of final design</u>, the engineering, procurement, and construction contractor should verify that the recommendations from the Front End Engineering Design Hazard Identification are complete and consistent with the requirements of the final design as determined by the engineering, procurement, and construction contractor.**
- **<u>Prior to construction of final design</u>, Texas LNG should file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations should be filed.**
- **<u>Prior to construction of final design</u>, Texas LNG should file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (i.e., temperature, pressures, flows, and compositions).**
- **<u>Prior to construction of final design</u>, Texas LNG should file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and approval. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**
- **<u>Prior to construction of final design</u>, Texas LNG should file an evaluation of the emergency shutdown valve closure times. Include an analysis that describes the time to detect an upset condition, notify plant personnel, and close the emergency shutdown valve(s). In addition, provide a dynamic surge analysis associated valve closures.**

- **<u>Prior to construction of final design</u>, Texas LNG should demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**
- **<u>Prior to construction of final design</u>, Texas LNG should file the electrical area classification drawings.**
- **<u>Prior to construction of final design</u>, Texas LNG should file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001).**
- **<u>Prior to construction of final design</u>, Texas LNG should file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems.**
- **<u>Prior to construction of final design</u>, Texas LNG should file the design specifications for the feed gas inlet facilities (e.g., metering, pigging system, pressure protection system, compression, etc.).**
- **<u>Prior to construction of final design</u>, Texas LNG should specify that piping and equipment that may be cooled with liquid nitrogen would be designed for liquid nitrogen temperatures, with regard to allowable movement and stresses.**
- **<u>Prior to construction of final design</u>, Texas LNG should include LNG tank fill flow measurement with high flow alarm.**
- **<u>Prior to construction of final design</u>, Texas LNG should include boil-off gas (BOG) flow, tank density profile and temperature profile measurement for each tank.**
- **<u>Prior to construction of final design</u>, Texas LNG should file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations.**
- **<u>Prior to construction of final design</u>, Texas LNG should file an analysis of the structural integrity of the outer containment of the full containment LNG storage tanks when exposed to a roof tank top fire or adjacent tank top fire.**
- **<u>Prior to construction of final design</u>, Texas LNG should file a projectile analysis to demonstrate that the outer concrete impoundment wall of a full-containment LNG tank could withstand wind borne projectiles. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths.**
- **<u>Prior to construction of final design</u>, Texas LNG should file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.**
- **<u>Prior to construction of final design</u>, Texas LNG should specify that all Emergency Shutdown (ESD) valves would be equipped with open and closed position switches**

connected to the Distributed Control System (DCS)/Safety Instrumented System (SIS).

- **<u>Prior to construction of final design</u>, Texas LNG should file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**

- **<u>Prior to construction of final design</u>, Texas LNG should file drawings and specifications for vehicle barriers at each facility entrance and control point for access control.**
- **<u>Prior to construction of final design,</u> Texas LNG should file drawings and specifications for protecting transfer piping, firewater equipment (e.g., hydrants, monitors, manifolds, etc.), pumps, and compressors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles.**
- **<u>Prior to construction of final design</u>, Texas LNG should file lighting drawings. The lighting drawings should show the location, elevation, type of light fixture, and lux levels of the lighting system and should illustrate adequate coverage for the perimeter of the facility and along paths/roads of access and egress.**
- **<u>Prior to construction of final design</u>, Texas LNG should file fencing drawings. The fencing drawings should provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a 10 feet clearance from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.).**
- **<u>Prior to construction of final design</u>, Texas LNG should file security camera and intrusion detection drawings. The security camera drawings should show the location, areas covered, and features of the camera (fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies, and cameras interior to the facility that would enable rapid monitoring of the LNG plant. The drawings should show or note the location of the intrusion detection to verify it covers the entire perimeter of the LNG plant.**
- **<u>Prior to construction of final design</u>, Texas LNG should file the details of a plant-wide ESD button, including details of the sequencing and reliability of the shutdown.**
- **<u>Prior to construction of final design</u>, Texas LNG should evaluate the terminal alarm system and external notification system design to ensure the location of the terminal alarms and other fire and evacuation alarm notification devices (e.g. audible/visual beacons and strobes) would provide adequate warning at the terminal and external off-site areas in the event of an emergency.**
- **<u>Prior to construction of final design</u>, Texas LNG should file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**
- **<u>Prior to construction of final design</u>, Texas LNG should file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments,**

and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of a down-comer that would transfer spills from the tank top to the ground-level impoundment system.

- **<u>Prior to construction of final design</u>, Texas LNG should file an analysis of the localized hazards to operators from a potential liquid nitrogen release and should also provide low oxygen detectors and other identified mitigation based on the analysis.**
- **<u>Prior to construction of final design</u>, Texas LNG should file complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**
- **<u>Prior to construction of final design</u>, Texas LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, and condensate.**
- **<u>Prior to construction of final design</u>, Texas LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as natural gas liquids and hydrogen sulfide.**
- **<u>Prior to construction of final design</u>, Texas LNG should file a technical review of facility design that:**
  a. **identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and**
  b. **demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.**
- **<u>Prior to construction of the final design,</u> Texas LNG should file a building siting assessment to ensure plant buildings that are occupied or critical to the safety of the LNG plant are adequately protected from potential hazards involving fires and vapor cloud explosions.**
- **<u>Prior to construction of final design</u>, Texas LNG should include smoke detection in occupied buildings.**
- **<u>Prior to construction of final design</u>, Texas LNG should include hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings.**
- **<u>Prior to construction of final design</u>, Texas LNG should include clean agent systems in the electrical switchgear and instrumentation buildings.**
- **<u>Prior to construction of final design,</u> Texas LNG should file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings should clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with**

NFPA 17, and wheeled and hand-held extinguishers location travel distances are along normal paths of access and egress and in compliance with NFPA 10. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.

- **<u>Prior to construction of final design</u>, Texas LNG should file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings should clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings should demonstrate that each process area, fire zone, or other sections of piping with several users can be isolated with post indicator valves and that firewater flow to cool exposed surfaces subjected to a fire. Drawings should also include piping and instrumentation diagrams of the firewater and foam systems.**
- **<u>Prior to construction of final design</u>, Texas LNG should file detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario.**
- **<u>Prior to construction of final design</u>, Texas LNG should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter should be connected to the DCS and recorded.**
- **<u>Prior to construction of final design</u>, Texas LNG should specify that the firewater pump shelter is designed with a removable roof for maintenance access to the firewater pumps.**
- **<u>Prior to construction of final design</u>, Texas LNG should account for the fire water required for foam generation in calculating the total fire water required for 2 hours of supply.**
- **<u>Prior to construction of final design</u>, Texas LNG should file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases.**
- **<u>Prior to construction of final design</u>, Texas LNG should file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 BTU/ft^2-hr zone from an impoundment, or provide an analysis that assesses the consequence of pressure vessel bursts and boiling liquid expanding vapor explosions. Trucks at the truck transfer station should be included in the analysis. Passive mitigation should be supported by calculations for the thickness limiting temperature rise and active mitigation should be justified with calculations demonstrating flow rates and durations of any cooling water will mitigate the heat absorbed by the vessel.**
- **<u>Prior to construction of final design</u>, Texas LNG should file an evaluation of the voting logic and voting degradation for hazard detectors.**
- **<u>Prior to commissioning</u>, Texas LNG should file a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Texas LNG should file**

documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.

- **Prior to commissioning, Texas LNG should file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**
- **Prior to commissioning, Texas LNG should file a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice, and should provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.**
- **Prior to commissioning, Texas LNG should file the procedures for pressure/leak tests which address the requirements of American Society of Mechanical Engineers (ASME) VIII and ASME B31.3. The procedures should include a line list of pneumatic and hydrostatic test pressures.**
- **Prior to commissioning, Texas LNG should file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.**
- **Prior to commissioning, Texas LNG should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**
- **Prior to commissioning, Texas LNG should maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training.**
- **Prior to commissioning, Texas LNG should file results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results should be provided thereafter annually.**
- **Prior to commissioning, Texas LNG should equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG storage tank and adjacent piping. The settlement record should be reported in the semi-annual operational reports.**
- **Prior to commissioning, Texas LNG should file a procedure that defines each LNG storage tank's total and differential settlement criteria. The procedures should specify values that would be used to determine if the annual tank survey results are within an acceptable tolerance and values that would require additional actions. In addition, the procedure should specify what actions would be taken after various levels of seismic events.**
- **Prior to introduction of hazardous fluids, Texas LNG should develop and implement procedures for plant personnel to monitor the rocket launches and shut down operating equipment in the event of a rocket launch failure from the Brownsville SpaceX facility.**

- **<u>Prior to introduction of hazardous fluids</u>, Texas LNG should develop and implement an alarm management program to ensure effectiveness of process alarms.**
- **<u>Prior to introduction of hazardous fluids</u>, Texas LNG should complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system.**
- **<u>Prior to introduction of hazardous fluids</u>, Texas LNG should complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**
- **<u>Prior to introduction of hazardous fluids</u>, Texas LNG should complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review should include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, should be filed.**
- **Texas LNG should file a request for written authorization from the Director of OEP <u>prior to unloading or loading the first LNG commissioning cargo</u>. After production of first LNG, Texas LNG should file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports should include a summary of activities, problems encountered, and remedial actions taken. The weekly reports should also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports should include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude should be reported to the FERC within 24 hours.**
- **<u>Prior to commencement of service</u>, Texas LNG should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001).**
- **<u>Prior to commencement of service</u>, Texas LNG should file plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.**
- **<u>Prior to commencement of service</u>, Texas LNG should develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Texas LNG staff.**
- **<u>Prior to commencement of service</u>, Texas LNG should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.**
- **<u>Prior to commencement of service</u>, Texas LNG should file a request for written authorization from the Director of OEP. Such authorization would only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation**

Security Act of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Texas LNG or other appropriate parties.

In addition, we recommend that the following measures should apply <u>throughout</u> the life of the Texas LNG Project.

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an <u>annual basis</u> or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Texas LNG should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**
- **<u>Semi-annual</u> operational reports should be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted <u>within 45 days after each period ending June 30 and December 31</u>. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.**
- **In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified <u>within 24 hours</u> and procedures for corrective action should be specified.**
- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made <u>immediately</u>, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to the FERC staff <u>within 24 hours</u>.**

This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:

a. **fire;**

b. **explosion;**

c. **estimated property damage of $50,000 or more;**

d. **death or personal injury necessitating in-patient hospitalization;**

e. **release of hazardous fluids for 5 minutes or more;**

f. **unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

g. **any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

h. **any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;**

i. **a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;**

j. **inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;**

k. **any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;**

l. **safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or**

m. **an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.**

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

4.12.7 Conclusions

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact to the human environment in terms of safety and whether the proposed facilities would be in the public interest based on whether it would operate safely, reliably, and securely.

As a cooperating agency, the DOT assists FERC staff in evaluating whether Texas LNG's proposed design would meet the DOT's 49 CFR 193 Subpart B siting requirements. The DOT reviewed the design spill information submitted by Texas LNG and on June 22, 2018, provided a letter to FERC staff stating that the DOT had no objection to Texas LNG's design spill selection methodology to comply with the Part 193 siting requirements for the proposed LNG liquefaction facilities, but would need to resolve legal control of exclusion zones. DOT will provide a LOD on the Project's compliance with 49 CFR 193 Subpart B. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the DOT's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG carrier traffic. The Coast Guard reviewed a WSA submitted by Texas LNG that focused on the navigation safety and maritime security aspects of LNG carrier transits along the affected waterway. On February 14, 2018, the Coast Guard issued a LOR to FERC staff indicating the Brownsville Ship Channel would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project, based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized and constructed, the facility would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, FAA assisted FERC staff in evaluating impacts to and from the SpaceX rocket launch facility. Specific recommendations are included to address potential impacts from rocket launch failures to the Project. However, the extent of impacts to SpaceX operations, National Space Program, and to the federal government would not fully be known until SpaceX submits an application requesting to launch with the FAA and whether the LNG plant is under construction or in operation.

FERC staff conducted a preliminary engineering and technical review of the Texas LNG design, including potential external impacts based on the site location. Based on this review, we recommend the Commission consider incorporating into the order a number of proposed mitigation measures and continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, FERC staff believe that the Texas LNG Project design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

4.13 CUMULATIVE IMPACTS

NEPA requires the lead federal agency to consider the potential cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action are superimposed on or added to impacts associated with past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

The Project-specific impacts of the Texas LNG Project are discussed in detail in other sections of this EIS. The purpose of this section is to identify and describe cumulative impacts that would potentially result from implementation of the proposed Project along with other projects in the vicinity that could affect the same resources in the same approximate timeframe. To ensure that this analysis focuses on relevant projects and potentially significant impacts, the actions included in this cumulative analysis are projects that:

- impact a resource potentially affected by the Project;
- impact that resource within all or part of the time span encompassed by the proposed or reasonably expected construction or operation schedule of the Project; and
- impact that resource within all or part of the geographical area affected by the Project. The geographical area considered varies depending on the resource being discussed, which is the general area ("geographic scope") in which the Project could contribute to cumulative impacts on that particular resource.

The geographic distribution of the area considered in the cumulative effects analysis varies by project and by resource. The cumulative impact analysis area, or geographic scope, for a resource may be substantially greater than the corresponding Project-specific area of impact in order to consider an area large enough to encompass likely effects from other projects on the same resource. The CEQ (1997) recommends setting the geographic scope based on the natural boundaries of the resource affected, rather than jurisdictional boundaries. The geographic scope for each resource evaluated for cumualtive impacts associated with the Texas LNG Project is presented in table 4.13-1 and further discussed below.

TABLE 4.13-1

Geographic Scope by Resource for Cumulative Impacts Associated with the Texas LNG Project

Resource	Geographic Scope
Geology	Area affected by and adjacent to the Project
Soils	Area affected by and adjacent to the Project
Groundwater	HUC 12 watershed
Surface Water	HUC 12 watershed
Wetlands	HUC 12 watershed
Vegetation	HUC 12 watershed
Wildlife	HUC 12 watershed

TABLE 4.13-1 Geographic Scope by Resource for Cumulative Impacts Associated with the Texas LNG Project	
Resource	**Geographic Scope**
Fisheries and Aquatic Resources	HUC 12 watershed
Threatened and Endangered Species	HUC 12 watershed
Land Use and Special Interest Areas	Cameron County
Visual Resources	Project viewshed (12.5 miles)
Socioeconomics	Cameron County
Transportation	Major roads and intersections used during construction and operation, Brownsville Ship Channel, and established navigation channels
Cultural Resources	Defined Area of Potential Effect [a]
Air Quality	Within 31 miles of the Project for operation impacts, within 0.5 mile of the Project for construction impacts [b]
Noise	Within 2 miles of the Project for operation impacts and 0.25 mile of the Project for construction impacts [b]
Environmental Justice	Cameron County/Census block groups within 2 miles of the Project

[a] The APE may differ based on the type of resource considered; for example, impacts on buried artifacts would generally be considered only within the direct footprint where project impacts overlap, while impacts on historic structures may necessitate a wider scope.

[b] Due to the duration of construction, similar timelines, and/or comments received during the Project scoping period, the Annova LNG and/or Rio Grande LNG Project were also considered for this resource.

The U.S. is divided and sub-divided into successively smaller hydrologic units, which are geographic areas representing part or all of a surface water drainage basin, a combination of drainage basins, or a distinct hydrologic feature. The unit used for our analysis in this EIS is the HUC 12 watershed. Because surface activities can affect the connectivity of resources within a watershed, we determined that the HUC 12 watershed within which the Project would be constructed is appropriate to use as the geographic scope for several resources including groundwater, surface water, wetlands, vegetation, wildlife, fisheries and aquatic resources, and threatened and endangered species. As such, other past, present, and reasonably foreseeable projects that overlap with the proposed Project's HUC 12 watershed could contribute to cumulative impacts on these resources.

Cumulative impacts analysis for geology, soils, and certain cultural resources are within and immediately adjacent to the construction footprint, as the features associated with these resources are confined to a specific location. Further, erosion control measures included in Texas LNG's ECP would keep disturbance within the approved work areas.

Cumulative impacts on visual resources were considered for other projects occurring within the viewshed of the proposed Project. Based on viewshed simulations conducted for the Project, as discussed further in section 4.8.5, we estimate the distance at which the tallest structures may be observed is about 12.5 miles; therefore, this distance was considered the geographic scope for assessing cumulative impacts on visual resources.

Analysis of cumulative impacts on socioeconomics and land use were confined to Cameron County. Cameron County is the primary area in which construction and operation personnel are expected to reside, as well as the level at which planning and zoning ordinances are often prescribed. Further, evaluation of other past, present, and reasonably foreseeable projects within Cameron County, would address potential cumulative impacts on all recreational areas identified in section 4.8.4.

As described in section 4.9.8, communities within 2 miles of the proposed Project facilities were evaluated for potential environmental justice concerns for the Project; therefore, the geographic scope for the analysis of potential cumulative impacts on environmental justice communities was determined to be 2 miles.

Cumulative impacts on traffic were assessed by evaluating other projects that would utilize the same primary transportation routes used by the proposed Project during construction and operation. For roadway traffic, this primarily includes SH 48. For marine traffic, this includes the Brownsville Ship Channel, including the Brazos Santiago Pass.

The geographic scope evaluated for impacts on air quality was defined as within 31 miles (50 kilometers) of the Project for operation impacts and 1 mile of the Project for construction impacts. The CEQ guidance document, *Considering Cumulative Effects Under the National Environmental Policy Act*, states that a project impact zone for the air quality resource may be the physiographic basin in which the proposed action would be located. In terms of meteorology, the physiographic environment in which the Texas LNG Project would be located is the Texas Coastal Zone, which means sea breezes and land breezes would play an important role regarding the transport and dispersion of air pollutants. At times, the sea breeze along the southern Texas coast can penetrate 40 kilometers or more inland from the coast. Therefore, establishing a geographic scope for cumulative impacts on air quality resulting from operations emissions of 50 kilometers from the Project site is consistent with the extent of inland penetration of the sea breeze from the coast.

Cumulative impacts resulting from increased noise during construction and operation of the proposed Project were evaluated within 0.25 mile and 2 miles from the proposed Project facilities, respectively. Noise decreases logarithmically with increasing distance from a noise source; therefore, noise impacts would only occur where other facilities or activities occur close to the proposed Project activities. As described in section 4.11.2.2, the nearest NSA to the proposed Project is 1.6 miles; therefore, a geographic scope of 2 miles was selected to assess potential cumulative noise impacts at the nearest NSAs during operation. Noise associated with construction of the Project would be short-term and temporary; therefore, a smaller geographic scope of 0.25 mile was utilized to assess potential cumulative noise impacts during construction.

4.13.1 Projects and Activities Considered

The Project area has been modified and developed since initial human habitation thousands of years ago to more recent and rapid development in the last two hundred years. The dredging of the Brownsville Ship Channel and development of the lower Rio Grande Valley as an industrial and port region has significantly contributed to the current environmental conditions characteristic of the area. With respect to past actions, CEQ guidance (2005) allows agencies to adopt a broad, aggregated approach without “delving into the historical details of individual past actions,” which is the approach taken in this EIS. Recently completed projects are included with past projects as part of the environmental baseline. Reasonably foreseeable projects that might cause cumulative impacts in combination with the Texas LNG Project include projects that are under construction, approved, proposed, or planned. For FERC-regulated projects, proposed projects are those for which the proponent has submitted a formal application to the FERC, and planned projects are projects that are either in pre-filing or have been announced, but have not been proposed. Planned projects also include projects not under the FERC's jurisdiction that have been identified through publicly available information, such as press releases, internet searches, Texas LNG's communications with local agencies, and information available from other federal agencies, provided in comments on the FERC docket for the Project.

Table 4.13.1-1 lists the projects and activities we considered in this cumulative impact analysis, including the location, distance from the Project, workforce, construction timeframe, and resources cumulatively affected in conjunction with the proposed facilities. Project locations are identified in figure 4.13.1-1. As noted in the following subsections, some projects were eliminated from further discussion if it was determined that they would not meet the criteria listed above or if sufficient information is not available to allow for meaningful analysis. Descriptions of potential cumulative impacts by resource category are presented in section 4.13.2. In cases where quantitative information is not available for projects considered in this analysis (e.g., projects in the planning stages or those contingent on economic conditions, availability of financing, or the issuance of permits), the potential impacts of those projects are considered qualitatively (see table 4.13.2-1).

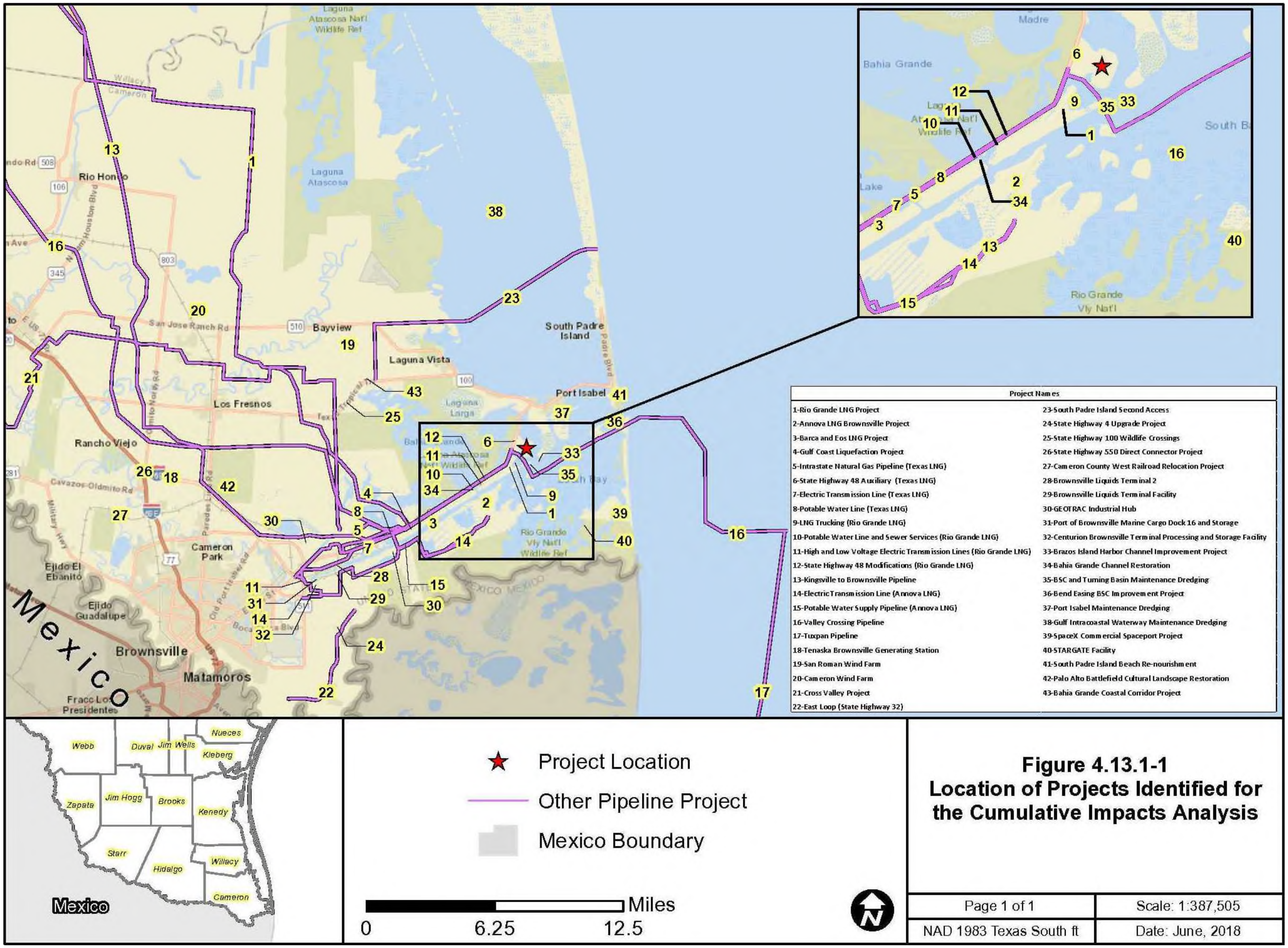

FIGURE 4.13.1-1 Location of Projects Identified for the Cumulative Impacts Analysis

TABLE 4.13.1-1

Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Texas LNG Project

Project/Activity (Map No.)	Estimated Timeframe (Construction/ Operation)	Closest Distance from Proposed Project	Project Size	Workforce (Construction/ Operation)	Included in Cumulative Impact Analysis	Resources Cumulatively Impacted
Future LNG Export Projects						
Rio Grande LNG Project (Rio Bravo Pipeline Project) (#1)	2018/2025 [f]	Adjacent	1,148.4 acres (Facility) 3,094 acres (Pipeline)	5,225/270	Yes	All Resources
Annova LNG Brownsville Project (#2)	2019/2022 [f]	1.7 miles	491 acres	1,200/165	Yes	All Resources except Geology and Soils
Barca and Eos LNG Project (#3)	IU	5.6 miles	IU	IU	No; the lease option with BND has expired	N/A
Gulf Coast Liquefaction Project (#4)	IU	6.5 miles	500 acres	3,000/250	No; as the project has not entered the FERC pre-filing process, it is not currently considered reasonably foreseeable	N/A
Non-jurisdictional Facilities Associated with the Texas LNG Project						
Intrastate Natural Gas Pipeline (#5)	IU	Adjacent	10.2 miles (108.3 acres)	IU	Yes	All Resources
State Highway 48 Auxiliary Lane (#6)	2019/2019	Adjacent	0.5 acre	IU	Yes	All Resources
Electric Transmission Line (#7)	2019/2020	Adjacent	11 miles (120.6 acres)	IU	Yes	All Resources
Potable Water Line (#8)	2019/2020	Adjacent	7.4 miles [a]	IU	Yes	All Resources
Non-jurisdictional Facilities Associated with the Rio Grande LNG Project						
LNG Trucking (#9)	2025	0.5 mile	12 to 15 tanker trucks/day	IU	Yes	Socioeconomics [e]
Potable Water Line and Sewer Services (#10)	2018/2019 [f]	2.7 miles	5 to 6 miles (est. 3.3 acres)	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation [e]

TABLE 4.13.1-1						
Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Texas LNG Project						
Project/Activity (Map No.)	**Estimated Timeframe (Construction/ Operation)**	**Closest Distance from Proposed Project**	**Project Size**	**Workforce (Construction/ Operation)**	**Included in Cumulative Impact Analysis**	**Resources Cumulatively Impacted**
High and Low Voltage Electric Transmission Lines (#11)	2020/2021	2.7 miles	12.7 miles (est. 142 acres)	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation [e]
State Highway 48 Modifications (#12)	2018/2019 [f]	2.0 miles	3 miles (est. 36.4 acres) [b]	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation [e]
Non-jurisdictional Facilities Associated with the Annova LNG Brownsville Project						
Kingsville to Brownsville Pipeline (#13)	2021/2021	2.9 miles	130 miles (est. 1,576 acres) [b]	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation, Air
Electric Transmission Line (#14)	2019/2021	3.3 miles	15 miles (100 acres)	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics [e]
Potable Water Supply Pipeline (#15)	2019/2021	3.3 miles	6 miles (30 acres)	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics [e]
Pipeline Projects						
Valley Crossing Pipeline (#16)	Underway/2018	Adjacent	168 miles (est. 2,545.8 acres) [c]	IU	Yes	Geology and Soils, Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation, Air [e]
Tuxpan Pipeline (#17)	Underway/2018	11 miles	Approx. 500 miles (est. 7,576.8 acres) [c]	IU	No, the project does not impact the same resources as the proposed Project (see section 4.13.1.5).	N/A

TABLE 4.13.1-1

Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Texas LNG Project

Project/Activity (Map No.)	Estimated Timeframe (Construction/ Operation)	Closest Distance from Proposed Project	Project Size	Workforce (Construction/ Operation)	Included in Cumulative Impact Analysis	Resources Cumulatively Impacted
Electric Transmission and Generation Projects						
Tenaska Brownsville Generating Station (#18)	2018/2019	16.6 miles	270 acres	600 to 700/23	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, TES, Land Use, Socioeconomics, Air [e]
San Roman Wind Farm (#19)	Operational as of 2016	7.1 miles	156 acres	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics [e]
Cameron Wind Farm (#20)	Operational as of 2015	16.6 miles	15,000 acres	IU	Yes	Land Use, Socioeconomics [e]
Cross Valley Project (#21)	Operational as of 2016	9.3 miles	96 miles (1,745.7 acres) [d]	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics [e]
Transportation Projects						
East Loop (State Highway 32) (#22)	2018/IU	12.1 miles	6.68 miles (126.9 acres)	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation [e]
South Padre Island Second Access (#23)	2019/2022	7.5 miles	17.6 miles (240.6 acres)	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation [e]
State Highway 4 Upgrade Project (#24)	2018/2020	4.6 miles	IU	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation [e]
State Highway 100 Wildlife Crossings (#25)	Completed 2017	8.5 miles	7.1 miles	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Socioeconomics, Transportation [e]

TABLE 4.13.1-1 Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Texas LNG Project						
Project/Activity (Map No.)	**Estimated Timeframe (Construction/ Operation)**	**Closest Distance from Proposed Project**	**Project Size**	**Workforce (Construction/ Operation)**	**Included in Cumulative Impact Analysis**	**Resources Cumulatively Impacted**
State Highway 550 Direct Connector Project (#26)	Completed 2014	1.8 miles	Approximately 10 miles	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Socioeconomics [e]
Cameron County West Railroad Relocation Project (#27)	Completed 2015	19.5 miles	Approximately 6 miles	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Socioeconomics [e]
Port of Brownsville Projects						
Brownsville Liquids Terminal 2 (#28)	Operational as of 2016	10.2 miles	IU	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation, Air
Brownsville Liquids Terminal Facility (#29)	Operational as of 2014	10.9 miles	IU	150/5	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation, Air
GEOTRAC Industrial Hub (#30)	Ongoing	7.9 miles	Approximately 1,400 acres	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Air
Port of Brownsville Marine Cargo Dock 16 and Storage Yard (#31)	Operational as of 2015	11.9 miles	IU	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation [e]
Centurion Brownsville Terminal Processing and Storage Facility (#32)	Operational as of 2017	12.0 miles	280 acres	500/35	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics, Transportation, Air

TABLE 4.13.1-1 Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Texas LNG Project						
Project/Activity (Map No.)	**Estimated Timeframe (Construction/ Operation)**	**Closest Distance from Proposed Project**	**Project Size**	**Workforce (Construction/ Operation)**	**Included in Cumulative Impact Analysis**	**Resources Cumulatively Impacted**
Waterway Improvement Projects						
Brazos Island Harbor Channel Improvement Project (#33)	October 2020/ September 2024	Adjacent	IU	IU	Yes	Geology and Soils, Groundwater, Surface Water, Aquatic Resources, TES, Land Use, Socioeconomics, Transportation, Air, Noise [e]
Bahia Grande Channel Restoration (#34)	IU	3.0 miles	IU	IU	Yes	Groundwater, Surface Water, Wetlands, Aquatic Resources, TES, Land Use, Socioeconomics, Transportation [e]
Brownsville Ship Channel and Turning Basin Maintenance Dredging (#35)	IU	Adjacent	IU	IU	Yes	Geology and Soils, Groundwater, Surface Water, Aquatic Resources, TES, Land Use, Socioeconomics, Transportation, Air, Noise [e]
Bend Easing Brownsville Ship Channel Improvement Project (#36)	IU	3.5 miles	IU	IU	Yes	Groundwater, Surface Water, Aquatic Resources, TES, Land Use, Socioeconomics, Transportation [e]
Port Isabel Maintenance Dredging (#37)	IU	1.2 miles	IU	IU	Yes	Groundwater, Surface Water, Aquatic Resources, TES, Land Use, Socioeconomics, Noise [e]
Gulf Intracoastal Waterway Maintenance Dredging (#38)	2018/2019	3.5 miles	IU	IU	Yes	Land Use, Socioeconomics [e]
Other Projects and Activities Considered						
SpaceX Commercial Spaceport Project (#39)	2014/2018	4.6 miles	70 acres	47/30 standard and 250 during launch	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics [e]
STARGATE Facility (#40)	Completed 2017	3.9 miles	2.3 acres	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Visual Resources, Socioeconomics [e]

TABLE 4.13.1-1						
Projects Identified within the Geographic Scope for Cumulative Impacts Associated with the Texas LNG Project						
Project/Activity (Map No.)	**Estimated Timeframe (Construction/ Operation)**	**Closest Distance from Proposed Project**	**Project Size**	**Workforce (Construction/ Operation)**	**Included in Cumulative Impact Analysis**	**Resources Cumulatively Impacted**
South Padre Island Beach Re-nourishment (#41)	Completed 2016	4.8 miles	0.8 mile	IU	Yes	Socioeconomics [e]
Palo Alto Battlefield Cultural Landscape Restoration (#42)	Ongoing	14.1 miles	IU	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Socioeconomics [e]
Bahia Grande Coastal Corridor Project (#43)	Ongoing	7.6 miles	Approximately 2,129 acres with a goal of 7,000 acres	IU	Yes	Groundwater, Surface Water, Wetlands, Vegetation and Wildlife, Aquatic Resources, TES, Land Use, Socioeconomics [e]

IU = Information unavailable; N/A = Not Applicable; TES = Threatened and Endangered Species

[a] The Texas LNG non-jurisdictional potable waterline would be located within the same construction corridor as the Texas LNG non-jurisdictional natural gas pipeline and would be constructed concurrently; therefore, the affected acres are captured within the Texas LNG non-jurisdictional natural gas pipeline acreage.

[b] Acreage is estimated based on an assumed 100-foot-wide construction corridor.

[c] Acreage is estimated based on an assumed 125-foot-wide construction corridor.

[d] Acreage is estimated based on an assumed 150-foot-wide construction corridor.

[e] The project is located within the geographic scope for other resources; however, the project is not anticipated to impact those resources.

[f] Actual construction schedule is dependent on receipt of all necessary permits and approvals.

4.13.1.1 Liquefaction and Export Projects

Annova LNG Brownsville Project

Annova is proposing to construct and operate the Annova LNG Project. The Annova LNG Project consists of a new LNG export terminal that would be located along the Brownsville Ship Channel in Cameron County, Texas capable of producing 7 MTPA of LNG for export. The Annova LNG Project would include six liquefactions trains, two 160,000 m^3 storage tanks, a marine berth to accommodate one LNG carrier, and other associated facilities. The Annova LNG Project would be constructed on a 731-acre parcel of land about 1.7 miles southwest of the Texas LNG Project site. Gas would be transported to the Annova Project via the Kingsville to Brownsville Pipeline (further discussed in section 4.13.1.5 below).

FERC approved Annova's request to enter the FERC pre-filing process on March 27, 2015 under Docket No. PF15-15-000. Annova LNG filed its formal application with FERC on July 13, 2016 under Docket No. CP16-480-000. Annova LNG anticipates that construction of its project would begin in 2019 and be completed in 2022. Due to the proximity of the Annova LNG Project to the Texas LNG Project, along with the overlapping construction schedules, construction and operation of the Annova Project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Rio Grande LNG Project and Rio Bravo Pipeline Project

Rio Grande LNG, LLC (RG LNG) is proposing to construct and operate a new LNG export terminal that would be located along the Brownsville Ship Channel in Cameron County, Texas as part of its Rio Grande LNG Project. The Rio Grande LNG Project would be capable of producing 27 MPTA of LNG for export and would consist of six liquefaction trains, a marine berth capable of receiving two LNG carriers at a time, and four 180,000 m^3 LNG storage tanks. The Rio Grande LNG Project would be constructed on a 984-acre parcel, and would impact a total of 1,148.4 acres during construction. The Rio Grande LNG Project is adjacent to the proposed Texas LNG Project site to the southwest.

Rio Bravo Pipeline, LLC (RB Pipeline) is proposing the Rio Bravo Pipeline Project, which consists of two 137-mile-long, parallel natural gas pipelines from the Agua Dulce Market Area in Kleberg County, Texas to the proposed Rio Grande LNG Project in Cameron County, Texas. The Rio Bravo Pipeline Project also includes three 180,000 hp compressor stations, two 30,000 hp interconnect booster stations, and a 2.4-mile-long header pipeline.

Due the relation between the Rio Grande LNG Project and the Rio Bravo Pipeline Project, FERC is reviewing these projects collectively. RG LNG and RB Pipeline (collectively referred to as Rio Grande Developers) were approved by FERC to participate in the FERC pre-filing process on April 13, 2015 under Docket No. PF15-20-000. The Rio Grande Developers filed a formal application with FERC on May 5, 2016 under Docket No. CP16-454-000. Rio Grande LNG, LLC anticipates beginning construction of the Rio Grande LNG Project in 2019 and completing commissioning in 2026. The Rio Bravo Pipeline Project would be constructed concurrently with the Rio Grande LNG Project, to ensure that the first pipeline is operational when the first liquefaction train is placed in-service. Due to the proximity of the Rio Grande

LNG Project and Rio Bravo Pipeline Project to the Texas LNG Project, along with the overlapping construction schedules, construction and operation of the Rio Grande LNG Project and Rio Bravo Pipeline Project were included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Barca and Eos LNG Projects

Barca LNG, LLC (Barca) and Eos LNG, LLC (Eos LNG) are each planning to construct and operate a floating LNG export terminal along the Brownsville Ship Channel in Cameron County, Texas about 5.6 miles southwest of the proposed Texas LNG Project site. The Barca and Eos LNG Projects would be on a 15-acre parcel owned by the BND and would each be capable of exporting LNG up to the equivalent of 584 Bcf/y of natural gas (DOE, 2018). The Barca and Eos LNG Projects were granted authorization by the DOE for export to FTA nations on November 26, 2013; however, because neither project has initiated the FERC pre-filing process and the lease option with the BND has expired, these projects are not considered reasonably foreseeable and were not included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Gulf Coast Liquefaction Project

The Gulf Coast Liquefaction Project consists of the construction and operation of a new LNG export terminal capable of producing LNG up to the equivalent of 1,022 Bcf/y of natural gas on the Brownsville Ship Channel, about 6.5 miles southwest of the proposed Texas LNG Project site. Gulf Coast Export, LLC filed an application with the DOE for authorization to export LNG to FTA and non-FTA countries as part of the Gulf Coast Liquefaction Project on January 10, 2012; however, these applications were vacated (FTA countries) and withdrawn (non-FTA countries) on June 27, 2016 (DOE, 2018). In addition, Gulf Coast Export, LLC has not initiated the FERC pre-filing process; therefore, the Gulf Coast Liquefaction Project is not reasonably foreseeable and was not included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.2 Non-jurisdictional Facilities Associated with the Texas LNG Project

There are several non-jurisdictional facilities associated with the Texas LNG Project including a new intrastate natural gas pipeline, an auxiliary lane on SH 48, a new electric transmission line, and a new potable water line. Detailed descriptions of each of these non-jurisdictional facilities are provided in section 1.4 of this EIS and further discussed below.

Intrastate Natural Gas Pipeline

Natural gas would be delivered to the Texas LNG Project site via a FERC non-jurisdictional intrastate natural gas pipeline (see section 1.4.1 and appendix H). Texas LNG anticipates that the 30-inch-diameter pipeline would be approximately 10.2 miles long and would interconnect with the proposed VCP (see section 4.13.1.5). Texas LNG also anticipates that an additional 15,000 hp of compression would be needed to move the incremental gas destined for Texas LNG in Agua Dulce at the same compressor station constructed for the VCP Project, with an additional 50,000 hp compression also needed about halfway between Agua Dulce and Brownsville. Construction of the 10.2-mile intrastate natural gas pipeline would likely require a

100-foot-wide construction right-of-way and would be primarily collocated with other non-jurisdictional facilities associated with the proposed Project, south of SH 48. A third-party company would complete construction of the intrastate pipeline prior to completion of Phase 1 construction. Due to overlapping construction footprints with other projects in the area, as well as overlapping construction schedules, the intrastate natural gas pipeline associated with the Texas LNG Project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

State Highway 48 Auxiliary Lane

As a means of minimizing traffic impacts during construction and operation of the Texas LNG Project, Texas LNG would add a new auxiliary lane on SH 48 adjacent to the proposed Texas LNG Project site. The auxiliary lane would be 6 feet-wide, and would consist of a 150-foot taper, 830 feet of deceleration length, and 100 feet of storage area. The auxiliary lane would continue approximately 1,100 feet north of the northern driveway to provide acceleration for vehicles exiting the Project site. Construction of the auxiliary lane is anticipated to occur in 2019. Due to the proximity of the SH 48 auxiliary lane to the proposed Project site as well as the overlapping construction schedule, this project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Electric Transmission Line

In order to provide electricity to the proposed Texas LNG terminal, AEP would construct a new 11-mile-long, 240 MW electric transmission line. The electric transmission line would require a 100-foot-wide permanent right-of-way immediately south of SH 48 from the existing AEP Union Carbide Substation southwest of the Project site. AEP expects to begin construction of the electric transmission line in 2019. Several other projects are proposed within the same corridor south of SH 48 including other non-jurisdictional facilities associated with the Texas LNG Project, non-jurisdictional facilities associated with the Rio Grande LNG Project (see section 4.13.1.3), the VCP (see section 4.13.1.5), and the Kingsville to Brownsville Pipeline Project (see section 4.13.1.4). Due to overlapping construction footprints with other projects in the area, as well as overlapping construction schedules, the AEP electric transmission line associated with the Texas LNG Project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Potable Water Line

To provide potable water to the proposed Texas LNG terminal, the BND would install approximately 7.4 miles of new, 6-inch-diameter potable water line from Fishing Harbor southwest of the Project site. The potable water line would be installed immediately south of SH 48, parallel to the non-jurisdictional electric transmission line associated with the Texas LNG Project, as discussed above. Construction of the potable water line is anticipated to occur concurrent with construction of the Texas LNG non-jurisdictional intrastate natural gas pipeline. Due to the proximity of the potable water line to the proposed Project site, as well as the concurrent construction schedule, the potable water line associated with the Texas LNG Project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.3 Non-jurisdictional Facilities Associated with the Rio Grande LNG Project

There are several non-jurisdictional facilities associated with the Rio Grande LNG Project including LNG trucking facilities, sewer services, a new potable water line, a new electric transmission line, and widening of SH 48. Detailed descriptions of each of these non-jurisdictional facilities are provided below.

LNG Trucking

RG LNG is proposing to conduct LNG trucking activities as part of the proposed Rio Grande LNG Project. The LNG trucking facilities would be within the proposed Rio Grande LNG Project site, approximately 0.5 mile southwest of the proposed Texas LNG Project site. While the trucking facilities are FERC jurisdictional and assessed with the Rio Grande LNG Project as a whole, once the LNG trucks leave the site, they no longer fall under the jurisdiction of FERC. During operation of the Rio Grande LNG Terminal, a portion of the LNG would be loaded onto trucks for distribution via roadways to refueling stations in Texas and the surrounding states. While no agreements have been executed for the transportation of LNG in trucks, RG LNG is proposing to construct four loading bays, each capable of accommodating up to 15 tanker trucks per day, for a total of 60 LNG trucks calling on the facility during daily operation. LNG trucks calling on the proposed Rio Grande LNG Terminal are expected to deliver the LNG to any of the 30 LNG fueling stations currently in operation in South Texas, or to additional LNG refueling stations currently under development. Due to the proximity of the Rio Grande LNG Project, from which the LNG trucks would originate, we have considered the non-jurisdictional LNG trucking activities associated with the Rio Grande LNG Project in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Potable Water Line and Sewer Services

In order to provide potable water service to the Rio Grande LNG Project, the BND would construct an approximately 5 to 6-mile potable water line to the Rio Grande LNG immediately south of SH 48. The BND would also construct a new 12-inch-diameter sewage pipeline from the Rio Grande LNG Project site, adjacent to the proposed Texas LNG Project site and continue for approximately 5 miles immediately south of SH 48 to an existing BND sewage treatment plant. Construction of the potable water and sewer systems for the Rio Grande LNG Project is anticipated to begin in 2018 and be completed by 2019. Due to the proximity of the potable water and sewage pipeline to the proposed Texas LNG Project site, as well as the concurrent construction schedule, the potable water line and sewage pipeline associated with the Rio Grande LNG Project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Electric Transmission Lines

AEP would construct two new 138-kilovolt overhead transmission lines to provide power to the proposed Rio Grande LNG Project. The electric transmission lines would connect to the existing AEP Loma Alta and Union Carbide substations. They would be immediately south of SH 48 for the majority of the route (see figure 4.13.1-1). Construction of the new electric transmission lines is anticipated to begin in 2020 and be complete by 2021. Due to the proximity of the new electric transmission lines to the proposed Texas LNG Project site, as well as the concurrent construction schedule, the electric transmission lines associated with the Rio Grande LNG Project were included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

SH 48 Modifications

To accommodate access to the Rio Grande LNG Project site, TXDOT would modify portions of SH 48. Modifications would occur immediately adjacent to the Rio Grande LNG Project site and include the addition of acceleration, deceleration, and turning lanes, as well as traffic signals. These modifications to SH 48 are anticipated to begin in 2018 and be completed by 2019. Due to the proximity of the SH 48 modifications to the proposed Texas LNG Project site, as well as the concurrent construction schedule, the SH 48 modifications associated with the Rio Grande LNG Project were included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.4 Non-jurisdictional Facilities Associated with the Annova LNG Project

There are several non-jurisdictional facilities associated with the Annova LNG Project (see section 4.13.1.1) including natural gas interconnection facilities, electric transmission line, and potable water line. Detailed descriptions of each of these non-jurisdictional facilities are provided below.

Kingsville to Brownsville Pipeline

According to Annova's FERC application, the Kingsville to Brownsville Project would consist of an approximately 130-mile-long, 36-inch-diameter natural gas pipeline originating in Kleberg County, Texas and terminating at the Annova LNG Project site. Annova anticipates that a third party company would construct the Kingsville to Brownsville Pipeline beginning in 2021. At its closest point, the Kingsville to Brownsville Pipeline is approximately 2.9 miles southwest of the proposed Project site. Due to the proximity of the Kingsville to Brownsville Pipeline to the proposed Project site, as well as the overlapping construction schedules, the Kingsville to Brownsville Pipeline was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Electric Transmission Line

Power would be supplied to the Annova LNG Project site through a new 138-kilovolt, 15-mile-long electric transmission line originating at an existing substation west of the Annova LNG Project site. The new electric transmission line would be constructed and operated by South Texas Electric Cooperative. Routing has not been finalized; however, construction is anticipated to begin in 2019 and be completed by 2021. Due to the proximity of the electric transmission line to the proposed Texas LNG Project site, as well as the concurrent construction schedule, the electric transmission line associated with the Annova LNG Project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Potable Water Supply Pipeline

Potable water would be supplied to the Annova LNG Project site via a new potable water supply pipeline to be constructed by the BND. The approximately 6-mile-long potable water line would connect to an existing pipeline southwest of the Annova LNG Project site. Annova anticipates that construction on the new potable water supply pipeline would begin in 2019 and be complete by 2021. Due to the proximity of the potable water supply pipeline to the proposed Texas LNG Project site, as well as the concurrent construction schedule, the potable water supply pipeline associated with the Annova LNG Project was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.5 Pipeline Projects

Valley Crossing Pipeline

The VCP consists of a 168-mile intrastate natural gas pipeline project that would provide natural gas from the Agua Dulce Hub in Nueces County, Texas, to south Texas and into Mexico (via the Tuxpan Pipeline, further discussed below) (Enbridge, 2017). At its closest point, the VCP would be located approximately 0.3 mile south of the proposed Texas LNG Project site (see figure 4.13.1-1). Based on publicly available information, construction of the VCP began in 2017 and is anticipated to be operational in 2018. Due to the proximity of the VCP to the proposed Project site, as well as the potential for short- and long-term impacts associated with the VCP to overlap with the Texas LNG Project, the VCP was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Tuxpan Pipeline

The Tuxpan Pipeline consists of approximately 500 miles of 42-inch-diameter natural gas pipeline, primarily located offshore in the Gulf of Mexico from its connection to the VCP (approximately 11 miles southeast of the proposed Texas LNG Project site) to its terminus in Tuxpan, Mexico. Construction of the project began in 2017 and is anticipated to be in operation by late 2018 (Comisión Federal de Electricidad, 2017). With regards to the assessment of cumulative impacts associated with the proposed Project, the Tuxpan Pipeline only occurs within the geographic scope for visual resources and operation emissions. The portion of the Tuxpan Pipeline that is within the geographic scope for visual resources would not affect visual resources, as it would be constructed underwater in the Gulf of Mexico. Similarly, based on publicly available information, it is not known if operation emission sources associated with the Tuxpan Pipeline would be within the geographic scope for our cumulative impacts assessment. Further, construction of the Tuxpan Pipeline will be complete prior to operation of vessels within the Gulf of Mexico associated with the Texas LNG Project. Because the Tuxpan Pipeline would not impact the same resources potentially impacted by the proposed Project within the geographic scopes identified in table 4.13.1-1, the Tuxpan Pipeline was not included in our cumulative impacts analysis.

4.13.1.6 Electric Transmission and Generation Projects

Tenaska Brownsville Generating Station

The Tenaska Brownsville Generating Station is an 800 megawatt, natural gas-fueled, electric generating station on 270 acres 16.6 miles west of the proposed Project site. Construction of the new generating station is anticipated to begin in 2018 with operation commencing in 2019 (Tenaska, Inc. 2018). Due to the location of the Tenaska Brownsville Generating Station within the geographic scope, as well as the overlapping construction schedules, the Tenaska Brownsville Generating Station was included in our cumulative impacts analysis, as indicated in table 4.13.1-1.

San Roman and Cameron Wind Farms

The San Roman Wind Farm, which began commercial operation in late 2016, consists of 31 wind turbines within a 3,290-acre area (of which 156 acres was disturbed for construction) approximately 7.1 miles northwest of the Project site. The San Roman Wind Farm is capable of producing up to 93 megawatts, providing electricity to power more than 30,000 homes (Wind Power Engineering and Development, 2016).

The Cameron Wind Farm began commercial operation in 2015 and consists of 55 wind turbines within a 15,000-acre area approximately 16.6 miles northwest of the proposed Project site. The Cameron Wind Farm is capable of producing up to 165 megawatts, providing power to 59,000 homes (Apex Clean Energy, 2017).

Although the San Roman and Cameron Wind Farms were recently completed and the construction schedules would not overlap with the proposed Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Therefore, due to the proximity of the San Roman and Cameron Wind Farms as well as the potential for impacts to overlap temporally, the San Roman and Cameron Wind Farms were considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Cross Valley Project

Completed in June 2016, the Cross Valley Project consists of a 96-mile-long electric transmission line originating near Edinburg in Hidalgo County, Texas and terminating east of Brownsville, approximately 9.3 miles southwest of the proposed Project site. Although the Cross Valley Project was recently completed and the construction schedule would not overlap with the proposed Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Therefore, due to the proximity of the Cross Valley Project as well as the potential for impacts to overlap temporally, the Cross Valley Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.7 Transportation Projects

East Loop (State Highway 32)

The Cameron County Regional Mobility Authority in cooperation with TXDOT is proposing to construct a new highway (East Loop or SH 32) in Cameron County. The East Loop would begin at the intersection Farm-to-Market Road 3068 to Farm-to-Market Road 1419 to SH 4 and would be a total of 6.66 miles (TX DOT, 2016). The project is approximately 12.1 miles southwest of the proposed Project site. Construction of the East Loop could begin as early as 2018. Due to the proximity of the East Loop to the proposed Project as well as the potential for overlapping construction schedules, the East Loop was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

South Padre Island Second Access Project

The South Padre Island Second Access Project is a 17.6-mile road project consisting of three components including a roadway on the mainland, the Laguna Madre crossing bridge, and a roadway on South Padre Island. The project is currently in the Federal Highway Administration environmental review process and expected to begin construction during 2018 (Cameron County Regional Mobility Authority, 2017). At its closest point, the project is approximately 7.5 miles north of the proposed Project. Due to the proximity of the South Padre Island Second Access Project to the proposed Project as well as the potential for overlapping construction schedules, the South Padre Island Second Access Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

State Highway 4 Upgrade Project

TX DOT is proposing a 1.4-mile upgrade to SH 4 comprised of a two-lane undivided highway to a planned entrance to the Port of Brownsville (TXDOT, 2018). The SH 4 Upgrade Project is approximately 4.6 miles southwest of the proposed Project site. Construction of the SH 4 Upgrade Project is anticipated to begin as early as 2018. Due to the proximity of the SH 4 Upgrade Project to the proposed Project as well as the potential for overlapping construction schedules, the SH 4 Upgrade Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

State Highway 100 Wildlife Crossings Project

The SH 100 Wildlife Crossings Project includes the construction of four new wildlife crossings and the rehabilitation of an existing wildlife crossing along 7.1 miles of SH 100 in Cameron County, Texas (United States Department of the Interior, 2015). Located approximately 8.5 miles northwest of the Project site, the SH 100 Wildlife Crossings Project was completed in 2017. Due to its location within the geographic scope of the proposed Project and the potential for short- and long-term impacts associated with the SH 100 Wildlife Crossings Project to overlap with the Texas LNG Project, the SH 100 Wildlife Crossings Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

State Highway 550 Direct Connector Project

Completed in 2014, the SH 550 Direct Connector Project is an approximately 10-mile-long project which included the construction of a new spur on SH 550 that provided a loop around the north-northeast quadrant of the City of Brownsville (TXDOT, 2009). At its closest point, the project is approximately 1.8 miles west of the proposed Project. Although the SH 550 Direct Connector Project was completed in 2014 and the construction schedule would not overlap with the proposed Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Therefore, due to the proximity of the SH 550 Direct Connector Project as well as the potential for impacts to overlap temporally, the SH 550 Direct Connector Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Cameron County West Railroad Relocation Project

The Cameron County West Railroad Relocation Project, which opened for train traffic in August 2015, involves the construction of a new international rail bridge that will pass over the U.S. – Mexico border, as well as the construction of a 6-mile-long rail line within the U.S., which will replace the existing rail connection between Brownsville and Matamoros, Mexico (Railway Age, 2015, Cameron County Regional Mobility Authority, 2017). At its closest point, the Cameron County West Railroad Relocation Project is approximately 19.5 miles from the proposed Project site. Although the Cameron County West Railroad Relocation Project has been completed and opened for operation in 2015 and the construction schedule would not overlap with the proposed Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Therefore, due to the Cameron County West Railroad Relocation Project's location within the geographic scope of the proposed Project as well as the potential for impacts to overlap temporally, the Cameron County West Railroad Relocation Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.8 Port of Brownsville Projects

Brownsville Liquids Terminal 2 Project

The Brownsville Liquids Terminal 2 Project, in Cameron County, Texas approximately 10.2 miles southwest of the Project site, consists of the construction of four tanks, ranging in size from 50,000 barrels to 100,000 barrels, with initial total capacity of 300,000 barrels that will have the capability of expanding to up to 700,000 barrels, if necessary (Howard Energy Partners, 2017). The Brownsville Liquids Terminal 2 Project was completed and opened for commercial operation in 2016; consequently, the construction schedule would not overlap with the proposed Project. However, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Therefore, due to the Brownsville Liquids Terminal 2 Project's location within the geographic scope of the proposed Project as well the potential for impacts to overlap temporally, the Brownsville Liquids Terminal 2 Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Brownsville Liquids Terminal Facility Project

Located in Cameron County, Texas approximately 10.9 miles southwest of the proposed Project site, the Brownsville Liquids Terminal Facility Project consists of a 21-tank, 225,000-barrel liquid bulk storage facility (Howard Energy Partners, 2017). In 2014, the Brownsville Liquids Terminal Facility opened for full commercial operation (The Brownsville Herald, 2014). Although the Brownsville Liquids Terminal Facility Project has been completed and opened for operation and the construction schedule would not overlap with the proposed Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Therefore, due to the Brownsville Liquids Terminal Facility Project's location within the geographic scope of the proposed Project as well as the potential for impacts to overlap temporally, the Brownsville Liquids Terminal Facility Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

GEOTRAC Industrial Hub Project

The GEOTRAC Industrial Hub Project includes an industrial park consisting of 1,400 developable acres in Cameron County, Texas (GEOTRAC Industrial HUB, 2015). Situated approximately 7.9 miles southwest of the Texas LNG Project site, the GEOTRAC Industrial Hub Project is within the geographic scope of the Project; and development will be ongoing as parcels are sold. Therefore, construction of the GEOTRAC Industrial Hub could overlap with the proposed Project. Due to the proximity of the GEOTRAC Industrial Hub to the proposed Project and the potential of overlapping schedules, the GEOTRAC Industrial Hub was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Port of Brownsville Marine Cargo Dock 16 and Storage Yard Project

The Port of Brownsville Marine Cargo Dock 16 and Storage Yard Project, consisting of a 600-foot-long marine cargo dock and storage yard, opened for commercial operation in August 2015 (World Maritime News, 2015). Located in Cameron County, the Port of Brownsville Marine Cargo Dock 16 and Storage Yard Project is approximately 11.9 miles southwest of the proposed Project site. Although the Port of Brownsville Marine Cargo Dock 16 and Storage Yard Project opened for operation in 2015 and the construction schedule would not overlap with the Texas LNG Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Consequently, due to the Port of Brownsville Marine Cargo Dock 16 and Storage Yard Project's location within the geographic scope of the Texas LNG Project as well as the potential for impacts to overlap temporally, the Port of Brownsville Marine Cargo Dock 16 and Storage Yard Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Centurion Brownsville Terminal Processing and Storage Facility Project

The Centurion Brownsville Terminal Processing and Storage Facility, located in Cameron County, Texas, approximately 12.0 miles southwest of the proposed Project site, includes a 1.5-million-barrel oil products storage terminal as well as two processing towers that will allow Centurion to process condensate at a rate of up to 50,000 barrels per day (Nexstar Broadcasting, Inc., 2015). The Centurion Brownsville Terminal Processing and Storage Facility

Project began construction in 2015 and began operation in 2017 (Oil and Gas Journal, 2017; Port of Brownsville, 2017b). Due to the Centurion Brownsville Terminal Processing and Storage Facility Project's location within the geographic scope of the Texas LNG Project and the potential for impacts to overlap temporally, the Centurion Brownsville Terminal Processing and Storage Facility Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.9 Waterway Improvement Projects

Brazos Island Harbor Channel Improvement Project

The Brazos Island Harbor Channel Improvement Project anticipates construction to begin in October of 2020 and be completed by September 2024. Construction activities would be adjacent to the proposed Project site and would include the deepening of the Brownsville Ship Channel from -42 to -52 feet MLLW (COE, 2014). Due to the proximity of the Brazos Island Harbor Channel Improvement Project's to the proposed Project and the potential of overlapping schedules, the Brazos Island Harbor Channel Improvement Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Bahia Grande Channel Restoration Project

The Bahia Grand Channel Restoration Project, located in Cameron County, Texas, has not yet begun construction. The Bahia Grand Channel Restoration Project, situated approximately 3.0 miles west of the proposed Project site, includes the widening of the Bahia Grande channel, the construction of a SH 48 bridge, a wildlife observation tower, and public parking (Texas State Historical Association, 2017). Due to the proximity of the Bahia Grande Channel Restoration Project to the proposed Project and the potential of overlapping schedules, the Bahia Grande Channel Restoration Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Brownsville Ship Channel and Turning Basin Maintenance Dredging

The Brownsville Ship Channel and Turning Basin Maintenance Dredging Project includes maintenance dredging of the Brownsville Ship Channel and turning basin to ensure an overall depth of -42 feet MLLW. Maintenance dredging activities were completed in 2016 (COE, 2015b) and are located adjacent to the proposed Project site. The current schedule of maintenance dredging is not publicly available; however, it would likely occur during the construction phase of the proposed Project; therefore, the Brownsville Ship Channel and Turning Basin Maintenance Dredging Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Bend Easing Brownsville Ship Channel Improvement Project

The Bend Easing Brownsville Ship Channel Improvement Project is currently under consideration by the BND and consists of easing the bend at the entrance to the Brownsville Ship just inside the Brazos Santiago Pass to allow large ships to more safely enter the channel. The Brazos Santiago Pass is approximately 3.5 miles east of the proposed Project site. This project is in the early design phase and its timing is unknown; however, because there is potential for the construction schedule to overlap with the proposed Project, it was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Port Isabel Maintenance Dredging

Similar to the Brownsville Ship Channel Turning Basin and Maintenance Dredging Project described above, the Port Isabel Channel must also be routinely dredged to maintain its operating depth. The Port Isabel Channel is located 1.2 miles northeast of the Project site and was last dredged in 2016 (COE, 2015b). The current schedule of maintenance dredging is not publicly available; however, it would likely occur during the construction phase of the proposed Project; therefore, the Port Isabel Maintenance Dredging Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Gulf Intracoastal Waterway Maintenance Dredging Project

The GIWW Maintenance Dredging Project includes maintenance dredging of the GIWW channel from Corpus Christi to Port Isabel. Dredging activities are currently scheduled to begin in late 2018 and be completed in 2019. At its closest point, the maintenance dredging activities would be approximately 3.5 miles north of the proposed Project site (GovTribe, 2018). Due to the GIWW Maintenance Dredging Project's location within the geographic scope and the potential of overlapping schedules with the proposed Project, the GIWW Maintenance Dredging Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.1.10 Other Projects and Activities Considered

SpaceX Commercial Spaceport Project

Located near Boca Chica Beach in Cameron County, Texas, the SpaceX Commercial Spaceport Project broke ground for construction in 2014 and anticipates launches to start as soon as 2018 (Spaceflight Insider, 2016). Situated approximately 4.6 miles southeast, from its closest point, from the proposed Project site, the SpaceX Commercial Spaceport Project includes the development of approximately 70 acres to construct a new commercial launch complex designed specifically for orbital missions (FAA, 2014). Due to the proximity of the SpaceX Commercial Spaceport Project to the proposed Project site and the potential of overlapping construction schedules, the SpaceX Commercial Spaceport Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

STARGATE Facility Project

The STARGATE Facility is on Boca Chica Beach in Cameron County, Texas and includes the development of approximately 2.3 acres to construct a radio frequency park adjacent to the SpaceX launch site command center (The University of Texas Rio Grande Valley, 2017). Construction of the STARGATE Facility was completed in 2017 (The University of Texas Rio Grande Valley, 2018) and is approximately 3.9 miles southwest from the proposed Texas LNG Project site. Although construction of the STARGATE Facility is complete and the construction schedule would not overlap with the Texas LNG Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Consequently, due to the STARGATE Facility's location within the geographic scope as well as the potential for impacts to overlap temporally, the STARGATE Facility was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

South Padre Island Beach Re-nourishment Project

The South Padre Island Beach Re-nourishment Project, approximately 4.8 miles northeast of the proposed Project site, includes the placement of large amounts of beach-quality sand, harvested from the Brazos Island Harbor Jetty and Entrance channel, onto approximately 0.8 mile of beaches and dunes on South Padre Island, Texas (COE, 2015c). Sand placement activities commenced in 2015 and were completed in 2016 (Padre Elite Team Blog, 2016). Although the South Padre Island Beach Re-nourishment Project has been completed and the construction schedule would not overlap with the Texas LNG Project, short- and long-term impacts may still exist at the time the proposed Project is anticipated to begin construction. Therefore, due to the location of the South Padre Island Beach Re-nourishment Project's location within the geographic scope of the proposed Project as well as the potential for impacts to overlap temporally, the South Padre Island Beach Re-nourishment Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

Palo Alto Battlefield Cultural Landscape Restoration Project

The Palo Alto Battlefield Cultural Landscape Restoration Project is in Cameron County, Texas approximately 14.1 miles northwest of the proposed Project Site. The Palo Alto Battlefield Cultural Landscape Restoration Project is currently underway and includes the restoration and mitigation of altered landscape situations on the core battlefield of Palo Alto through vegetation management practices. The project aims to remove the invasive woody and cacti vegetation from the battlefield and reintroduce gulf cordgrass. In addition to mechanical, cultural, chemical, and biological treatments to maintain the cultural landscape of the battlefield, prescribed fires will be utilized to promote the development of the cordgrass as well as prevent the re-establishment of the invasive wood and cacti vegetation (NPS, 2017). Due to the location of the Palo Alto Battlefield Cultural Landscape Restoration Project's within the geographic scope and the potential of overlapping schedules with the proposed Project, the Palo Alto Battlefield Cultural Landscape Restoration Project was considered in our cumulative impacts assessment, as indicated in table 4.13.1-1.

Bahia Grande Coastal Corridor Project

The Bahia Grande Coastal Corridor Project is in Cameron County, Texas approximately 7.6 miles from the proposed Project site at its closest point. The Bahia Grande Coastal Corridor Project, currently underway, aims to provide protection and prevent future listing of state threatened species by acquiring approximately 7,000 acres of undeveloped properties that would ultimately connect the Laguna Atascosa NWR, Lower Rio Grande Valley NWR, and the Boca Chica State Park. In addition, the project would connect over two million acres of intact habitat on private ranch property with the Rio Bravo Protected Area, comprised of 1.3 million acres managed by Mexico's National Commission of Protected Areas (Gulf Coast Ecosystem Restoration Council, 2017, Gulf Coast Ecosystem Restoration Council, 2014).

Once the approximately 7,000 acres is acquired, restoration activities would be implemented and would include monitoring non-native invasive plant and animal species, enhancing native grasslands by controlling invasive brush, restoring natural tidal hydrology by completing internal basin connections, and restoring freshwater hydrology to the Bahia Grande Coastal Corridor ecosystem as well as improving water quality of the surrounding receiving waters by rerouting ditches to ensure water drains across the landscape through existing basins (Gulf Coast Ecosystem Restoration Council, 2014). To date, 2,129 acres have been acquired (The Nature Conservancy, 2018).

Due to the location of the Bahia Grande Corridor Project in the geographic scope and the potential of overlapping schedules with the proposed Project, the Bahia Grande Coastal Corridor Project was considered in our cumulative impacts analysis, as indicated in table 4.13.1-1.

4.13.2 Potential Cumulative Impacts by Resource

Impacts on resources were evaluated quantitatively where information is available or where reasonable assumptions could be made for estimating impacts (e.g., length of project and right-of-way width to estimate area). Quantitative impacts associated with each project considered in the cumulative impacts analysis is presented in table 4.13.2-1. Potential cumulative impacts on each resource are further discussed in the following sections.

TABLE 4.13.2-1

Quantitative Impacts for Projects Considered for Cumulative Impacts Associated with the Texas LNG Project

Project/Activity (Map No.)	Total Project Size (acres)	Wetland Impacts (acres in HUC 12)	Vegetation Impacts (acres in HUC 12)	Land Use (acres in Cameron County)
Future LNG Export Projects				
Rio Grande LNG Project (#1)	1,148.4 (Facility) 3,094 (Pipeline)	182.4 (Facility) 79.0 (Pipeline)	591.5 (Facility) 231.7 (Pipeline)	1,148.4 (Facility) 511.2 (Pipeline)
Annova LNG Brownsville Project (#2)	491.0	57.7	465.0	491.0
Non-jurisdictional Facilities Associated with the Texas LNG Project				
Intrastate Natural Gas Pipeline (#5)	108.3	56.3	107.4	108.3
State Highway 48 Auxiliary Lane (#6)	0.5	0	0.5	0.5
Electric Transmission Line (#7)	120.6	48.3	119.6	120.6
Potable Water Line (#8)	N/A [a]	N/A [a]	N/A [a]	N/A [a]
Non-jurisdictional Facilities Associated with the Rio Grande LNG Project				
LNG Trucking (#9)	N/A	N/A	N/A	N/A
Potable Water Line and Sewer Services (#10)	3.3		3.3	3.3
High and Low Voltage Electric Transmission Lines (#11)	142.0	54.0 [g]	142.0	142.0
State Highway 48 Modifications (#12)	36.4 [f]		36.4 [f]	36.4 [f]

TABLE 4.13.2-1 Quantitative Impacts for Projects Considered for Cumulative Impacts Associated with the Texas LNG Project				
Project/Activity (Map No.)	**Total Project Size (acres)**	**Wetland Impacts (acres in HUC 12)**	**Vegetation Impacts (acres in HUC 12)**	**Land Use (acres in Cameron County)**
Non-jurisdictional Facilities Associated with the Annova LNG Project				
Kingsville to Brownsville Pipeline (#13)	1,576.0 [f]	IU	291.6 [f]	480.0 [f]
Electric Transmission Line (#14)	100	26.1	100	100
Potable Water Supply Pipeline (#15)	30	6.3	30	30
Pipeline Projects				
Valley Crossing Pipeline (#16)	2,545.8 [f]	IU	474.3 [f]	750.6 [f]
Tuxpan Project (#17)	7,576.8 [f]	N/A [b]	N/A [b]	N/A [c]
Electric Transmission and Generation Projects				
Tenaska Brownsville Generating Station (#18)	270	IU	270	270
San Roman Wind Farm (#19)	156	IU	156	156
Cameron Wind Farm (#20)	15,000	N/A [b]	N/A [b]	IU [d]
Cross Valley Project (#21)	1,745.7 [f]	24.0	518.3 [f]	866.5 [f]
Transportation Projects				
East Loop (State Highway 32) (#22)	126.9	IU	126.9	126.9
South Padre Island Second Access (#23)	240.6	IU	31.6 [f]	240.6
State Highway 4 Upgrade Project (#24)	IU	IU	IU	IU
State Highway 100 Wildlife Crossings (#25)	IU	IU	IU	IU
State Highway 550 Direct Connector Project (#26)	IU	IU	IU	IU
Cameron County West Railroad Relocation Project (#27)	IU	IU	IU	IU
Port of Brownsville Projects				
Brownsville Liquids Terminal 2 (#28)	IU	IU	IU	IU
Brownsville Liquids Terminal Facility (#29)	IU	IU	IU	IU
GEOTRAC Industrial Hub (#30)	1,400	81	1,400	1,400
Port of Brownsville Marine Cargo Dock 16 and Storage Yard (#31)	IU	IU	IU	IU
Centurion Brownsville Terminal Processing and Storage Facility (#32)	280	IU	280	280

TABLE 4.13.2-1 Quantitative Impacts for Projects Considered for Cumulative Impacts Associated with the Texas LNG Project				
Project/Activity (Map No.)	**Total Project Size (acres)**	**Wetland Impacts (acres in HUC 12)**	**Vegetation Impacts (acres in HUC 12)**	**Land Use (acres in Cameron County)**
Waterway Improvement Projects				
Brazos Island Harbor Channel Improvement Project (#33)	IU	0	0	IU
Bahia Grande Channel Restoration (#34)	IU	IU	IU	IU
Brownsville Ship Channel and Turning Basin Maintenance Dredging (#35)	IU	0	0	IU
Bend Easing Brownsville Ship Channel Improvement Project (#36)	IU	IU	0	IU
Port Isabel Maintenance Dredging (#37)	IU	0	0	IU
Gulf Intracoastal Waterway Maintenance Dredging (#38)	IU	0	0	IU
Other Projects and Activities Considered				
SpaceX Commercial Spaceport Project (#39)	70	16	70	70
STARGATE Facility (#40)	2.3	IU	2.3	2.3
South Padre Island Beach Re-nourishment (#41)	IU	IU	IU	IU
Palo Alto Battlefield Cultural Landscape Restoration (#42)	IU	IU	IU	IU
Bahia Grande Coastal Corridor Project (#43)	2,129	IU	(2,129) [e]	(2,129) [e]

IU = Information Unavailable
N/A = Not Applicable
[a] The Texas LNG non-jurisdictional potable waterline would be located within the same corridor as the non-jurisdictional pipeline; therefore, impacts are captured with the non-jurisdictional pipeline.
[b] Project is not located within the same HUC 12 as the Texas LNG Project.
[c] Project is not located within the same county as the Texas LNG Project.
[d] The Cameron Wind Farm is located on approximately 15,000 acres; however, the amount of land that was disturbed during construction is unknown.
[e] Project will not result in a change in land use or impact vegetation
[f] Impacts were estimated based on publicly available information such as mapping exhibits and assumptions regarding construction corridor size (see table 4.13.1-1).
[g] Includes impacts for all of the non-jurisdictional facilities associated with the Rio Grande LNG Project.

4.13.2.1 Geologic Resources

The geographic scope for cumulative impacts on geological resources was considered to be the area that would be affected by and adjacent to the Texas LNG Project. Other projects located within the geographic scope for geological resources that are included in the cumulative impacts analysis are identified in table 4.13.1-1.

Elevations within the Project site range from 0 feet to 25 feet NAVD 88. Texas LNG would modify the existing site elevations to accommodate the construction of the Project facilities through cut and fill techniques, use of dredge material, and import of fill. The portions of the Texas LNG Project site that would support LNG facilities would be modified to an elevation of 16 feet NAVD 88. The LNG storage tanks would be constructed to an elevation of 10 feet NAVD 88, with secondary containment berms at 22 feet NAVD 88. Other, non-critical, components of the Texas LNG terminal would be constructed at an elevation of 7 feet NAVD 88. Texas LNG would also create the -43 foot-deep NAVD 88 maneuvering basin through dredging an estimated 3.9 million cubic yards of material. Texas LNG would use the dredge material to the extent practicable on site; however, the dredge material that cannot be reused would be disposed of at PA 5A.

Construction of the Texas LNG Project would result in permanent changes to the topographic contours present at the site. Similarly, the Rio Grande LNG Project, located adjacent to the proposed Texas LNG Project site would also permanently alter topographic contours through cut and fill activities, import of fill, and dredging of a marine berth. The Brazos Island Harbor Channel Improvement Project involves the deepening of the Brownsville Ship Channel from -42 feet to -52 feet, which would also alter topographic contours near the Texas LNG Project site. The non-jurisdictional facilities associated with the Texas LNG Project consist of modifications to SH 48 as well as the installation of a natural gas pipeline, water line, and electric transmission line. Within the geographic scope for cumulative impacts on geologic resources, these non-jurisdictional facilities would be adjacent to the existing SH 48. Natural topography was likely altered in this area during the initial construction of SH 48. Further, it is anticipated that contours would be restored following the completion of construction of the natural gas pipeline, water line, and electric transmission line, as well as the VCP.

Fuel and non-fuel mineral resources are not anticipated to be impacted by the Texas LNG Project, as no active mining operations or oil and gas wells are within 0.25 mile of the Texas LNG Project site. Therefore, cumulative impacts on mineral resources due to the construction and operation of the Texas LNG Project would not occur.

As described in section 4.12, the potential for impacts on or by the Texas LNG Project related to geologic hazards is low. Hurricanes and/or storm surge are the geologic hazards with the greatest potential to affect the Project. Both Texas LNG and Rio Grande LNG have designed their respective facilities to withstand predicted maximum hurricane force winds and storm surge. The non-jurisdictional facilities are not anticipated to exacerbate potential impacts associated with a hurricane or storm surge; however, aboveground components, such as the electric transmission lines could be damaged. The deepening of the Brownsville Ship Channel associated with the Brazos Island Harbor Channel Improvement Project is not anticipated to affect storm surge during hurricanes or other large storms; therefore, no cumulative impacts on geologic hazards would occur from this project (COE, 2014).

Overall, cumulative impacts on geologic resources resulting from the construction and operation of the Texas LNG Project and other projects identified in the geographic scope would primarily consist of permanent modification to existing contours. No mineral resources would be affected by the Texas LNG Project and potential effects associated with geologic hazards have been acceptably mitigated for through facility design. Therefore, we have determined that cumulative impacts on geologic resources would be permanent but minor.

4.13.2.2 Soils

The geographic scope for cumulative impacts on soils was considered to be the area that would be affected by and adjacent to the Texas LNG Project. Other projects within the geographic scope for soils that are included in the cumulative impacts analysis are identified in table 4.13.1-1.

Construction activities including clearing, grading, excavation, backfilling, and movement of construction equipment may affect soils within the Texas LNG Project site. Clearing of vegetation exposes and loosens soils making it more susceptible to wind and water erosion and establishment of invasive plant species. Movement of heavy construction equipment, grading, and spoil storage can result in compaction of soils, which can reduce porosity, increase runoff, and inhibit revegetation. Excavation and movement of soils, as well as import of soils for fill, can result in changes to the physical properties of soils on the site and mix topsoil and subsoil, which can also inhibit successful revegetation. Soil impacts would be greatest in areas where permanent aboveground facilities would be placed, such as the liquefaction trains and LNG storage tanks, and areas that would be permanently paved or graveled. Other areas temporarily used during construction may have permanent impacts on soils due to cut and fill activities or importation of soils. Areas temporarily impacted by construction of the Project, as identified in table 2.2-1, would be restored following the completion of construction, with minimal long-term impacts on soils.

Through implementation of best management practices during construction, including installation and maintenance of ECDs, Texas LNG would minimize the potential for soil impacts to extend beyond the Project site. Other best management practices that would minimize impacts on soils during construction would include segregation of topsoil from subsoil, where feasible, and decompaction of soils in temporary workspaces.

Cumulative impacts on soils may occur when adjacent projects increase the area of soil disturbance, resulting in greater potential for the adverse impacts identified above, or when projects disturb the same area in succession. In the latter circumstance, soil disturbance may be prolonged and revegetation delayed, so that soils are not sufficiently stabilized resulting in increased potential for runoff and erosion. In addition, prolonged exposure of soils can provide additional opportunity for the establishment of invasive plant species. None of the other projects identified above would occur within the same footprint as the Texas LNG Project, with the exception of the VCP, which has a small amount of temporary workspace located within the Project site.[51] The non-jurisdictional facilities associated with the Texas LNG Project and the Rio Grande LNG Project are adjacent to the Project site. The Brazos Island Harbor Channel Improvement Project is also adjacent to the Project site; however, because all activities would occur within the Brownsville Ship Channel, no impacts on soils are anticipated. While a small amount of temporary workspace associated with the VCP are within the proposed Project site,

[51] Non-jurisdictional facilities located within the Project site are captured in the Project impacts discussed throughout this EIS.

installation of the VCP will be completed in 2018 and it is anticipated to be restored prior to the start of construction on the Texas LNG Project; therefore, cumulative impacts on soils as a result of the VCP are not anticipated. Impacts on sediments associated with this project are discussed in section 4.13.2.3.

Soil impacts resulting from the Rio Grande LNG Project would be similar to those described above for the Texas LNG Project. Construction of the Rio Grande LNG Project and the Texas LNG Project are anticipated to occur concurrently; therefore, soils would be disturbed and exposed within both sites at the same time. Similarly, construction of the non-jurisdictional facilities associated with the Texas LNG Project would also occur concurrently with Project construction. The majority of soil impacts within the Rio Grande LNG Project site would also be permanent. The SH 48 modifications would result in permanent impacts on soils associated with the addition of the paved auxiliary lane. Impacts on soils would also occur during construction of the natural gas pipeline, water line, and electric transmission line; however, these impacts are anticipated to be temporary. As a result of concurrent construction of the projects identified above, a contiguous disturbed area would total approximately 1,096.7 acres.[52] The Rio Grande LNG Project is also regulated by FERC and would implement the measures in accordance with the FERC Plan and Procedures to minimize erosion and offsite transport of soils and ensure successful stabilization of soils through revegetation. While not FERC-regulated, it is anticipated that the construction of the non-jurisdictional facilities associated with the Texas LNG Project would also implement erosion controls similar to those outlined in the FERC Plan and Procedures. Due to the concurrent construction of multiple large-scale projects within the geographic scope for cumulative impacts on soils, and the anticipated permanent impacts on soils as a result of those projects, cumulative impacts on soils are anticipated to be moderate.

4.13.2.3 Water Resources

Groundwater Resources

The geographic scope for cumulative impacts on groundwater resources was considered to be the HUC 12 watershed affected by the Texas LNG Project and underlying aquifers. Other projects located within the geographic scope for groundwater resources that are included in the cumulative impacts analysis are identified in table 4.13.1-1.

Cumulative impacts on groundwater may occur through construction activities, including clearing and grading; dewatering; contamination through fuel and other hazardous material spills; and groundwater withdrawal. As discussed in section 4.3.1.4, the majority of potential impacts on groundwater resources associated with the Texas LNG Project would be short-term and localized, primarily associated with clearing, grading, excavating, filling, and placement of piles and foundations, with groundwater effects limited to water table elevations in the immediate vicinity of the Project site. The majority of the other projects considered for cumulative impacts on groundwater would involve similar ground disturbing activities that could temporarily affect groundwater levels.

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52 Acreage includes terrestrial impacts associated with the proposed Project, the Rio Grande LNG Project site, and the off-site acreages associated with the non-jurisdictional facilities associated with the proposed Project.

Texas LNG would not directly withdraw groundwater during construction or operation of the Project; however, water would be sourced indirectly from the BPUB via the BND, of which groundwater comprises approximately 20 percent of the water supply. Due to the relatively minor volumes of groundwater that would likely be associated with the Texas LNG Project as compared to overall groundwater withdrawals in the region, any impact on groundwater levels attributed to Texas LNG water use would be negligible. Proposed groundwater use is not known for the majority of the projects considered; therefore, a quantitative analysis of anticipated groundwater withdrawals is not feasible. However, because groundwater is not the primary source of potable water in the region and the Texas LNG Project would not directly withdraw groundwater, cumulative impacts on groundwater use are anticipated to be permanent and negligible.

Shallow groundwater areas could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials (e.g. fuels, lubricants, and coolants) used during construction and operation of the Texas LNG Project and other projects within HUC 12 watershed. However, Texas LNG would implement its Project-specific ECP, as well as its SPAR Plan during construction and SPCC Plan during operation, to minimize the risk of spills and mitigate potential impacts. Therefore, the potential impacts on groundwater as a result of contamination, if any, are anticipated to be temporary, localized, and minor. Other projects considered are anticipated to implement similar measures to prevent spills of hazardous materials from contaminating groundwater; therefore, we have determined that cumulative impacts on groundwater quality would be minor.

Surface Water Resources

The geographic scope established for surface water resources was the HUC 12 watershed. Several of the projects listed in table 4.13.1-1 could be under construction at the same time as the Texas LNG Project. Thus, there is the potential for cumulative impacts on water quality within the HUC 12 watershed if the Texas LNG Project was constructed during the same time period as these other projects or has overlapping operational effects.

Construction and operation of the Texas LNG Project would result in decreased water quality of the Brownsville Ship Channel within the vicinity of the Project site as a result of initial dredging and maintenance dredging, as well as vessel traffic, site modification and stormwater runoff, industrial wastewater, and hydrostatic testing. Impacts on water quality from dredging would be reduced by the use of a hydraulic cutterhead dredge and compliance with applicable COE permit conditions, as discussed in section 4.3.2.3. Shoreline erosion would be controlled by avoidance of propeller scour and the placement of rock rip-rap shoreline protection. Ballast water discharges would be governed by federal oversight and applicable Coast Guard requirements. Cooling water intake and discharge by LNG carriers would have short-term and negligible effects on water quality in the vicinity of the LNG carrier. Through implementation of NPDES regulations, Texas LNG's SPAR Plan, and ECP, potential impacts resulting from stormwater runoff would be adequately minimized or avoided. Texas LNG would minimize or avoid the potential for discharge of hydrostatic test water to cause localized, short-term turbidity in the Brownsville Ship Channel utilizing energy dissipation devices. Taken together, the effects of the Texas LNG Project construction and operation would have an incremental impact on surface water resources, mainly the Brownsville Ship Channel, but the effects would not be significant.

In-water activities, such as dredging and open-cut pipeline crossing techniques have the greatest potential to contribute to cumulative impacts on surface water resources. If dredging of the maneuvering basin associated with the Texas LNG Project were to occur concurrently with other in-water activities, especially those requiring dredging (Annova LNG Project, Rio Grande LNG Project, and waterway improvement projects) adverse impacts on water quality associated with increased turbidity and sedimentation could be exacerbated. Pipeline projects may also impact surface water resources through increases of turbidity and sedimentation, if the waterbodies are crossed via an open-cut crossing technique; however, these impacts are typically minor due to the short duration of in-water activities and would be unlikely to reach the Brownsville Ship Channel. Further, it is anticipated that larger waterbodies, such as the Brownsville Ship Channel would be crossed via horizontal directional drill for pipeline projects, including the Kingsville to Brownsville Pipeline and VCP; thereby, avoiding direct impacts on the waterbody.

Concurrent dredging of the Texas LNG Project, Annova LNG Project, Rio Grande LNG Project, and the Brazos Island Harbor Channel Improvement Project would result in the greatest cumulative impacts on surface water resources. All of these projects currently have similar proposed construction schedules that could overlap, if all regulatory approvals and authorizations are obtained as currently foreseen by the project proponents. Dredging associated with the Texas LNG Project would occur over 11 months. It is anticipated that timelines for dredging of the other LNG projects would be similar. All three LNG projects are proposing to utilize hydraulic cutterhead dredges that would minimize turbidity to the extent practicable; however, based on the turbidity modeling analysis conducted for the Texas LNG Project (see section 4.3.2.3), impacts associated with turbidity would extend west into the Brownsville Ship Channel, towards the Annova LNG and Rio Grande LNG Project areas, but would only extend an estimated 460 feet. Dredging of the Brazos Island Harbor Channel Improvement Project could further add to decreased water quality within the Brownsville Ship Channel if conducted concurrent with the other project dredging activities. Further, the concurrent dredging and thus concurrent placement of dredge material in confined dredge material placement areas would also result in increased effluent discharge into the Brownsville Ship Channel. Increased effluent discharge would likely result in increased turbidity in the vicinity of the discharge structures.

Annova evaluated the potential cumulative impact on sedimentation during construction dredging (Black and Veatch, 2017).[53] Annova's analysis also considered the potential for cumulative contribution from the Rio Grande LNG and Texas LNG Projects, as well as other projects occurring within the Brownsville Ship Channel. The majority of expected sedimentation due to construction is attributed to the LNG projects, which results in an estimated maximum sedimentation of 0.3, 0.41, and 0.22 inches for the Annova, Rio Grande, and Texas LNG Projects, respectively. Due to the distance between the Annova and Texas LNG projects, they are not expected to have significant overlapping effects. However, up to 0.63 inch of sedimentation could occur if the Texas LNG and Rio Grande Projects were to conduct

[53] The Black and Veatch (2017) cumulative sedimentation analysis was filed with the Annova LNG Project's (FERC Docket No. CP16-480-000) Response to FERC's May 25, 20176 Data Request (Accession No. 20170731-5180).

construction dredging at the same time. The Bahia Grande Estuary Channel Widening/Restoration could also contribute an estimated 0.5 inch of additional sedimentation. The Brazos Island Harbor Channel Improvement project is not expected to result in sediment accumulation during dredging as the purpose of the project is to deepen the main channel and any accumulated sediments would likely be accounted for with the allowed over-dredge depth to achieve the final design depth. As discussed in section 4.3.2.3, operation of the Texas LNG Project is not anticipated to result in sedimentation rates greater than current conditions in the Brownsville Ship Channel (approximately 0.98 inch per year); however, increased accumulation of sediments of approximately 0.4 inch per year are estimated to occur as a result of changes in hydrodynamic characteristics associated with the Brazos Island Harbor Channel Improvement Project (Black and Veatch, 2017).

In addition to dredging, other activities associated with the Texas LNG Project and other projects considered could result in a cumulative impact on surface water resources including pile driving, hydrostatic test water withdrawal and discharge, stormwater runoff, potential spills of hazardous materials, and increased vessel traffic within the Brownsville Ship Channel.

Concurrent construction of other projects involving clearing, grading, or other earthwork may also increase the potential for cumulative impacts on water quality from increased stormwater runoff. In addition, several of the projects identified in table 4.13.1-1 would require hydrostatic testing of storage tanks and/or pipelines. All project proponents would be required to adhere to state and federal regulations regarding hydrostatic, construction, and industrial stormwater and wastewater discharges. Compliance with these regulations by Texas LNG and the other project proponents; implementation of best management practices, including the Project-specific ECP and other project plans, would minimize potential cumulative impacts on surface water resources from stormwater runoff and wastewater discharges. Similarly, it can be reasonably assumed that all projects considered in the cumulative impacts analysis for surface water resources would be utilizing equipment and or materials that could be hazardous to the environment in the event of a spill. However, it is anticipated that all of these projects would prepare and implement a SPAR Plan or similar plan to prevent spills of hazardous materials from reaching surface water resources, as well as the measures to be implemented if such a spill occurs.

The operation of all three proposed Brownsville LNG projects would also result in a substantial increase in the number of large, ocean-going vessels transiting the Brownsville Ship Channel (estimated to be about 511 LNG carriers per year combined), as discussed in section 4.13.2.10. Other industrial projects along the Brownsville Ship Channel (i.e., the Port of Brownsville projects identified in table 4.13.1-1) are also anticipated to result in increased vessel traffic, although the exact number of additional vessels is not known. During operation, increased vessel traffic would result in a cumulative impact on surface water resources from increases in turbidity and shoreline erosion. Impacts on turbidity would be limited to the duration of each vessel's transit time in the Brownsville Ship Channel, and would be greater for larger ships, such as the LNG carriers. It is anticipated that the water quality would return to baseline conditions once each LNG carrier docks or leaves the Brownsville Ship Channel. Shoreline erosion would primarily occur while the LNG carriers or other large vessels requiring the assistance of tug boats are maneuvering at each of the LNG terminals or other project docks. Each of the three LNG projects has designed their respective facilities to minimize shoreline erosion through placement of rock riprap along the shoreline, or similar measures. It is anticipated that other projects along the Brownsville Ship Channel would implement similar measures to protect the shoreline. Each project would also be responsible for maintaining their shoreline protection to prevent future erosion.

Increased vessel traffic would also result in increased cooling and ballast water exchanges. Cooling water exchanges would result in minor changes in water temperature at the point of discharge, but these impacts are not anticipated to extend beyond the maneuvering basin, with temperatures quickly returning to ambient temperatures. Therefore, cumulative impacts as a result of cooling water are anticipated to be negligible. The Coast Guard requires that all vessels carry out an open-ocean ballast water exchange prior to calling at U.S. ports. Ballast water can affect water quality by discharging water that differs in the physiochemical properties of the ambient water, including pH, salinity, and temperature. Based on the anticipated volumes and frequency of ballast water discharge that would occur as a result of the Texas LNG Project; it is not anticipated that changes in the physiochemical properties of water within the Brownsville Ship Channel would extend beyond the maneuvering basin at the Texas LNG Project site. Similarly, it is anticipated that ballast water and cooling water impacts associated with LNG carriers calling on the Annova LNG and Rio Grande LNG terminals and other vessels transiting the Brownsville Ship Channel would also be localized; therefore, cumulative impacts on water quality as a result of ballast and cooling water exchanges are anticipated to be negligible.

Overall, cumulative impacts on surface water resources are anticipated to be greatest if dredging activities associated with the projects considered in this cumulative impact analysis occurs concurrently. Concurrent dredging activities and other impacts on surface water resources during construction activities, as described above, are anticipated to be temporary and moderate. Similarly, cumulative impacts on surface water quality during operation would be permanent and moderate to significant due to the persistent transit of LNG carriers and other large vessels within the Brownsville Ship Channel resulting in the increased erosion of shorelines along unarmored portions of the Brownsville Ship Channel. Similar to the Texas LNG Project, each of the other projects discussed would be required to comply with water quality standards in accordance with the CWA to minimize impacts on surface water resources.

4.13.2.4 Wetlands

The geographic scope for cumulative impacts on wetlands was determined to be the HUC 12 watershed. As identified in table 4.13.1-1, several other projects in this area could contribute to cumulative impacts on wetlands. Quantitative information regarding wetland impacts is not publicly available for all of the other projects considered in the cumulative impacts analysis; however, it is available for the non-jurisdictional facilities associated with the Texas LNG Project (104.6 acres), Annova LNG Project (57.7 acres) and associated non-jurisdictional facilities (32.4 acres, excluding the Kingsville to Brownsville Pipeline for which wetland impacts are unknown), Rio Grande LNG Project (261.4 acres, including impacts associated with the Rio Bravo Pipeline within the HUC 12 watershed) and associated non-jurisdictional facilities (54.0 acres), GEOTRAC Industrial Hub (81 acres), SpaceX Commercial Space Port Project (16 acres), and Cross Valley Project (24 acres) (see table 4.13.2-1).

As described in section 4.4.2, construction and operation of the Texas LNG Project would result in the temporary and permanent disturbance of wetlands. Wetlands that would be affected by the Texas LNG Project include PEM wetlands as well as tidal flats. The majority of the Project impacts would be on tidal flats (43.6 acres), which would be dredged for construction of the maneuvering basin. A smaller amount of PEM wetlands would be temporarily and permanently impacted (0.5 acre and 1.1 acre, respectively) within the interior portion of the Texas LNG Project site. Impacts on wetlands would be associated with dredging, clearing, grading, construction of permanent facilities, and temporary workspace and laydown areas. Texas LNG is currently proposing to mitigate for permanent impacts on wetlands through the preservation of 405 acres of tidal flats within the Loma Ecological Preserve. Texas LNG is currently finalizing its Mitigation Plan with the COE (see section 4.4.2).

The total known wetland impacts associated with the other projects, as identified above and in table 4.13.2-1, is 676.3 acres, including the Texas LNG Project impacts. The HUC 12 watershed has a total area of 234,353 acres. Based on NWI data developed by the FWS, approximately 49,220 acres of wetlands are present within the HUC 12 watershed; therefore, it is anticipated that, at a minimum, approximately 1.4 percent of the wetlands within the watershed would be affected by the projects considered in our cumulative impacts analysis. Development of the Bahia Grande Estuary Channel Restoration project would expand the Bahia Grande Channel, increasing tidal exchange and improving estuary function, resulting in positive cumulative impacts on estuarine wetlands within the HUC 12 watershed.

Wetlands provide important ecosystem functions due to their ability to retain water, minimizing flooding and improving water quality by filtering contaminants before reaching surface waterbodies. Therefore, conversion of wetlands to uplands or developed land can affect water quality, as well as flooding, within a watershed. Wetlands also provide valuable wildlife habitat. Several of the projects identified in table 4.13.1-1 are not anticipated to result in significant permanent impacts on wetlands. For example, the majority of pipeline and electric transmission projects would only temporarily impact wetlands during construction. These types of projects may result in a permanent conversion of cover type within wetlands such as forested or scrub shrub to herbaceous; however, following completion of construction, areas affected by these types of projects typically maintain their functionality as a wetland. The COE issues permits under Section 404 of the CWA for construction in jurisdictional Waters of the U.S., including wetlands, and requires mitigation or compensation to ensure there is no net loss of wetlands or wetland functions. All projects and activities would be required to comply with the CWA by avoiding, minimizing, or mitigating wetland impacts. However, the proposed Project and several of the other projects considered in this cumulative impacts analysis have mitigated or are proposing to mitigate with preservation of existing wetlands rather than enhancement or creation of wetlands. This, combined with the number of projects within the watershed that would impact wetlands, would result in moderate cumulative impacts on wetlands.

4.13.2.5 Vegetation

The geographic scope for cumulative impacts on vegetation was considered to be the HUC 12 watershed affected by the Texas LNG Project. Other projects located within the geographic scope for vegetation that are included in the cumulative impacts analysis are identified in table 4.13.1-1.

As described in section 4.5.2, a total of 277.7 acres of vegetation would be cleared during construction of the Texas LNG Project (excludes open water areas). Following construction, approximately 249.3 acres would be converted to developed land or would not be restored to preconstruction contours, resulting in a permanent loss of 63.6 acres of loma evergreen shrublands, 54.0 acres of sea ox-eye daisy flats, 42.0 acres of tidal flats, 31.9 acres of salt and brackish high tidal marsh, 20.2 acres of loma grasslands, 14.7 acres of loma deciduous shrublands, 13.0 acres of salty prairie, and 9.9 acres of barren land (barren land is sparsely vegetated in some areas). While some of the areas used for construction may be revegetated during operation of the facility, these areas would be maintained with upland herbaceous species and are not anticipated to be restored to preconstruction vegetation composition (e.g., loma evergreen shrublands would not reestablish).

Construction and operation of several of the projects listed above would also result in the permanent conversion of vegetated habitats to industrial land. Other projects, such as pipeline or electric transmission line projects would result in temporary impacts on vegetation during construction and could result in the conversion of wetlands or shrublands to upland or herbaceous vegetation; however, permanent conversion of vegetation to developed land associated with these types of projects is typically limited to associated aboveground facilities. Based on publicly available information, we know or can estimate the amount of vegetation that would be disturbed by most of the projects considered, as indicated in table 4.13.2-1. However, certain projects such as the South Padre Island Beach Re-nourishment, Highway 100 Wildlife Crossings, Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor Project are focused on maintenance or enhancement of the natural environment; as such these projects may result in positive effects on vegetation and wildlife in the geographic scope. Several linear projects included in the cumulative impacts analysis extend outside of the HUC 12 watershed, including the VCP, Kingsville to Brownsville Pipeline, Rio Bravo Pipeline, Cross Valley Project, and South Padre Island Second Access Project. While information is available for the total impacts associated with each project, data is not presented for impacts within individual HUC 12 watersheds (with the exception of the Rio Bravo Pipeline). Therefore, we calculated the percent of the project impacts in the HUC 12 watershed based on the length of each project within the watershed. We then applied this percentage to the total project impacts to estimate the acres of vegetation that would be impacted by each project in the HUC 12 watershed. Overall, an estimated total of 5,726 acres of vegetation would be impacted by the projects identified above within the HUC 12 watershed.[54] This accounts for approximately 2.4 percent of the total watershed area (234,353 acres); however, a large portion of the watershed is developed land or open water.

Vegetation plays an important role in an ecosystem, providing wildlife habitat, stabilizing soils, assisting in drainage, and providing filtration of stormwater within the watershed. Removal of vegetation can lead to loss or degradation of wildlife habitat, increased stormwater runoff, decreased water quality, increased erosion, and increased flooding. In addition, the Texas LNG Project, Annova LNG Project, and Rio Grande LNG Project would all impact rare or unique plant communities, including those associated with the loma landforms. While sufficient

[54] Impacts within the Project HUC 12 watershed was estimated for linear projects that are located in multiple watersheds based on the approximate percent of the linear project within the Project HUC 12 watershed.

information is unavailable to accurately quantify the extent that all projects considered for cumulative impacts on vegetation would impact rare plant communities, it can be reasonably assumed that at least some of the projects, in addition to the FERC-regulated projects for which information is available, would impact these resources.

All projects potentially contributing to cumulative impacts on vegetation would be required to adhere to applicable federal, state, and local regulations regarding water quality, erosion, and construction within floodplains. In addition, the majority of the projects considered for cumulative impacts on vegetation are within the eastern portion of the watershed (see figure 4.13-1), where coastal processes have a greater impact on the vegetation communities, as well as the soil characteristics and revegetation potential. Due to the saline soils characteristic of the region (see section 4.2.1) revegetation is anticipated to be difficult for the Texas LNG Project, as well as the majority of other projects considered. However, as discussed above, several of the projects considered for cumulative impacts on vegetation consist of large industrial developments that would result in the permanent loss of vegetation.

Due to the relatively large proportion of the HUC 12 watershed that would be affected by the projects considered, as well as the low revegetation potential and presence of rare plant communities in the HUC 12 watershed, we have determined that cumulative impacts on vegetation as a result of the Texas LNG Project and other projects in the area would be permanent and moderate.

4.13.2.6 Wildlife

The geographic scope for cumulative impacts on wildlife was considered to be the HUC 12 watershed affected by the Texas LNG Project. Other projects within the geographic scope for wildlife that are included in the cumulative impacts analysis are identified in table 4.13.1-1.

Impacts on wildlife associated with the Texas LNG Project include the disturbance, loss, and/or conversion of approximately 277.7 acres of terrestrial habitat (cumulative impacts on aquatic resources are discussed in section 4.13.2.7) within the Project site. Approximately 36 acres (including 7 acres of temporary workspace) of additional impacts would occur as a result of fencing that would exclude wildlife from habitats not directly disturbed by construction of the Project (see section 4.6.1.2). In addition, direct mortality of less mobile individuals such as small mammals, amphibians, and/or reptiles may occur during the initial clearing and grading activities. Other impacts on wildlife include impacts from elevated structures (bird strikes), construction and operation noise, facility lighting, and increased road traffic.

It is anticipated that the majority of the projects identified above that were considered for cumulative impacts on wildlife would result in similar impacts to those described for the Texas LNG Project. The waterway improvement projects are anticipated to directly impact aquatic wildlife, as further discussed in section 4.13.2.7; however, the impact on other wildlife is anticipated to be more indirect, likely associated with temporary increases in noise and light. As detailed in table 4.13.1-1, construction and/or operation of most of the projects identified above are anticipated to be concurrent with the Texas LNG Project.

Quantitative cumulative impacts on wildlife habitat are synonymous with the cumulative impacts discussed in section 4.13.2.5 for vegetation. Habitat loss and conversion associated with the projects identified above accounts for the primary direct impact on wildlife species. Increased development and loss of habitat within the HUC 12 watershed would cause wildlife to either adapt to new conditions (in the case of some generalist species) or relocate to undisturbed suitable habitat. Displacement of wildlife could result in additional stress and increased competition in available habitats. Further, the projects considered are within bird migration routes. Development, construction activities, and removal of habitat could require migrating birds to travel greater distances to locate suitable stopover habitat or stop in less suitable habitat. Depending on the additional distances traveled and/or quality of habitat found this could result in increased energy expenditure, competition, and/or predation.

Alternatively, conservation and restoration projects, such as the Bahia Grande Coastal Corridor Project, Palo Alto Cultural Landscape Restoration, and ongoing management and acquisition of NWR and state preserve lands, would have a positive cumulative impact on wildlife habitat. Conservation of these areas in perpetuity ensures that no future development would occur. Thus, these areas would continue to serve as suitable wildlife habitat in the area. Nevertheless, as discussed in section 4.13.2.5, given the number of large-scale developments in the area, cumulative impacts on wildlife habitat (vegetation) are anticipated to be permanent and moderate.

Cumulative impacts on wildlife as a result of increased noise, lighting, road traffic, and general human activity, would be greatest during the concurrent construction of the Texas LNG Project and other projects considered; however, due to operation noise and permanent facility lighting associated with the Texas LNG Project and several of the other projects that have permanent facilities, permanent cumulative impacts would also occur. While portions of the HUC 12 watershed are already developed and characterized by industrial activities, such as those projects closer to Brownsville, other areas, such as the northern and eastern portions of the HUC 12 watershed, including the Texas LNG Project site, are less developed (see figure 4.13.1-1).

In general, projects in areas characterized by more extensive existing development are anticipated to have less of an impact on wildlife than projects in areas where there is less development. Wildlife inhabiting developed areas are likely to consist of human commensal species or individuals that have otherwise become acclimated to human activity; whereas, wildlife in less developed areas may be more sensitive to human presence.

Cumulative impacts on wildlife resulting from noise would be greatest during the concurrent construction of the projects considered, but would also occur to a lesser degree during operation. Quantitative cumulative noise impacts are further discussed in section 4.13.2.12. While noise contributions from the Texas LNG Project would not directly impact wildlife beyond the geographic scope for cumulative noise impacts, an overall increase in noise associated with projects throughout the HUC 12 watershed, could limit the available habitat not affected by noise to which disturbed wildlife can relocate. Wildlife that cannot relocate from noise emitting sources could be adversely affected by increasing stress levels and masking auditory cues necessary to avoid predation or hunt prey, and find mates.

Construction lighting requirements likely varies among the projects considered; however, it can reasonably be assumed that several of the larger industrial projects, waterway improvement projects, and transportation projects could require nighttime construction lighting. The majority of the projects considered are not anticipated to require operational facility lighting, with the exception of the industrial developments (e.g., the three Brownsville LNG projects and Port of Brownsville projects). Increased lighting can cause more mobile wildlife to become disoriented, such as migrating birds, and can increase predation on prey species by making them more visible to predators. Artificial lighting can also adversely affect wildlife behavior by causing individuals to avoid the area or alter sleep/activity patterns. Texas LNG and the other FERC-regulated projects would minimize impacts on wildlife as a result of lighting by implementing project-specific facility lighting plans that incorporate the use of shielded, down-facing lights, to the extent practicable. It is anticipated that other facilities would utilize similar methods to minimize the impacts of lighting on wildlife.

Elevated structures such as storage tanks, communication towers, flares, and transmission lines would also result in cumulative impacts on migratory birds. Texas LNG has indicated that it would minimize the likelihood of bird strikes with the communication tower through implementation of measures recommended by FWS. Texas LNG has also indicated it would light elevated structures (in accordance with FAA regulations) in a manner that would cause the least impact on migratory birds (flashing lights). It is anticipated that other projects with elevated structures would implement similar measures to minimize impacts on migratory birds. However, while these measures would minimize impacts on migratory birds, bird strikes with elevated structures could still occur.

Increased road traffic associated with the projects considered would result in cumulative impacts on wildlife as a result of increased noise, light, and wildlife-vehicle collisions. The effects of increased noise on wildlife are discussed above. While increased light associated with road traffic could have a cumulative effect on wildlife, it is anticipated that the majority of workers would be traveling to and from project areas during daylight hours when most wildlife species are less active and more visible to drivers. Wildlife in the area are currently exposed to traffic along existing roads and wildlife crossing projects, such as the SH 100 Wildlife Crossing are anticipated to reduce the risk of collision where they have been implemented.

Overall, cumulative impacts on wildlife would be greatest during the concurrent construction of the projects considered, and would continue, to a lesser extent during operation. Cumulative impacts on wildlife would occur as a result of habitat disturbance and loss and increased noise, light, and road traffic. While most projects considered are anticipated to implement best management practices to ensure restoration of temporarily impacted wildlife habitat and minimize noise and lighting, we have determined that cumulative impacts on wildlife, including migratory birds, would be permanent and moderate.

4.13.2.7 Aquatic Resources

The geographic scope for cumulative impacts on aquatic resources was considered to be the proposed Project HUC 12 watershed. Other projects within the geographic scope for aquatic resources that are included in the cumulative impacts analysis are identified in table 4.13.1-1.

The Texas LNG Project would result in both beneficial and adverse impacts on aquatic resources. Adverse impacts on aquatic resources would primarily be associated with the construction phase of the Project resulting in disturbance of benthic and water column habitats, including EFH, during dredging of 73.5 acres, as well as increased underwater sound pressure levels associated with dredging and pile driving. Minimization of impacts on water quality potentially affecting aquatic resources, such as increases in turbidity and sedimentation would be the same as that discussed in section 4.13.2.3 regarding surface water resources. In addition to impacts on water quality and benthic habitats associated with the disturbance of sediment during dredging, there would also be potential for entrainment or direct mortality of some aquatic species. Texas LNG would use a hydraulic cutterhead dredge, which has a slow intake velocity and is thus less likely to entrain more mobile species (e.g., fish) than other dredging techniques. However, less mobile species, such as invertebrates, would likely be come entrained during dredging, resulting in the direct mortality of those individuals.

The Texas LNG Project would also result in beneficial impacts on aquatic resources, including benthic habitats and EFH. As discussed in sections 4.6.2.2 and 4.6.3.3, dredging of the maneuvering basin is anticipated to remove a berm formed from historical maintenance dredging activities along the north bank of the Brownsville Ship Channel that has restricted tidal exchange within the larger tidal complex north of the Project site. Based on Texas LNG's maneuvering basin design, tidal flows would be restored to the areas north of the Project site following the completion of dredging activities, thus restoring and creating benthic habitats as well as EFH.

All projects impacting waterbodies within the HUC 12 watershed could contribute to negligible incremental impacts on water quality if the impacts are of great enough magnitude and duration to adversely affect water quality in the Brownsville Ship Channel (as discussed in section 4.13.2.3). However, the potential for cumulative impacts on aquatic resources would be greatest for those projects that would be directly impacting the Brownsville Ship Channel and adjacent waterways through dredging, increased vessel traffic, pile driving, or other in-water activities. The projects identified in table 4.13.1-1 that are anticipated to contribute the most to potential cumulative impacts on aquatic resources include the Annova LNG Project, Rio Grande LNG Project, Port of Brownsville projects, and the waterway improvement projects, especially the Brazos Island Harbor Channel Improvement Project.

As discussed in section 4.13.2.3, the other Brownsville LNG projects as well as the Brazos Island Harbor Channel Improvement Project, could be constructed concurrently with the Texas LNG Project. This would result in active dredging of a large portion of the Brownsville Ship Channel for an extended duration. In addition to the increases in turbidity affecting water quality (see section 4.13.2.3), dredging would decrease dissolved oxygen levels and result in a cumulative impact on the amount of benthic habitats and species that are directly affected. This would reduce the overall prey availability for predators in the area that feed on these species. In addition, more mobile species would also have to travel further to relocate to suitable habitat where dredging is not occurring, or be forced to occupy less suitable habitat, both of which could reduce the overall fitness of the individual and affect behaviors, such as foraging and mating. Therefore, cumulative impacts on aquatic resources as result of dredging activities would be moderate and short-term.

Similarly, concurrent dredging of the projects identified above would result in cumulative impacts on EFH. However, the Texas LNG Project would result in some long-term beneficial impacts on EFH, through the restoration of EFH functionality to tidal flats north of the Project site; although some of the tidal flats within the Project site would be permanently converted to deepwater habitats. The Brazos Island Harbor Channel Improvement Project would require the deepening of the Brownsville Ship Channel through dredging of the existing channel; therefore, impacts on EFH are anticipated to be temporary, as there would be no change in the type of EFH available following completion of the project and the macroinvertebrates and worms inhabiting these areas would be expected to recolonize quickly. In addition to soft bottom and pelagic (water column) EFH, the Annova LNG and Rio Grande LNG projects would permanently impact mangrove, emergent marsh, and sand/shell bottom EFH. However, all of the proposed LNG projects would be required to mitigate for the permanent impacts on EFH as part of the Section 404 permit process; therefore, cumulative impacts on EFH would be minor.

Cumulative impacts on aquatic resources could also occur as a result of concurrent pile driving activities. As discussed in section 4.6.2.2 and 4.11.2.3, in-water pile driving can increase underwater sound pressures that can result in injury or mortality to fish and other wildlife (see section 4.13.2.8 for a discussion of cumulative impacts resulting from pile driving on marine mammals and sea turtles). Texas LNG would minimize impacts on aquatic resources from pile driving by driving most piles into the tidal flats rather than open water and utilizing soft starts. The only other projects considered for which pile driving is anticipated to overlap with the Texas LNG Project are the other two Brownsville LNG projects. Both of these projects are anticipated to implement measures similar to Texas LNG to minimize impacts on fish associated with pile driving. However, concurrent in-water pile driving could limit the available habitat for fish avoiding the increased underwater sound pressure levels and increase density within those habitats. While pile driving for the Texas LNG Project would occur over a 13-month period, in-water pile driving would be limited to an estimated 12 days, minimizing the duration during which cumulative impacts would occur. Therefore, cumulative impacts on aquatic resources as a result of pile driving are anticipated to be temporary and minor.

In addition to cumulative impacts that would occur during construction of the Texas LNG Project, operation of the Project would also affect aquatic resources. During operation of both Project phases, Texas LNG anticipates that up to 74 LNG carriers would call on the LNG terminal annually. Increased vessel traffic would result in increased impacts on aquatic resources associated with ballast and cooling water exchanges and potential fuel spills. The Annova LNG and Rio Grande LNG projects are anticipated to have the greatest contribution to cumulative impacts on aquatic resources from increased vessel traffic. As discussed further in section 4.13.2.10, the three Brownsville LNG projects would result in a cumulative increase in ship traffic in the Brownsville Ship Channel during operation. Combined, the three projects would contribute an additional 511 vessels per year, a 48 percent increase in the current vessel traffic within the Brownsville Ship Channel (approximately 1,057 vessels per year).

Cooling water discharges that occur while LNG carriers are maneuvering to the Texas LNG terminal and while they are docked at the Texas LNG terminal would result in increases in water temperature. As discussed in section 4.13.2.3, increases in water temperature as result of cooling water discharges are anticipated to be localized, with water temperatures quickly returning to ambient levels and are not anticipated to overlap with the other LNG project sites;

therefore, cumulative impacts on aquatic resources resulting from cooling water discharges would be intermittent and negligible.

In addition, ballast water can be a source for introduction of non-native species, as discussed in section 4.6.2.2. The cumulative increase in vessel traffic within the Brownsville Ship Channel would create greater opportunity for the introduction of non-native species in ballast water. However, all LNG carriers and other ocean-going vessels utilizing the Brownsville Ship Channel would be required to adhere to the Coast Guard regulations regarding ballast water to minimize the potential introduction of non-native species; therefore, cumulative impacts on aquatic resources from ballast water would be negligible. Ballast water discharges can also result in localized changes to the physiochemical composition of the water within the maneuvering basin. As discussed in section 4.13.2.3, these impacts would be localized and would quickly return to ambient levels. Cumulative impacts from changes in water quality on aquatic resources would be similar to those described above for cooling water.

4.13.2.8 Threatened, Endangered, and Other Special Status Species

The geographic scope for threatened and endangered species was generally determined to be the HUC 12 watershed; however, due to the diversity in life history and range of threatened and endangered species potentially affected by the Texas LNG Project, cumulative impacts were independently reviewed for each species or group of species. For example, threatened or endangered bird species are more mobile with larger ranges when compared to terrestrial reptiles that may not extend beyond a relatively small area. Discussions of cumulative impacts on threatened and endangered species are grouped by taxa and are limited to only those threatened and endangered species identified in section 4.7 as potentially affected by the Texas LNG Project. Species that are not anticipated to be present at the Project site, or otherwise affected by the Texas LNG Project, due to a lack of suitable habitat or species range, are not discussed further with regard to cumulative impacts.

Mammals

<u>West Indian Manatee</u>

Other projects considered for cumulative impacts on West Indian manatees are those that would conduct activities within or otherwise affect the Brownsville Ship Channel. Projects considered for cumulative impacts on West Indian manatee include the Rio Grande LNG Project, Annova LNG Project, VCP, Kingsville to Brownsville Pipeline, the waterway improvement projects, and the Port of Brownsville Projects.

As discussed in our BA, we have determined that the Texas LNG Project is not likely to adversely affect the West Indian manatee; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1). Impacts on West Indian manatee resulting from the Texas LNG Project are most likely to occur during dredging and pile driving activities, as well as increased vessel traffic during construction and operation. However, due to the rarity of manatee occurrence in the Brownsville area, as well as the lack of suitable foraging habitat, impacts are not anticipated to occur.

Impacts on West Indian manatees resulting from the other two LNG projects considered (Rio Grande LNG and Annova LNG) would be similar to those discussed for the Texas LNG Project. While both the VCP and the Kingsville to Brownsville Pipeline would cross the Brownsville Ship Channel, it is anticipated that these crossings would be conducted via horizontal directional drill and would not result in any direct impacts on the Brownsville Ship Channel. Therefore, these pipeline projects are not anticipated to affect West Indian manatee. In addition, most of the Port of Brownsville projects considered were all recently completed and would not overlap with construction of the Texas LNG Project. Therefore, the Port of Brownsville projects are not anticipated to contribute to cumulative impacts on West Indian manatees.

Publicly available information regarding the anticipated schedules for the projects discussed above indicate that it is possible that construction activities associated with several of the waterway improvement projects and both of the other LNG projects would be concurrent with the Texas LNG Project. All projects operating within the Brownsville Ship Channel are anticipated to implement measures identified by FWS (see our BA) to minimize potential impacts on manatees. Due to the rarity of the West Indian manatee and measures that would be implemented if a manatee were to occur within the Brownsville Ship Channel, cumulative impacts are not anticipated to occur.

Whales

Other projects considered for cumulative impacts on federally listed threatened and endangered whales (including the sperm whale, fin whale, and sei whale) and the Gulf of Mexico Bryde's whale that is proposed for listing are those that would include large ocean going vessels, such as LNG carriers, transiting in the Gulf of Mexico to and from the Texas LNG terminal. Projects considered for cumulative impacts on whales include the Rio Grande LNG Project, Annova LNG Project, and Port of Brownsville projects, all of which would contribute to large vessel traffic. The Tuxpan Project would also be constructed within the Gulf of Mexico; however, based on the anticipated project schedule, construction of the Tuxpan Project would be completed prior to the start of construction of the Texas LNG Project and is therefore not anticipated to contribute to cumulative impacts on federally listed whale species.

As discussed in our BA, we have determined that the Texas LNG Project is not likely to adversely affect whales; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1). Although no whale species are expected to venture into the relatively shallow waters surrounding the Texas LNG Project site, individual whales may be subjected to strikes by LNG carriers and other large vessels transiting in the Gulf of Mexico to and from the Brownsville Ship Channel. Although federally listed whale species in the Gulf of Mexico vary in distribution, habitat, and behavior, effects of the Texas LNG Project are expected to be similar for all listed whale species. Texas LNG currently estimates that up to 74 LNG carriers per year would visit the Texas LNG terminal; however, the likelihood of collision with a whale is low because whales are generally able to detect and avoid large vessels and Texas LNG would encourage LNG carrier operators to adhere to collision-avoidance measures, as described in NMFS' most recent *Vessel Strike Avoidance Measures and Reporting for Mariners* (revised February 2008).

Impacts on whales resulting from the other two LNG projects considered (Rio Grande LNG and Annova LNG) as well as the Port of Brownsville projects that could result in increased vessel traffic, would be similar to those discussed for the Texas LNG Project and additive. The number of additional vessels associated with the Port of Brownsville projects is not publicly available; however, during operations, about 125, 312, and 74 LNG carriers would call on the Annova, Rio Grande, and Texas LNG terminals per year, respectively. It is anticipated that vessels calling on other Port of Brownsville facilities, including the Annova LNG and Rio Grande LNG projects, would also comply with NMFS' measures to minimize vessel strikes. Nevertheless, the three LNG projects would result in an estimated 17 percent annual increase in ship traffic within the Brownsville Ship Channel during construction and 48 percent during operation, which would increase the likelihood of vessel strikes; therefore, cumulative impacts on federally listed whales is anticipated to be intermittent and minor.

Ocelot and Jaguarundi

The geographic scope for cumulative impacts on the ocelot and jaguarundi was considered to be terrestrial projects within the HUC 12 watershed affected by the Texas LNG Project. Projects considered for cumulative impacts on the ocelot and jaguarundi include the Rio Grande LNG Project and associated non-jurisdictional facilities, Annova LNG Project and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the Texas LNG Project, VCP, Kingsville to Brownsville Pipeline, San Roman Wind Farm, Cross Valley Project, six transportation projects, five Port of Brownsville Projects, SpaceX Commercial Spaceport Project, Stargate Facility, Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor Project.

Dense thornscrub associated with the lomas on the Texas LNG Project site provide suitable habitat for ocelot and jaguarundi, as discussed in our BA. Further, surveys of the Project site identified feline tracks consistent with ocelot; however, these could not be definitively identified. While the Project site contains suitable habitat and is within the known range of ocelots and jaguarundi, the Project site likely serves only as stopover or temporary habitat for transient individuals rather than a breeding pair due to its size and lack of connectivity with larger more contiguous tracts, such as those present within the Laguna Atascosa NWR. Further, if an ocelot or jaguarundi is present on the site at the start of construction activities it would likely relocate to suitable adjacent habitat. Therefore, we have determined that the Texas LNG Project is not likely to adversely affect the ocelot and jaguarundi; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1.5).

As discussed in greater detail in our BA, the primary threat to ocelot and jaguarundi populations in the U.S. is habitat loss, degradation, and fragmentation (FWS, 2010b). The Texas LNG Project would contribute to habitat loss; however, this loss represents a small fraction of the overall available habitat present in the region. Nevertheless, habitat loss has been identified by the FWS as a primary threat to ocelot recovery. Also as discussed in our BA, the population size in Texas and growing isolation from loss of habitat connectivity with ocelot and jaguarundi populations in Mexico are contributing to a growing threat of genetic inbreeding in the Texas ocelot and jaguarundi populations. Moreover, the construction of roads through ocelot and jaguarundi habitat has resulted in high rates of road mortality, further inhibiting population growth and connectivity with adjacent populations (FWS, 2010b). These are important factors to consider when addressing potential cumulative impacts on these species.

Not all of the projects listed above are anticipated to impact ocelot and jaguarundi habitat, such as the San Roman Wind Farm, which is located in primarily agricultural and open land, and the Port of Brownsville projects, which are located within densely developed, previously disturbed areas. In addition, several projects would result in beneficial impacts on ocelots and jaguarundis including the Bahia Grande Coastal Corridor Project, the purpose of which is to further conserve land, and the SH 100 Wildlife Crossings, which are intended to minimize impacts from road traffic. The other two LNG projects, as well as the pipeline projects proposed in the area, are anticipated to have the greatest impacts on ocelot habitat through removal and conversion to industrial uses and fragmentation, respectively. In addition, these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross. Direct mortality as a result of construction of the projects considered in this cumulative impacts analysis for ocelots and jaguarundi are unlikely due to the ability of individuals to leave the area; however, long-term impacts resulting from habitat loss and the potential for subsequent reduced genetic diversity from inbreeding could occur.

As discussed above, the past and continued development in and around Brownsville and across the border in Mexico has decreased the available corridor habitat necessary to connect ocelot and jaguarundi populations in Mexico and the U.S. While relatively small barriers such as the Brownsville Ship Channel and SH 4 do not create a significant impediment to individual movements, ocelots and jaguarundi require contiguous dense thornscrub for cover over longer distances (TPWD, 2017h; 2017i). In addition, ocelots and jaguarundis are elusive species with relatively large home ranges and low population densities that tend to avoid human development and activity (FWS, 2010b). The current remaining habitat corridor in the region to connect U.S. and Mexico populations of these federally listed species is located adjacent to and within the proposed Rio Grande LNG and Texas LNG Project sites north of the Brownsville Ship Channel and within and adjacent to the proposed Annova LNG Project site south of the Brownsville Ship Channel. The area adjacent to the proposed Rio Grande LNG Project site (see figure 4.7.1-1) is a conservation easement that would not be developed in the future. Annova has been working closely with the FWS to configure their proposed project to reduce potential impacts on ocelots and jaguarundis to the maximum extent practicable. This includes maintaining an approximately 1,500-foot-wide corridor to the west of the Annova LNG terminal, directly across from the existing wildlife corridor on the north side of the Brownsville Ship Channel. Further, the entirety of the Texas LNG Project site would not be fenced, potentially deterring transiting ocelots, but not excluding them.

While a travel corridor would be maintained to allow ocelots and jaguarundis to move between Mexico and the U.S., the addition of three large industrial facilities in proximity to that corridor (Annova LNG, Rio Grande LNG, and Texas LNG), would create additional noise, light, and traffic, all of which could deter ocelots or jaguarundis from utilizing the corridor. However, in an effort to minimize impacts as a result of increased light pollution on all wildlife, including ocelots and jaguarundis, all three LNG projects have indicated that they would utilize down-facing lights. Other impacts, such as those associated with noise, would be minimized by the projects to the extent practicable; however, due to the proximity of the Annova LNG and Rio

Grande LNG Projects to the wildlife corridors, facility-generated noise during construction and operation would still be audible to ocelots and jaguarundis utilizing the wildlife corridor.

In addition, increased road traffic along SH 4 associated with the Annova LNG Project, Kingsville to Brownsville Pipeline, VCP, SpaceX Commercial Spaceport Project, and the Stargate Facility, as well as increased traffic along SH 48 associated with the Texas LNG Project, Rio Grande LNG Project, Kingsville to Brownsville Pipeline, VCP, and the Port of Brownsville projects would result in increased potential for vehicle strikes on ocelots and jaguarundis.

As described above, there is potential for the continued reduction of suitable ocelot and jaguarundi habitat to a single, narrow corridor among industrial facilities. The loss, degradation, and fragmentation of habitat have been cited by the FWS in its 2010 Recovery Plan, as the primary threat to U.S. ocelot and jaguarundi populations. The further narrowing of this corridor could result in decreased dispersal of individuals between U.S. and Mexico populations, resulting in decreased genetic diversity (inbreeding). Further, the projects assessed for cumulative impacts on ocelots and jaguarundis would increase road traffic, particularly during periods of concurrent construction (see table 4.13.1-1), which is the primary cause of direct mortality on U.S. ocelot and jaguarundi populations (TPWD, 2017h; 2017i). Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would be permanent and significant.

Birds

Four bird species of concern have the potential to occur in the vicinity of the Project site. As discussed in our BA, we have determined that the Project *would be unlikely to cause a trend towards federal listing* for the red-crowned parrot (candidate for listing) due to the lack of habitat at the Texas LNG Project site. Three federally listed birds more likely to use the Texas LNG Project site are discussed further below.

<u>Northern Aplomado Falcon</u>

The geographic scope for cumulative impacts on the northern aplomado falcon was considered to be terrestrial projects within the HUC 12 watershed affected by the Texas LNG Project. Projects considered for cumulative impacts on the northern aplomado falcon include the Rio Grande LNG Project and associated non-jurisdictional facilities, Annova LNG Project and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the Texas LNG Project, VCP, Kingsville to Brownsville Pipeline, San Roman Wind Farm, Cross Valley Project, transportation projects, Port of Brownsville projects, SpaceX Commercial Spaceport Project, Stargate Facility, Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor Project.

The Texas LNG Project site provides suitable nesting and foraging habitat for the northern aplomado falcon. As discussed in our BA, Texas LNG implemented design measures recommended by the FWS to avoid impacts on suitable habitat to the extent practicable. Further, surveys of the Project site did not identify any existing nests that could be utilized by northern aplomado falcons. Texas LNG has also indicated that surveys would be conducted prior to the start of construction to ensure that no nesting birds are present. Therefore, we have determined that the Texas LNG Project is not likely to adversely affect the northern aplomado falcon; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1).

For the majority of projects considered, impacts on northern aplomado falcons are not known; however, suitable habitat is also present on the Annova LNG and Rio Grande LNG sites and would likely be crossed by the linear transmission and pipeline projects in the area. The Port of Brownsville projects are primarily located in an already industrialized area that likely does not provide suitable habitat for northern aplomado falcons. Further, the San Roman Wind Farm, LNG projects, and overhead transmission line projects include elevated structures and wires that could result in bird strikes. These impacts would be similar to those discussed in section 4.13.2.6 for migratory birds. Impacts on habitat associated with the pipeline and transmission lines are anticipated to be temporary with construction areas restored following the completion of activities.

Permanent aboveground facilities such as the LNG projects would result in the removal of suitable foraging and nesting habitat for Aplomado falcons. These cumulative impacts on habitat could prevent establishment of nesting pairs and would limit available foraging habitat within the area; therefore, cumulative impacts on northern aplomado falcons are anticipated to be permanent and moderate.

Shorebirds

Other projects considered for cumulative impacts on threatened or endangered shorebirds (piping plover and red knot) are those that would conduct activities adjacent to the Brownsville Ship Channel. Projects considered for cumulative impacts on piping plover and red knot include the Rio Grande LNG Project, Annova LNG Project, VCP, Kingsville to Brownsville Pipeline, waterway improvement projects, and Port of Brownsville projects.

We have determined that the Texas LNG Project is not likely to adversely affect the two federally listed shorebirds (piping plover and red knot), as discussed in our BA; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1). Suitable wintering habitat is present within the Texas LNG Project site for both species and designated critical habitat is present within PA 5A for piping plover. Texas LNG has indicated that it would implement measures recommended by FWS to minimize potential impacts on piping plover and red knot by conducting preconstruction surveys.

The other industrial development projects considered, including the LNG projects and Port of Brownsville projects are anticipated to result in similar impacts on piping plover and red knot. The Texas LNG Project, other LNG projects, and some of the Port of Brownsville projects would result in the permanent conversion of the existing shoreline habitat to industrial land; however, the dredging of the Texas LNG marine berth would likely restore tidal flats north of the Texas LNG Project site, potentially creating habitat for shorebirds (see sections 4.6.2.2 and our BA). The projects considered would result in a cumulative impact on piping plover and red knot; however, there is abundant wintering habitat present throughout the southern Texas coast, including within the Laguna Atascosa NWR, Lower Rio Grande Valley NWR, and the Loma Ecological Preserve. Therefore, cumulative impacts on piping plovers and red knots are not anticipated to be significant.

Sea Turtles

Other projects considered for cumulative impacts on sea turtles are those that would conduct activities within or otherwise affect the Brownsville Ship Channel. Projects considered for impacts on sea turtles include the Rio Grande LNG Project, Annova LNG Project, VCP, Kingsville to Brownsville Pipeline, waterway improvement projects, and Port of Brownsville projects.

As discussed in our BA, we have determined that the Texas LNG Project is not likely to adversely affect sea turtles; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1). Impacts on sea turtles associated with the Texas LNG Project are most likely to occur as a result of dredging and pile driving activities, as well as increased vessel traffic during construction and operation. Texas LNG has indicated that it would implement measures designed to minimize potential impacts on sea turtles including conducting the majority of pile driving from land, prior to dredging, utilizing a cutterhead suction dredge, and providing all vessels associated with the Project guidance regarding measures to be implemented to avoid vessel strikes. Based on the implementation of these measures, we have determined that the Texas LNG Project is not likely to adversely affect sea turtles; however, due to the concurrent construction schedules and scopes of the other projects considered, cumulative impacts on sea turtles would be likely to occur.

Impacts on sea turtles resulting from the other two LNG projects considered (Rio Grande LNG and Annova LNG) would be similar to those discussed for the Texas LNG Project, as would the measures that would be implemented to minimize impacts (see our recommendation in section 4.6.2.2. While both the VCP and the Kingsville to Brownsville Pipeline would cross the Brownsville Ship Channel, it is anticipated that these crossings would be conducted via horizontal directional drill and would not result in any direct impacts on the Brownsville Ship Channel. Therefore, these pipeline projects are not anticipated to affect sea turtles. In addition, all but one (GEOTRAC Industrial Hub) of the Port of Brownsville projects considered were all recently completed and would not overlap with construction of the Texas LNG Project. Therefore, the recently completed Port of Brownsville projects are not anticipated to contribute to cumulative impacts on sea turtles. The GEOTRAC Industrial Hub consists of multiple parcels of land identified for future industrial development, several of which are adjacent to the Brownsville Ship Channel. While development of these areas is anticipated to be ongoing as future projects arise, it is unknown whether the development of any of the parcels adjacent to the Brownsville Ship Channel would overlap with the Texas LNG Project. If development of these areas did overlap with construction of the Texas LNG Project, impacts are anticipated to be similar, potentially requiring dredging and/or shoreline stabilization, vessel traffic, and land disturbance. If constructed concurrent with the Texas LNG Project, development of other parcels along the Brownsville Ship Channel as part of the GEOTRAC Industrial Hub, could contribute to cumulative impacts on sea turtles.

Based on the biological opinion issued for the Brazos Island Channel Improvement Project, dredging activities in the Brownsville Ship Channel utilizing hopper dredges routinely result in the direct mortality of sea turtles (COE, 2014). While the COE would implement numerous measures to reduce sea turtle mortality, such as pre-dredging trawls to safely remove sea turtles from the area, NMFS has conducted a jeopardy analysis and issued a take permit to the COE with limits on the number of sea turtles that can be taken during dredging activities. It is anticipated that the other waterway improvement projects, all of which require dredging activities, would have the potential to similarly impact sea turtles.

Publicly available information regarding the current anticipated schedules for the projects discussed above indicate that it is possible that construction activities associated with several of the waterway improvement projects and both of the other LNG projects would be concurrent with the Texas LNG Project. In general, sea turtles present in the area at the start of construction activities are anticipated to relocate to nearby suitable habitat or avoid the area. However, the concurrent construction activities within the Brownsville Ship Channel could limit the habitat available to which sea turtles could relocate. For instance, a sea turtle startled into moving from one project area may relocate to another project area, and so on until suitable habitat is found. During dredging activities in which hopper dredges are used, such as the Brazos Island Harbor Channel Improvement Project, this could cause sea turtles to move into the dredging area that might otherwise have been avoided by the turtle.

Similar to the impacts discussed in section 4.13.2.6 for other wildlife species, increased disturbance and searching for available habitat could result in increased stress and energy expenditure for sea turtles in the area. Further, increases in sedimentation and turbidity (see section 4.13.2.3) as well as disturbance of benthic environments that serve as habitat for sea turtle prey species could also result in cumulative impacts on sea turtles by reducing water quality and prey availability.

Concurrent pile driving and dredging activities are anticipated to result in cumulative impacts from increased underwater noise. Due to the short impulsive nature of pile driving noises, it is very unlikely that the peak sound pressure levels from multiple pile drivers would occur at exactly the same instant, so there would be no increase in the predicted pile driving peak sound pressure levels. Rather, the number of pile driving events would increase due to the multiple active construction areas; although, because Texas LNG is only proposing 12 days of in-water pile driving, and Rio Grande LNG is also proposing short-duration in-water pile driving, there is limited potential for these schedules to overlap. Further, at locations midway between two active pile driving projects, the sound exposure levels would be expected to increase during simultaneous pile driving activities. The threshold distances for permanent and temporary injury for sea turtles, as outlined for the Texas LNG Project in table 4.7.1-1, would not be expected to increase significantly in size. However, during simultaneous pile driving at all three LNG projects, the behavioral disturbance area for sea turtles would increase. In some cases the behavioral disturbance distances for the projects would overlap and would likely encompass much of the Brownsville Ship Channel. The anticipated cumulative impacts from underwater noise impacts are further discussed in section 4.13.2.12.

The greatest impact on sea turtles during concurrent pile driving would be limiting the available habitat for avoiding increased underwater noise levels. Sea turtles would be more likely to encounter behavioral and injury thresholds when avoiding pile driving associated with one project. For example, a sea turtle avoiding pile driving associated with the Rio Grande LNG Project could relocate near pile driving associated with the Texas LNG Project resulting in increased energy expenditure as well as increased potential for injury. Both the Annova LNG and Rio Grande LNG projects are anticipated to implement measures similar to Texas LNG, including limiting in-water pile driving to the minimum extent practicable, utilizing soft starts, utilizing mitigation measures such as bubble curtains or cushion blocks (see our recommendation in section 4.6.2.2), and consulting with NMFS regarding other measures that could be implemented.

In addition to impacts on sea turtles resulting from construction activities, increased vessel traffic associated with the LNG projects and the Port of Brownsville projects could also affect sea turtles in the area. Vessel strikes are a common cause of sea turtle mortality; however, it is anticipated that most vessels would adhere to the NMFS Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008). Further, the Brownsville Ship Channel is an active vessel transit route to the Port of Brownsville and receives over 1,000 ships per year (BND, 2017). Therefore, the increase in ship traffic could increase the likelihood of vessel strikes; however, this increase is not anticipated to be significant due to implementation of NMFS guidance.

Based on the size and proximity of the projects considered, as well as the overlapping construction schedules, a cumulative impact on sea turtles is anticipated to occur. All projects are subject to the requirements of the ESA and are thus required to consult with NMFS regarding potential impacts on sea turtles. Through this consultation process, the projects considered would be required to implement best management practices and/or other measures recommended by NMFS to minimize potential impacts on sea turtles. In some instances, such as the Brazos Island Harbor Channel Improvement Project, take of sea turtles may still be likely and NMFS would issue a take permit. In other cases, such as the Texas LNG Project, implementation of these measures may result in a determination that the project is not likely to adversely affect sea turtles. Individually, the projects considered are not anticipated to have significant impacts on sea turtles; however, the density and nature of activities potentially occurring within the area and at the same time would result in moderate cumulative impacts on resident sea turtles; however, these impacts are not anticipated to have population-level effects.

Marine Mammals

Other projects considered for cumulative impacts on marine mammals that are not otherwise listed as threatened or endangered (i.e., the whale species and West Indian manatee discussed above) are those that would conduct activities within or otherwise affect the Brownsville Ship Channel. Projects considered for impacts on marine mammals include the Rio Grande LNG Project, Annova LNG Project, VCP, Kingsville to Brownsville Pipeline, waterway improvement projects, and Port of Brownsville projects.

While there are several marine mammal species with potential to occur within the Brownsville Ship Channel, only bottlenose dolphins are considered common. Marine mammals are highly mobile and would likely avoid the Texas LNG Project area during construction. The greatest potential for impacts on marine mammals associated with the Project would be pile driving and increased potential for vessel strikes during construction and operation. Texas LNG would minimize impacts from pile driving on marine mammals by implementing measures such as limiting in water pile driving to the minimum extent practicable, utilizing soft starts, utilizing mitigation measures such as bubble curtains or cushion blocks (see our recommendation in section 4.6.2.2), and consulting with NMFS regarding other measures that could be implemented.

The Annova LNG and Rio Grande LNG projects are the only other projects anticipated to require pile driving, which could be concurrent with the pile driving activities associated with the Texas LNG Project. As discussed above for sea turtles, it is anticipated that these projects would implement similar measures to minimize impacts on marine mammals during pile driving. If concurrent pile driving were to occur, marine mammals in the area may have to travel greater distances to avoid underwater sound pressure levels that exceed the NMFS thresholds (see section 4.7.2.2). The anticipated cumulative impacts from underwater noise impacts are further discussed in section 4.13.2.12. However, because in-water pile driving associated with the Texas LNG Project would be limited to an estimated 12 days, cumulative impacts on marine mammals as a result of pile driving is anticipated to be minor.

Increased vessel traffic during construction and operation of the Texas LNG Project and other projects considered, would result in an increased potential for vessel strikes on marine mammals. Texas LNG has indicated that it would provide the NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) to all ship captains calling on the Texas LNG terminal and would advocate compliance with the measures identified in the guidance document to minimize the likelihood of vessel strikes. It is anticipated that vessels calling on other Port of Brownsville facilities, including the Annova LNG and Rio Grande LNG projects, would similarly advocate for compliance with NMFS' measures to minimize vessel strikes. In addition, the Brownsville Ship Channel is an active industrial channel that is regularly transited by vessels; therefore, it is assumed that marine mammals in the area are accustomed to their presence. Nevertheless, the three LNG projects would result in a 17 percent increase in ship traffic within the Brownsville Ship Channel during construction and 48 percent during operation, which would increase the likelihood of vessel strikes; therefore, cumulative impacts on marine mammals from increased vessel traffic is anticipated to be intermittent and minor.

4.13.2.9 Land Use, Recreation, and Visual Resources.

Land Use

The geographic scope for land use and recreation areas for the Texas LNG Project was determined to be Cameron County. The projects listed in table 4.13.1-1 would disturb thousands of additional acres of land affecting a variety of land uses. Large industrial projects identified in table 4.13.1-1 have the most potential to contribute to cumulative impacts on land use and recreation areas.

Projects with permanent aboveground components (e.g., buildings), wind energy projects, roads, and aboveground electrical transmission lines would generally have greater impacts on land use than the operational impacts of a pipeline, which would be buried and thus allow for most uses of the land following construction. Therefore, with the exception of aboveground facilities and the permanent right-of-way, pipeline projects typically only have temporary impacts on land use. The majority of long-term or permanent impacts on land use are associated with vegetation clearing and maintenance of the pipeline right-of-way.

As discussed in section 4.8, the Texas LNG Project would be located on a parcel owned by the BND that is zoned for industrial use. Nevertheless, the site is undeveloped and construction and operation of the Project would result in a conversion of the existing, non-industrial land use to industrial land. As a result, the Project site includes open land (46.8 percent), wetlands (0.5 percent), tidal flats (14.0 percent), scrub shrub (27.8 percent) and open water (10.9 percent). The nearest residences are located at least 1.6 miles away in Port Isabel and Laguna Heights, Texas.

Land use adjacent to the Project site includes open water as well as industrial/commercial use associated with the Brownsville Ship Channel to the south, State Highway 48 to the west and undeveloped land primarily consisting of tidal flats to the north and east. Recreational use of the area also occurs in the Laguna Atascosa and Lower Rio Grande Valley NWRs north and south of the site, respectively, the NPS-managed NHLs to the west and south, and various other parks and preserves to the east (see table 4.8.4-1). Recreation and special use areas are within the vicinity of the Project site are further discussed in section 4.8.4.

Where available, we used quantitative information to assess potential cumulative impacts on land use, as presented in table 4.13.2-1. Ongoing and recently completed projects, such as the San Roman Wind Farm (3,290 acres, of which 156 acres were disturbed during construction) and the Cameron Wind Farm (15,000 acres), have contributed to the conversion of the land in Cameron County to industrial use; however, given that the actual acreage of conversion within these facilities is minimal (i.e., the majority of land is still able to be used for agricultural purposes), contributions to cumulative impacts on land use from these projects would be permanent, but negligible, when considered with the total available land in Cameron County. Construction of the Highway 100 Wildlife Crossings occurred within and adjacent to an existing roadway; therefore, contributions to cumulative impacts from construction of these crossings would also be negligible. Larger transportation projects, such as the South Padre Island Second Access and the East Loop (SH 32) projects would have a greater impact on land use, as they would require the development of some previously undeveloped areas to roadways, rather than the modification of existing roads.

If the Annova LNG and Rio Grande LNG Projects are permitted and constructed, these projects would convert land in Cameron County from the current, undeveloped land use to industrial land. While cumulative impacts on land use would be permanent, these types of projects are consistent with BND's long-term plan for the Port of Brownsville and the Brownsville Ship Channel, which identifies the area as intended for heavy industrial use. Further, the Annova LNG and Rio Grande LNG projects, as FERC-jurisdictional projects, would be required to adhere to our Plan, modified as applicable for the specific projects, so as to minimize impacts on land use. In total, the three Brownsville LNG terminals (excludes the Rio Bravo Pipeline) would affect 1,950.9 acres of generally undeveloped land, including a mixture of vegetated (herbaceous or scrub shrub) and unvegetated land, 1,444.4 acres of which would be permanently converted to developed land. Further, the non-jurisdictional facilities associated with all three of the Brownsville LNG projects would total 1,021.1 acres (including an estimated

480 acres within Cameron County associated with the Kingsville to Brownsville Pipeline) and the Rio Bravo Pipeline would impact 511.2 acres in Cameron County. Although we do not have project-specific land use information for projects not under the jurisdiction of the FERC, we can estimate the total impact of each project based on the length of the project and industry standards on the right-of-way width for a given diameter pipeline. Assuming a construction right-of-way width of 125 and 150 feet, respectively, VCP would impact about 2,545.8 acres of land and the Cross Valley Project would impact about 1,745.7 acres of land, of which about 750.6 and 866.5 acres, respectively, would be in Cameron County. While the Texas LNG Project would be consistent with BND's long-term plan, construction and operation of this and other projects would result in permanent changes in land use and would contribute to a cumulative impact on land use in Cameron County.

The Texas LNG Project, if built at the same time as other current and foreseeable future projects, could result in cumulative impacts on recreation and special-interest areas if they affect the same areas or features at the same time. The Texas LNG Project site would be near several recreation and special interest areas, including the Lower Rio Grande Valley NWR, Laguna Atascosa NWR, and the Jamie J. Zapata Memorial Boat Ramp, among others (see table 4.8.4-1). Project impacts on these recreation areas vary based on distance from the Project site and proximity to LNG carrier transit routes. Recreation areas that are near the Texas LNG Project or along the LNG carrier transit routes would experience greater impact than those at greater distances from the Project site. Project impacts on each of the recreation areas within the vicinity of the Project site are further discussed in section 4.8.4.

Based on the information currently available for the other projects, the Annova LNG and Rio Grande LNG projects, and their associated pipelines and non-jurisdictional facilities could impact the recreation and special use areas that would be in proximity to the Texas LNG Project site. Construction of these projects at the same time and at locations near the Texas LNG Project site would result in short-term cumulative impacts on the recreation and special use areas. While, none of these recreation areas would be encumbered by the footprint of the Texas LNG Project or other projects considered, the noise and LNG carrier traffic associated with the operation of these facilities could result in permanent indirect impacts. However, given the existing inventory of recreation areas in Cameron County and their large geographic area with multiple access points, cumulative impacts on recreation would be minor.

In summary, the Texas LNG Project would result in temporary, short-term, and permanent impacts on existing land use and short-term and permanent impacts on recreation areas. If other projects in Cameron County are built at the same time as the Texas LNG Project, cumulative impacts on land use and recreation areas would be additive. However, certain projects such as the South Padre Island Beach Re-nourishment, the Highway 100 Wildlife Crossings, the Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor Project are focused on maintenance or enhancement of the natural environment; as such these projects may result in positive effects on land use and recreation in Cameron County. Overall, the cumulative impacts of the Project when considered with other projects would be short-term (during construction) to permanent (operation of the Project), and minor given the area of Cameron County (over 800,000 acres) and the large inventory of recreation areas with multiple access points. Further, the Texas LNG Project would be consistent with BND's long-term plan, which identifies the area as intended for heavy industrial use.

Visual Resources

The geographic scope of analysis for cumulative impacts on visual resources was considered to be areas within the viewshed of the LNG terminal. For the Texas LNG Project this was determined to be the distance at which the storage tanks and/or flares, which would be the tallest features at the LNG terminal site, would be visible from neighboring communities (about 12.5 miles). Projects with permanent aboveground components, such as the Annova and Rio Grande LNG terminals, have the most potential to contribute to cumulative impacts on visual resources.

As described above for land use, projects with permanent aboveground components (e.g., buildings), wind energy projects, roads, and aboveground electrical transmission lines would generally have greater impacts on visual resources than the operational impacts of a pipeline, which would be buried and thus allow for restoration of vegetative cover following construction. Therefore, with the exception of aboveground facilities and the permanent right-of-way, pipeline projects typically only have temporary to short-term impacts on the viewshed.

The area around the Project site is flat and relatively open with scattered scrub shrub vegetation. As described in section 4.9.6.2, the Port of Brownsville and the Brownsville Ship Channel support the shipping of domestic and foreign products; therefore, the movement of these vessels contributes to the characterization of the existing viewshed. Visual receptors in the vicinity of the Project site include recreational and commercial users of the Brownsville Ship Channel. Land-based visual receptors would include motorists on State Highway 48, visitors to the Laguna Atascosa and Lower Rio Grande Valley NWRs, and other nearby recreation areas, as discussed above.

The most prominent visual feature at the Texas LNG terminal would be the two LNG storage tanks, which would be 290 feet wide and 190 feet in height, and the main flare, which would be 315 feet in height. To determine how visible the LNG terminal would be from various vantage points, Texas LNG conducted visual simulations from eight key observation points, including SH 48 (Laguna Atascosa NWR), Port Isabel State Historic Site, Isla Blanca Park, Palo Alto Battlefield NHP, and Palmito Ranch Battlefield NHL in response to concerns raised by the NPS. These key observation points ranged from as close as 200 feet to as far away as 15.0 miles from the Project site. Based on these simulations and our evaluation of other sources and maps, we determined that the Texas LNG terminal would be most visible from the Isla Blanca Park and SH 48 key observation points. Using this information, we determined that the visually sensitive resources in the Project area that would be most affected by the Texas LNG terminal would be the Loma Ecological Preserve, South Bay Coastal Preserve and South Bay Paddling Trail, SH 48, and the Laguna Atascosa NWR (see section 4.8.5). Palmito Ranch Battlefield NHL would also be affected, as the Texas LNG terminal would be clearly visible. From the other six key observation points the Texas LNG terminal would be difficult to see, obscured in part or whole by existing vegetation, or appear as an undiscernible feature on the horizon. However, wildfire, road widening or other actions may remove the vegetative screen making the project clearly visible. Therefore, the projects that have the greatest potential to contribute to cumulative visual impacts would be within about 3.0 miles of the Texas LNG terminal, these would include the Annova LNG and Rio Grande LNG projects and associated pipelines and non-jurisdictional facilities, the non-jurisdictional facilities associated with the Texas LNG Project, and the waterway improvement projects.

The visual impacts associated with waterway improvement projects would be limited to short-term impacts during active dredging and construction; similarly, contributions from the proposed new pipeline projects would be limited to the period of active construction. Therefore, contributions to cumulative impacts from these projects would be negligible.

Given the Project site's proximity to residential areas, it may be possible to see the LNG terminal from certain vantage points in Port Isabel and Laguna Heights, in particular elevated sites such as the Port Isabel Lighthouse. South Padre Island, in particular, has numerous high rise condominiums that would have views of the Project facilities, especially from the higher floors. However, as discussed in section 4.8.5, the distance to the LNG terminal site limits its visibility and as such it would not be a prominent feature in the viewshed for these residences.

The potential for cumulative visual impacts would be greatest if, in addition to the Texas LNG Project, the Annova LNG and Rio Grande LNG projects are permitted and built concurrently. In particular, motorists on SH 48 and visitors to the nearby recreation areas where two or three LNG Terminals would be visible (including the NWRs, Loma Ecological Preserve, and South Bay Coastal Preserve and South Bay Paddling Trail) would experience a permanent change in the existing viewshed during construction and operation of the projects.

Short-term impacts during construction would include the presence of equipment and workers, the increase in construction related traffic (on land and in the Brownsville Ship Channel), and the installation of large structures at the terminal sites. For land and water-based mobile receptors this impact would be short-term, lasting only the duration of time for the vehicle or vessel to pass the site. Texas LNG has not proposed any mitigation to the visual impacts associated with the Project; however, the Rio Grande LNG Project would minimize impacts on visual resources by constructing a levee around the LNG terminal site that, once complete, would obstruct most construction activities.

Following construction permanent changes to the visual character of the area would result from the operation of the terminals due to the presence of aboveground structures. While Texas LNG and Annova LNG have not proposed any measures for visual screening of the respective LNG terminals during operation, Rio Grande LNG would implement visual screening measures. Rio Grande LNG would minimize impacts on visual resources by the use of ground flares, strategic selection of color schemes for the storage tanks, horticultural plantings, and a levee that would obstruct low-to-ground operational facilities from view.

The Texas LNG Project would result in temporary, short-term, and permanent impacts on the viewshed. If other Projects are constructed at the same time as the Texas LNG Project, cumulative impacts on the viewshed would occur as a result of large construction equipment, such as cranes. The Texas LNG terminal would result in a permanent change in the existing viewshed for nearby visual receptors. Due to the relatively undeveloped nature of the Project area, the visual sensitivity of nearby recreation areas, and the inability to implement visual screening measures for the Texas LNG and Annova LNG Projects, cumulative impacts on visual resources, especial visually sensitive areas such as the Laguna Atascosa NWR, would be significant.

4.13.2.10 Socioeconomics

The geographic scope for the assessment of cumulative impacts for the Project on socioeconomic resources includes Cameron County where the majority of the Project workforce is anticipated to reside. While many of the projects listed in table 4.13.1-1 have the potential to contribute to cumulative impacts on socioeconomic resources within the geographic scope of assessment, these impacts would be greatest during concurrent construction of projects with large construction workforces, such as the Annova LNG and Rio Grande LNG projects.

Population and Employment

Texas LNG anticipates initiating Project construction in 2019. Construction would occur over a five-year period (under the Peak Impact Scenario, as discussed in section 4.9) and construction workers would be on site throughout the duration. The average monthly construction workforce during this period would be 700 workers, of which 140 would be non-local workers (20 percent). During peak construction, the workforce would be about 1,312 workers (assuming construction of both Phases), of which up to 262 would be non-local workers (20 percent). If 20 percent of the non-local workers were accompanied by family members, this would represent a 0.2 percent increase in population in Cameron County. Operation of both phases of the Project would result in the creation of 110 permanent positions (see section 4.9).

Several of the projects listed in table 4.13.1-1 would also require construction workers during the same period as the Texas LNG Project, most notably the Annova LNG and Rio Grande LNG Projects. If these projects were constructed concurrently, the construction labor requirements would be highest where peak construction workforce periods overlap. Based on the average construction workforce, these projects would be expected to employ an average of over 4,350 construction workers in total, and at peak construction the combined workforces would be about 7,737 workers. Following construction, the three Brownsville LNG projects would result in the addition of 545 or more permanent jobs. In addition to this direct employment, the projects would likely result in increased indirect employment based on the purchases of goods and services. Texas LNG estimates that about $186 million would be spent on direct expenditures for materials and payroll within the Project area; collectively, the three Brownsville LNG projects would spend an estimated $4.9 billion on direct expenditures. These expenditures and workforce associated with construction and operation of the LNG terminals would result in cumulative positive, short-term and permanent impacts on the local economy.

Other projects identified in table 4.13.1-1 would likely have staggered timelines for specific labor needs, so some construction personnel working within the geographic scope may be able to support multiple projects. This would have a cumulative effect of decreasing the overall labor force required to meet the needs for all projects; however, based on the size and types of these other projects, as well as the temporary nature of construction, the overall impact would likely be negligible. Finally, some of the projects identified in table 4.13.1-1 may not be permitted and/or built, which would reduce the total labor need within the geographic scope of analysis.

The Texas LNG Project would reduce unemployment in the Project area and potentially could result in the need to train and hire construction workers from outside the Project area. Positive benefits from the new jobs and workers in the area would include increasing revenue for local business owners, and generating new tax revenue in the geographic scope of analysis. Expenditures and the workforce required for construction of the Texas LNG Project, in combination with other projects in the geographic scope, would result in temporary cumulative impacts during the construction period. Operation of the Project and other projects would result in a minor, permanent impact on the local economy and construction workforce.

Housing and Public Services

The influx of non-local workers associated with construction of the Texas LNG Project would affect the availability of housing in Cameron County. The cumulative impact on local housing may result in increased rental rates and housing shortages for lodging if all of the proposed and planned projects in the geographic scope of analysis are implemented according to the expected timeframes. This would benefit the local housing market, but would adversely affect those seeking housing.

The anticipated peak, construction workforce for the Texas LNG Project (1,312 workers) is estimated to occupy less than 1 percent of the available housing in Cameron County throughout the duration of construction (see section 4.9.4). Based on our understanding, the Annova LNG and Rio Grande LNG projects proponents have identified different geographic areas from which the respective local workforces would be sourced or where individuals would likely relocate during construction. The workforces for the Annova LNG and Rio Grande LNG projects would be primarily based out of the Willacy, Cameron, and Hidalgo Counties, Texas, and thus would not result in significant cumulative impacts on any single community.

The combined construction workforces for the projects identified in table 4.13.1-1 would increase the need for some public services, such as police, medical services, and schools. The majority of the impacts would be concentrated in Cameron County; however, some of the Rio Grande LNG Project workforce is anticipated to reside in Willacy and Hidalgo Counties, thus distributing the increased need for these services associated with the Rio Grande LNG Project throughout three counties. Similarly, a portion of the Annova LNG workforce is anticipated to reside in Willacy County. Texas LNG would work closely with emergency service providers to ensure that individuals are trained to provide the necessary support and have appropriate equipment available during both construction and operation of the Project. In addition Texas LNG and the other LNG projects would develop a Cost Sharing Plan to ensure adequate funding is available for the training and coordination with emergency service providers.

With construction of the three Brownsville LNG projects lasting several years, it is likely that some non-local construction workers would relocate to the area with their families, including school age children. This would increase the population in some schools where the non-local workers reside. However, it is likely that those families would be housed throughout many school districts in various counties and the increase in school population would be distributed through many schools.

Based on the number of available rental units and motels/hotels in Project area, it is anticipated that there would be sufficient housing available for the anticipated peak Project workforce for the Texas LNG Project. While the other LNG projects may be constructed concurrently with the Texas LNG Project, non-local workers for these projects are expected to find housing in Cameron County, as well as different areas, including Willacy and Hidalgo Counties. Similarly, the increased need for public services and school enrollment to support non-local workers and their families for the Texas LNG Project and other projects would be spread across the geographic scope. Further, with the expected increase in local taxes and government revenue associated with the proposed projects, we conclude that cumulative impacts on available housing and public services during construction of the Project would be temporary and minor. Operation of the Texas LNG Project would require 110 new full-time workers and would, with other projects in the vicinity, contribute to minor cumulative impacts on housing resources and public services.

Land Transportation

The greatest potential for cumulative impacts on roadway traffic would be associated with construction of the Texas LNG Project. During construction and operation of the Texas LNG Project as well as the other projects described above and identified in table 4.13.1-1, roadways in the area would experience a substantial increase in daily vehicle trips as a result of material and equipment deliveries and commuting of construction personnel to and from the Project site. Due to staggered construction schedules and the distance between the project sites for other projects identified in table 4.13.1-1, cumulative impacts on traffic from these projects that are not located adjacent to the Brownsville Ship Channel may be substantial at times, but are expected to be intermittent, short-term, and localized. Traffic volumes and analysis is only available for the other FERC-regulated projects, including the Rio Grande LNG Project and the Annova LNG Project; therefore, our analysis of cumulative impacts on roadway traffic is focused on projects for which quantitative data is available.

All three of the currently proposed Brownsville LNG facilities adjacent to and within the Brownsville Ship Channel could be constructed concurrently if they receive the necessary regulatory approvals. The project proponents for these LNG facilities commissioned traffic impact assessments to assess potential impacts of vehicular traffic associated with both construction and operation of the three projects, and to develop measures to mitigate impacts on local users of area roadways (Aldana Engineering and Traffic Design, LLC 2016). As discussed in section 4.9.6.1, the Project site would be access via two driveways off of SH 48.

Construction traffic associated with the Annova LNG Project is expected to primarily use SH 4, and would not contribute to cumulative impacts on SH 48 with the Texas LNG Project. However, the Rio Grande LNG Project site is also proposed along SH 48 near the Texas LNG Project site and concurrent construction would result in a cumulative traffic increase. Texas LNG anticipates that an estimated 1,454 vehicles would arrive and depart the facility per day during peak construction. Rio Grande LNG anticipates 9,500 vehicle departures/arrivals during peak construction, including truck deliveries and worker vehicles.

Texas LNG anticipates that the proposed southern driveway would generate approximately 300 right turn (northbound) movements during peak times, exceeding the threshold for needing an auxiliary lane (see section 4.9.6.1). Therefore, the traffic impact assessment recommends that an auxiliary lane with deceleration, storage, and taper be constructed at the SH 48 northbound approach to the southern driveway at the Project site. Further, the study states that the auxiliary lane should be continued approximately 1,100 feet north of the northern proposed driveway to provide for acceleration with storage and taper.

Similarly, the traffic impact assessment conducted for the Rio Grande LNG Project found that the existing roadway network which would provide access to the LNG Terminal (SH 48 between SH 550 and SH 100) has sufficient capacity to accommodate the expected peak hour traffic volumes associated with construction of the Rio Grande LNG Project. However, some improvements would be necessary to safely accommodate peak hour traffic flows, including auxiliary lanes similar to those recommended for the Texas LNG Project. Rio Grande LNG and Texas LNG have also committed to hiring off-duty police officers or flagmen to direct traffic during peak commuting hours and would provide off-site parking for construction personnel.

Operation of the Texas LNG Project would result in an average of 65 roundtrips to the site per day associated with worker commutes and truck deliveries. The traffic impact analysis determined SH 48 would continue to provide ample capacity with this minor increase in traffic (Aldana Engineering and Traffic Design, LLC, 2016). Operation of the Rio Grande LNG Project, which is also accessed by SH 48, would also contribute to an increase in traffic on that roadway (300 roundtrips per day).

If the Texas LNG and Rio Grande LNG projects were constructed concurrently, the combined impact of construction traffic would be approximately 10,954 daily trips during active construction. This cumulative impact would result in increased wait times and congestion on local roadways. Wait times and congestion would return to near preconstruction conditions during operation of the projects. The Texas LNG Project accounts for approximately 13 percent of the estimated increase in vehicle trips during construction.

Based on the results of the commissioned traffic studies for the Texas LNG Project and the other Brownsville LNG projects, in conjunction with Texas LNG's and Rio Grande LNG's proposed roadway improvements, the projects would contribute to a moderate cumulative impact on roadways during the construction period (Peak Impact Scenario). The Texas LNG Project and Rio Grande LNG Project would contribute to a permanent, but minor impact on SH 48 during operations, as only a small number of new permanent employees would be required to operate the Texas LNG terminal.

Marine Transportation

Current vessel traffic in the Brownsville Ship Channel is about 1,057 vessels per year, which equates to an average of about 88 vessels per month, including 61 barges (Port of Brownsville 2015b). Texas LNG estimates that 109 barge deliveries would occur during construction period for the Texas LNG Project to supplement truck transport of construction materials. When combined with deliveries associated with construction of the Annova LNG and Rio Grande LNG projects, 144 and 880 respectively, this would result in an anticipated

17 percent annual increase in ship traffic within the Brownsville Ship Channel. This increase in ship traffic in combination with other projects, for which the number of deliveries is not publicly known, would noticeably increase the number of barges transiting the channel. Impacts on other users of the waterway from barge traffic associated with construction would be consistent with existing use of the waterway.

Texas LNG estimates that during operation, up to 74 LNG carriers would call on the LNG terminal per year during operation of both Phase 1 and Phase 2; about 125 and 312 vessels per year would call on the Annova LNG and Rio Grande LNG terminals, respectively, resulting in a 48 percent increase in vessels transiting the Brownsville Ship Channel annually. Texas LNG anticipates that LNG carriers would take 1 to 1.5 hours to reach the LNG terminal from the entrance to the Brownsville Ship Channel (up to 3 hours round-trip). On average, approximately six LNG carriers would call on the Texas LNG terminal each month; therefore, LNG carriers calling at the Texas LNG terminal would be transiting in the Brownsville Ship Channel for a combined duration of 18 hours per month. This is a relatively minor addition to the average ship traffic and transit times of vessels currently operating in the Brownsville Ship Channel. However, because large vessel traffic in the Brownsville Ship Channel is one-way, and LNG vessels are subject to a moving security zone during transit, LNG vessels in transit to the Rio Grande LNG, Annova LNG, and Texas LNG projects could cumulatively preclude other vessel traffic up to 40 hours per week. The LNG vessels calling at the Annova LNG and Rio Grande LNG terminals would be subject to similar requirements. To minimize impacts on other users of the Brownsville Ship Channel, it is anticipated that vessels would follow required mandates put forth in the LNG Terminal Manual, including the requirement to notify LNG terminal managers and relevant authorities of the expected arrival of an LNG vessel four days in advance to ensure that the timing of LNG vessel channel transits are aligned with other shipping schedules. Further, all three LNG projects have received LORs from the Coast Guard confirming that the Brownsville Ship Channel is suitable for the anticipated volume of LNG carriers associated with each project, as well as the anticipated volume for all three projects combined.

As previously described, construction of the Texas LNG Project and other projects are likely to temporarily increase barge and support vessel traffic in the Brownsville Ship Channel. Concurrent construction of the Texas LNG Project and other projects considered would likely result in a cumulative impact on vessel traffic in the waterway, primarily by increasing vessel travel times due to congestion. During operations, LNG vessels calling on the LNG terminal and other LNG facilities along the Brownsville Ship Channel would have moving security zones that could preclude other vessels from transiting the waterway. Mandates for prior notice of expected arrivals would minimize impacts on other vessels. As a result, we conclude that there would be a moderate cumulative impact on vessel traffic in the Brownsville Ship Channel during construction and operation of the Texas LNG Project.

Environmental Justice

In section 4.9.8, we present the minority and low-income population percentages in the State of Texas, Cameron County, and the corresponding census blocks groups (tables 4.9.8-1 and 4.9.8-2). This analysis found that minority populations and low income communities, as defined per the EPA guidelines, are present in the geographic scope and may be subject to cumulative impacts from the Texas LNG Project and other projects considered. The geographic scope for the assessment of cumulative impacts on socioeconomic indicators was defined as Cameron County. However, we specifically evaluated environmental justice communities within 2 miles of the Texas LNG Project site, to provide an overview of potential cumulative impacts on these communities.

As discussed in section 4.9.8, the nearest residential areas associated with environmental justice communities are about 1.8 miles from the Texas LNG Project site. As such, impacts on the human environment from construction of the Texas LNG Project would consist of traffic delays, increased enrollment at public schools, increased noise (primarily during construction), and displacement of recreational fishermen and other visitors to the public use areas near the Project site. These impacts would be minor and short-term, with the greatest impacts primarily occurring during construction.

Several of the projects listed in table 4.13.1-1 could contribute to potential impacts on minority populations and low income communities, most notably the Annova LNG and Rio Grande LNG Projects. Contractors working on these projects would be required to comply with applicable equal opportunity and non-discrimination laws and policies. The criteria for all positions would be based upon qualifications and in accordance with applicable, federal, state, and local employment laws and policies. Like the Texas LNG Project, tax revenues generated from construction of these projects could be used to offset impacts on public schools and infrastructure.

Potential air pollutant emissions from operation of the Texas LNG Project would be below the threshold for unhealthy air quality. Other projects that are permitted and built would be held to the same air quality standards. Therefore, the Texas LNG Project's contribution to cumulative impacts on the low-income or minority populations in the Project area would be limited to minor and temporary traffic delays and potential impacts on public schools during construction.

FERC and Texas LNG have issued documents and notices about the Project available to the public. FERC held public scoping meetings, as described in section 1.3, during which materials were provided in both English and Spanish to accommodate the local Hispanic and Latino population. In addition, during the public scoping meeting in Port Isabel for the Rio Grande LNG, Annova, and Texas LNG projects, both English and Spanish-speakers were present to converse one-on-one with stakeholders in attendance. While environmental justice communities have been identified within the geographic scope for the Texas LNG Project, the Project impacts discussed in this EIS such as traffic delays during construction, impediment of fishing/recreational opportunities at discrete locations, constraints on public services, and impacts on air quality and noise would be the same for all communities, regardless of race or income. Therefore the Texas LNG Project is not expected to contribute to cumulative disproportionate, adverse effects on minority and low-income residents in the area.

4.13.2.11 Cultural Resources

The geographic scope for cumulative impacts on cultural resources was determined to be the Texas LNG Project APE. While there are several other projects that occur within this area, as indicated on figure 4.13.1-1, the only cultural resource site that is present in this area and would be affected by the Texas LNG Project is Site 41CF8. As discussed in section 4.10, this site would be adversely affected by the Project and Texas LNG would implement a treatment plan, in coordination with THC and ACHP to recover and document artifacts associated with the site. Because the Texas LNG Project would result in the removal of Site 41CF8, no cumulative impacts from other projects in the area would occur.

Based on consultations with the NPS on the Palmito Ranch Battlefield NHL and the Palo Alto Battlefield NHL and NHP, Texas LNG examined potential visual impacts from the Project on these areas. Visual simulations created from points in proximity to the battlefields represent visitors' views of the battlefields. As described in section 4.8.5, nighttime and daytime visual impacts on the Palmito Ranch Battlefield NHL at three KOPs would vary from minor to moderate. The Project facilities would be at least partially visible but not prominent at any of the Palmito Ranch Battlefield NHL KOPs to varying degrees of distance, partial screening, and foreground vegetation. The other two LNG projects (Annova LNG and Rio Grande LNG) would also be visible from KOP 3, KOP 4 and KOP 5; however, based on distance and direction it is anticipated that the Texas LNG facilities when viewed from KOP 3 would be obscured by the Annova LNG and/or Rio Grande LNG Projects.

Texas LNG also examined visual impacts on the Palo Alto Battlefield NHL and NHP at two key observation points. The Texas LNG Project facilities would either not be visible or would be barely visible on the horizon at these locations (see section 4.8.5). Based on distance, direction, and existing vegetation buffers the Texas LNG Project would not contribute to cumulative impacts on the Palo Alto Battlefield NHL and NHP.

4.13.2.12 Air Quality and Noise

Air Quality

<u>Construction</u>

The geographic scope for assessment of cumulative impacts on air quality during construction of the proposed Texas LNG Project is the area within 0.5 mile of the LNG Terminal, because construction emissions would be highly localized; however, the Annova LNG Project was also included due to the size of the Project and comments we received during the scoping period.[55] The projects within the construction geographic scope that are most likely to contribute to cumulative air impacts include the Annova LNG and Rio Grande LNG projects, non-jurisdictional facilities associated with the Texas LNG Project, and waterway improvement projects within the Brownsville Ship Channel.

Construction of the Texas LNG terminal would affect air quality due to emissions from combustion engines used to power construction equipment, vehicle emissions travelling to- and from the LNG Terminal site, marine deliveries of construction materials, and fugitive dust resulting from earth-disturbing activities and equipment movement on dirt roads.

[55] Although the typical construction geographic scope for air quality is 0.25 mile, we expand this on a case-by-case basis for large projects like LNG terminal.

Air emissions from projects in the vicinity of the Project would be additive. Because construction emissions would be temporary and limited to the construction period, standard EPA emission thresholds do not apply. General Conformity applicability thresholds do not apply at the LNG terminal site because the Project area is in attainment for all the NAAQS. Table 4.13.2-2 estimates the total cumulative emissions from concurrent construction of the Texas LNG, Rio Grande LNG, and Annova LNG projects. While construction emissions estimates from non-jurisdictional projects and waterway improvement projects within the Brownsville Ship Channel are not available, based on the intermittent and short-term nature of construction, these Projects would have a minor impact on cumulative air emissions when considered with the proposed LNG terminals in the Project vicinity.

Cumulative impacts from construction would be limited to the duration of the construction period. However, with other Projects in the vicinity, construction of the Texas LNG Project would contribute to localized elevated emissions near construction areas during the period(s) when construction of these activities would overlap. Due to the magnitude of the combined emissions, the greatest potential for cumulative impacts would be during Years 3 and 4 (see table 4.13.2-2). When compared with the EPA's most recently available national emissions inventory data, cumulative construction emissions of NOx, SO_2, PM_{10}, and $PM_{2.5}$, would represent greater than 5 percent of the 2014 inventory emissions levels (about 7.5, 52.4, 18.9, and 11.9 percent, respectively). The EPA's national emissions inventory data include estimated emissions from on- and off-road mobile sources (vehicle travel), point sources (such as electric power generation facilities), and nonpoint sources (stationary sources that are individually small and numerous, such as residential heating and commercial marine vessels [EPA 2014]). Previous national emissions inventories conducted in 2008 and 2011 documented greater total emissions for criteria pollutants than the 2014 data; however, we have presented data from 2014 as a conservative estimate and to present the most recent inventory data. Further, since the 2014 emissions inventory, economic growth in Cameron County may have resulted in increased air emissions. Given the high level of construction emissions estimated for the three LNG terminals relative to the most recently inventoried emissions in the Project area, simultaneous construction of these projects could result in a temporary, moderate to major increase in emissions of criteria pollutants during construction. Construction emissions are localized, and impacts would be greatest in the immediate vicinity of the LNG terminal sites. Texas LNG, Rio Grande LNG, and Annova LNG would implement mitigation measures to minimize construction impacts on air quality, including application of water to minimize fugitive dust, limit engine idling, and using recent models of construction equipment manufactured to meet air quality standards (as discussed in section 4.11.1).

TABLE 4.13.2-2

Estimated Construction Emissions for the Brownsville Area LNG Projects (tons per year) [a,b]

Facility and Year	NO_x	CO	SO_2	PM_{10}	$PM_{2.5}$	VOC	CO_2e
Rio Grande LNG Terminal							
Year 1	12.0	18.6	2.0	589.4	60	0.7	653.8
Year 2	69.7	111.4	11.8	1,199.5	125.8	4.2	9,711.0
Year 3	127.8	174.3	23.5	1,146.6	125.8	6.4	15,835.2
Year 4	59.3	118.5	10.6	91.4	14.2	3.6	9,046.0
Year 5	45.0	106.7	8.0	56.1	9.2	2.9	7,532.0

TABLE 4.13.2-2 Estimated Construction Emissions for the Brownsville Area LNG Projects (tons per year) [a,b]							
Facility and Year	**NO_x**	**CO**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**VOC**	**CO_2e**
Year 6	39.0	70.2	7.1	26.9	5.8	2.1	6,310.0
Year 7	1.2	10.4	<0.1	13.9	1.4	0.1	1,054.0
Year 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.8
Annova LNG							
Year 1	23	40	0.04	293	30	2.6	7,802
Year 2	172	220	0.3	158	25	22	56,316
Year 3	152	224	0.25	126	21	17	44,492
Year 4	131	202	0.22	65	14	13	39,619
Year 5	50	86	0.08	59	8	6	15,025
Texas LNG							
Year 1	63.4	36.5	4.3	180.7	29.2	4.1	8,879.6
Year 2	284.9	164.4	19.2	812.9	131.0	18.4	39,939.6
Year 3	397.9	229.6	26.8	1,135.3	183.0	25.7	55,782.8
Year 4	243.3	140.4	16.4	694.4	111.9	15.7	34,118.2
Year 5	31.9	18.4	2.2	91.1	14.7	2.1	4,476.6
Total Annual Construction Emissions							
Year 1	98.4	95.1	6.34	1,063.1	119.2	7.4	17,335.4
Year 2	526.6	495.8	31.3	2,170.4	281.8	44.6	105,966.6
Year 3	677.7	627.9	50.55	2,407.9	329.8	49.1	116,110
Year 4	433.6	460.9	27.22	850.8	140.1	32.3	82,783.2
Year 5	126.9	211.1	10.28	206.2	31.9	11	27,033.6
Year 6	39	70.2	7.1	26.9	5.8	2.1	6,310
Year 7	1.2	10.4	<0.1	13.9	1.4	0.1	1,054
Year 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.8
EPA National Emissions Inventory, Cameron County [c]							
2008	9,366.2	52,511.8	107.0	32,165.8	4,371.8	28,884.9	--[d]
2011	9,101.9	52,167.4	217.1	21,988.4	3,167.0	30,044.6	--[d]
2014	7,864.3	43,352.9	82.0	11,023.3	2,340.3	24,701.4	--[d]

a Emissions estimates include construction emissions from on- and off-road vehicle activity, truck deliveries, vessel activity, worker commutes, and fugitive dust.

b Rio Grande LNG estimated annual fugitive emissions from use of the temporary haul road; to estimate annual construction emissions, the total fugitive emissions were included for Year 1, Year 2, and Year 3. In Year 1, given that construction would not commence until about 6 months into the year, annual estimated fugitive emissions from the haul road were assumed to be half of those estimated for Year 2 and Year 3.

c Due to refinements and modifications in the methods used to compile each inventory, the inventory results should not be used to describe year-to-year emissions trends.

d Given that CO_2 is not provided for all source categories in the emissions inventory data, and methane is not tracked, no value is presented here.

Further, transport of construction materials associated with the Project could occur within the HGB area, which is a marginal nonattainment area for the 2008 8-hour ozone standard. Similarly, the Annova LNG and Rio Grande LNG projects would also receive deliveries of construction materials originating from or being transported through the HGB area. Although cumulative emissions are not subject to General Conformity, the cumulative construction emissions from the Texas LNG, Rio Grande LNG, and Annova LNG projects occurring within the HGB area would not be expected to result in an exceedance of applicable general conformity thresholds for the HGB area.

Operation

Cumulative impacts associated with the operation of the LNG terminals are evaluated according to the significant impact area of the proposed facilities, determined through a significant impact modeling assessment. Projects that are most likely to result in and contribute to cumulative air impacts with operation of the Texas LNG terminal include the Annova LNG Project, the Rio Grande LNG Project, non-jurisdictional facilities associated with the Brownsville LNG Projects, Port of Brownsville Projects, and waterway improvement projects.

Air pollutant emissions during operation of the Texas LNG terminal would result from operation of the various components of the LNG terminal, marine traffic, and vehicles driven by personnel commuting to and from the site. The region in the vicinity of the LNG terminal is currently in attainment with the NAAQS; however, increases in industrial point sources could affect local and regional air quality.

The Annova LNG and Rio Grande LNG terminals have the greatest potential to contribute to cumulative impacts on air quality with the proposed Texas LNG terminal, given the proximity and similar operations of the projects. Emissions from currently operational facilities, such as the Brownsville Liquids Terminal and Port of Brownsville Marine Cargo Dock 16 and Storage Yard, are captured in ambient air quality monitoring data. While estimates of construction emissions from non-jurisdictional projects and waterway improvement projects within the Brownsville Ship Channel are not available, based on the intermittent and short-term nature of construction and lack of operation emissions, these Projects would have a negligible impact on cumulative air emissions if they are concurrent with operations of the proposed Texas LNG Terminal.

We assessed the air dispersion modeling results provided for the Texas LNG, Rio Grande LNG, and Annova LNG terminals and used these models to estimate the cumulative air emissions during concurrent operation at all three facilities. Appendix F describes the methods used to conduct the cumulative assessment and provides the results of our analysis, including figures depicting the cumulative concentrations of each criteria air pollutant assessed (figures F-1 through F-8 in appendix F). Table 4.13.2-3, below, totals the modeled ambient pollutant concentrations for the Brownsville area LNG Terminals operating during full build-out, including LNG carriers and support vessels operating during LNG loading and unloading at the Terminal sites. The estimated cumulative peak concentration is based on combining the predicted concentrations from each project at each receptor location regardless of the time when each concentration occurs. Since the timing and location of the maximum predicted impacts from each terminal would differ, and because it is unlikely that all three terminals would be loading LNG vessels simultaneously, the method used to develop the peak cumulative concentrations is conservative.

Peak estimated concentration for criteria pollutants and averaging periods were compared to the NAAQS, which represent standardized air quality criteria and were therefore used as a benchmark for comparison against model results. For all pollutants, except for 1-hour NO_2, cumulative impacts are predicted to be below the NAAQS and would disperse before reaching population centers in Port Isabel and Laguna Heights (see appendix F). For 1-hour NO_2, the predicted maximum cumulative impact is estimated to exceed the short-term NAAQS of

188 µg/m^3. The predicted peak cumulative impact, however, is located between the fence lines of the Rio Grande LNG and Texas LNG terminals. It is unlikely, but possible, that people may be exposed to the NO_2 concentrations above the 1-hour NAAQS, which would occur on property within the Port of Brownsville (see appendix F and figure 4.13.2-1 below). Concentrations of 1-hour NO_2 in residential areas in Port Isabel and Laguna Heights are estimated to be below 75 µg/m^3, which is well below the 1-hour NAAQS. While concurrent maximum operations of the LNG facilities would result in increased concentrations of air pollutants in the immediate vicinity of the facilities, the projects emissions are not expected to result in a significant impact on regional air quality, nor would any exceedance of the NAAQS occur in a populated area.

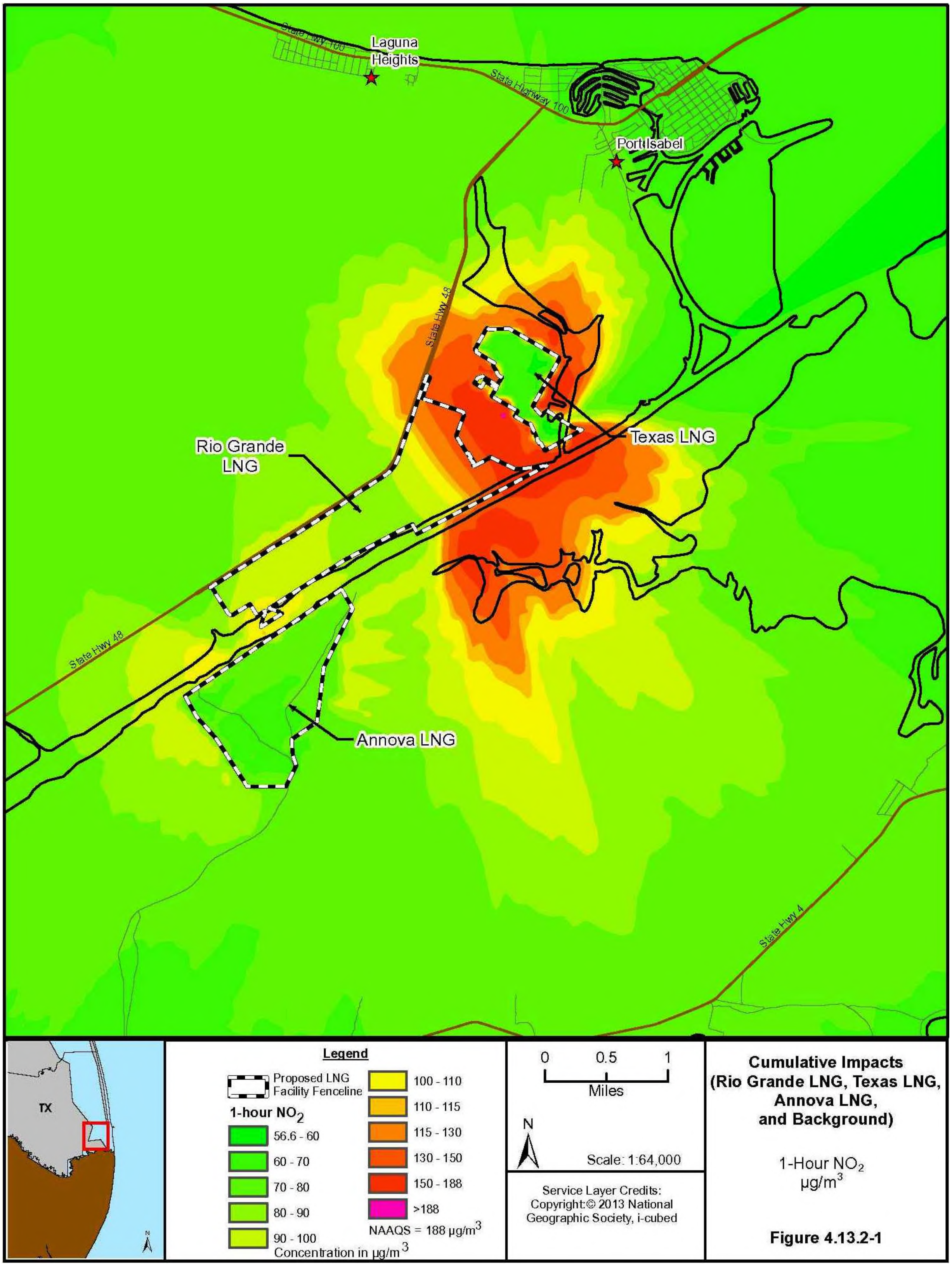

FIGURE 4.13.2-1 Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background Concentrations), 1-Hour NO_2

TABLE 4.13.2-3							
Peak Concentrations Estimated in Cumulative Air Dispersion Modeling for Stationary Source and LNG Vessels for the Brownsville Area LNG Projects							
Criteria Air Pollutant	**Averaging Period**	**Background Concentration [a] (μg/m^3)**	**Peak Concentration based on Modeled Results (μg/m^3) [b]**				**NAAQS (μg/m^3)**
			Rio Grande LNG Terminal	**Annova LNG**	**Texas LNG**	**Peak Cumulative Concentration [c]**	
CO	1-hour	2,175.5	276.1	247.9	470.6	2,746	40,000
	8-hour	1,259.5	174.0	101.7	83.4	1,453	10,000
NO_2	1-hour	49.9	78.9	39.3	134.7	196	188
	Annual	6.1	2.7	0.5	1.8	9	100
SO_2	1-hour	10.6	2.0	3.8	10.3	23	196
PM_{10}	24-hour	62.0	1.4	0.7	2.3	64	150
$PM_{2.5}$	24-hour	22.9	1.3	0.7	2.0	25	35
	Annual	9.1	0.3	0.1	0.1	9	12

a Background concentrations retrieved from Tables 4-1 and 4-2 of dispersion modeling report provided for the Texas LNG Project (available on FERC's eLibrary website, located at http://www.ferc.gov/docs-filing/elibrary.asp, by searching Docket Number CP16-116-000 and accession numbers 20170928-5165).

b Modeled impacts include stationary sources and LNG vessels at the LNG terminal sites.

c Peak concentrations predicted for each of the three projects for each receptor location were conservatively combined without regard to day or time of occurrence, and include background concentrations. The peak cumulative concentration for each pollutant and averaging period does not equal the sum of the peak concentrations for each terminal and background, since peak concentrations associated with each terminal occur at different locations.

In addition to operation of the LNG terminal and the vessel emissions described in section 4.11.1.3, air emissions from LNG vessels, considered mobile sources of air emissions, would occur along the entire LNG vessel route during operations. These emissions would be cumulative with the other ships using the ship channel. These mobile sources would be transitory in nature and emissions would occur over a large area, however the cumulative ship emissions would result in long term elevated emissions for the area.

Conclusion

In summary, the Texas LNG Project would result in impacts on air quality during construction and long-term impacts during operations. Cumulative impacts from construction would be limited to the duration of the construction period. However, with other Projects in the vicinity, construction of the Texas LNG Project would contribute to localized moderate elevated emissions near construction areas during the period(s) when construction of these activities would overlap. Operational air emissions from the Texas LNG Project would contribute to cumulative emissions with other projects in the geographic scope, and would be required to comply with applicable air quality regulations. Overall, impacts from the Texas LNG Project along with the other facilities would cause elevated levels of air contaminants in the area and a potential exceedance of the 1-hour NO_2 NAAQS in an uninhabited area between the facilities.

Therefore, cumulative impacts on regional air quality as a result of the operation of the Texas LNG Project and other facilities would be long-term during the operational life of the Project, but minor. In addition, emissions from LNG vessels would occur along vessel transit routes and would be cumulative with the other ships using the ship channel. These emissions sources would be transitory in nature and emissions would occur over a large area; however, the cumulative ship emissions would result in long term elevated emissions for the area.

Noise

The geographic scope for operational noise from long term projects includes any facilities that can cause an impact at NSAs within 1 mile of the Project. The Annova LNG and Rio Grande LNG Projects have been included in the cumulative impact assessment, as well as other existing and proposed projects in the area. The geographic scope for construction noise typically includes other identified projects within 0.25 mile of the Project. However, due to the duration of construction and similar timelines, we have included the Rio Grande LNG and Annova LNG projects in our cumulative construction noise impact analysis. Cumulative noise impacts on residences and other NSAs are related to the distance from the disparate noise sources as well as the timing of each noise source. Projects within the construction and operational noise geographic scopes are identified in table 4.13.1-1.

After construction is completed for the non-LNG projects, including the gas and water pipeline projects, power line projects, channel improvements and maintenance dredging, and road projects, there would be minimal operational noise impacts. The non-jurisdictional SH 48 auxiliary lane that would be developed for the Texas LNG Project would have some long-term but minor noise associated with vehicle traffic entering and leaving the Project site. Therefore, these projects are not expected to have any significant long-term operational cumulative impacts.

Construction noise from the non-jurisdictional facilities associated with the Texas LNG Project is expected to be localized and limited in duration. These projects are small compared to the scope of the proposed three LNG projects, and are generally linear activities with construction moving through the length of the right-of-way with limited durations near any given location. These projects are not expected to occur within 0.25 mile of any of the Project NSAs; therefore, the construction activities associated with the non-jurisdictional facilities are not expected to result in cumulative impacts from noise at NSAs.

Maintenance dredging and channel improvement activities would result in periodic small increases in the sound level impacts due to operation of dredging equipment. Sound levels from the maintenance dredging are not expected to cause a significant impact at the NSAs.

The SpaceX Commercial Spaceport Project, approximately 4.6 miles southeast of the proposed Project, anticipates rocket launches starting as soon as late 2018. Once they commence, commercial spaceflight launches would be a significant noise source at the NSAs. However, spaceflight launches are not expected to cause a significant cumulative environmental noise impact because they are short-duration events lasting only a few minutes from start to finish, they are typically scheduled during the daytime, and each launch would be well publicized, so nearby residents would be ready for the short-term intense noise of the rocket launch. During the launches, noise from the launch would dominate the sound levels at the nearby residences and low-frequency noise would likely cause noise-induced-structural vibration. Project related noise contributions would not be significant during this brief period, as the sound field would be dominated by launch noise.

As significant cumulative noise impacts are not expected from the non-LNG projects considered, as discussed above, the cumulative assessment for noise impacts focuses on the two other LNG projects in the planning and permitting stages in the general vicinity of the Project: the Rio Grande LNG and Annova LNG projects. The potential cumulative noise impact of these three LNG projects has been evaluated for construction and facility operations, for both airborne and underwater sound. Construction noise impacts would be cumulative only if construction activities occur simultaneously. Given the current schedules for the three Brownsville LNG projects, it is likely that there would be some overlap in construction activities because of the long duration of construction for the three projects. For the purposes of this analysis we have assumed that peak construction of all three projects would overlap; however, the construction phases may not coincide, so maximum construction sound levels may not occur at all projects simultaneously.

Construction – Airborne Noise

Construction activities for the three LNG projects would be similar, and would include heavy equipment operation, pile driving, dredging, and other activities similar to those described in section 4.11.2.3. In order to evaluate the potential cumulative impact of construction activities, basic sound propagation calculations were used to estimate the combined construction sound levels at a set of standardized NSAs and calculation point (CP) locations.

The standardized NSA and CP locations were selected using the common NSAs for each of the three proposed projects. NSAs and CPs in close proximity were combined into single representative NSA or CP positions for the cumulative analysis. Three CP locations were included for each project: the Palmito Ranch Battlefield (CP-1), a central CP location in the Laguna Atascosa NWR (CP-2), and at the location in the Laguna Atascosa NWR at the closest approach to the given LNG project. CP-1 and CP-2 were the same for all projects.

In order to quantify the highest sound level contribution from each project in the Laguna Atascosa NWR, the closest location in the Laguna Atascosa NWR for each of the projects was specified as a calculation point. Each was given a unique designation for each project: CP-TX, CP-AN, and CP-RG for Texas LNG, Annova LNG, and Rio Grande LNG, respectively. Each project reported the project operations sound level contribution at the project-specific CP. These three CPs have not been used to calculate impacts in the cumulative tables, rather, they are presented separately for each project to indicate the highest expected project sound level contributions in the Laguna Atascosa NWR for operations and construction noise.

A list of the standardized NSAs and CPs is presented in table 4.13.2-4. A map showing the location of the standardized cumulative NSAs and CPs is shown in figure 4.13.2-2.

TABLE 4.13.2-4

Standardized NSAs and Calculation Point Locations for Cumulative Noise Analysis

NSA	Location	Coordinates
NSA C1	Laguna Heights neighborhood, Lincoln Ave. and Pennsylvania Ave.	26.077312° -97.249653°
NSA C2	Residences, Mobile home park, on Port Rd., southeast of Woodys Ln.	26.067031° -97.217732°
NSA C3	Residences, Northwest end of West Scallop	26.063153° -97.208717°
NSA C4	Residences, Weems Rd. and LBJ St.	25.993437° -97.182485
NSA C5	Residences, North end of 199, north of Boca Chica Blvd.	25.965084° -97.245563°
NSA C6	Residence located east of Palmito Hill Rd. on private drive	25.952706° -97.289272°
CP	**Locations**	**Coordinates**
CP-1	Palmito Ranch Battlefield	25.959536° -97.303490°
CP-2	Laguna Atascosa NWR, Calculation Point	26.028053° -97.265482°
CP-AN, CP-TX, CP-RG [a]	Laguna Atascosa NWR, Closest location to given Facility	Varies

[a] The CP-AN, CP-TX, and CP-RG points represent the locations of the highest sound level contribution from each individual facility in the nearby Laguna Atascosa NWR.

FIGURE 4.13.2-2 Cumulative Impact NSAs and Calculation Point Locations

Cumulative effects of construction noise were analyzed by combining the predicted construction sound levels for each project. Each of the three LNG projects used a slightly different methodology for calculating construction noise impacts. These variations were normalized during the cumulative assessment process and all predicted values were compared on an L_{dn} basis. For those cumulative NSAs at which the construction noise had not been calculated by a project in the FERC application, a hemispherical spreading calculation was used to estimate the construction contributions based on reported construction sound levels at other NSAs. The existing ambient sound levels for each NSA, as reported in table 4.13.2-5, were determined by using the lowest measured ambient level at a corresponding project NSA for the three projects. For example, if the measured ambient sound level at NSA C2 differed among FERC applications for the three projects, the lowest ambient sound level reported was used as the ambient for the cumulative analysis. The source of the ambient sound level data is provided in table 4.13.2-5.

There was some variation in the assumptions included in the three projects for construction activities. For example, Annova LNG assumed 24-hour construction activities while Rio Grande LNG and Texas LNG used 12-hour daytime shifts for general construction and pile driving, and 24-hour operations for dredging. These assumptions were carried into the cumulative assessment. Annova LNG and Texas LNG reported construction sound levels as 24-hour L_{dn} values, while Rio Grande LNG reported construction contributions as daytime L_{eq}. In order to directly compare the construction sound level contributions, the sound level metrics were standardized to the 24-hour L_{dn} and the reported sound levels for Rio Grande LNG were adjusted to the 24-hour L_{dn}. A more detailed discussion of the sound level metric standardization is provided in appendix G.

Table 4.13.2-5 shows the individual project and cumulative construction noise contributions of the three LNG projects at the NSAs and CPs. The individual sound level contribution predictions from all construction activities are lower than the FERC criterion of 55 dBA L_{dn} at all NSAs. However, the cumulative construction sound level from the three projects ranges from 51.7 to 55.8 dBA L_{dn}, and exceeds 55 dBA L_{dn} at NSAs C2, C3, and C5. The cumulative sound levels are also expected to exceed 55 dBA L_{dn} at locations in the Laguna Atascosa NWR, with cumulative sound levels at CP-2 of 58.4 dBA L_{dn}. Construction sound levels would be expected to exceed 55 dBA L_{dn} at locations in the Laguna Atascosa NWR within about 0.75 mile of SH 48. The predicted increase in the ambient sound levels is also shown in table 4.13.2-5, and these range from 2.2 to 9.8 dBA at the NSAs, and from 3.1 to 10.1 dBA at the two CP locations. An increase of greater than 10 dBA is typically perceived as a doubling of loudness.

The evaluation above is a very conservative estimate of the potential cumulative impact of construction noise, as it combines the maximum and simultaneous construction sound levels from the three projects. This would require that all three project schedules align so that pile driving, dredging, and site preparation occur at full intensity at the same time. To obtain a more realistic and likely evaluation of the construction impact, an incremental analysis was made by comparing the increase in sound level at each NSA and CP due to only the highest predicted individual project contribution to the additional increase due to the other two projects. This analysis shows the potential cumulative impact of all three projects compared to the loudest single project. The impacts derived from this analysis represent for a more likely scenario in which the three project construction schedules do not align exactly.

Table 4.13.2-6 shows the incremental effect of cumulative construction noise at each NSA and CP, compared with the highest predicted *individual* project contribution affecting each NSA. This table shows that cumulative construction noise causes an incremental increase of between 0.7 and 2.7 dB at the NSAs and CPs, compared to the highest individual project construction noise. NSA C4, with an increase of 2.7 dBA L_{dn}, shows the largest cumulative effect. A three decibel increase is generally considered perceptible to most people, so the cumulative impact of construction noise at NSA C4 would be perceptible. At other NSAs, the cumulative increases are 1.5 dBA L_{dn} or lower and would generally be considered imperceptible. At these NSAs, due to the distance between the projects, the *closest* construction activity sound levels would typically dominate the acoustical environment at the NSA.

The sound levels at the project-specific CPs during construction were an Annova LNG contribution of 60.6 dBA L_{dn} at CP-AN, a Rio Grande LNG contribution of 48.7 dBA L_{dn} at CP-RG (based on 12-hour per day construction and 51.7 L_{max} dBA), and a Texas LNG contribution of 63.5 dBA L_{dn} at CP-TX. This demonstrates that construction sound levels in the Laguna Atascosa NWR are dominated by contributions from Texas LNG.

TABLE 4.13.2-5

Summary of Cumulative LNG Construction Impacts at Standardized NSA and CP Locations, All Levels are dBA L_{dn}

Location	Predicted Construction Sound Level Contributions [b]				Existing Ambient	Ambient Data [a]:	Combined Ambient plus Cumul. LNG	Predicted Increase over Ambient
	Annova LNG	Rio Grande LNG	Texas LNG	Cumulative LNG				
NSA C1	49.0	49.2	**50.3**	54.3	56.0	AN NSA 1	58.2	2.2
NSA C2	47.1	43.1	**54.9**	55.8	50.2	TX NSAs 1 & 2	56.9	6.7
NSA C3	46.8	42.7	**54.6**	55.5	50.2	TX NSA 3	56.6	6.4
NSA C4	**48.0**	46.7	46.0	51.8	46.0	AN NSA 2	52.8	6.8
NSA C5	**54.0**	47.9	44.2	55.3	46.0	AN NSA 2	55.8	9.8
NSA C6	**49.8**	46.0	41.7	51.7	46.0	AN NSA 2	52.8	6.8
CP-1	**52.0**	39.9	41.6	52.6	43.0	AN NSA 4	53.1	10.1
CP-2	**56.9**	48.7	51.0	58.4	59.0	TX Laguna Atascosa NWR	62.1	2.7

a The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs. AN = Annova LNG, RG = Rio Grande LNG, and TX = Texas LNG.
b The bold values highlight the highest individual LNG facility contributions, as used in table 4.13.2-4

TABLE 4.13.2-6
Calculation of the Incremental Impact of Cumulative LNG Construction Noise at Standardized NSA and CP Locations, All Levels are dBA L_{dn}

Location	Existing Ambient [a]	Highest Individual LNG Construction Contribution	Highest Contrib. Plus Ambient	Increase over Ambient Due to only the Single Highest LNG Contribution	Additional Increase Caused by Cumulative Construction Noise
NSA C1	56.0	50.3	57.0	1.0	1.2
NSA C2	50.2	54.9	56.2	6.0	0.7
NSA C3	50.2	54.6	55.9	5.7	0.7

TABLE 4.13.2-6 Calculation of the Incremental Impact of Cumulative LNG Construction Noise at Standardized NSA and CP Locations, All Levels are dBA L_{dn}					
Location	**Existing Ambient [a]**	**Highest Individual LNG Construction Contribution**	**Highest Contrib. Plus Ambient**	**Increase over Ambient Due to only the Single Highest LNG Contribution**	**Additional Increase Caused by Cumulative Construction Noise**
NSA C4	46.0	48.0	50.1	4.1	2.7
NSA C5	46.0	54.0	54.6	8.6	1.2
NSA C6	46.0	49.8	51.3	5.3	1.5
CP-1	43.0	52.0	52.5	9.5	0.6
CP-2	59.0	56.9	61.1	2.1	0.6

[a] The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs. See table 4.13.2-5 for the data source.

Construction – Vessel Traffic

During construction of the three LNG projects, the area would experience an increase in noise due to marine traffic delivering construction supplies. The Texas LNG Project is not anticipated to contribute significantly to the cumulative noise impact because only a small amount of the anticipated construction supplies would arrive via barges or ships (109 deliveries over the five-year construction period). Rio Grande LNG estimates that barges would make 880 marine deliveries to the project site during construction. Marine deliveries to the Rio Grande LNG site would occur about 15 times per month during the first 5 years of construction; no deliveries are currently anticipated during the remainder of the construction period, though sporadic deliveries could occur as needed. Annova LNG estimates that a total of 24 to 36 barge deliveries to the project site per year would be required during construction. If these construction periods overlap, the total expected construction barge traffic is approximately 20 visits a month, or one barge visit every 1.5 days. This is only slightly more than the one barge visit every two days estimated for the Rio Grande LNG project and the cumulative effects would not be significant.

Construction – Underwater Noise

Underwater noise would be produced by construction activities including in-water pile driving and dredging, and increased vessel traffic associated with equipment delivery. Cumulative impacts for underwater construction noise would be limited due to the large distance between the various project marine facilities.

The marine facilities closest to each other are the proposed Texas LNG and Rio Grande LNG facilities, with a center to center distance of about 4,400 feet. As an example of the distance effects, underwater pile driving sound levels would be expected to decrease by 32 decibels re 1 µPa at a distance of 4,400 feet compared to reference levels at 32 feet. The LNG sites are so far apart that pile driving activities at any single facility would have a limited cumulative effect on underwater noise at locations close to either of the other construction areas.

Due to the short impulsive nature of pile driving noises, it is very unlikely that the peak sound pressure levels from multiple pile drivers would occur at exactly the same instant, so there would be no increase in the predicted pile driving peak sound pressure levels. Rather, the number of pile driving events would increase due to the multiple active construction areas.

At locations midway between two active pile driving projects, the sound exposure levels would be expected to increase during simultaneous pile driving activities. The threshold distances for permanent and temporary injury for marine mammals, fish, and sea turtles, as outlined for the Texas LNG project in tables 4.6.2-2 and 4.7.1-1, would not be expected to increase significantly in size. However, during simultaneous pile driving at the three projects, the behavioral disturbance area for most species would increase. In some cases the behavioral disturbance distances for the projects would overlap and would likely encompass much of the Brownsville Ship Channel. Cumulative impacts on aquatic resources as a result of underwater noise are discussed further in section 4.13.2.7 and 4.13.2.8.

As an example of the potential overlap between adjacent behavioral disturbance areas, figure 4.6.2-2 displays the behavioral disturbance distances for pile driving for the Texas LNG project. As shown, for cetaceans during vibratory pile driving, the behavioral disturbance area encompasses the Brownsville Ship Channel from the ocean to several miles inland, and encompasses the Brownsville Ship Channel adjacent to both the Rio Grande LNG and Annova LNG sites. For impact pile driving, the behavioral disturbance area for fish extends to encompass portions of the BSC adjacent to the Rio Grande LNG site. For these two combinations of activity and species, the behavioral disturbance areas would overlap with adjacent projects, and would increase the total continuous behavioral disturbance areas. The other behavioral disturbance areas: cetaceans (impact pile), sea turtles (impact pile and vibratory pile), and fish (vibratory pile), are much smaller, and would not likely overlap with the disturbance areas for other projects.

As a mitigating factor, the expected durations of the marine pile-driving activities for the three projects are limited. Texas LNG plans to drive only 12 piles in-water over 12 days. Rio Grande LNG expects that marine pile-driving would be required for sheet piling, which is anticipated to occur over 25 days and for installation of four in-water piles, which would take four days. Annova LNG expects to perform in-water pile driving over the course of five days. Due to the long construction schedules for the projects, and the limited duration of in-water pile driving, it seems unlikely that there would be significant overlap in the in-water pile driving schedules. Even with complete overlap in pile-driving activity schedules, there could possibly be only four days in which all three projects would be driving (non-sheet) piles.

Dredging activities at all three projects would have the potential to produce underwater noise. The predicted behavioral disturbance areas for Texas LNG's dredging activities are shown in figure 4.6.2-3. The proposed dredging activities would be far enough apart that generally there would be no cumulative impacts expected for underwater dredging noise for species other than mid-frequency cetaceans. For mid-frequency cetaceans, the behavioral disturbance range would tend to overlap with dredging areas for the Rio Grande LNG site. If these activities occurred simultaneously, the expected area of potential auditory impact for mid-frequency cetaceans would extend from the mouth of the Brownsville Ship Channel to inland of the Rio Grande LNG site. However, the Brownsville Ship Channel is an active waterway that already has ongoing and regular maintenance dredging activities. The additional construction dredging activities associated with the projects is not expected to be significantly different than the existing maintenance dredging and is not expected to cause a significant cumulative underwater noise impact in the Brownsville Ship Channel.

Operations – Airborne Noise

In order to consistently analyze the potential cumulative impact of airborne operational noise from the three proposed LNG projects, the noise models for each project were used to predict the sound levels due to facility operation at the standardized NSAs and at the three CPs located close to points of interest.

The methodology behind the noise model development for the Texas LNG Project is presented in section 4.11.2 of this EIS. The methodology for the other two LNG projects is described in their FERC Applications.[56] Generally, each project used three-dimensional environmental noise modeling software to predict the sound levels from the respective project equipment. In order to combine the sound level predictions for operations noise, each project submitted the noise model results in a standardized grid format as outlined in the August 25, 2017 Environmental Information Request issued for the Texas LNG Project.[57] The standardized grid results used the same spacing and nominally the same boundaries. The grid maps were overlaid and logarithmically summed and the overall cumulative impact of operations noise from the three projects was calculated. Figure 4.13.2-3 shows the predicted sound levels as 24-hour L_{dn} values for the three projects in simultaneous operation at full project completion.

In addition to the grid map results, predicted operations sound levels were calculated by each project for the cumulative NSAs and CP locations described in table 4.13.2-4. The predicted sound levels were logarithmically summed for the cumulative NSAs and for CPs 1 and 2.

Each project also reported predicted sound levels at the location in the Laguna Atascosa NWR closest to the project, with these unique CPs labeled as CP-TX, CP-RG, and CP-AN, for the Texas LNG, Rio Grande LNG, and Annova LNG, projects respectively. These project specific calculation points were used to evaluate the highest predicted individual project sound level in the Laguna Atascosa NWR. Cumulative sound levels were not calculated for these points as the levels were predicted by each project for only that respective project CP.

Table 4.13.2-7 presents a summary of the predicted operation sound levels at the cumulative NSA and CP locations for each of the individual LNG projects. As shown in this table, the expected increases in the sound levels at the standardized NSA locations range from 0.3 to 1.5 dBA L_{dn}. These are very small increases and would be considered imperceptible to most listeners. The small difference in the overall cumulative increases and those increases predicted for each separate project is due to the large distances between the noise generating equipment at the project sites, and the small impact of the more distant projects to the overall

[56] Available online at www.ferc.gov. Annova LNG: FERC Docket No. CP16-480-000; Rio Grande LNG: FERC Docket Nos., CP16-454-000 and CP16-455-000.

[57] Available online at www.ferc.gov. FERC Docket No. CP16-116-000, Accession No. 20170825-3017.

sound levels at each NSA location.

Sound levels at CP-1, representing the Palmito Ranch Battlefield NHL are predicted to have a cumulative increase of 1.3 dBA L_{dn}, which would be imperceptible for most listeners. At CP-2 in the Laguna Atascosa NWR, the sound level impact is somewhat higher, with a predicted cumulative increase of 4.8 decibels and an overall cumulative sound level of 62 dBA L_{dn}. As shown on figure 4.13.2-3, there would be areas in the Laguna Atascosa NWR in which the cumulative sound levels exceed 55 dBA L_{dn}. The sound levels in the Laguna Atascosa NWR are generally dominated by contributions from the Rio Grande LNG facility.

The sound levels at the project-specific CPs during operation were an Annova LNG contribution of 55.4 dBA L_{dn} at CP-AN, a Rio Grande LNG contribution of 69.7 dBA L_{dn} at CP-RG, and a Texas LNG contribution of 52.9 dBA L_{dn} at CP-TX. This demonstrates that operational sound levels in the Laguna Atascosa NWR are dominated by contributions from Rio Grande LNG, due to its proximity to the Laguna Atascosa NWR.

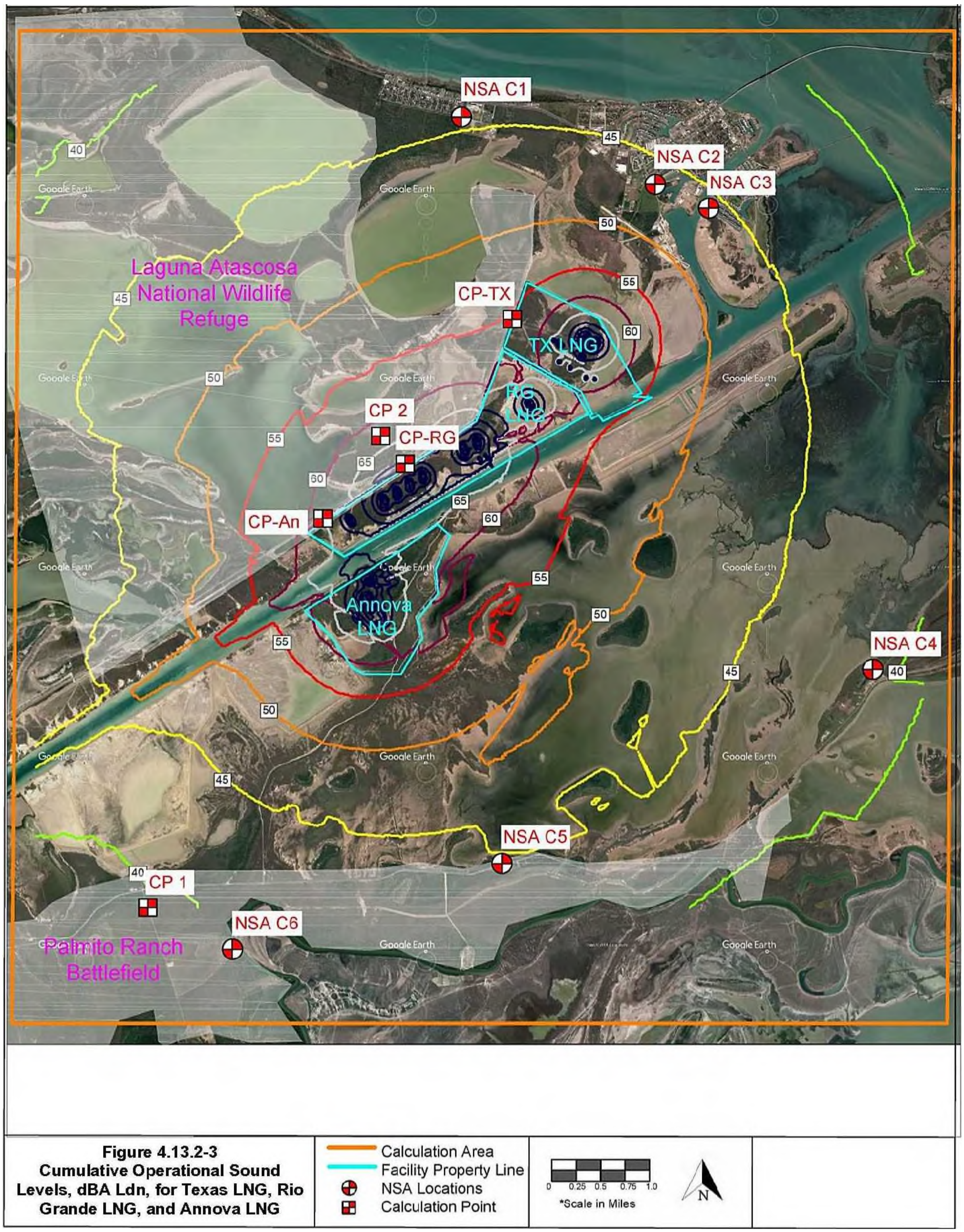

FIGURE 4.13.2-3 Cumulative Operational Sound Levels, dBA L_{dn}, for Texas LNG, Rio Grande LNG, and Annova LNG

As shown in figure 4.13.2-3, the area of the Laguna Atascosa NWR with sound levels exceeding 55 dBA L_{dn} extends to approximately 1 mile northwest of SH 48. Sound levels in this area are dominated by operational noise from the Rio Grande LNG facility, as the process area for that facility is directly across SH 48. Cumulative impacts resulting from increased noise on wildlife is further discussed in section 4.13.2.6.

TABLE 4.13.2-7

Cumulative Operational Noise Impacts from LNG Facilities

Location	Predicted Sound Level Contributions, dBA L_{dn}				Existing Ambient	Ambient Data [a]:	Combined Ambient plus Cumul. LNG	Predicted Increase over Ambient
	Annova LNG	Rio Grande LNG	Texas LNG	Cumulative LNG				
NSA C1	31.4	41.9	40.2	44.4	56.0	AN NSA 1	56.3	0.3
NSA C2	30.4	40.2	44.8	46.2	50.2	TX NSAs 1 & 2	51.7	1.5
NSA C3	30.4	39.7	44.4	45.8	50.2	TX NSA 3	51.5	1.3
NSA C4	31.4	38.7	34.7	40.7	46.0	AN NSA 2	47.1	1.1
NSA C5	39.4	41.0	32.2	43.6	46.0	AN NSA 2	61.4	0.1
NSA C6	34.4	37.3	28.7	39.5	46.0	AN NSA 2	46.9	0.9
CP 1	33.4	36.1	28.5	38.4	43.0	AN NSA 4	44.3	1.3
CP 2	46.4	61.8	41.0	62.0	59.0	TX	63.8	4.8

[a] The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs. AN = Annova LNG, RG = Rio Grande LNG, and TX = Texas LNG.

Operations – Flaring

There will be flaring noise associated with all three projects. However, all three projects note that flaring will be part of standard operations. The maximum sound levels predicted for flaring were 52 dBA, 59 dBA, and 43 dBA for Annova LNG, Rio Grande LNG, and Texas LNG projects, respectively, at the worst-case NSAs for each project. Although possible, it is unlikely that flaring would occur simultaneously at all three projects. In the event of simultaneous flaring at all three projects, the highest predicted sound levels would be at cumulative NSA C1, with a predicted cumulative flaring sound level of 59.6 dBA, or 0.6 dBA higher than the individual impact of the Rio Grande LNG flare operating alone. This is an insignificant difference indicating that the cumulative impact of flaring events would be minimal. However, with three facilities in operation, the frequency of occurrence of flaring events would be approximately tripled, so flaring events would occur more often, though the overall sound level from each flaring event would be similar or lower than predicted by each project.

Operations – Maintenance Dredging

Occasional maintenance dredging would be required during the operational lifespan of the three LNG projects to maintain the channel, turning basin, and other marine facilities associated with the projects. Generally, the projects anticipate that maintenance dredging would be necessary every few years. Maintenance dredging activities would be substantially quieter than the sound levels reported with construction sound level predictions, as the predicted construction levels also include pile driving, general construction, and dredging activities. The

Brownsville Ship Channel is an active waterway that already has ongoing and regular maintenance dredging. The additional maintenance dredging activities associated with the projects are not expected to cause a significant cumulative airborne noise impact at the NSAs.

Conclusions

The cumulative noise impacts of reasonably foreseeable future actions have been reviewed. Of these actions, significant cumulative noise impacts would be expected only from the three LNG-related projects due to their size, extent, construction techniques, and long operational lifespan. In order to evaluate the potential cumulative impact of construction and operations noise from these LNG projects, the predicted sound levels for construction and for operations were combined at a standardized set of cumulative NSAs.

For simultaneous construction activities at all three LNG projects, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 dBA L_{dn} at the NSAs and sound levels of slightly over 55 dBA L_{dn} are predicted for NSAs C2, C3, and C5, resulting in a minor to significant impact. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the NSAs. These increases would result in a minor to significant impact; however, all levels would be below 55 dBA $L_{dn.}$ For CP-1, the predicted cumulative construction increase was 10.1 dBA L_{dn} over the existing ambient, resulting in a significant impact. At CP-2 in the Laguna Atascosa NWR there is a higher ambient sound level so the predicted increase due to cumulative construction noise would be 2.7 dBA $L_{dn,}$ resulting in a minor impact.

For operational noise with all three projects fully operational, the predicted sound level impacts are much lower than construction impacts, with potential increases over the existing ambient of between 0.3 and 1.5 dBA L_{dn} at NSAs, resulting in a minor impacts. Operational impacts are slightly higher at CP-1 and CP-2, with possible increases in sound levels due to operations of between 1.3 and 4.8 dBA L_{dn}. This is generally considered a minor to moderate long-term impact.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS OF THE ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented in this section are those of the FERC environmental staff. Our conclusions and recommendations are based on input from the COE, Coast Guard, DOE, DOT, FWS, NPS, NMFS, and FAA as cooperating agencies in the preparation of this draft EIS. However, the cooperating agencies will present their own conclusions and recommendations in their respective Records of Decision or determinations. The cooperating agencies can adopt this draft EIS consistent with 40 CFR 1501.3 if, after an independent review of the document, they conclude that their requirements have been satisfied. Otherwise, they may elect to conduct their own supplemental environmental analyses.

We conclude that construction and operation of the Texas LNG Project would result in adverse environmental impacts. Most adverse environmental impacts would be temporary or short-term during construction; however, long-term and permanent impacts on water quality, aquatic resources, wildlife, visual resources, recreation, noise, and air quality would also occur as part of the Project. As part of our analysis, we developed specific mitigation measures that are practical, appropriate, and reasonable for the construction and operation of the Project. We are, therefore, recommending that these mitigation measures be attached as conditions to any authorization issued by the Commission. We conclude that, with the exception of visual impacts, implementation of the mitigation proposed by Texas LNG and our recommended mitigation would ensure that impacts in the Project area would be avoided or minimized and would not be significant. A summary of the Project impacts and our conclusions are presented below by resource.

5.1.1 Geologic Resources

Construction and operation of the Project would not materially alter the geologic conditions of the Project area, and the Project would not affect the extraction of mineral resources during construction or operation. Blasting is not anticipated during construction of the Project. Based on Texas LNG's proposal, including implementation of the Project-specific ECP, we conclude that impacts on geologic resources would be adequately minimized and would not be significant.

5.1.2 Soils

Construction of the Project facilities would disturb soils, resulting in increased potential for erosion, compaction, and the mixing of topsoil and subsoil. One soil in the Project area is highly susceptible to erosion by water. Most soils in the Project area are compaction prone and have low revegetation potential due to high salinity. Texas LNG would also import soils and use dredge material to raise the elevation of the Project site. Texas LNG would implement the measures outlined in the Project-specific ECP to minimize impacts on soils.

Texas LNG did not identify any areas of contamination on the Project site and confirmed that imported soil would be free of contamination. However, there is potential for soils to become contaminated from spills of hazardous materials during construction and operation.

Texas LNG has prepared its SPAR Plan for use during construction to minimize the potential for spills; however, as Texas LNG has not provided its SPCC Plan that would minimize spills during operation of the Project, we are recommending that Texas LNG provide the FERC staff the SPCC Plan for review prior to construction.

As part of development of the Project maneuvering basin, Texas LNG would hydraulically dredge an estimated 3.9 million cubic yards of material from the Project site. Dredging, management of the dredge material, and use of PA 5A is the responsibility of the COE through permitting. Texas LNG would deposit the dredge material via temporary pipeline at PA 5A, an existing dredge disposal site, as authorized by its permits.

5.1.3 Water Resources

5.1.3.1 Groundwater

Texas LNG would not directly withdraw groundwater for construction or operation of the Project; however, it would use 2.5 million gallons of freshwater during construction and 16 million gallons during operation supplied by BPUB's municipal water supply. Approximately 20 percent of the municipal supplies are withdrawn from groundwater; therefore, a portion of water used for the Project would presumably be indirectly sourced from groundwater supplies in the region. Based on the projected water uses for Cameron County, Texas LNG's 16 million gallons of municipal water per year represents less than 0.1 percent of the total projected water use for the City of Brownsville in 2020; therefore, the Project would not significantly impact groundwater quantity.

Shallow groundwater areas could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials used during construction and operation of the Project and by placement of deep piles. In addition, clearing and grading could result in minor impacts on groundwater by increasing soil compaction, sheet flow, and decreasing aquifer recharge rates. Because the recharge areas are much larger than the Project footprint, changes in groundwater recharge as a result of Project construction is not anticipated to be significant. No active public water supply wells, wellhead protection areas, or springs are within 150 feet of the proposed Project site.

Texas LNG did not identify any areas of groundwater contamination within the Project site. However, shallow groundwater areas could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials used during construction and operation of the Project. Through the implementation of Texas LNG's SPAR Plan during construction and SPCC Plan during operation, impacts on groundwater as a result of contamination would not be significant.

5.1.3.2 Surface Water

No waterbodies are present within the Project site, with the exception of the Brownsville Ship Channel. Land disturbing activities would increase the potential for stormwater runoff and erosion; however, Texas LNG would implement the measures outlined in its Project-specific ECP and conduct all activities in accordance with the NPDES permit for construction stormwater discharges. Texas LNG would also minimize the potential for spills of hazardous materials to contaminate surface water resources through the implementation of its Project-specific ECP, SPAR Plan, and SPCC Plan.

Texas LNG would dredge approximately 3.9 million cubic yards of material from existing tidal flats and the bank of the Brownsville Ship Channel to create the proposed marine berth. Dredging would be conducted by a hydraulic cutterhead dredge, which would minimize turbidity compared with a mechanical dredge within the Project area. Texas LNG would dispose of dredge material at PA 5A, an existing confined dredge disposal site, in a way to ensure maximum settlement of sediment prior to discharge of water at the existing PA 5A outfall. We conclude that Texas LNG's proposed dredge disposal methods would sufficiently minimize Project-related turbidity and sedimentation within the Brownsville Ship Channel. Texas LNG would conduct maintenance dredging of the marine berth every 3 to 5 years, generating 300,000 to 500,000 cubic yards of dredge material that would be disposed of at an existing placement area.

Dredge plume propagation modeling conducted by Texas LNG indicates that water quality parameters would be met within 460 feet of dredging activities. Texas LNG would conduct all dredging activities during construction and operation (maintenance dredging) in accordance with permits issued by the COE. Based on the use of the hydraulic dredge method, placement of dredge material in an existing disposal area, and the ongoing maintenance dredging within the Brownsville Ship Channel, we conclude that impacts on surface water quality as a result of dredging would be temporary, minor, and not significant.

Prior to commencement of operation, Texas LNG would hydrostatically test the LNG terminal piping and the storage tanks, obtaining most of the hydrostatic test water (approximately 34.4 million gallons) from the Brownsville Ship Channel. Texas LNG would use additives to limit bacteria and other corrosive components in seawater used for hydrostatic testing. Before returning the water to the Brownsville Ship Channel, Texas LNG would filter the water to remove suspended solids and neutralize or biodegrade the chemical additives into non-hazardous materials. In addition, Texas LNG would implement measures to minimize the potential for scour during discharge. Therefore, impacts on surface water as a result of hydrostatic testing are not anticipated to be significant.

During operation of the Project, an estimated 74 LNG carriers would call on the LNG terminal annually. LNG carriers would discharge ballast water as well as cooling water within the maneuvering basin during LNG loading. Discharged ballast water and cooling water could have different salinity, pH, temperature, and dissolved oxygen concentrations than the Brownsville Ship Channel. Due to the volume of water that would be discharged and the limited number of LNG carriers that would call on the LNG terminal annually we conclude that impacts on surface water quality as a result of ballast water and cooling water discharges would be limited to the area immediately adjacent to the LNG carrier and not significant.

5.1.4 Wetlands

Construction of the Project would impact 45.2 acres of wetlands, primarily consisting of tidal flats, of which, 42.9 acres would be permanently impacted as a result of dredging of the maneuvering basin, and to a lesser extent, fill for permanent structures. While the Project would result in the permanent impact of tidal flats, dredging of the maneuvering basin would also restore tidal exchange to adjacent tidal flats, resulting in a beneficial impact on wetlands. Texas LNG has prepared a Compensatory Mitigation Plan to mitigate for permanent wetland impacts with preservation of 405 acres southeast of the proposed Project site. All necessary wetland mitigation would be finalized in accordance with Texas LNG's COE Section 404 permit. Temporary wetland impacts would be minimized through the implementation of mitigation measures outlined in the Project-specific ECP and would be restored following the completion of construction activities. Therefore, we conclude that the Project would not significantly impact wetlands.

5.1.5 Vegetation

A total of 263.2 acres of vegetation would be cleared during construction, 249.3 acres of which would be permanently impacted by operation of the Project. The majority of vegetation that would be cleared within the Project site consists of loma evergreen shrublands and sea ox-eye daisy flats. No forested land would be impacted by the Project. Vegetation Texas LNG would clear for construction of the Project includes five rare plant communities, primarily associated with the loma habitat on the Project site. TPWD expressed interest in preserving populations of one rare plant species documented at the Project site, lily of the loma. Therefore, we recommend that Texas LNG coordinate with TPWD regarding seed/fruit collection from rare plant species impacted by the Project. Based on implementation of our recommendation we conclude that Project impacts on rare plant communities would not be significant.

Based on conversations with the local NRCS and PMC, revegetation of the Project site is anticipated to be difficult. Texas LNG would utilize a site-specific, native seed mix developed in coordination with the NRCS and PMC to ensure species with the greatest potential for successful establishment are planted following construction. Texas LNG also proposes to strip topsoil with the greatest potential for revegetation from portions of the Project site that would be permanently converted to industrial facilities and use it in the restoration of temporary workspaces to help facilitate revegetation. Texas LNG would also implement the measures outlined in its Project-specific ECP, which requires the use of temporary and permanent erosion control measures, revegetation procedures, and post-construction monitoring. Therefore we conclude that impacts on vegetation from the conversion of vegetation to industrial areas within the Project site would be permanent, but not significant.

Land disturbance during construction of the Project would result in the increased potential for establishment of exotic or invasive plant communities and noxious weeds. Texas LNG would implement measures outlined in its Noxious Weed and Invasive Plant Plan to minimize the spread of invasive species and treat invasive species if they become established. Therefore, we conclude that the Project would not contribute to the introduction or spread of exotic or invasive plant species.

5.1.6 Wildlife and Aquatic Resources

5.1.6.1 Wildlife

The removal of vegetation within the Project site and conversion of the site to industrial use would permanently affect wildlife and wildlife habitats. Impacts on wildlife from construction of the Project would include displacement, stress, and direct mortality of some less mobile species. Vegetation clearing would reduce suitable cover, nesting, and foraging habitat for some wildlife species; however, dredging of the maneuvering basin would restore tidal connectivity to the tidal flats north of the Project site, improving habitat for aquatic species as well as shorebirds. During construction and operation, increases in lighting and noise would likely deter wildlife from the area; however, there is abundant available habitat in the surrounding areas. The greatest noise impacts would be during construction, especially pile driving, however, these impacts would be short-term. Texas LNG would implement measures outlined in its Facility Lighting Plan to minimize the effects of lighting on wildlife during operation. Impacts on wildlife would be further minimized through the implementation of the Project-specific ECP; therefore, we conclude impacts on wildlife would not be significant.

Suitable habitat for migratory BCC is present within the Project site and Texas LNG observed several BCC during surveys. In addition to disturbance of habitat and potential sensory disturbances, elevated structures such as the storage tanks and flares would also affect migratory birds by increasing the potential for collisions. Texas LNG would implement measures in coordination with the FWS, as recommended by FERC staff, to minimize impacts on migratory birds during construction and operation, including pre-construction bird surveys, and vegetation clearing restrictions during construction and operation. Based on the potential impacts on migratory bird habitat and the measures that Texas LNG would implement during construction and operation to minimize impacts on migratory birds in the area, including our recommendation, we conclude that the Project would not have a significant impact on migratory bird populations.

The proposed Project site is across SH 48, but approximately 200 feet from the Laguna Atascosa NWR. Due to the proximity of the Project site to the NWR, wildlife within the NWR would likely be impacted by increased noise and light during both construction and operation. Further, wildlife displaced from the Project site during construction and operation could relocate to the NWR, increasing competition for resources. Impacts on wildlife within the Laguna Atascosa NWR would be greatest during the construction phase, due to increased traffic on SH 48 and increased noise from construction activities. During operation, noise impacts on wildlife within the Laguna Atascosa NWR would be much less and would decrease as distance from the Project site increases. Therefore, we conclude that impacts on wildlife within the Laguna Atascosa NWR would not be significant.

5.1.6.2 Aquatic Resources

Dredging of the maneuvering basin during construction, as well as maintenance dredging during operation, would temporarily increase noise, turbidity, and sedimentation within the Brownsville Ship Channel, reducing light penetration and decreasing dissolved oxygen concentrations, adversely affecting fish eggs and juvenile fish survival, benthic community diversity and health, foraging success, and suitability of spawning habitat. Further, sediments in the water column could be deposited on nearby substrates, burying aquatic macroinvertebrates. Texas LNG would use a hydraulic cutterhead dredge to minimize the impacts from turbidity and sedimentation. Based on the estimates of underwater sound that would occur during dredging, behavioral disturbance of fish would occur within 96 feet of the dredge and injury would occur within 89 feet.

Dredging of the maneuvering basin would permanently convert 39.4 acres of tidal flats to open water habitat and would impact the existing open water areas associated with the Brownsville Ship Channel, all of which is characterized as EFH. However, tidal flats within and surrounding the Project site have been cut off from the influences of natural tidal exchange. Dredging is anticipated to restore tidal flows to the tidal flats surrounding the Project site improving the overall aquatic habitat and enhancing EFH in the area. This EIS serves as our initiation of the essential fish habitat consultation with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act.

Project in-water pile driving would create sound waves that would adversely affect fish and other aquatic resources (see section 5.1.7). Behavioral and injury thresholds for fish would be exceeded within 7,065 feet and 1,522 feet of the pile driving activities, respectively. Texas LNG would minimize impacts on aquatic resources from pile driving by conducting most pile driving activities prior to dredging the maneuvering basin, with only 12 piles proposed to be installed in the water over 12 days. In addition, Texas LNG would utilize bubble curtains and cushion blocks to minimize underwater sound pressures. Further, we recommend that Texas LNG conduct test pile drives and measure the actual underwater noise prior to initiating pile driving activities to ensure that the underwater sound pressures are not more than predicted.

LNG carriers would discharge ballast and cooling water that would result in temporary and localized changes in pH, salinity, temperature, and dissolved oxygen levels. Given the volume of ballast and cooling water discharged relative to the total volume of water within the maneuvering basin and the mobility of aquatic life, we have determined that impacts on aquatic resources resulting from ballast and cooling water discharges would be intermittent and not significant. Cooling water intakes and intakes associated with the seawater firewater systems would also result in in the entrainment of small organisms, such as fish larvae and eggs. All intakes would be screened; however, direct mortality of smaller organisms is anticipated to occur. Due to the limited frequency of LNG carriers calling on the LNG terminal (74 per year) and the infrequent use of the seawater firewater system, impacts on aquatic resources from entrainment would not be significant. Increased vessel traffic during construction and operation of the Project would also result in an increased potential for spills of hazardous materials; however, all ships are required to maintain a SOPEP to minimize impacts on aquatic resources.

Through the implementation of Texas LNG's minimization measures, as well as our recommendation, the Project would not have significant impacts on aquatic resources.

5.1.7 Threatened, Endangered and Special Status Species

There are 18 federally listed threatened and endangered species, one species proposed for listing, and one candidate species that could occur within the Project site or along vessel transit routes. Suitable habitat is present for all 20 species; however, during species-specific surveys conducted for federally listed plants (South Texas ambrosia and Texas ayenia), no specimens were documented. Therefore, we conclude that the Project would have no effect on these two species.

Impacts on federally listed marine species such as sea turtles, West Indian manatee, and whales, as well as other marine mammals protected under the MMPA, would primarily occur due to increased potential for vessel strikes along the LNG carrier transit routes as well as increases in turbidity and noise during dredging and pile driving. Impacts from the Project on federally listed birds and terrestrial mammals would primarily result from the removal of suitable habitat, as well as the increased lighting and noise associated with construction and operation of the Project. Texas LNG has proposed measures to minimize and avoid impacts on federally listed species, including but not limited to conducting species-specific surveys for birds prior to construction, implementing the NMFS *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008), and utilization of bubble curtains and cushion blocks during in-water pile driving. In addition, we recommend that Texas LNG utilize biological monitors for all in-water construction activities to further minimize impacts on aquatic threatened and endangered species.

As consultations with FWS and NMFS are ongoing, we recommend that Texas LNG not begin any Project construction until FERC staff completes ESA consultations with these agencies. While suitable habitat is present within the proposed Project site and the potential for federally listed species to occur in the Project area or along the vessel transit routes, but not be directly impacted by the Project, we conclude that the Project *is not likely to adversely affect* federally listed species, would not result in the *adverse modification of critical habitat*, and would not significantly impact marine mammals.

Several state-listed species also have the potential to occur within the Project site. Texas LNG has coordinated with TPWD regarding the measures that would be implemented to minimize impacts on state-listed species. The TPWD is particularly concerned with Texas tortoises and has recommended that Texas LNG develop a plan for the capture and relocation of tortoises prior to construction. We recommend that Texas LNG prepare this plan in coordination with the TPWD prior to construction. Through the implementation of measures identified by TPWD and committed to by Texas LNG, as well as our recommendation, impacts on state-listed species would not be significant.

5.1.8 Land Use, Recreation, and Visual Resources

5.1.8.1 Land Use

Land use within the Project site consists of wetlands, scrub shrub, open land, and open water. The Project would impact 311.5 acres, of which 282.0 acres would be converted to industrial land for operation or would be permanently impacted by grading and dredging activities. There are no planned residential developments within 0.25 mile of the Project site. In addition, no structures are within 100 feet of the proposed Project area. The Project site is crossed by a 5-foot-wide right-of-way easement that contains an abandoned, underground 4.5-inch-diameter natural gas gathering line that would be removed prior to dredging the maneuvering basin. Although the Project would result in the conversion of a large portion of currently undeveloped land into industrial land, the Project site is zoned for industrial use; therefore, we conclude that Project impacts on land use in the area would not be significant.

5.1.8.2 Recreation

A total of nine recreational use areas were identified within five miles of the Project site, including the Laguna Atascosa NWR that is across SH 48, 200 feet from the Project site. All designated recreation areas within the Laguna Atascosa NWR are more than two miles from the proposed Project site. However, two designated recreation areas in the Bahia Grande Unit are directly off of SH 48 which would be affected by increased traffic during construction of the Project. Texas LNG anticipates that traffic would be greatest during non-peak times (prior to 7 am and after 5 pm).

Other recreation areas including the SBCP and South Bay Paddling Trail, Isla Blanca Park, and Loma Ecological Preserve are further from the Project site, but are near the vessel transit routes. Increased ship traffic during construction and operation, including LNG carriers, could adversely affect recreational boaters accessing the areas by delaying or temporarily restricting access across the Brownsville Ship Channel; however, because the proposed Project would only result in an incremental increase in ship traffic within an existing ship channel, impacts on recreation areas as a result of ship traffic would be minor. Due to the distance from the Project site, impacts on the remaining five recreation areas would be primarily limited to increases in roadway traffic during construction and visual impacts during operation, which are further discussed in sections 5.1.9 and 5.1.8.3, respectively.

There are also several recreational tour operators based in Port Isabel and South Padre Island which utilize waterways near the Project site, including the Brownsville Ship Channel. The Project facilities would result in a change in the land use, which would adversely affect recreation activities, such as dolphin watching, that may occur relatively close to the Project site. It is likely that increased noise during construction and operation could deter some of these activities in the immediate area and cause them to move to other less developed areas. In addition, increased ship traffic during construction and operation would increase the time it takes for recreational vessels to transit the Brownsville Ship Channel. Construction and operation could have moderate, but not significant, temporary and permanent impacts on recreation activities that may currently operate, at least partially, near the Project site within the Brownsville Ship Channel.

5.1.9 Visual Resources

During construction, visual impacts would primarily result from the use of large construction equipment such as cranes. Texas LNG assessed potential operational impacts on the viewshed from several KOPs including recreation areas, residential areas, and roadways, by producing visual simulations of the Project facilities during the day, at night, and during flaring events. While the LNG terminal, especially the storage tanks and flares, would be visible from most of the KOPs, it would generally not dominate the viewshed. However, the LNG terminal would dominate the daytime and nighttime viewshed at KOP 6 (SH 48 and the Laguna Atascosa NWR) and likely at the Loma Ecological Preserve.

The Project facilities would likely be visible from some residences in Port Isabel and South Padre Island. South Padre Island, in particular, has numerous high rise condominiums that would have views of the Project facilities, especially from the higher floors. In addition to residences, the Project facilities would be visible from sightseeing tours that operate within the Brownsville Ship Channel.

Due to the relatively undeveloped nature of the Project area, the visual sensitivity of nearby recreation areas, and the inability to implement visual screening measures, the Project would result in a significant impact on visual resources when viewed from the Laguna Atascosa NWR and would have a negligible to moderate permanent impact on the other visual resources evaluated. The Project would not affect nationally or state-designated visual resources including scenic byways or scenic rivers.

5.1.10 Socioeconomics

Texas LNG estimates that under the Peak Impact Scenario, approximately 1,312 onsite workers would be required during peak construction with an average of 700 workers. Texas LNG anticipates that 80 percent of the construction workforce would be locally sourced; however, the exact number that would relocate is unknown. Although it is unlikely that all 1,312 workers would relocate with families, this addition would represent a 0.1 percent increase in the total population of Cameron County and would not be significant. During operation, Texas LNG would employ a total of 110 full-time employees. This workforce would represent a negligible, but permanent increase in the population in the Project vicinity.

The total direct, indirect, and induced impacts of Phase 1 construction is projected to be $251.8 million. The total construction impact for Phase 2 (direct, indirect, and induced effects) is estimated to be $281.9 million and would add $97.4 million in value added to the local economy. Following the completion of Phase 2 construction, the total value added to the local economy from operation of both Project phases combined would be an estimated $367 million, increasing the GRP for Cameron County by 7.2 percent. Texas LNG estimates that without tax abatements, operation of the Project over a 25-year period would result in total ad valorem tax revenue of $567 million. If tax abatements were granted, the estimated ad valorem tax revenue for the same 25-year period would be $493 million, assuming the Peak Impact Scenario.

During construction of the Project, traffic levels on area roadways would increase due to the presence of worker vehicles, construction vehicles, and trucks delivering materials to the site. Texas LNG estimates that during the Peak Impact Scenario, an estimated 1,454 vehicles would arrive and depart the facility per day during peak construction. During operation, Texas LNG estimates that there would be 130 vehicle trips per day during peak traffic hours. As a result of Texas LNG's Traffic Impact Analysis, an auxiliary lane with deceleration, storage, and taper would be constructed at the SH 48 northbound approach to the southern driveway at the Project site, and the auxiliary lane would be continued approximately 1,100 feet north of the northern proposed driveway to provide for acceleration with storage and taper. To minimize traffic and safety hazards with workers turning left out of the Project site, Texas LNG has indicated that it would coordinate with the Cameron County Sherriff's office to manually control the traffic during construction as a result of employees leaving the Project site and turning left on SH 48. Further we are recommending that Texas LNG develop a Traffic Management Plan that includes busing workers to and from the Project site to minimize impacts on traffic. Based on the implementation of these measures as well as our recommendation, we have determined that the Project impacts on traffic would not be significant.

During construction, Texas LNG estimates that the MOF would receive a total of 109 barge/vessel deliveries. During operation, an estimated 74 LNG carriers would call on the LNG terminal annually. This accounts for an approximately 7 percent increase in annual vessel traffic associated with the Brownsville Ship Channel. The Coast Guard issued the LOR for the Project, which stated that the Brownsville Ship Channel is considered suitable for LNG marine traffic in accordance with the guidance in the Coast Guard Navigation and Vessel Inspection Circular 01-2011. Due to the infrequent number of anticipated barge deliveries during construction and the LOR issued by the Coast Guard for the Project, we have determined that the Project would not significantly impact marine transportation during construction or operation.

During operation, the Project would have a positive economic effect on the general community, including minority and low-income populations through job creation, economic activity, and tax payments. The Project would not significantly affect urban or residential areas, nor would there be disproportionately high and adverse human health or environmental effects on minority populations, low-income communities, or Indian tribes. Therefore, we conclude that construction and operation of the Project would not disproportionately affect any population group, and no environmental justice issues are anticipated as a result of construction or operation of the Project.

5.1.11 Cultural Resources

One previously recorded cultural resource site, Site 41CF8 (Garcia Pasture Site), is within the Project site and the direct APE and is listed on the NRHP. Cultural resource surveys of the site conducted for the Project identified two areas within the site that contain intact buried cultural deposits that would be considered contributing elements to the Garcia Pasture Site. No other cultural resource sites were identified within the Project APE. We have identified site 41CF8 as an historic property in the APE that would be adversely affected. Texas LNG has produced a treatment plan that the THC found acceptable. We have not yet completed consultations with the ACHP regarding the adverse impacts on the Garcia Pasture Site; therefore, we recommend that consultations with ACHP be completed prior to the start of construction. With the implementation of our recommendation as well as Texas LNG's treatment plan, we have determined that impacts on cultural resources would not be significant.

5.1.12 Air Quality and Noise

5.1.12.1 Air Quality

Construction of the Project would result in temporary impacts on air quality associated with the emissions generated from fossil-fuel fired construction equipment and fugitive dust. Emissions from construction activities over the nearly 5-year construction period for the Project would be temporary and localized and, therefore, not have a long-term effect on regional air quality. The Project would be in an area currently classified as being in attainment for all criteria pollutant standards. Fugitive dust emissions would be minimized through implementation of Texas LNG's Fugitive Dust Control Plan.

During operation of Phase 1 and before completion of construction and commissioning of Phase 2, when commissioning and/or operational activities are occurring concurrent with construction activities, impacts could be greater than those from the Project operations alone. The combination of construction, commissioning, and operational short-term emissions would, at times, be in excess of the modeled operational emissions alone in 2022, 2023, and 2024. During the concurrent construction, commissioning, and operational activities, the higher level of emissions could result in intermittent exceedances of certain NAAQS. These exceedances would not be persistent at any one time during these years due to the dynamic and fluctuating nature of construction activities within a day, week, or month.

The Project is not subject to the federal PSD review/permitting; as a result, the LNG terminal is subject to the NSR minor source construction permitting program under Texas regulations. Because potential operating emissions for the Project exceed the Title V major source threshold for at least one criteria air pollutant, the LNG terminal is subject to the Title V operating permit program. Texas LNG submitted an air quality impact analysis demonstrating that for operational emissions of each criteria air pollutant, the model-predicted impact plus background concentration does not cause or contribute to an exceedance of the NAAQS.

We analyzed the estimated emissions from construction and operation of the Project, and the potential air quality impacts from operation of the LNG facility and other nearby proposed sources. Based on our independent review of the analyses conducted and Texas LNG's proposed mitigation measures, we conclude that construction of the Project would result in elevated emissions near construction areas and would impact local air quality. Through use of mitigation measures during construction activities and application of best available control technologies during operation, we conclude that there would be no regionally significant impacts on air quality.

5.1.12.2 Noise

Noise levels associated with construction activity would vary depending on the phase of construction in progress at any time. The highest level of construction noise at the Project typically occurs during earth-moving and pile-driving work. The predicted sound levels at nearby NSAs during Project construction were lower than the Commission's noise standard of 55 dBA L_{dn}.

Pile driving, which would occur for approximately 13 months, with peak pile driving activities occurring over 4 months, was calculated to produce L_{eq} sound levels that are below our noise criterion of 55 dBA at the nearest NSA. The calculated maximum sound levels or L_{max} of pile driving (i.e., highest sound level during each hammer strike) would be similar to, to slightly above, the existing ambient levels. Although pile driving would be clearly audible at nearby residences when ambient sound levels are low, it would only occur during daytime construction hours (typically 7 a.m. to 5 p.m.). The impulsive noise of pile driving would be audible outside of residences, and potentially indoors in the homes closest to the Project. Therefore, to ensure that impacts due to maximum pile driving noise levels at the Project would be minimized, we recommend that Texas LNG monitor sound levels during the start of pile driving activities. If the sound levels due to pile driving are greater than 10 dBA over the ambient sound levels, then Texas LNG would cease activities, implement noise mitigation, and file evidence of reduced pile driving sound levels. Additionally, Texas LNG committed to implementing noise mitigations during pile driving, such as cushion blocks or bubble curtains, that will reduce the pile driving sound levels.

During operation, the LNG terminal would generate noise levels that would occur throughout the life of the Project. Noise would be produced continually by a number of sources that include various types of compressors, combustion turbines, cooling fans, pumps and piping. The LNG terminal would be constructed in two phases, and each phase would be commissioned and brought online as it is completed. Operational noise levels were modeled for Phase 1 and for Phases 1 and 2 in simultaneous operation. The predicted sound levels for operations for Phase 1 and for the combination of Phases 1 and 2 were below our 55 dBA L_{dn} criteria at the nearest NSAs, and resulted in potential increases in the ambient sound levels of 0.1 to 0.7 for Phase 1 and 0.1 to 1.0 dBA L_{dn} for Phase 1 and 2. These increases would be considered imperceptible to most listeners. Therefore, noise impacts due to operation of the Project would not be significant.

In order to ensure that the sound levels due to the Project are consistent with modeling used in our analysis, we recommend that Texas LNG perform a full load noise survey within 60 days of placing each liquefaction train into service. In addition, we recommend that a full load noise survey be conducted for the facility, after the completion of Phases 1 and 2. All post-construction survey recommendations require noise mitigation to be implemented if the noise attributable to the Project is greater than 55 dBA L_{dn} at any nearby NSAs. Based on the noise analysis above, and our recommendations, we conclude that construction and operation of the Project would not have a significant impact on the noise environment near the Project.

5.1.13 Reliability and Safety

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact to the human environment in terms of safety and whether the proposed facilities would be in the public interest based on whether it would operate safely, reliably, and securely.

As a cooperating agency, the DOT assists FERC staff in evaluating whether Texas LNG's proposed design would meet the DOT's 49 CFR 193 Subpart B siting requirements. The DOT reviewed the design spill information submitted by Texas LNG and on June 22, 2018, provided a letter to FERC staff stating that the DOT had no objection to Texas LNG's design spill selection methodology to comply with the Part 193 siting requirements for the proposed LNG liquefaction facilities, but would need to resolve legal control of exclusion zones. DOT will provide a LOD on the Project's compliance with 49 CFR 193 Subpart B. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the DOT's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG carrier traffic. The Coast Guard reviewed a

WSA submitted by Texas LNG that focused on the navigation safety and maritime security aspects of LNG carrier transits along the affected waterway. On February 14, 2018, the Coast Guard issued a LOR to FERC staff indicating the Brownsville Ship Channel would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project, based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized and constructed, the facility would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, FAA assisted FERC staff in evaluating impacts to and from the SpaceX rocket launch facility. Specific recommendations are included to address potential impacts from rocket launch failures to the Project. However, the extent of impacts to SpaceX operations, National Space Program, and to the federal government would not fully be known until SpaceX submits an application requesting to launch with the FAA and whether the LNG plant is under construction or in operation.

FERC staff conducted a preliminary engineering and technical review of the Texas LNG design, including potential external impacts based on the site location. Based on this review, we recommend the Commission consider incorporating into the order a number of proposed mitigation measures and continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, FERC staff believe that the Texas LNG Project design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

5.1.14 Cumulative Impacts

We considered the potential contributions of Project-related impacts on cumulative impacts in the defined geographic scope and within the same timeframe as the proposed Project for the affected resources. As part of that assessment, we identified existing projects, projects under construction, projects that are proposed or planned, and reasonably foreseeable future projects – including proposed LNG terminals, currently operating and future oil and gas projects, land transportation projects, commercial and industrial developments, and dredging projects.

As discussed in detail in section 4.13 and summarized in sections 5.1.1 through 5.1.11, with measures to minimize effects on environmental resources, mitigation measures, laws and regulations protecting environmental resources, and permitting requirements for the Texas LNG Project and other projects, the potential for the Project to significantly contribute to cumulative impacts is not anticipated for the following environmental resources: geology, soils, groundwater, wetlands, vegetation, wildlife, aquatic resources, land use, recreation, socioeconomics, and air quality. Cumulative impacts for the remaining resources are summarized below

The greatest potential for cumulative impacts associated with surface water resources would be during dredging activities, as well as during operation. Concurrent dredging of the maneuvering basin for the proposed Project as well as the Rio Grande LNG, Annova LNG, Bahia Grande Estuary Channel Widening/Restoration, and Brazos Island Harbor Channel Improvement Project would result in increased turbidity and sedimentation, resulting in short-term impacts on water quality. Due to the distance between the Annova and Texas LNG Projects, they are not expected to have significant overlapping effects. However, up to 0.63 inch of sedimentation could occur if the Texas LNG and Rio Grande Projects were to conduct construction dredging at the same time. The Bahia Grande Estuary Channel Widening/Restoration could also contribute an estimated 0.5 inch of additional sedimentation. The Brazos Island Harbor Channel Improvement project is not expected result in sediment accumulation during dredging as the purpose of the project is to deepen the main channel and any accumulated sediments would likely be accounted for with the allowed over-dredge depth to achieve the final design depth. While the Brownsville Ship Channel is a routinely maintained, manmade channel, concurrent dredging activities and other impacts on surface water resources during construction activities, as described above, are anticipated to be temporary and moderate.

The operation of all three proposed Brownsville LNG projects would also result in a substantial increase in the number of large, ocean-going vessels transiting the Brownsville Ship Channel (estimated to be about 511 LNG carriers per year combined). During operation, increased vessel traffic would result in a cumulative impact on surface water resources from increases in turbidity and shoreline erosion. Each of the three LNG projects has designed its respective facilities to minimize shoreline erosion through placement of rock riprap along the shoreline, or similar measures. Cumulative impacts on surface water quality during operation would be permanent and moderate to significant due to the persistent transit of LNG carriers and other large vessels within the Brownsville Ship Channel resulting in the increased erosion of shorelines along unarmored portions of the Brownsville Ship Channel.

The proposed Project, Rio Grande LNG and Annova LNG Projects, as well as the pipeline projects proposed in the area, are anticipated to have the greatest cumulative impacts on ocelot habitat through removal and conversion to industrial uses and fragmentation, respectively. In addition, these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross, thus increasing the potential for vehicle strikes. The current remaining habitat corridor in the region to connect U.S. and Mexico populations of these federally listed species is adjacent to and within the proposed Rio Grande LNG and Texas LNG Project sites north of the Brownsville Ship Channel and within and adjacent to the proposed Annova LNG Project site south of the Brownsville Ship Channel. Other impacts, such as those associated with noise, would be minimized by the projects to the extent practicable; however, due to the proximity of the Annova LNG and Rio Grande LNG Projects to the wildlife corridors, facility-generated noise during construction and operation would still be audible to ocelots and jaguarundis utilizing the wildlife corridor. Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would be permanent and significant.

The proposed Project would contribute to cumulative impacts on other special status species as well, as discussed in section 4.13.2.8; however, these impacts are not anticipated to be significant.

Projects with permanent aboveground components, such as the Annova and Rio Grande LNG terminals, have the most potential to contribute to cumulative impacts on visual resources. In particular, motorists on SH 48 and visitors to the nearby recreation areas where two or three LNG Terminals would be visible (including the NWRs, Loma Ecological Preserve, and South Bay Coastal Preserve and South Bay Paddling Trail) would experience a permanent change in the existing viewshed during construction and operation of the projects. As summarized in section 5.1.8.3 above, the proposed Project would significantly impact visual resources in the area. Due to the proximity of the Rio Grande LNG and Annova LNG Projects to the same visual receptors as the Texas LNG Project, significant cumulative impacts on visual resources are anticipated.

Cumulative noise impacts would primarily occur as a result of the concurrent construction and operation of the Texas LNG, Rio Grande LNG, and Annova LNG Projects. For simultaneous construction activities at all three LNG projects, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 dBA L_{dn} at the NSAs and sound levels of slightly over 55 dBA L_{dn} are predicted for several NSAs, and range from less than noticeable increases in ambient noise to a doubling of noise at specific NSAs. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the NSAs. These increases would result in a minor to moderate impact; however, all levels would be below 55 dBA L_{dn}. For the Palmito Ranch Battlefield National Historic Landmark, the predicted cumulative construction increase was 10.1 dBA L_{dn} over the existing ambient, which could result in periods of perceived doubling of noise. At the Laguna Atascosa NWR there is a higher ambient sound level so the predicted increase due to cumulative construction noise would be 2.7 dBA L_{dn}, resulting in a minor impact.

For operational noise with all three projects fully operational, the predicted sound level impacts are much lower than construction impacts, with potential increases over the existing ambient of between 0.3 and 1.5 dBA L_{dn} at NSAs, resulting in minor impacts. Operational impacts are slightly higher at the Palmito Ranch Battlefield National Historic Landmark and the Laguna Atascosa NWR, with possible increases in sound levels due to operations of between 1.3 and 4.8 dBA L_{dn}. This is generally considered a minor to moderate long-term impact.

5.1.15 Alternatives

In accordance with NEPA and FERC policy, we evaluated the no-action alternative, system alternatives, and other siting and design alternatives that could achieve the Project objectives. Alternatives were evaluated and compared to the proposed Project to determine whether these alternatives provided a significant environmental advantage over the proposed Project. While the no-action alternative would avoid the environmental impacts identified in this EIS, adoption of this alternative would preclude meeting the Project objectives. If the Project is not approved and built, other LNG export projects could be developed in the Gulf Coast region or elsewhere in the U.S., resulting in both adverse and beneficial environmental impacts. LNG terminal developments of similar scope and magnitude to the proposed Project would likely result in environmental impacts of comparable significance, especially those projects in a similar regional setting.

Texas LNG did not identify specific geographic markets that would require the proposed Project to be constructed within Texas. Therefore, we evaluated 16 system alternatives that would utilize existing, proposed, or planned LNG export terminals along the Texas and Louisiana Gulf Coast. To meet all or part of Texas LNG's DOE-approved export volume, additional facilities similar to those of the proposed Project would be required. Any such project would require review and authorization of the additional facilities would likely result in similar impacts to the proposed Project, and would not result in a significant environmental advantage. Therefore, the system alternatives were not evaluated further.

We also evaluated alternative sites within several ports along the Gulf Coast. Of the sites evaluated, those only those within the Port of Brownsville were considered feasible, based on the availability of land, proximity to existing natural gas pipeline systems, and distance from residences. We then evaluated four sites along the Brownsville Ship Channel; however, two of the sites were determined to be too small and were dismissed from further evaluation. The remaining two sites that we evaluated include the proposed site and Alternative Site 2. While Alternative Site 2 would have an adequate amount of land available for construction of the LNG terminal, it would require a greater amount of fill to raise the site elevation, would require a greater amount of dredging for the turning basin, and would result in greater impacts on wetlands. Due to the reasons listed above, we do not consider Alternative Site 2 to provide a significant environmental advantage to the proposed Project.

In addition to siting, we also evaluated power generation alternatives and flaring system alternatives. Texas LNG is proposing to utilize electric-driven motors for the Project refrigeration compressors rather than gas-fired turbines. The use of electric-driven motors significantly reduces air emissions associated with the Project; therefore, we determined that the use of electric-driven motors provides a significant environmental advantage over gas-driven turbines. We considered the use of ground flares rather than Texas LNG's proposed elevated flares to minimize impacts on visual resources and migratory birds; however, the use of a ground flare would require the development of additional land. Both the ground flare and the elevated flare would adversely impact environmental resources; therefore, we determined that there would not be a significant environmental advantage to either flare system.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission authorizes the Texas LNG Project, we are recommending that the following measures be included as specific conditions in the Commission's Order. We believe that these measures would further mitigate the environmental impacts associated with the construction and operation of the proposed Project.

1. Texas LNG shall follow the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests) and as identified in the EIS, unless modified by the Order. Texas LNG must:

   a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;

   b. justify each modification relative to site-specific conditions;

c. explain how that modification provides and equal or greater level of environmental protection than the original measure; and

d. receive approval in writing from the Director of OEP **before using that modification**.

2. The Director of the OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Project. This authority shall allow:

   a. the modification of conditions of the Order;

   b. stop-work authority and authority to cease operation; and

   c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from project construction and operation.

3. **Prior to any construction**, Texas LNG shall file an affirmative statement with the Secretary certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with the construction and restoration activities.

4. The authorized facility locations shall be as shown in the EIS, as supplemented by filed maps. **As soon as they are available, and before the start of construction**, Texas LNG shall file with the Secretary any revised detailed survey maps at a scale not smaller than 1:6,000. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on those maps.

5. Texas LNG shall file with the Secretary detailed alignment maps and aerial photographs at a scale not smaller than 1:6,000 identifying all facility relocations, and staging areas, storage yards, access roads, and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly required in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened and endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

This requirement does not apply to extra workspace allowed by the Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* and/or minor field realignments per landowner needs, and requirements that do not affect other landowners or sensitive environmental areas such as wetlands.

Examples of alternations requiring approval include all facility location changes resulting from:

a. implementation of cultural resources mitigation measures;

b. implementation of endangered, threatened, or special concern species mitigation measures;

c. recommendations by state regulatory authorities; and

d. agreements with individual landowners that affect other landowners or could affect environmentally sensitive areas.

6. **Within 60 days of the acceptance of the authorization and before construction begins**, Texas LNG shall file an Implementation Plan with the Secretary, for review and written approval by the Director of OEP. Texas LNG must file revisions to the plans as schedules change. The plans shall identify the following:

a. how Texas LNG will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;

b. how Texas LNG will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

c. the number of EIs assigned to the Project and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

e. the location and dates of the environmental compliance training and instructions Texas LNG will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel change), with the opportunity for OEP staff to participate in the training session(s);

f. the company personnel (if known) and specific portion of Texas LNG's organization having responsibility for compliance;

g. the procedures (including use of contract penalties) Texas LNG will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

    i. the completion of all required surveys and reports;

    ii. the environmental compliance training of onsite personnel;

    iii. the start of construction; and

    iv. the start and completion of restoration.

7. Texas LNG shall employ at least one EI for the Project. Each EI shall be:

    a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorization documents;

    b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 6 above) and any other authorizing document;

    c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

    d. a full-time position, separate from all other activity inspectors;

    e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

    f. responsible for maintaining status reports.

8. Beginning with the filing of its Implementation Plan, Texas LNG shall file updated status reports with the Secretary on a **monthly** basis until all construction and restoration activities are complete. Problems of a significant magnitude shall be reported to the FERC **within 24 hours**. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include the following:

    a. an update on Texas LNG's efforts to obtain the necessary federal authorizations;

    b. Project schedule including the current construction status, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally-sensitive areas;

    c. a listing of all problems encountered, contractor nonconformance/deficiency logs, and each instance of noncompliance observed by the EIs during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies).

d. a description of the corrective and remedial actions implemented in response to all instances of noncompliance, nonconformance, or deficiency;

e. the effectiveness of all corrective and remedial actions implemented;

f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Order, and measures taken to satisfy their concerns; and

g. copies of any correspondence received by Texas LNG from other federal, state, or local permitting agencies concerning instances of noncompliance, and Texas LNG's response.

9. Texas LNG must receive written authorization from the Director of OEP **before commencing construction of any Project facilities**. To obtain such authorization, Texas LNG must file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

10. Texas LNG must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the LNG terminal**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

11. Texas LNG must receive written authorization from the Director of OEP **before placing the LNG terminal into service**. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with the FERC approval, can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the LNG terminal are proceeding satisfactorily.

12. **Within 30 days of placing the authorized facilities in service**, Texas LNG shall file an affirmative statement with the Secretary, certified by a senior company official:

a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

b. identifying which conditions of the Order Texas LNG has complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

13. **Prior to construction,** Texas LNG shall file with the Secretary for review and written approval by the Director of the OEP, its SPCC Plan for operation of the Project. *(section 4.2.4)*

14. **Prior to construction,** Texas LNG shall file with the Secretary a plan for the collection of seed/fruit from rare plant species within the proposed Project site developed in consultation with TPWD. (*section 4.5.4)*

15. **Prior to construction,** Texas LNG shall consult with the FWS to develop a revised Migratory Bird Plan that addresses TPWD and FWS recommendations. Texas LNG shall file with the Secretary the final Migratory Bird Plan and evidence of consultation with the FWS. *(section 4.6.1.3)*

16. **Prior to initiating pile driving activities**, Texas LNG shall perform initial test drives to measure the actual underwater noise generated during in-water pile driving. Following the completion of the initial test drives, Texas LNG shall file with the Secretary and NMFS the acoustic monitoring methods and results, including any additional mitigation measures that it will implement to reduce noise to acceptable levels. Texas LNG shall not initiate in-water pile driving for the Project until approved by the Director of OEP. *(section 4.6.2.2)*

17. **During in-water construction activities,** Texas LNG shall utilize biological monitors to ensure that federally listed or other special status species are not present within the Project area. In the event that federally listed or other special status species are observed, Texas LNG shall stop all in-water construction activities until the individual(s) leave the area on their own and Texas LNG shall notify FWS or NMFS. *(section 4.7.1)*

18. Texas LNG shall **not begin** construction activities **until**:

    a. the FERC staff receives comments from the FWS and the NMFS regarding the proposed action;

    b. the FERC staff completes Section 7 ESA consultation with the FWS and NMFS; and

    c. Texas LNG has received written notification from the Director of OEP that construction or use of mitigation may begin. *(section 4.7.1)*

19. **Prior to construction,** Texas LNG shall file with the Secretary a plan for the capture and relocation of Texas tortoises developed in consultation with the TPWD. *(section 4.7.2.1)*

20. **Prior to construction,** Texas LNG shall file with the Secretary a determination from the Coastal Coordination Advisory Committee that the Project is consistent with the laws and regulations of the state's Coastal Zone Management Program. *(section 4.8.6)*

21. **Prior to construction,** Texas LNG shall file with the Secretary a Traffic Management Plan for review and written approval by the Director of OEP that includes additional measures to minimize impacts on roadway traffic, including transporting workers from offsite locations via buses. *(section 4.9.6.1)*

22. Texas LNG shall **not begin construction** of facilities and/or use of staging, storage, or temporary work areas and new or to-be-improved access roads **until**:

a. the ACHP has been afforded an opportunity to comment on the undertaking;

b. FERC staff has executed an MOA regarding the resolution of adverse effects on cultural resources;

c. the Director of OEP notifies Texas LNG in writing that treatment measures (including archaeological data recovery) may be implemented; and

d. Texas LNG documents the completion of treatment, and the Director of OEP issues a written notice to proceed with construction. *(section 4.10.3)*

23. Texas LNG shall monitor sound levels during pile-driving activities, and file **weekly** noise data with the Secretary **following the start of pile-driving activities** that identify the noise impact on the nearest NSAs. If any measured noise impacts due to pile driving (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, Texas LNG shall:

a. cease pile-driving activities and implement noise mitigation measures; and

b. file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile driving may resume.

24. Texas LNG shall file a full power load noise survey with the Secretary for the LNG terminal **no later than 60 days** after each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA, **within 60 days** Texas LNG shall reduce operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. Texas LNG shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section 4.11.2.4)*

25. Texas LNG shall file a noise survey with the Secretary **no later than 60 days** after placing the entire LNG terminal into service. If a full load condition noise survey is not possible, Texas LNG shall provide an interim survey at the maximum possible horsepower load **within 60 days** of placing the LNG terminal into service and provide the full load survey **within 6 months**. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA under interim or full horsepower load conditions, Texas LNG shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Texas LNG shall confirm compliance with the above requirement by filing an additional noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section 4.11.2.4)*

26. **Prior to the end of the DEIS comment period,** Texas LNG shall file clarification on any potential helicopter landing areas, including consideration of other locations away from critical buildings and equipment. Included in this clarification, Texas LNG shall file a description of its intended use (e.g., emergency response, annual exercises,

executive transportation, etc.), expected operational frequencies, analysis of crash impact probabilities, and evaluation of potential consequences. *(section 4.12.6)*

27. **Prior to initial site preparation**, Texas LNG shall file with the Secretary documentation demonstrating it has received a determination of no hazard (with or without conditions) by DOT FAA for LNG carriers that may exceed the height requirements in 14 CFR 77.9. *(section 4.12.6)*

28. **Prior to construction of the final design**, Texas LNG shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Texas:

    a. site preparation drawings and specifications prior to construction;

    b. LNG storage tank and foundation design drawings and calculations prior to construction;

    c. LNG terminal structures and foundation design drawings and calculations prior to their construction;

    d. seismic specifications for procured Seismic Category I equipment prior to the issuing of requests for quotations; and

    e. quality control procedures to be used for civil/structural design and construction early in the design phase.

    In addition, Texas LNG shall file, in its Implementation Plan, the schedule for producing this information. *(section 4.12.6)*

29. **Prior to commencement of service**, Texas LNG shall file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, for the site grade and LNG earthen impoundment berms which ensures the minimum elevation relative to mean sea level will be maintained for the life of the facility considering settlement, subsidence, and sea level rise. *(section 4.12.6)*

Conditions 30 through 118 shall apply to the Texas LNG Terminal facilities. Information pertaining to these specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, shall be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See *Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information*, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements will be subject to public disclosure. All information shall be filed **a minimum of 30 days** before approval to proceed is requested.

30. **Prior to initial site preparation**, Texas LNG shall develop, file, and implement procedures to position construction crews outside of areas that could be impacted by rocket launch debris of a failed launch during initial moments of rocket launch activity from the Brownsville SpaceX facility. *(section 4.12.6)*

31. **Prior to initial site preparation**, Texas LNG shall file an overall Project schedule, which includes the proposed stages of the commissioning plan. *(section 4.12.6)*

32. **Prior to initial site preparation**, Texas LNG shall file quality assurance and quality control procedures for construction activities for both the Engineering Procurement Contractor and Texas LNG to monitor construction activities. *(section 4.12.6)*

33. **Prior to initial site preparation**, Texas LNG shall file procedures for controlling access during construction. *(section 4.12.6)*

34. **Prior to initial site preparation**, Texas LNG shall develop an Emergency Response Plan (ERP) (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with state and local emergency response agencies;

    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

    c. procedures for notifying residents and recreational users within areas of potential hazard;

    d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

    e. locations of permanent sirens and other warning devices; and

    f. an "emergency coordinator" on each LNG carrier to activate sirens and other warning devices.

    Texas LNG shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its ERP at **3-month intervals**. *(section 4.12.6)*

35. **Prior to initial site preparation**, Texas LNG shall file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Texas LNG shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost Sharing Plan **at 3-month intervals**. *(section 4.12.6)*

36. **Prior to construction of final design**, Texas LNG shall file change logs that list and explain any changes made from the front end engineering design provided in Texas LNG's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. Records of changes shall be kept so FERC staff can verify during construction inspections. *(section 4.12.6)*

37. **Prior to construction of final design**, Texas LNG shall file information/revisions pertaining to Texas LNG's response numbers 5, 11, 12, 15, 19, 20, 21, 22, 23, and 25 of its July 29, 2016 filing, which indicated features to be included or considered in the final design. *(section 4.12.6)*

38. **Prior to construction of final design**, Texas LNG shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. *(section 4.12.6)*

39. **Prior to construction of final design**, Texas LNG shall provide three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion. *(section 4.12.6)*

40. **Prior to construction of final design**, Texas LNG shall file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances. *(section 4.12.6)*

41. **Prior to construction of final design**, Texas LNG shall file a complete specification and drawings of the proposed LNG tank design and installation. *(section 4.12.6)*

42. **Prior to construction of final design**, Texas LNG shall file the evaluation and conclusions by the tank manufacturer regarding the potential for the layering effect and the steps to avoid rollover for various LNG rundown scenarios, especially bottom fill, during the production of excessively warm LNG. This evaluation shall consider the suppression of flashing in the bottom fill downpipe caused by static pressure in the column resulting in failure of the LNG to completely reach equilibrium temperature at tank operating pressure. *(section 4.12.6)*

43. **Prior to construction of final design**, Texas LNG shall file engineering information that protects the LNG rundown system from the high pressure liquefaction system, including consideration for specifying the LNG rundown system from the main cryogenic heat exchanger (MCHE) to the LNG storage tanks at the same pressure as the LNG side of the MCHE with the specification break downstream of the motor operated valve (MOV) valves (i.e., MOV-51001 and 51002) located on the LNG storage tank fill lines. The evaluation shall consider removal of the end flash gas separator 1410-V-101 from the LNG product rundown system or a high-high liquid shutdown capability to ensure LNG will not overfill the drum and release LNG into the vapor handling system. In addition, Texas LNG shall provide the control loop simulation summary for the LNG rundown system. *(section 4.12.6)*

44. **Prior to construction of the final design**, Texas LNG shall file engineering information that demonstrates unobstructed flow of the LNG tank recycle line, including consideration for the 16-inch-diameter pump recirculation piping connection to the LNG storage tank top fill line being downstream of the motor control valves (i.e., MOV-51001). *(section 4.12.6)*

45. **Prior to construction of the final design**, Texas LNG shall file engineering information that demonstrates detection and protection as a result of cryogenic temperature conditions in the Demethanizer, including consideration for the addition of low temperature shutdown capabilities on temperature transmitters TI-21056 and TIC-21015 on the Demethanizer 1210-T-101 that would close the bottom outlet valve XZV-21006 in the event of depressurization that results in cryogenic temperatures at the bottom of the Demethanizer with the bottom outlet valve XZV-21006 remaining open until the cryogenic temperature condition has been removed. *(section 4.12.6)*

46. **Prior to construction of the final design**, Texas LNG shall file engineering information that demonstrates protection of the Demethanizer Reboiler from cryogenic temperatures, including consideration for specifying the hot oil tubing and tube sheet within the Demethanizer Reboiler 1210-E-102 for cryogenic service. *(section 4.12.6)*

47. **Prior to construction of the final design**, Texas LNG shall file engineering information that demonstrates protection of the carbon steel condensate line from cryogenic fluid on the Spare Flare KO Drum 1840-V-103, including consideration of an automatic shutoff valve on the 4-inch-diameter condensate line (1840-PC-84002-4") downstream of the ¾-inch bleed valve controlled by low-low temperature, as well as designing the piping segment between the Spare Flare KO Drum and this low-low temperature shutoff valve for cryogenic temperatures. *(section 4.12.6)*

48. **Prior to construction of final design**, Texas LNG shall file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications shall include:

    a. Building Specifications (control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);

    b. Mechanical Specifications (piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);

    c. Electrical and Instrumentation Specifications (power system specifications, control system specifications, safety instrument system (SIS) specifications, cable specifications, other electrical and instrumentation specifications); and

    d. Security and Fire Safety Specifications (security, passive protection, hazard detection, hazard control, firewater). *(section 4.12.6)*

49. **Prior to construction of final design**, Texas LNG shall file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs.

The PFDs shall include heat and material balances. The P&IDs shall include the following information:

a. equipment tag number, name, size, duty, capacity, and design conditions;

b. equipment insulation type and thickness;

c. storage tank pipe penetration size and nozzle schedule;

d. valve high pressure side and internal and external vent locations;

e. piping with line number, piping class specification, size, and insulation type and thickness;

f. piping specification breaks and insulation limits;

g. all control and manual valves numbered;

h. relief valves with size and set points; and

i. drawing revision number and date. *(section 4.12.6)*

50. **Prior to construction of final design**, Texas LNG shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities. *(section 4.12.6)*

51. **Prior to construction of final design**, Texas LNG shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs. *(section 4.12.6)*

52. **Prior to construction of final design**, the engineering, procurement, and construction contractor shall verify that the recommendations from the Front End Engineering Design Hazard Identification are complete and consistent with the requirements of the final design as determined by the engineering, procurement, and construction contractor. *(section 4.12.6)*

53. **Prior to construction of final design**, Texas LNG shall file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations shall be filed. *(section 4.12.6)*

54. **Prior to construction of final design**, Texas LNG shall file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (i.e., temperature, pressures, flows, and compositions). *(section 4.12.6)*

55. **Prior to construction of final design**, Texas LNG shall file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and approval. The cause-and-effect matrices shall include alarms and

shutdown functions, details of the voting and shutdown logic, and set points. *(section 4.12.6)*

56. **Prior to construction of final design**, Texas LNG shall file an evaluation of the emergency shutdown valve closure times. Include an analysis that describes the time to detect an upset condition, notify plant personnel, and close the emergency shutdown valve(s). In addition, provide a dynamic surge analysis associated valve closures. *(section 4.12.6)*

57. **Prior to construction of final design**, Texas LNG shall demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators. *(section 4.12.6)*

58. **Prior to construction of final design**, Texas LNG shall file the electrical area classification drawings. *(section 4.12.6)*

59. **Prior to construction of final design**, Texas LNG shall file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001). *(section 4.12.6)*

60. **Prior to construction of final design**, Texas LNG shall file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that shall continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. *(section 4.12.6)*

61. **Prior to construction of final design**, Texas LNG shall file the design specifications for the feed gas inlet facilities (e.g., metering, pigging system, pressure protection system, compression, etc.). *(section 4.12.6)*

62. **Prior to construction of final design**, Texas LNG shall specify that piping and equipment that may be cooled with liquid nitrogen will be designed for liquid nitrogen temperatures, with regard to allowable movement and stresses. *(section 4.12.6)*

63. **Prior to construction of final design**, Texas LNG shall include LNG tank fill flow measurement with high flow alarm. *(section 4.12.6)*

64. **Prior to construction of final design**, Texas LNG shall include boil-off gas (BOG) flow, tank density profile and temperature profile measurement for each tank. *(section 4.12.6)*

65. **Prior to construction of final design**, Texas LNG shall file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations. *(section 4.12.6)*

66. **Prior to construction of final design**, Texas LNG shall file an analysis of the structural integrity of the outer containment of the full containment LNG storage tanks when exposed to a roof tank top fire or adjacent tank top fire. *(section 4.12.6)*

67. **Prior to construction of final design**, Texas LNG shall file a projectile analysis to demonstrate that the outer concrete impoundment wall of a full-containment LNG tank could withstand wind borne projectiles. The analysis shall detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. *(section 4.12.6)*

68. **Prior to construction of final design**, Texas LNG shall file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks. *(section 4.12.6)*

69. **Prior to construction of final design**, Texas LNG shall specify that all Emergency Shutdown (ESD) valves will be equipped with open and closed position switches connected to the Distributed Control System (DCS)/Safety Instrumented System (SIS). *(section 4.12.6)*

70. **Prior to construction of final design**, Texas LNG shall file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons shall be easily accessible, conspicuously labeled, and located in an area which will be accessible during an emergency. *(section 4.12.6)*

71. **Prior to construction of final design**, Texas LNG shall file drawings and specifications for vehicle barriers at each facility entrance and control point for access control. *(section 4.12.6)*

72. **Prior to construction of final design**, Texas LNG shall file drawings and specifications for protecting transfer piping, firewater equipment (e.g., hydrants, monitors, manifolds, etc.), pumps, and compressors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles. *(section 4.12.6)*

73. **Prior to construction of final design**, Texas LNG shall file lighting drawings. The lighting drawings shall show the location, elevation, type of light fixture, and lux levels of the lighting system and shall illustrate adequate coverage for the perimeter of the facility and along paths/roads of access and egress. *(section 4.12.6)*

74. **Prior to construction of final design**, Texas LNG shall file fencing drawings. The fencing drawings shall provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a 10 feet clearance from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.). *(section 4.12.6)*

75. **Prior to construction of final design**, Texas LNG shall file security camera and intrusion detection drawings. The security camera drawings shall show the location, areas covered, and features of the camera (fixed, tilt/pan/zoom, motion detection alerts,

low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies, and cameras interior to the facility that will enable rapid monitoring of the LNG plant. The drawings shall show or note the location of the intrusion detection to verify it covers the entire perimeter of the LNG plant. *(section 4.12.6)*

76. **Prior to construction of final design**, Texas LNG shall file the details of a plant-wide ESD button, including details of the sequencing and reliability of the shutdown. *(section 4.12.6)*

77. **Prior to construction of final design**, Texas LNG shall evaluate the terminal alarm system and external notification system design to ensure the location of the terminal alarms and other fire and evacuation alarm notification devices (e.g. audible/visual beacons and strobes) will provide adequate warning at the terminal and external off-site areas in the event of an emergency. *(section 4.12.6)*

78. **Prior to construction of final design**, Texas LNG shall file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. *(section 4.12.6)*

79. **Prior to construction of final design**, Texas LNG shall file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of a down-comer that would transfer spills from the tank top to the ground-level impoundment system. *(section 4.12.6)*

80. **Prior to construction of final design**, Texas LNG shall file an analysis of the localized hazards to operators from a potential liquid nitrogen release and shall also provide low oxygen detectors and other identified mitigation based on the analysis. *(section 4.12.6)*

81. **Prior to construction of final design**, Texas LNG shall file complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment. *(section 4.12.6)*

82. **Prior to construction of final design**, Texas LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, and condensate. *(section 4.12.6)*

83. **Prior to construction of final design**, Texas LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as natural gas liquids and hydrogen sulfide. *(section 4.12.6)*

84. **Prior to construction of final design**, Texas LNG shall file a technical review of facility design that:

a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and

b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. *(section 4.12.6)*

85. **Prior to construction of the final design**, Texas LNG shall file a building siting assessment to ensure plant buildings that are occupied or critical to the safety of the LNG plant are adequately protected from potential hazards involving fires and vapor cloud explosions. *(section 4.12.6)*

86. **Prior to construction of final design**, Texas LNG shall include smoke detection in occupied buildings. *(section 4.12.6)*

87. **Prior to construction of final design**, Texas LNG shall include hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings. *(section 4.12.6)*

88. **Prior to construction of final design**, Texas LNG shall include clean agent systems in the electrical switchgear and instrumentation buildings. *(section 4.12.6)*

89. **Prior to construction of final design**, Texas LNG shall file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings shall clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with NFPA 17, and wheeled and hand-held extinguishers location travel distances are along normal paths of access and egress and in compliance with NFPA 10. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units. *(section 4.12.6)*

90. **Prior to construction of final design**, Texas LNG shall file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings shall clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings shall demonstrate that each process area, fire zone, or other sections of piping with several users can be isolated with post indicator valves and that firewater flow to cool exposed surfaces subjected to a fire. Drawings shall also include piping and instrumentation diagrams of the firewater and foam systems. *(section 4.12.6)*

91. **Prior to construction of final design**, Texas LNG shall file detailed calculations to confirm that the final fire water volumes will be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario. *(section 4.12.6)*

92. **Prior to construction of final design**, Texas LNG shall specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter shall be connected to the DCS and recorded. *(section 4.12.6)*

93. **Prior to construction of final design**, Texas LNG shall specify that the firewater pump shelter is designed with a removable roof for maintenance access to the firewater pumps. *(section 4.12.6)*

94. **Prior to construction of final design**, Texas LNG shall account for the fire water required for foam generation in calculating the total fire water required for 2 hours of supply. *(section 4.12.6)*

95. **Prior to construction of final design**, Texas LNG shall file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases. *(section 4.12.6)*

96. **Prior to construction of final design**, Texas LNG shall file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 BTU/ft^2-hr zone from an impoundment, or provide an analysis that assesses the consequence of pressure vessel bursts and boiling liquid expanding vapor explosions. Trucks at the truck transfer station shall be included in the analysis. Passive mitigation shall be supported by calculations for the thickness limiting temperature rise and active mitigation shall be justified with calculations demonstrating flow rates and durations of any cooling water will mitigate the heat absorbed by the vessel. *(section 4.12.6)*

97. **Prior to construction of final design**, Texas LNG shall file an evaluation of the voting logic and voting degradation for hazard detectors. *(section 4.12.6)*

98. **Prior to commissioning**, Texas LNG shall file a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Texas LNG shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued. *(section 4.12.6)*

99. **Prior to commissioning**, Texas LNG shall file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. *(section 4.12.6)*

100. **Prior to commissioning**, Texas LNG shall file a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas

Association's Purging Principles and Practice, and shall provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing. *(section 4.12.6)*

101. **Prior to commissioning**, Texas LNG shall file the procedures for pressure/leak tests which address the requirements of American Society of Mechanical Engineers (ASME) VIII and ASME B31.3. The procedures shall include a line list of pneumatic and hydrostatic test pressures. *(section 4.12.6)*

102. **Prior to commissioning**, Texas LNG shall file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms. *(section 4.12.6)*

103. **Prior to commissioning**, Texas LNG shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. *(section 4.12.6)*

104. **Prior to commissioning**, Texas LNG shall maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training. *(section 4.12.6)*

105. **Prior to commissioning**, Texas LNG shall file results of the LNG storage tank hydrostatic test and foundation settlement results. At a minimum, foundation settlement results shall be provided thereafter annually. *(section 4.12.6)*

106. **Prior to commissioning**, Texas LNG shall equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG storage tank and adjacent piping. The settlement record shall be reported in the semi-annual operational reports. *(section 4.12.6)*

107. **Prior to commissioning**, Texas LNG shall file a procedure that defines each LNG storage tank's total and differential settlement criteria. The procedures shall specify values that will be used to determine if the annual tank survey results are within an acceptable tolerance and values that will require additional actions. In addition, the procedure shall specify what actions would be taken after various levels of seismic events. *(section 4.12.6)*

108. **Prior to introduction of hazardous fluids**, Texas LNG shall develop and implement procedures for plant personnel to monitor the rocket launches and shut down operating equipment in the event of a rocket launch failure from the Brownsville SpaceX facility. *(section 4.12.6)*

109. **Prior to introduction of hazardous fluids**, Texas LNG shall develop and implement an alarm management program to ensure effectiveness of process alarms. *(section 4.12.6)*

110. **Prior to introduction of hazardous fluids**, Texas LNG shall complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system. *(section 4.12.6)*

111. **Prior to introduction of hazardous fluids**, Texas LNG shall complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). *(section 4.12.6)*

112. **Prior to introduction of hazardous fluids**, Texas LNG shall complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review shall include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, shall be filed. *(section 4.12.6)*

113. Texas LNG shall file a request for written authorization from the Director of OEP **prior to unloading or loading the first LNG commissioning cargo**. After production of first LNG, Texas LNG shall file **weekly** reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports shall include a summary of activities, problems encountered, and remedial actions taken. The weekly reports shall also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports shall include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude shall be reported to the FERC **within 24 hours**. *(section 4.12.6)*

114. **Prior to commencement of service**, Texas LNG shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001). *(section 4.12.6)*

115. **Prior to commencement of service**, Texas LNG shall file plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring. *(section 4.12.6)*

116. **Prior to commencement of service**, Texas LNG shall develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Texas LNG staff. *(section 4.12.6)*

117. **Prior to commencement of service**, Texas LNG shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant. *(section 4.12.6)*

118. **Prior to commencement of service**, Texas LNG shall file a request for written authorization from the Director of OEP. Such authorization will only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the Maritime Transportation Security Act of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Texas LNG or other appropriate parties. *(section 4.12.6)*

In addition, conditions 119 through 122 shall apply **throughout the life of the Texas LNG Project**.

119. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Texas LNG shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted. *(section 4.12.6)*

120. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled “Significant Plant Modifications Proposed for the Next 12 Months (dates)” shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities. *(section 4.12.6)*

121. In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified. *(section 4.12.6)*

122. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) shall be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to the FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for 5 minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan. *(section 4.12.6)*

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.